NUCLEAR ENGINEERING CALCULATION COVER SHEET
NEPM-QA-0221-1

1. Page 1 of 36
Total Pages 36

>2. TYPE: CALC >3. NUMBER: EC-ENVR-1059 >4. REVISION: 0

*>5. UNIT 3 *>6. QUALITY CLASS: Q

>7. DESCRIPTION: CRHE Accident Dispersion Factors (χ/Q) RB U2 Intake

8. SUPERSEDED BY:

9. Alternate Number: 10. Cycle:

11. Computer Code/Model used: ARCON96 12. Discipline: R

>13. Are any results of this calculation described in the Licensing Documents?

☒ Yes, *Refer to NDAP-QA-0730 and NDAP-QA-0731* ☐ No

>14. Is this calculation changing any method of evaluation described in the FSAR and using the results to support or change the FSAR? (Refer to PPL Resource Manual for Definition of FSAR)

☒ Yes, *50.59 screen or evaluation required.* ☐ No

>15. Is this calculation Prepared by an External Organization?

☒ Yes ☐ No

EG771 Qualifications may not be required for individuals from external organizations (see Section 7.4.3).

	Print Name(EG771 Qualification Required)	Signature	Date
>16. Prepared by:	M. M. Waselus		7/11/05
>17. Reviewed by:	K. E. Weise		7-12-05
>18. Verified by:	K. E. Weise		7/12/05
>19. Approved by:	M. G. Capiotis (Qualified per NEPM-QA-0241 and comply with Section 7.8 of NEPM-QA-0221)		7/12/05
>20. Accepted by:	TERRENCE F. MACKAY (EG771 Qualification Required) and comply with Section 7.9 of NEPM-QA-0221		7/19/05

TO BE COMPLETED BY DCS

DCS SIGNATURE/DATE

ADD A NEW COVER PAGE FOR EACH REVISION
FORM NEPM-QA-0221-1, Revision 8, Page 1 of 1, ELECTRONIC FORM

* Verified Fields
> REQUIRED FIELDS

ADD A NEW COVER PAGE FOR EACH REVISION
* Verified Fields

PP&L CALCULATION SHEET				
Dept.	0341 Rad & Eff Tech.	PROJECT		
Date	7/11/05	CRHE Accident Dispersion Factors	Calc. No.	EC-ENVR-1059
Designed By	M. M. Waselus	(χ/Q) RB U2 Intake	Sh. No.	2
Checked By	K. E. Weise			

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Dept. 0341 Rad & Eff Tech.	PROJECT		
Date 7/11/05	CRHE Accident Dispersion Factors	Calc. No.	EC-ENVR-1059
Designed By M. M. Waselus	(χ/Q) RB U2 Intake	Sh. No.	3
Checked By K. E. Weise			

1.0 PURPOSE

The purpose of this analysis is to calculate short term accident χ/Q's for the SSES Control Room Habitability Envelope (CRHE) using the methodology provided in NUREG/CR-6331 - ARCON96 (Reference 1) and onsite meteorological data documented in Reference 2. The ARCON96 code uses hourly meteorological data and recently developed methods for estimating χ/Q's in the vicinity of buildings to calculate relative concentrations at control room air intakes that would be exceeded no more than five percent of the time. These concentrations are calculated for averaging periods ranging from one hour to 30 days in duration. The term χ/Q (sec/m^3) is an expression of the relative dispersion occurring between a source (release) location and a receptor location. This relative dispersion is used to determine the expected atmospheric concentration at some defined distance away from the source for a known quantity of effluent released.

The potential release points evaluated in this analysis are defined as follows:

1. Reactor Building Unit 1 exhaust vent.
2. Reactor Building Unit 2 exhaust vent.
3. Turbine Building Unit 1 exhaust vent.
4. Turbine Building Unit 2 exhaust vent.
5. Standby Gas Treatment System exhaust vent.
6. Reactor Building Unit 1 closest distance.
7. Reactor Building Unit 2 closest distance.
8. Turbine Building Unit 1 closest distance.
9. Turbine Building Unit 2 closest distance.
10. Reactor Building Unit 1 main steam tunnel blowout panel.
11. Reactor Building Unit 2 main steam tunnel blowout panel.
12. Turbine Building Unit 1 main steam tunnel blowout panel.
13. Turbine Building Unit 2 main steam tunnel blowout panel.

13. Turbine Building Unit 2 main steam tunnel blowout panel.

The CRHE outside air intake is located on the roof of the Unit 2 reactor building in the vicinity of column lines U and 36.

References 7 to 23 provide details of the layout of the SSES plant structures, exhaust vents and components. By inspection of the locations of the potential release points relative to the location of the CRHE intake and the potential to be a source of post LOCA activity release, release points 3, 4, 5, 11 and 13 (listed below) are seen as limiting and are further evaluated in detail herein. The Reactor Building exhaust vents (release points 1 & 2) are not a source of post LOCA activity releases. The Reactor Building closest distance (release points 6 & 7) would only be potential release points during the 10 minute drawdown period. During this time there is negligible activity released to the Reactor Building available for release to the environment. The Turbine Building closest points (release points 8 & 9) are bounded by the Turbine Building exhaust vents (release points 3 & 4) which are at the same elevation as the CRHE intake. The Reactor Building and Turbine Building Unit 1 blowout panels (release points 10 & 12) are bounded by the Reactor Building and Turbine Building Unit 2 blowout panels (release points 11 & 13). See Figure 1 on page 10 for the relative locations of the 13 release points and the CRHE outside air intake. The specific locations requiring ARCON96 χ/Qs are:

3. Turbine Building Unit 1 exhaust vent.
4. Turbine Building Unit 2 exhaust vent.
5. Standby Gas Treatment System exhaust vent.
11. Reactor Building Unit 2 main steam tunnel blowout panel.
13. Turbine Building Unit 2 main steam tunnel blowout panel.

2.0 CONCLUSIONS AND RECOMMENDATIONS

The CRHE χ/Q's for the above release points as determined in this calculation are listed as follows.

#	Release Point	CRHE χ/Q'S (sec/m^3) without Occupancy Correction Factors				
	Time Period	0 to 2 hours	2 to 8 hours	8 to 24 hours	1 to 4 days	4 to 30 days
3	TB Unit 1 Exhaust Vent	1.24E-03	9.55E-04	3.14E-04	1.99E-04	1.73E-04
4	TB Unit 2 Exhaust Vent	1.36E-03	1.03E-03	3.36E-04	2.20E-04	1.85E-04
5	SGTS Exhaust Vent	1.45E-03	1.12E-03	3.55E-04	2.29E-04	2.01E04
11	RB Unit 2 MST Blowout Panel	1.94E-03	1.41E-03	5.12E-04	3.28E-04	2.68E-04
13	TB Unit 2 MST Blowout Panel	1.47E-03	1.01E-03	4.01E-04	2.95E-04	2.26E-04

These χ/Q values are to be used in subsequent CRHE radiological evaluations for SSES.

3.0 ASSUMPTIONS / INPUT

There are no assumptions in this analysis which require future confirmation.

The input data and assumptions used in this analysis are summarized as follows:

1. Reactor building grade elevation – 670' (Reference 9).
2. Turbine and Control building grade elevation – 676' (Reference 9).
3. Elevation of the 5 release points and references are shown on Table 2.
4. All release points are assumed to be ground level release type as discussed in References 4 and 6.
5. Plant north and true north are essentially the same at SSES.
6. Other input is referenced as appropriate throughout the analysis.

4.0 METHODOLOGY

The χ/Q's for the SSES CRHE are determined using the ARCON96 computer code. ARCON96 mainly requires inputs involving physical relationships between release points and receptor locations. Table 1 lists the required inputs in order for ARCON96 to provide the χ/Q's. ARCON96 also has default values for other parameters used in the dispersion model, but they are not normally changed. These parameters, as used herein, will remain the default values except for the Surface Roughness Length and

herein, will remain the default values except for the Surface Roughness Length and

Averaging Sector Width Constant, which will be set at 0.2 and 4.3, respectively, in lieu of the default values of 0.1 and 4.0, in accordance with the recommendations in USNRC Regulatory Guide 1.194 (Reference 3).

Table 1 – Inputs required for ARCON96	
Meteorological Input	**Receptor Input**
Number of Met Data Files	Distance to receptor
Lower Measurement Height	Intake Height
Upper Measurement Height	Elevation Difference
Wind Speed	Direction to Source
Source Input	
Release Type	**Output Files**
Release Height	Output File Name fn.log
Building Area	CFD File Name fn.cfd
Vertical Velocity	Expanded Output no
Stack Flow	
Stack Radius	

Meteorological Input

The meteorological data files consist of five files documented in Reference 2. The meteorological data consists of five years of hourly data, covering the years from 1999 to 2003. Each record of the hourly data contains a location identifier, Julian day (1-366), hour (0 to 23), low-level direction, low-level speed, stability class (1=A to 7=G), upper level direction, and upper level speed. The identifier and upper level data is optional. Wind speeds are entered in tenths of a reporting unit with no decimal. Wind directions are from 1 to 360 in degrees.

These five files were combined into one file for ease of code execution. This file contains all the data for the SSES site from 1999-2003, which satisfies the ARCON96 (Reference 1) requirements for having 3 to 5 years of hourly data. The Upper and Lower Measurement Heights are 10m and 60 m, respectively, and the Wind Speed units are m/s (Reference 2).

Source Input

Five Source (or Release) points are analyzed. These sources are chosen to primarily support Condition IV type accidents, but are not limited to just these accidents. The release points along with the release height and references are listed in Table 2.

Table 2 – Release Points and Release Heights

#	Description	Release Elevation, ft	Release Height, ft (1)	Release Height, m	Reference
3	Turbine Building Unit 1 exhaust vent	874.7	204.7	62.4	16
4	Turbine Building Unit 2 exhaust vent	874.7	204.7	62.4	16
5	Standby Gas Treatment System exhaust vent	874.7	204.7	62.4	16
11	RB Unit 2 main steam tunnel blowout panel	802.5	132.5	40.4	18
13	TB Unit 2 main steam tunnel blowout panel	717.5	47.5	14.5	19,21

1. Release height = Release elevation (ft) – 670 ft (grade elevation for RB).

The Building Area used for determining the wake effects is 2685 m^2 per Reference 5 (included as Attachment 6).

The remaining values for Source input (vertical velocity, stack flow and stack radius)are specified as 0 since only ground level release types are being analyzed.

Receptor Input

The receptor considered in the calculation is the SSES CRHE outside air intake. The CRHE Intake is approximately located at column lines U and 36 on the roof of the Unit #2 Reactor Building. Reference 12 provides a sketch of the general arrangement of several of the release points. No dimensions are taken from Reference 12, it is used for general orientation only. The CRHE intake elevation is taken as the Reactor Building roof elevation of 872' (Reference 11). Grade elevation for the SSES site at the Reactor Building is 670' (Reference 9). Therefore, the CRHE intake height is 202' [872' – 670']

Building is 670' (Reference 9). Therefore, the CRHE intake height is 202' [872' – 670']

or 61.6 m. The Turbine Building elevations are measured from the Turbine Building grade elevation of 676' (Reference 9) and the elevation difference is +6 feet or +1.8 m. This only affects release point 13, TB Unit 2 main steam blowout panel.

For release points 3, 4 and 5 the release height is conservatively set equal to the intake height at a value of 0. (No credit is taken for any elevation difference).

With the combinations of release points and intake identified, the direction and distance between the release point and the intake is determined by scaling from the reference drawings. Wind direction data are recorded as the direction from which the wind blows (e.g., a north wind blows from the north, a wind blowing out of the west is recorded with a direction of 270 degrees). The direction input to ARCON96 is the wind direction that would carry the plume from the release point to the intake. For example, an analyst standing at the intake facing west to the release point, would enter 270 degrees; an analyst facing north, would enter 360 degrees, etc.

The source-to-receptor distance is the shortest horizontal distance between the release point and the intake. ARCON96 uses this distance and the elevations of the source and receptor to calculate the slant path. For releases within building complexes, the distance between the release point and the intake could be through intervening buildings. In these cases, the length of the shortest path is taken around or over the intervening building as the source-to-receptor distance (e.g., "taut string length"). Taut string distances are not used in this analysis and the horizontal values from Table 3 are conservatively used directly in ARCON96. The source-to-receptor horizontal distances and direction are listed in Table 3. The values were determined by scaling from the reference drawings.

Table 3 - Release Point Horizontal Distances and Directions

#	Description	Horizontal Distance meters	Direction degrees	Reference
3	TB Unit 1 exhaust vent	66.1	322	11,16,22
4	TB Unit 2 exhaust vent	62.6	317	11,16,22
5	SGTS exhaust vent	60.98	320	11,16,22
11	RB Unit 2 MST blowout panel	47.26	299	11,17,23
13	TB Unit 2 MST blowout panel	40.85	255	19,21

The approximate roof elevations for the structures are listed as follows:

1. Turbine Building 786' Reference 9
2. Control Building 810' Reference 9
3. Reactor Building 872' Reference 11

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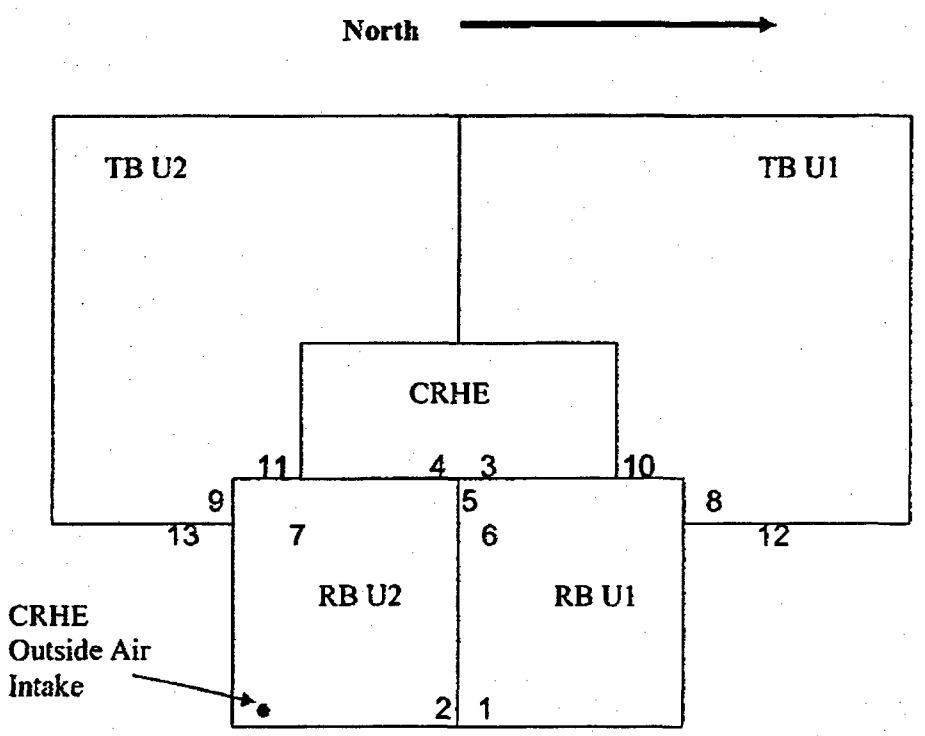
Date	7/11/05	CRHE Accident Dispersion Factors	Calc. No.	EC-ENVR-1059
Designed By	M. M. Waselus	(χ/Q) RB U2 Intake	Sh. No.	10
Checked By	K. E. Weise			

The overall site/building arrangement is shown on Reference 10. The relative locations of the release points corresponding to the above are shown as follows on Figure 1:

FIGURE 1



PP&L CALCULATION SHEET			
Dept.	0341 Rad & Eff Tech.	PROJECT	
Date	7/11/05	CRHE Accident Dispersion Factors	Calc. No. EC-ENVR-1059
Designed By	M. M. Waselus	(χ/Q) RB U2 Intake	Sh. No. 11
Checked By	K. E. Weise		

5.0 5.0 RESULTS

The results of the analysis are provided on the ARCON96 computer outputs (Attachments 1 to 5) and summarized on Table 5. As noted in Reference 6, section 4.2.6, ARCON96 output does not include the CRHE occupancy correction factors that may be applied in CRHE dose evaluations.

Table 5 – CRHE χ/Q's as a Function of Release Point without Occupancy Correction

# of Releases	Release Point	0 to 2 hours sec/m^3	2 to 8 hours sec/m^3	8 to 24 hours sec/m^3	1 to 4 days sec/m^3	4 to 30 days sec/m^3	ARCON96 file	Reference
1 Unit	TB Unit 1 Exhaust Vent	1.24E-03	9.55E-04	3.14E-04	1.99E-04	1.73E-04	RB2TB1EV.log	Attachment 1
1 Unit	TB Unit 2 Exhaust Vent	1.36E-03	1.03E-03	3.36E-04	2.20E-04	1.85E-04	RB2TB2EV.log	Attachment 2
1 SGTS	SGTS Exhaust Vent	1.45E-03	1.12E-03	3.55E-04	2.29E-04	2.01E04	RB2SGTSV.log	Attachment 3
1 Unit 1	RB Unit 2 MST Blowout Panel	1.94E-03	1.41E-03	5.12E-04	3.28E-04	2.68E-04	RB2MSTP.log	Attachment 4
1 Unit 3	TB Unit 2 MST Blowout Panel	1.47E-03	1.01E-03	4.01E-04	2.95E-04	2.26E-04	RB2TBMST.log	Attachment 5

6.0 REFERENCES

1. NUREG/CR-6331, Atmospheric Relative Concentrations in Building Wakes, Revision 1, May, 1997 (ARCON96 computer code).
2. EC-ENVR-1057, Offsite χ/Q values for SSES Based on 1999 – 2003 Meteorological Data, Revision 0.
3. USNRC Regulatory Guide 1.194, Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants, June, 2003.
4. NEI-99-03, Control Room Habitability Assessment Guidance, Nuclear Energy Institute, 6/2001.
5. Building Cross Sectional Area calculated herein included as Attachment 6.
6. USNRC Regulatory Guide 1.183, Alternative Radiological Source Terms For Evaluating Design Basis Accidents At Nuclear Power Reactors, July 2000.
7. PPL Drawing E-106446 Sheet 10 Revision 16.
8. PPL Drawing E-106446 Sheet 15 Revision 9.
9. PPL Drawing E-106312 Revision F.
10. PPL Drawing E105002 Sheet 1 Revision 12.
11. PPL Drawing E-105004 Sheet 7 Revision 27.
12. FSAR Figure 6.4-2. Revision 49.
13. PPL Drawing E-105004 Sheet 4 Revision 25.
14. PPL Drawing E-106454 Sheet 14 Revision 11.
15. PPL Drawing E-106458 Sheet 14 Revision 8.
16. PPL Drawing E-106429-8 Revision 16.
17. PPL Drawing E-105007 Sheet 1 Revision 9.
18. PPL Drawing E-105618 Revision 1.
19. PPL Drawing E-105670 Revision 8.
20. PPL Drawing E-105005 Sheet 1 Revision 9.
21. PPL Drawing E-105004 Sheet 3 Revision 26.
22. PPL Drawing E-106429-10 Revision 15.
23. PPL Drawing E-105004 Sheet 6 Revision 22.
21. PPL Drawing E-105004 Sheet 3 Revision 26.

24. PPL Drawing E-105329 Revision 9.
25. PPL Drawing E-105257 Revision 9.
26. PPL Drawing E-105259 Revision 8.
27. PPL Drawing E-105004 Sheet 5 Revision 27.

Attachment 1 – RB2TB1EV.log
ARCON96 Output
for
Turbine Building Unit 1 Exhaust Vent

RB2TB1EV.log

```
PTitrogram Title:  ARCON96.

Dd Feveloped For:  U.S. Nuclear Regulatory Commission
                   Office of Nuclear Reactor Regulation
                   Division of Reactor Program Management

D   ate:           June 25, 1997    11:00 a.m.

NacNRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
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Celcode Developer: J. V. Ramsdell   Phone: (509) 372 6316
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Cumcode Documentation:  NUREG/CR-6331 Rev. 1

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ERuPrrogram Run   7/ 9/2005  at  08:47:05

 AF******* ARCON INPUT **********

ber    Number of Meteorological Data Files  =  1
sorc   Meteorological Data File Names
:\AF     C:\ARCON96\SQ99_0~1.MET

ght    Height of lower wind instrument (m)  =     10.0
ght    Height of upper wind instrument (m)  =     60.0
 sp    Wind speeds entered as miles per hour

ind-   Ground-level release
base   Release height (m)                   =       .0
ldir   Building Area (m^2)                  =   2685.0
luer   Effluent vertical velocity (m/s)     =       .00
 : or  Vent or stack flow  (m^3/s)          =       .00
 : or  Vent or stack radius (m)             =       .00

acti   Direction .. intake to source (deg)  =      322
```

```
l di   Wind direction sector width (deg)     =      90
l di   Wind direction window (deg)           =  277 - 007
:anc   Distance to intake (m)                =    66.1
ıke    Intake height  (m)                    =      .0
:ain   Terrain elevation difference (m)      =      .0

ıut    Output file names
l2TB     RB2TB1EV.log
l2TB     RB2TB1EV.cfd

.mum   Minimum Wind Speed (m/s)              =      .5
'ace   Surface roughness length (m)          =      .20
:or    Sector averaging constant             =     4.3

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

ınde   Expanded output for code testing not selected

ıl n   Total number of hours of data processed =  43824
:s c   Hours of missing data                 =    297
:s d   Hours direction in window             =   6049
:s e   Hours elevated plume w/ dir. in window =      0
:s c   Hours of calm winds                   =    454
:s d   Hours direction not in window or calm =  37024

'RIB   DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
  PE  AVER. PER.          1          2          4          8         12         24         96        168        360        720
t LI  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
' LI    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
RAN ABOVE RANGE         0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
RAN    IN RANGE      6503.      8237.     10974.     15307.     18889.     26551.     40991.     42163.     42457.     43155.
RAN BELOW RANGE         0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
 ZE        ZERO     37024.     35244.     32428.     27949.     24411.     16602.      1966.       458.         0.         0.
. X/  TOTAL X/Qs     43527.     43481.     43402.     43256.     43300.     43153.     42957.     42621.     42457.     43155.
' ZE  % NON ZERO      14.94      18.94      25.28      35.39      43.62      61.53      95.42      98.93     100.00     100.00

ı PE   95th PERCENTILE X/Q VALUES
                  1.24E-03   1.21E-03   1.14E-03   1.03E-03   8.21E-04   5.51E-04   2.87E-04   2.44E-04   2.09E-04   1.89E-04

 X/Q   95% X/Q for standard averaging intervals

› 2    0 to 2 hours        1.24E-03
› 8    2 to 8 hours        9.55E-04
› 24   8 to 24 hours       3.14E-04
› 4    1 to 4 days         1.99E-04
› 30   4 to 30 days        1.73E-04
```

		HOURLY VALUE RANGE MAX X/Q	MIN X/Q
CE	CENTERLINE	1.64E-03	2.51E-04
SE	SECTOR-AVERAGE	9.54E-04	1.46E-04

PROGORMAL PROGRAM COMPLETION

Attachment 2 – RB2TB2EV.log
ARCON96 Output
for
Turbine Building Unit 2 Exhaust Vent

RB2TB2EV.log

```
ETiProgram Title:  ARCON96.

Dd Developed For:  U.S. Nuclear Regulatory Commission
                   Office of Nuclear Reactor Regulation
                   Division of Reactor Program Management

I   )ate:          June 25, 1997    11:00 a.m.

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CelCode Developer: J. V. Ramsdell   Phone: (509) 372 6316
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CumCode Documentation:  NUREG/CR-6331 Rev. 1

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puloarty would not infringe privately owned rights.

I RuProgram Run   7/ 9/2005  at  08:47:46

 AF******* ARCON INPUT **********

per    Number of Meteorological Data Files  =  1
aorc   Meteorological Data File Names
:\AF     C:\ARCON96\SQ99_0~1.MET

ght    Height of lower wind instrument (m)  =     10.0
ght    Height of upper wind instrument (m)  =     60.0
i sp   Wind speeds entered as miles per hour

and-   Ground-level release
aas(   Release height (m)                   =       .0
ldir   Building Area (m^2)                  =   2685.0
luer   Effluent vertical velocity (m/s)     =       .00
t or   Vent or stack flow  (m^3/s)          =       .00
t or   Vent or stack radius (m)             =       .00
```

```
scti   Direction .. intake to source (deg)  =      317
i di   Wind direction sector width (deg)    =       90
i di   Wind direction window (deg)          =  272 - 002
tanc   Distance to intake (m)               =     62.6
ake    Intake height  (m)                   =       .0
rair   Terrain elevation difference (m)     =       .0

put    Output file names
32TI     RB2TB2EV.log
32TI     RB2TB2EV.cfd

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

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

ande   Expanded output for code testing not selected

al r   Total number of hours of data processed =  43824
rs (   Hours of missing data                 =    297
rs (   Hours direction in window             =   5830
rs (   Hours elevated plume w/ dir. in window =      0
rs (   Hours of calm winds                   =    454
rs (   Hours direction not in window or calm =  37243

TRII   DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
. PI   AVER. PER.          1         2         4         8        12        24        96       168       360       720
R LI   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
N LI     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
 RAI ABOVE RANGE          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
 RAI    IN RANGE       6284.     7988.    10648.    14825.    18317.    25854.    40946.    42128.    42457.    43155.
 RAI BELOW RANGE          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
   ZI        ZERO      37243.    35493.    32754.    28431.    24983.    17299.     2011.      493.        0.        0.
L X/   TOTAL X/Qs      43527.    43481.    43402.    43256.    43300.    43153.    42957.    42621.    42457.    43155.
N ZI   % NON ZERO       14.44     18.37     24.53     34.27     42.30     59.91     95.32     98.84    100.00    100.00

h PI   95th PERCENTILE X/Q VALUES
       1.36E-03  1.33E-03  1.25E-03  1.11E-03  8.93E-04  5.94E-04  3.13E-04  2.63E-04  2.25E-04  2.02E-04

 X/(   95% X/Q for standard averaging intervals

o 2    0 to 2 hours        1.36E-03
o 8    2 to 8 hours        1.03E-03
o 2    8 to 24 hours       3.36E-04
o 4    1 to 4 days         2.20E-04
o 3(   4 to 30 days        1.85E-04
```

		HOURLY VALUE RANGE MAX X/Q	MIN X/Q
CE	CENTERLINE	1.82E-03	2.78E-04
SE	SECTOR-AVERAGE	1.06E-03	1.62E-04

NROGORMAL PROGRAM COMPLETION

Attachment 3 – RB2SGTSV.log
ARCON96 Output
for
Standby Gas Treatment System Exhaust Vent

RB2SGTSV.log

```
PTitrogram Title:  ARCON96.

Dd Developed For:  U.S. Nuclear Regulatory Commission
                   Office of Nuclear Reactor Regulation
                   Division of Reactor Program Management

D   ate:           June 25, 1997    11:00 a.m.

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Oelcode Developer: J. V. Ramsdell   Phone: (509) 372 6316
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Gumcode Documentation:  NUREG/CR-6331 Rev. 1

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ly ciability or responsibilities for any third party's use, or the results of such
t anyse, of any portion of this program or represents that its use by such third
pulcarty would not infringe privately owned rights.

I Rurrogram Run   7/ 9/2005  at  06:43:20

' AF******* ARCON INPUT **********

ber    Number of Meteorological Data Files  =  1
sorc   Meteorological Data File Names
:\AF     C:\ARCON96\SQ99_0~1.MET

ght    Height of lower wind instrument (m)  =     10.0
ght    Height of upper wind instrument (m)  =     60.0
i sp   Wind speeds entered as miles per hour

ind-   Ground-level release
ase    Release height (m)                   =       .0
ldir   Building Area (m^2)                  =   2685.0
luer   Effluent vertical velocity (m/s)     =       .00
t or   Vent or stack flow  (m^3/s)          =       .00
t or   Vent or stack radius (m)             =       .00
```

```
ıcti   Direction .. intake to source (deg)  =      320
l di   Wind direction sector width (deg)    =       90
l di   Wind direction window (deg)          =  275 - 005
:anc   Distance to intake (m)               =     61.0
ıke    Intake height  (m)                   =       .0
'ain   Terrain elevation difference (m)     =       .0

ıut    Output file names
)2sg     RB2sgtsv.log
)2sg     RB2sgtsv.cfd

.mum   Minimum Wind Speed (m/s)             =       .5
'ace   Surface roughness length (m)         =       .20
:or    Sector averaging constant            =      4.3

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

ınde   Expanded output for code testing not selected

ıl n   Total number of hours of data processed =  43824
's o   Hours of missing data                  =    297
:s d   Hours direction in window             =   5965
:s e   Hours elevated plume w/ dir. in window =      0
:s o   Hours of calm winds                   =    454
:s d   Hours direction not in window or calm =  37108

'RIB   DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
  PE  AVER. PER.          1          2          4          8         12         24         96        168        360        720
: LI  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
' LI    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
 RAN ABOVE RANGE         0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
 RAN    IN RANGE      6419.      8132.     10828.     15071.     18596.     26160.     40812.     42116.     42457.     43155.
 RAN BELOW RANGE         0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
  ZE        ZERO     37108.     35349.     32574.     28185.     24704.     16993.      2145.       505.         0.         0.
, X/  TOTAL X/Qs     43527.     43481.     43402.     43256.     43300.     43153.     42957.     42621.     42457.     43155.
I ZE  % NON ZERO      14.75      18.70      24.95      34.84      42.95      60.62      95.01      98.82     100.00     100.00

, PE   95th PERCENTILE X/Q VALUES
                  1.45E-03   1.40E-03   1.33E-03   1.20E-03   9.51E-04   6.37E-04   3.31E-04   2.81E-04   2.42E-04   2.19E-04

 X/Q   95% X/Q for standard averaging intervals

, 2    0 to 2 hours        1.45E-03
, 8    2 to 8 hours        1.12E-03
, 24   8 to 24 hours       3.55E-04
, 4    1 to 4 days         2.29E-04
, 30   4 to 30 days        2.01E-04
```

		HOURLY VALUE RANGE MAX X/Q	MIN X/Q
CE	CENTERLINE	1.91E-03	2.92E-04
SE	SECTOR-AVERAGE	1.11E-03	1.70E-04

PROGORMAL PROGRAM COMPLETION

Attachment 4 – RB2MSTP.log
ARCON96 Output
for
Reactor Building Unit 2 Main Steam Tunnel Blowout Panel

RB2MSTP.log

```
ITiProgram Title:  ARCON96.

Bd Developed For:  U.S. Nuclear Regulatory Commission
                   Office of Nuclear Reactor Regulation
                   Division of Reactor Program Management

I   )ate:          June 25, 1997    11:00 a.m.

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CelCode Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                    e-mail: j_ramsdell@pnl.gov

CumCode Documentation:  NUREG/CR-6331 Rev. 1

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pulcarty would not infringe privately owned rights.

IRuProgram Run   7/ 9/2005  at  10:34:08

 AF******* ARCON INPUT **********

ber    Number of Meteorological Data Files  =  1
sorc   Meteorological Data File Names
:\AF     C:\ARCON96\SQ99_0~1.MET

ght    Height of lower wind instrument (m)  =     10.0
ght    Height of upper wind instrument (m)  =     60.0
i sp   Wind speeds entered as miles per hour

ind-   Ground-level release
base   Release height (m)                   =     40.4
ldir   Building Area (m^2)                  =   2685.0
luer   Effluent vertical velocity (m/s)     =       .00
: or   Vent or stack flow  (m^3/s)          =       .00
: or   Vent or stack radius (m)             =       .00
```
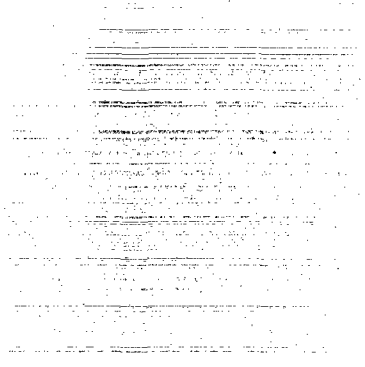

```
ıcti   Direction .. intake to source (deg)  =      299
 di    Wind direction sector width (deg)    =       90
 di    Wind direction window (deg)          =  254 - 344
:anc   Distance to intake (m)               =     47.3
ıke    Intake height  (m)                   =     61.6
:air   Terrain elevation difference (m)     =       .0

ɔut    Output file names
32MS     RB2MSTP.log
32MS     RB2MSTP.cfd

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

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

ınde   Expanded output for code testing not selected

ıl r   Total number of hours of data processed =  43824
:s c   Hours of missing data                =    297
:s d   Hours direction in window            =   6493
:s e   Hours elevated plume w/ dir. in window =     0
:s c   Hours of calm winds                  =    668
:s d   Hours direction not in window or calm =  36366

TRIE   DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
. PE  AVER. PER.          1         2         4         8        12        24        96       168       360       720
% LI  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
% LI    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
 RAN ABOVE RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
 RAN    IN RANGE      7161.     9051.    11968.    16489.    20083.    27657.    41411.    42301.    42457.    43155.
 RAN BELOW RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
  ZE        ZERO     36366.    34430.    31434.    26767.    23217.    15496.     1546.      320.        0.        0.
. X/  TOTAL X/Qs     43527.    43481.    43402.    43256.    43300.    43153.    42957.    42621.    42457.    43155.
% ZE  % NON ZERO      16.45     20.82     27.57     38.12     46.38     64.09     96.40     99.25    100.00    100.00

ı PE   95th PERCENTILE X/Q VALUES
       1.94E-03  1.86E-03  1.71E-03  1.55E-03  1.26E-03  8.57E-04  4.60E-04  3.85E-04  3.28E-04  2.94E-04

 X/Q   95% X/Q for standard averaging intervals

ɔ 2    0 to 2 hours        1.94E-03
ɔ 8    2 to 8 hours        1.41E-03
ɔ 24   8 to 24 hours       5.12E-04
ɔ 4    1 to 4 days         3.28E-04
ɔ 3(   4 to 30 days        2.68E-04
```

		HOURLY VALUE RANGE MAX X/Q	MIN X/Q
CE	CENTERLINE	2.89E-03	2.36E-04
SE	SECTOR-AVERAGE	1.68E-03	1.38E-04

NROGORMAL PROGRAM COMPLETION

Attachment 5 – RB2TBMST.log
ARCON96 Output
for
Turbine Building Unit 2 Main Steam Tunnel Blowout Panel



RB2TBMST.log

```
PTitrogram Title:  ARCON96.

Dd Peveloped For:  U.S. Nuclear Regulatory Commission
                   Office of Nuclear Reactor Regulation
                   Division of Reactor Program Management

L   ate:           June 25, 1997    11:00 a.m.

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                                    e-mail: lab2@nrc.gov

Oelcode Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                    e-mail: j_ramsdell@pnl.gov

Cume'ode Documentation:  NUREG/CR-6331 Rev. 1

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by ciability or responsibilities for any third party's use, or the results of such
t anyse, of any portion of this program or represents that its use by such third
pulcarty would not infringe privately owned rights.

ERunrogram Run   7/ 9/2005  at  10:39:56

 AF******* ARCON INPUT **********

 ber    Number of Meteorological Data Files  =  1
 borc   Meteorological Data File Names
 :\AF     C:\ARCON96\SQ99_0~1.MET

 ght    Height of lower wind instrument (m)  =     10.0
 ght    Height of upper wind instrument (m)  =     60.0
 sp     Wind speeds entered as miles per hour

 ind-   Ground-level release
 ase    Release height (m)                   =     14.5
 ldir   Building Area (m^2)                  =   2685.0
 luer   Effluent vertical velocity (m/s)     =       .00
 : or   Vent or stack flow  (m^3/s)          =       .00
 t or   Vent or stack radius (m)             =       .00
```

```
icti   Direction .. intake to source (deg)  =      255
l di   Wind direction sector width (deg)    =       90
l di   Wind direction window (deg)          =  210 - 300
anc    Distance to intake (m)               =     40.8
ke     Intake height  (m)                   =     61.6
ain    Terrain elevation difference (m)     =      1.8

ut     Output file names
2TB      RB2TBMST.log
2TB      RB2TBMST.cfd

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

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

nde    Expanded output for code testing not selected

l n    Total number of hours of data processed =  43824
s c    Hours of missing data                =     297
s d    Hours direction in window            =    9752
s e    Hours elevated plume w/ dir. in window =      0
s c    Hours of calm winds                  =     454
s d    Hours direction not in window or calm =   33321

RIE    DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
 PE  AVER. PER.        1        2        4        8       12       24       96      168      360      720
 LI  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
 LI    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
 RAN ABOVE RANGE       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
 RAN    IN RANGE   10206.   12801.   16612.   22124.   26303.   33407.   42414.   42583.   42457.   43155.
 RAN BELOW RANGE       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
  ZE        ZERO   33321.   30680.   26790.   21132.   16997.    9746.     543.      38.       0.       0.
 X/  TOTAL X/Qs   43527.   43481.   43402.   43256.   43300.   43153.   42957.   42621.   42457.   43155.
 ZE  % NON ZERO    23.45    29.44    38.27    51.15    60.75    77.42    98.74    99.91   100.00   100.00

 PE   95th PERCENTILE X/Q VALUES
           1.47E-03 1.40E-03 1.27E-03 1.13E-03 9.07E-04 6.43E-04 3.82E-04 3.24E-04 2.87E-04 2.47E-04

 X/Q   95% X/Q for standard averaging intervals

 2     0 to 2 hours        1.47E-03
 8     2 to 8 hours        1.01E-03
 24    8 to 24 hours       4.01E-04
 4     1 to 4 days         2.95E-04
 30    4 to 30 days        2.26E-04
```

		HOURLY VALUE RANGE MAX X/Q	MIN X/Q
CE	CENTERLINE	2.02E-03	2.21E-04
SE	SECTOR-AVERAGE	1.18E-03	1.29E-04

NROGORMAL PROGRAM COMPLETION

Attachment 6 –Building Cross Sectional Area Calculation

**Analysis Of Vertical Cross-Sectional Area (Minimum)
Of Reactor Building For Evaluation Of χ/Q's**

The general arrangement of the reactor building is shown in SSES design drawing E106312, Revision F (Reference 9). Above the turbine building roof elevation, the reactor building area includes the superstructure area and the area associated with the blowout panels and duct spaces between Column Lines P and M (see SSES design drawing E105004, Sheet 6, Revision 22; Reference 23). Below the turbine building roof elevation, credit is only taken for the reactor building area between Column Lines U and P, including the concrete outer walls.

1. Reactor Building Roof to Bottom Of Superstructure

References: SSES Drawings
E105007, Sheet 1, Revision 9 (Reference 20)
E105329, Revision 9 (Reference 24)

Reactor Building Roof Elevation = 873'-1½ " = 873.12 ft
Superstructure Bottom Elevation = 809'- 7 5/8" = 809.64 ft
∴ Height = 873.12 ft - 809.64 ft = 63.49 ft

Width Of Superstructure = 161'-9 5/8" = 161.80 ft

Area = 63.49 ft X 161.80 ft = 10273 ft^2

2. Reactor Building Bottom Of Superstructure to Turbine Building Roof Elevation

References: SSES Drawings
E105004, Sheet 7, Revision 27 (Reference 11)
E105007, Sheet 1, Revision 9 (Reference 20)
E105004, Sheet 6, Revision 6 (Reference 22)
E105329, Revision 9 (Reference 24)
E105257, Revision 9 (Reference 25)
E105259, Revision 8 (Reference 26)
E105004, Sheet 5, Revision 27 (Reference 27)

Superstructure Bottom Elevation = 809'- 7 5/8" = 809.64 ft
Turbine Building Roof Elevation = 789'-8¾ " = 789.73 ft
∴ Height = 809.64 ft - 789.73 ft = 19.91 ft

Width = (1'-6") + Distance Column U to Column P + (16'-0") + (1'-9 5/16")
Width = (1'-6") + (26'-6") + (27'-6") + (17'-6") + (8'-0") + (25'-6") + (29'-0")
+(16'-0") + (1'-9 5/16")
Width = 153.28 ft

Area = 19.91 ft X 153.28 ft = 3052 ft^2
+(16'-0") + (1'-9 5/16")
Width = 153.28 ft

3. Turbine Building Roof Elevation to Grade Elevation

References: SSES Drawings
E105007, Sheet 1, Revision 9 (Reference 20)
E105257, Revision 9 (Reference 25)
E105259, Revision 8 (Reference 26)

Turbine Building Roof Elevation = 789'-8¾ " = 789.73 ft
Grade Elevation = 676'-0"
∴ Height = 789.73 ft - 676 ft = 113.73 ft

Width = (1'-6") + Distance Column U to Column P + (1'-6")
Width = (1'-6") + (26'-6") + (27'-6") + (17'-6") + (8'-0") + (25'-6") + (29'-0")+(1'-6")
Width = 137 ft

Area = 113.73 ft X 137 ft = 15581 ft^2

4. Total Reactor Building Minimum Cross-Sectional Area

Total Area = 10273 ft^2 + 3052 ft^2 + 15581 ft^2
Total Area = 28906 ft^2 x (.0929 m^2 / ft^2) = 2685 m^2