ANALYSIS OF CONTROL ROOM χ/Q VALUES FOR RELEASES AT THE INDIAN POINT GENERATING STATION UNIT NUMBER 3 USING THE ARCON96 COMPUTER CODE

ABS CONSULTING REPORT R-1109298-01, REVISION 4
2 FEBRUARY 2005

ABS Consulting

APPROVAL COVER SHEET

| Title: | Analysis of Control Room χ/Q Values for Releases at the Indian Point Generating |
| | Station Unit Number 3 Using the ARCON96 Computer Code |

Report Number:	R-1109298-C1
Client:	Entergy Nuclear Northeast
Project:	Analysis of Control Room χ/Q Values for Indian Point Generating Station Unit Number 3

Revision Number	Approval Date	Prepared	Reviewed	Approved
0	9/18/02	T. Edward Fenstermacher	Jackie Lewis	Keith Woodard
1	12/4/02	T. Edward Fenstermacher	Jackie Lewis	Mark Abrams
2	?/10/05	T. Edward Fenstermacher	Jackie Lewis	Keith Woodard
3	1/24/05	T. Edward Fenstermacher	Jackie Lewis	Keith Woodard
4	1/2/05	J. Edw Fenstermacher	Jackie Lewis	Mark Abrams

Table of Revisions

Revision 0   Date: 18 September 2002
Original Issue

Revision 1   Date: 4 December 2002
Revised to include title page, table of revisions, summary, clarify reference for ARCON96, add reference for WK2ARCON, add reference for meteorological data, clarify reference for units of meteorological data.

Revision 2   Date: 10 January 2005
Revised to replace Table 1, which had erroneous values for the coordinates for the Auxiliary Boiler Feed Building. The spelling of "Auxiliary" was corrected in several places

Revision 3   Date: 24 January 2005
Revised to replace Auxiliary Boiler Feed Building fan release point with organ pipe and silencer release points. Also, corrected height and size of containment vent release.

Revision 4   Date: 2 February 2005
Revised to correct release height from silencer from 133' 1¾" to 113' 1¾"

Summary

The χ/Q values for the meteorological dispersion between several release points and the Indian Point 3 control room intake were determined using the ARCON96 computer code. The release points considered were the containment vent, the containment surface, the side of the auxiliary boiler feed building, the auxiliary boiler feed building atmospheric dump valve silencers, and the auxiliary boiler feed building safety valve organ pipes. Release periods of 0 hours to 2 hours, 2 hours to 8 hours, 8 hours to 24 hours, 1 day to 4 days, and 4 days to 30 days were calculated. The χ/Q values were highest for the auxiliary boiler feed building organ pipes, followed by the side of the auxiliary boiler feed building, the auxiliary boiler feed building silencers, and the containment vent. The χ/Q values were lowest for the containment surface release.

Table of Contents

Introduction

ABS Consulting engineers have used the ARCON96[1] computer code to analyze the χ/Q values at the control room intake for releases at Unit 3 of the Indian Point Generating Station. Pacific Northwest National Laboratory developed ARCON96 for the United States Nuclear Regulatory Commission. The purpose of the code is to determine the χ/Q values at receptors on or near buildings from releases on or near buildings for various averaging times. It includes corrections for building wakes, low wind speeds, elevated and vent releases, and area releases.

Input Data

ARCON96 requires the use of hourly meteorological data for a period of at least one year. This data must include the wind direction, wind speed, and stability class; and may optionally include wind direction and wind speed for a second meteorological instrument at another height. The meteorological data used for this analysis was collected at the Indian Point Generating Station in 1995, 1996, and 1997[2]. ABS Consulting received the data on diskettes and a program was written to extract the data to the format required by ARCON96[3]. The wind instruments at heights of 10 m and 60 m were used. Wind speed in the unconverted data has units of miles per hour for wind speed and °F for temperature and temperature difference measurements[4]. The converted file retains the wind speed units as miles per hour, while the temperature differences are converted to stability classes A to G.

ARCON96 also requires data on the source and receptor locations, as well as other geometric data, flow data, and the initial plume dimensions. For the source, the code requires that the release be specified as a ground, vent, or stack release. If the release is well above the attached building, it is a stack release. If it is not a stack release, but is released with a large enough vertical velocity, ARCON96 treats it as a vent release. The code treats releases from the surface of the building without vertical velocity as ground releases. The model also requires the release height, building area, vertical velocity, stack flow (volumetric flow rate), and stack radius. The building area was taken to be the lateral area of the containment building. The receptor data includes the distance from the source, the direction from the source, the intake height, and the elevation difference if the source and receptor are measured from different reference planes. ARCON96 also requires the initial plume dimensions for area releases. The determination of these values will be discussed below. There are several other input values, but they did not need to be altered from their default values for this analysis.

The ARCON96 analysis for the Indian Point Nuclear Plant required calculation of χ/Q values for five locations: a containment surface leak, a release from the containment vent, the side of the auxiliary boiler feed building, the auxiliary boiler feed building safety valve organ pipes, and the auxiliary boiler feed building atmospheric dump valve silencers. Instructions on determining the locations of the release points and the control room intake were taken from Letter NEA-05-002[5]. We took the information used to determine the location and size of the containment surface leak (described in the next paragraph) from U.E. & C. drawing 9321-F-13193[6] and the receptor location (the point on the surface closest to the control room intake was chosen). The height of the containment vent was taken from the same drawing, and the horizontal coordinates were taken from drawing C004[7]. The locations of the auxiliary boiler feed building safety valve "organ pipes" were taken from drawing 9321-F-20493[8] for the horizontal coordinates and from drawing 9321-F-20503[9] for the elevation. The location of the silencers was taken from Con Ed Drawing A210148-1[10]. The location of the intersection of the shield wall and the containment (the closest point on the auxiliary feed pump building south wall to the control room intake) was taken from drawings C004[7] and 9321-F-40433-5[11], and the dimensions of the blowout panels from Drawing 9321-F-14853[12]. The location of the control room intake was taken from drawing 9321-F-

40173[13]. These values were then used to determine the distance from the source to the receptor, and with a correction from plant north to true north, for the direction to the source. The grade elevation, used to determine the height of the source and receptor locations above the ground, was taken to be the top of the paved area South and West of the containment on drawing C004[7].

The ARCON96 manual states that, "Methods for determining the initial diffusion coefficients that define a virtual source involve subjective decisions." Numerical integration over the part of the surface available for release, (that is, above the adjoining buildings where present), was used to determine the effective distance and height of the containment surface release. The heights and locations of the adjoining buildings (i.e., the electrical tunnel, auxiliary feed pump building, and fan house) were taken from drawings 9321-F-15363[14] and 9321-F-40433-5[11]. The initial plume standard deviations used were equal to one-sixth of the width and available height of the containment. For the release from the side of the auxiliary boiler feed, the intersection of the containment and the shield wall was the closest point to the control room intake, and was used for the release. The initial plume dimensions for that case were one sixth of the height and average width of the blowout panels on the south side of the building, projected onto a vertical plane perpendicular to the line of sight from the release point to the control room intake. The auxiliary boiler feed building safety valve organ pipes were modeled using the closest point on the organ pipe that is closest to the control room intake, and was modeled as a point release. The auxiliary boiler feed building atmospheric dump valve silencers were modeled using the closest point on the silencer that is closest to the control room intake, and was modeled as a point release. The containment vent release was modeled at the center of the vent. The initial horizontal plume dimension for vent releases is the equivalent vent diameter divided by six. Table 1 shows the source and receptor locations, Table 2 shows the geometric input data locations, and Table 3 shows the flow and initial plume size data, and Table 4 shows miscellaneous input data.

Location	Position, ft		
	N	E	Elevation
Containment Surface	5997.0	1475.1	150.1
Containment Vent	6023.0	1475.0	268.0
Auxiliary Boiler Feed Building Side	5991.7	1410.1	66.5
Auxiliary Boiler Feed Building Organ Pipes	5995.5	1395.6	97.0
Auxiliary Boiler Feed Building Silencers	6012.9	1390.1	113.1
Control Room Intake	5783.8	1476.0	25.5

Table 1. Source and receptor locations on plant grid.

Location	Distance to Receptor m	Intake Height m	Direction to Source °	Release Type Flag	Release Height m	Building Area m²
Containment Surface	65.01	2.29	38.32	1	40.25	3059.33
Containment Vent	72.92	2.29	38.32	1	76.21	3059.33
Auxiliary Boiler Feed Building Side	66.49	2.29	20.98	1	14.78	3059.33
Auxiliary Boiler Feed Building Organ Pipes	68.88	2.29	17.76	1	24.08	3059.33
Auxiliary Boiler Feed Building Silencers	73.76	2.29	18.01	1	29.00	3059.33

Table 2. ARCON96 geometric input data.

Methodology

We prepared the input data on a Microsoft® Excel spreadsheet. A Visual Basic® macro translated the data from the spreadsheet into input files for ARCON96, and wrote a batch file to run the cases. The batch file invoked ARCON96 to run the individual cases and produce the required output. Another Visual Basic® macro read the data back into the spreadsheet. The results for the individual cases were printed and used to verify that the input and output data agreed with the values on the spreadsheet.

Location	Vertical Velocity m/s	Stack Flow m³/s	Stack Radius m	Initial Plume Dimensions m	
				σ_y	σ_z
Containment Surface	0.00	0.00	0.00	7.32	13.31
Containment Vent	0.00	0.00	0.00	0.26	0.00
Auxiliary Boiler Feed Building Side	0.00	0.00	0.00	0.96	2.39
Auxiliary Boiler Feed Building Organ Pipes	0.00	0.00	0.00	0.00	0.00
Auxiliary Boiler Feed Building Silencers	0.00	0.00	0.00	0.00	0.00

Table 3. ARCON96 flow and plume dimension data.

Reference Information	
Grade, feet	18
North Adjustment, °	38.5611
Wind Speed Units	2
Lower Met Height	10
Upper Met Height	60
Roughness Length	0.1
Minimum Wind Speed, m/s	0.5
Averaging Sector Width	4
Wind Direction Window, °	90
Elevation Difference	0

Table 4. ARCON96 miscellaneous data.

Results

Table 5 shows the results of the ARCON96 analysis. The highest values of χ/Q come from the auxiliary boiler feed building safety valve organ pipes, followed by releases from the side of the auxiliary boiler feed building, auxiliary boiler feed building atmospheric dump valve silencers, the containment vent, and the containment surface.

ID	95% χ/Q from ARCON96				
	0 to 2 hours	2 to 8 hours	8 to 24 hours	1 to 4 days	4 to 30 days
Containment Surface	3.57E-04	3.12E-04	1.24E-04	1.06E-04	7.99E-05
Containment Vent	6.00E-04	5.20E-04	2.12E-04	1.76E-04	1.30E-04
Auxiliary Boiler Feed Building Side	9.86E-04	8.74E-04	4.50E-04	3.50E-04	2.80E-04
Auxiliary Boiler Feed Building Organ Pipes	1.14E-03	1.04E-03	5.05E-04	4.01E-04	3.21E-04
Auxiliary Boiler Feed Building Silencers	1.00E-03	8.79E-04	4.41E-04	3.47E-04	2.78E-04

Table 5. Results of ARCON96 analysis.

References

1. Atmospheric Relative Concentrations in Building Wakes, NUREG/CR-6331REV1, Pacific Northwest National Laboratory, Richland, WA, May 1997. (ARCON96 Manual)

2. Memorandum M-254060-01, April 5, 1999.

3. MET2ARCN Code Certification Package, CCP-Beth-04, April 11, 2000.

4. Memorandum M-254060-02, April 7, 2000.

5. Letter NEA-05-002, Floyd Gumble, Senior Lead Engineer, Entergy Nuclear Northwest to T. Edward Fenstermacher, ABS Consulting, January 20, 2005.

6. Containment Discharge Duct for Consolidated Edison Company Indian Point Generating Station Unit No. 3, U. E. & C. Drawing No. 9321-F-13193.

7. Power Authority State of New York, Indian Point Unit No. 3 – Additional Facilities, Plot Plan Sheet 2, Drawing No. C004 Revision 8.

8. Yard Area – West of Containment Building Main Steam Piping Plan Sheet No. 1, Drawing No. 9321-F-20493 Rev. 17

9. Yard Area – West of Containment Building Main Steam Piping Sections and Elevations Sheet No. 2, Drawing No. 9321-F-20503 Rev. 15

10. Flow Off Muffler Additions Main Steam Dump Valve Vent Lines Sheet No. 1, A210148-1.

11. Miscellaneous Plant Areas & Buildings Ventilation Systems Plans, Sections and Details for Consolidated Edison Company Indian Point Generating Station Unit No. 3, U. E. & C. Drawing No. 9321-F-40433-5.

12. Drawing 9321-F-14853 Rev. 3

13. Indian Point Unit No. 3 Nuclear Power Plant, Control Building (El 15'-00") Air Conditioning Equipment Room Plants & Sections, New York Power Authority Drawing 9321-F-40173 Revision 11.

14. Profile Looking North Thru Intake Structure, Turbine, Prim. Aux. Bldgs. & Waste H. T. Pit for Consolidated Edison Company Indian Point Generating Station Unit No. 3, U. E. & C. Drawing No. 9321-F-15363.

ATTACHMENT 1. ARCON96 LOG FILES

Printed copies of the log files from the four ARCON96 computer code runs follow.

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

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use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.

Program Run   2/ 2/2005 at 14:57:18

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

    Number of Meteorological Data Files = 3
    Meteorological Data File Names
      C:\IP3Prime\IP_1995.MET
      C:\IP3Prime\IP_1996.MET
      C:\IP3Prime\IP_1997.MET

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

    Ground-level release
    Release height (m)   =   40.3
    Building Area (m^2)   = 3059.3

```
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) =      038
Wind direction sector width (deg)   =       90
Wind direction window (deg)         =  353 - 083
Distance to intake (m)              =      65.0
Intake height  (m)                  =       2.3
Terrain elevation difference (m)    =       .0

Output file names
   ip3s01r1.log
   ip3s01r1.cfd

Minimum Wind Speed (m/s)            =       .5
Surface roughness length (m)        =       .10
Sector averaging constant           =      4.0

Initial value of sigma y            =      7.32
Initial value of sigma z            =     13.31

Expanded output for code testing not selected

Total number of hours of data processed =  26304
Hours of missing data               =      170
Hours direction in window           =     8468
Hours elevated plume w/ dir. in window =      0
Hours of calm winds                 =      361
Hours direction not in window or calm =  17305
```

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	8829.	10172.	11979.	14584.	16697.	20464.	25561.	25549.	25378.	25002.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	17305.	15946.	14109.	11444.	9351.	5547.	280.	46.	0.	0.
TOTAL X/Qs	26134.	26118.	26088.	26028.	26048.	26011.	25841.	25595.	25378.	25002.
% NON ZERO	33.78	38.95	45.92	56.03	64.10	78.67	98.92	99.82	100.00	100.00

95th PERCENTILE X/Q VALUES

	3.57E-04	3.54E-04	3.45E-04	3.23E-04	2.65E-04	1.90E-04	1.27E-04	1.07E-04	9.39E-05	8.61E-05

95% X/Q for standard averaging intervals

0 to 2 hours	3.57E-04
2 to 8 hours	3.12E-04
8 to 24 hours	1.24E-04
1 to 4 days	1.06E-04
4 to 30 days	7.99E-05

	HOURLY VALUE RANGE	
	MAX X/Q	MIN X/Q
CENTERLINE	3.97E-04	3.53E-05
SECTOR-AVERAGE	2.49E-04	2.21E-05

NORMAL PROGRAM COMPLETION

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

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Program Run   2/ 2/2005 at 14:57:18

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

    Number of Meteorological Data Files = 3
    Meteorological Data File Names
      C:\IP3Prime\IP_1995.MET
      C:\IP3Prime\IP_1996.MET
      C:\IP3Prime\IP_1997.MET

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

    Ground-level release
    Release height (m)   =   76.2
    Building Area (m^2)   =   3059.3

```
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)  =      038
Wind direction sector width (deg)     =       90
Wind direction window (deg)           =  353 - 083
Distance to intake (m)                =     72.9
Intake height  (m)                    =      2.3
Terrain elevation difference (m)      =       .0

Output file names
  ip3s02r1.log
  ip3s02r1.cfd

Minimum Wind Speed (m/s)              =       .5
Surface roughness length (m)          =      .10
Sector averaging constant             =      4.0

Initial value of sigma y              =      .26
Initial value of sigma z              =      .00

Expanded output for code testing not selected

Total number of hours of data processed =  26304
Hours of missing data                 =      170
Hours direction in window             =     8497
Hours elevated plume w/ dir. in window =      0
Hours of calm winds                   =      293
Hours direction not in window or calm =    17344
```

```
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     8790.    10124.    11924.    14514.    16620.    20376.    25539.    25549.    25378.    25002.
BELOW RANGE       0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
      ZERO    17344.    15994.    14164.    11514.     9428.     5635.      302.       46.        0.        0.
 TOTAL X/Qs   26134.    26118.    26088.    26028.    26048.    26011.    25841.    25595.    25378.    25002.
% NON ZERO     33.63     38.76     45.71     55.76     63.81     78.34     98.83     99.82    100.00    100.00

  95th PERCENTILE X/Q VALUES
            6.00E-04  5.92E-04  5.72E-04  5.40E-04  4.48E-04  3.21E-04  2.12E-04  1.78E-04  1.54E-04  1.41E-04
```

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

0 to 2 hours        6.00E-04
2 to 8 hours        5.20E-04
8 to 24 hours       2.12E-04
1 to 4 days         1.76E-04
4 to 30 days        1.30E-04

                        HOURLY VALUE RANGE
                      MAX X/Q              MIN X/Q
        CENTERLINE    7.74E-04             3.39E-05
        SECTOR-AVERAGE 4.85E-04            2.13E-05

NORMAL PROGRAM COMPLETION
```

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
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Code Documentation: NUREG/CR-6331 Rev. 1

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party would not infringe privately owned rights.

Program Run   2/ 2/2005 at 14:57:19

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

    Number of Meteorological Data Files = 3
    Meteorological Data File Names
      C:\IP3Prime\IP_1995.MET
      C:\IP3Prime\IP_1996.MET
      C:\IP3Prime\IP_1997.MET

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

    Ground-level release
    Release height (m)   =   14.8
    Building Area (m^2)   =   3059.3

```
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) =       021
Wind direction sector width (deg)    =        90
Wind direction window (deg)          =   336 - 066
Distance to intake (m)               =      66.5
Intake height  (m)                   =       2.3
Terrain elevation difference (m)     =        .0

Output file names
  ip3s03r1.log
  ip3s03r1.cfd

Minimum Wind Speed (m/s)             =        .5
Surface roughness length (m)         =        .10
Sector averaging constant            =       4.0

Initial value of sigma y             =        .96
Initial value of sigma z             =       2.39

Expanded output for code testing not selected

Total number of hours of data processed =  26304
Hours of missing data                    =    170
Hours direction in window                =  10861
Hours elevated plume w/ dir. in window   =      0
Hours of calm winds                      =    284
Hours direction not in window or calm    =  14989
```

```
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	11145.	12697.	14733.	17551.	19624.	22947.	25829.	25595.	25378.	25002.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	14989.	13421.	11355.	8477.	6424.	3064.	12.	0.	0.	0.
TOTAL X/Qs	26134.	26118.	26088.	26028.	26048.	26011.	25841.	25595.	25378.	25002.
% NON ZERO	42.65	48.61	56.47	67.43	75.34	88.22	99.95	100.00	100.00	100.00

```
95th PERCENTILE X/Q VALUES
```

9.86E-04	9.62E-04	9.38E-04	9.02E-04	7.75E-04	6.01E-04	4.12E-04	3.58E-04	3.23E-04	2.98E-04

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

0 to 2 hours        9.86E-04
2 to 8 hours        8.74E-04
8 to 24 hours       4.50E-04
1 to 4 days         3.50E-04
4 to 30 days        2.80E-04

                        HOURLY VALUE RANGE
                    MAX X/Q              MIN X/Q
        CENTERLINE      1.38E-03             1.95E-04
        SECTOR-AVERAGE  8.62E-04             1.22E-04

NORMAL PROGRAM COMPLETION
```

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   2/ 2/2005 at 14:57:19

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

    Number of Meteorological Data Files = 3
    Meteorological Data File Names
      C:\IP3Prime\IP_1995.MET
      C:\IP3Prime\IP_1996.MET
      C:\IP3Prime\IP_1997.MET

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

    Ground-level release
    Release height (m)   =   24.1
    Building Area (m^2)   = 3059.3

```
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)  =       018
Wind direction sector width (deg)     =       90
Wind direction window (deg)           =     333 - 063
Distance to intake (m)                =      68.9
Intake height   (m)                   =       2.3
Terrain elevation difference (m)      =       .0

Output file names
  ip3s04r1.log
  ip3s04r1.cfd

Minimum Wind Speed (m/s)              =       .5
Surface roughness length (m)          =       .10
Sector averaging constant             =      4.0

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 =  26304
Hours of missing data                 =       170
Hours direction in window             =     10871
Hours elevated plume w/ dir. in window =       0
Hours of calm winds                   =       284
Hours direction not in window or calm =     14979
```

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	11155.	12764.	14857.	17704.	19764.	23061.	25829.	25595.	25378.	25002.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	14979.	13354.	11231.	8324.	6284.	2950.	12.	0.	0.	0.
TOTAL X/Qs	26134.	26118.	26088.	26028.	26048.	26011.	25841.	25595.	25378.	25002.
% NON ZERO	42.68	48.87	56.95	68.02	75.88	88.66	99.95	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

1.14E-03	1.11E-03	1.09E-03	1.06E-03	9.00E-04	6.91E-04	4.73E-04	4.12E-04	3.69E-04	3.41E-04

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

0 to 2 hours        1.14E-03
2 to 8 hours        1.04E-03
8 to 24 hours       5.05E-04
1 to 4 days         4.01E-04
4 to 30 days        3.21E-04

                        HOURLY VALUE RANGE
                    MAX X/Q              MIN X/Q
        CENTERLINE  1.55E-03             1.97E-04
    SECTOR-AVERAGE  9.74E-04             1.24E-04

NORMAL PROGRAM COMPLETION
```

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

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party would not infringe privately owned rights.

Program Run   2/ 2/2005 at 14:57:19

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

    Number of Meteorological Data Files = 3
    Meteorological Data File Names
      C:\IP3Prime\IP_1995.MET
      C:\IP3Prime\IP_1996.MET
      C:\IP3Prime\IP_1997.MET

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

    Ground-level release
    Release height (m)   =   29.0
    Building Area (m^2)   = 3059.3

```
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)  =        018
Wind direction sector width (deg)    =         90
Wind direction window (deg)          =    333 - 063
Distance to intake (m)               =       73.8
Intake height  (m)                   =        2.3
Terrain elevation difference (m)     =         .0

Output file names
  ip3s05r1.log
  ip3s05r1.cfd

Minimum Wind Speed (m/s)             =         .5
Surface roughness length (m)         =        .10
Sector averaging constant            =        4.0

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 =  26304
Hours of missing data                =        170
Hours direction in window            =      10871
Hours elevated plume w/ dir. in window =        0
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```

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

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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	11155.	12764.	14857.	17704.	19764.	23061.	25829.	25595.	25378.	25002.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	14979.	13354.	11231.	8324.	6284.	2950.	12.	0.	0.	0.
TOTAL X/Qs	26134.	26118.	26088.	26028.	26048.	26011.	25841.	25595.	25378.	25002.
% NON ZERO	42.68	48.87	56.95	68.02	75.88	88.66	99.95	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

	1.00E-03	9.84E-04	9.60E-04	9.10E-04	7.80E-04	5.97E-04	4.09E-04	3.57E-04	3.19E-04	2.95E-04

95% X/Q for standard averaging intervals

```
0 to 2 hours        1.00E-03
2 to 8 hours        8.79E-04
8 to 24 hours       4.41E-04
1 to 4 days         3.47E-04
4 to 30 days        2.78E-04
```

```
                      HOURLY VALUE RANGE
                    MAX X/Q          MIN X/Q
     CENTERLINE     1.33E-03         1.66E-04
     SECTOR-AVERAGE 8.31E-04         1.04E-04
```

NORMAL PROGRAM COMPLETION