

Attachment 1  
to NLS2000033

**Review of Sciencetech Calculation 17080-M-01,  
X/Q Values for Control Room Intake  
Using ARCON96  
Attachment 1 to NEDC 99-031, Revision 1  
(91 pages plus 6 page NEDC cover)**

**ATTACHMENT 1 DESIGN CALCULATION COVER SHEET**

Title: <u>Review of Scientech Calculation 17080-M-01, X/Q Values for Control Room Intake Using ARCON96</u> System/Structure: <u>HVAC, SGT, SC / ERP</u> Component: <u>N/A</u> Classification: [ X ] Essential; [ ] Non-Essential	Calculation No: <u>NEDC 99-031</u> Task Identification No: <u>N/A</u> Design Change No: <u>N/A</u> Discipline: <u>Mechanical Design</u>
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**Calc. Description:**

**PURPOSE:**

This calculation incorporates by attachment Scientech Engineering Calculation No. 17080-M-01, Rev. 1, prepared under Task Agreement 99A-C20, in accordance with CNS Engineering Procedure 3.4.7, Section 4. The calculation determines atmospheric diffusion factors (X/Q values) at the Control Room intake for use in the Control Room Habitability Calculations for the postulated Design Basis Accidents, i.e., Loss of Coolant Accident (LOCA), Fuel Handling Accident (FHA), Main Steam Line Break (MSLB), and Control Rod Drop Accident (CRDA). This calculation has been prepared as a Status 2 calculation for NRC review and will be as-built upon NRC approval. Revision 1 of this calculation incorporates the CNS response to the NRC Request for Additional Information. (See NLS2000029 dated 03/20/00) The NRC requested changing the calculation of the initial diffusion coefficients for diffuse releases to building dimensions divided by a factor of 6.

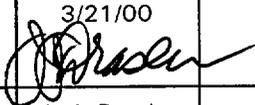
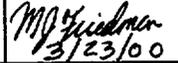
**RESULTS:**

The results are tabulated in Section 10, Table 2 of Scientech's calculation for each of three (3) release locations:

1. Reactor Building Vent (for various reactor building ventilation flow rates),
2. Elevated Release Point (ERP) (point release), and
3. Turbine Building (diffuse release).

**ATTACHMENTS:**

1. Scientech Engineering Calculation No. 17080-M-01, Rev.1 (including attachments thereto).
2. CNS Meteorology Data 1994-1998
3. Reviewer Comments and Resolutions

1	2	Incorporate Comments From NRC	Scientech, Inc. 3/20/00	J. J. Drasler 3/21/00 	N/A	M.J. Friedman 3/23/00 
0	2	Original Issue	Scientech, Inc. 12/2/99	J. J. Drasler 12/3/99	N/A	M.J. Friedman 12/10/99
Rev. No.	Status	Revision Description	Prepared By/Date	Reviewed By/Date	Independent Design Verification/Date	Approved By/Date

**Status Codes**

- |                     |                          |
|---------------------|--------------------------|
| 1. As - Built       | 3. For Construction      |
| 2. Information Only | 4. Superseded or Deleted |





Nebraska Public Power District

## DESIGN CALCULATIONS SHEET

NEDC: 99-031 Preparer: Scientech, Inc. Reviewer: J. J. Drasler  
 Rev. No: 1 Date: 3/20/00 Date: 3/21/00

**PURPOSE**

This calculation incorporates by attachment Scientech Engineering Calculation No. 17080-M-01, Rev. 1, prepared under Task Agreement 99A-C20, in accordance with CNS Engineering Procedure 3.4.7, Section 4. The calculation determines atmospheric diffusion factors (X/Q values) at the Control Room intake for use in the Control Room Habitability Calculations for the postulated Design Basis Accidents, i.e., Loss of Coolant Accident (LOCA), Fuel Handling Accident (FHA), Main Steam Line Break (MSLB), and Control Rod Drop Accident (CRDA).

**EXTENT OF REVIEW**

Scientech's calculation was performed under their own QA program, which included an independent technical review. Therefore, the NPPD review does not include in-depth checks of mathematical calculations, but rather focuses on general acceptability of design inputs, assumptions, methodology, and conclusions. Any significant comments or concerns identified during the review have been resolved with Scientech and incorporated.

**REVIEW SUMMARY**

Scientech's calculation is organized into a single main portion and Attachment A, which includes the computer code input and output.

1. **Purpose** - The purpose of the calculation is as given above and as stated in Section 1 of Scientech's calculation. This section was reviewed and found to be acceptable.
2. **Design Inputs** - Design Inputs are identified throughout the text and particularly in Section 4 of Scientech's calculation with the reference for the design inputs listed in Section 5. The design inputs were reviewed and found to be acceptable. The Reactor Building design flow of 74,000 cfm used in Design Input 4.1 is acceptable since the dispersion factors for a Reactor Building release were calculated for a range of values up to and including the design flow. The minimum stack (ERP) flow of 552 cfm used as Design Input 4.3 is conservatively lower than the SGTS design flow rate of 1780 cfm.

Meteorological data was verified by first comparing the electronic met data files sent to Scientech (Attachment 2) against published CNS site specific data, Meteorological Program For The Cooper Nuclear Station, for each of the 5 years used in the calculation. Next, the ARCON96 input files for the elevated release and ground level release were spot checked against the same published CNS site specific data. These same input files were also compared against Section 4.4.2 of NUREG/CR-6331, Rev.1, to confirm that data format and units were correct.

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## DESIGN CALCULATIONS SHEET

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Documents comprising CNS-controlled source documents whose revision could impact input used in this calculation are identified on the Cross Reference Index in the front of this calculation. Non-status 1 inputs were verified using additional information and were found to be acceptable for use in this calculation.

3. **Assumptions** - Major assumptions are identified in Section 6 of Scientech's calculation. Additional assumptions are inferred in the input documents used and identified throughout Scientech's calculation by inference according to context and use. The assumptions were reviewed and found to be acceptable.
4. **Methodology** - The methodology is described in Section 3, Technical Approach. In general, 5 years of site meteorological data is reduced using the ARCON96 code (NUREG/CR-6331, Rev. 1) to determine the 95th percentile relative concentrations for each of three (3) releases:
  - 1) Reactor Building Vent (for various reactor building ventilation flow rates),
  - 2) Elevated Release Point (ERP) (point release), and
  - 3) Turbine Building (diffuse release).

The ARCON96 computer code is described in Section 7 and the computer input and output are listed in Attachment A. Section 8.1 describes use of the CNS meteorological data while calculations for the source geometry are included in Section 8.2. Figure 2 shows a schematic of the release points and control room intake with the input data used for the ARCON96 code. Table 1 summarizes the inputs used for the ARCON96 code.

Revision 1 of this calculation used diffusion coefficients consistent with Reference 5.17 instead of the ARCON96 code manual. Use of the Reference 5.17 diffusion coefficients is acceptable because it makes the results even more conservative.

The methodology was reviewed and found to be acceptable.

5. **Results / Conclusions** - Results and conclusions are given in Sections 10 and 11, respectively, of Scientech's calculation. Table 2 lists the calculated X/Q values for each of the different release conditions analyzed. Values are presented for each of the five years analyzed along with the maximum value for the five year interval.

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DESIGN CALCULATIONS SHEET

NEDC: 99-031

Preparer: Scientech, Inc.

Reviewer: J. J. Drasler 

Rev. No: 1

Date: 3/20/00

Date: 3/21/00

These results and conclusions sections were reviewed and found to be acceptable. The calculated X/Q values are acceptable for use in the control room habitability calculations. For conservatism, the highest values listed in Table 2 for each release point should be used in the dose calculations.



ENGINEERING CALCULATION

CLIENT/PROJECT NPPD/Cooper Nuclear Station CALC. NO. 17080-M-01 REV. 1

TITLE  $\frac{\chi}{Q}$  Values for Control Room Intake Using ARCON96

AUTHOR/DATE: <i>Harry A. Waugage</i> 3/20/2000	VERIFIED BY/DATE: <i>DOS for RPEly</i> 3/20/00	APPROVED BY/DATE: <i>[Signature]</i> 3/20/00
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**Purpose**

The objective of this analysis is to determine the atmospheric dispersion factors ( $\frac{\chi}{Q}$  values) for Cooper Nuclear Station (CNS) control room intake for release of radionuclides from the Reactor Building, Turbine Building, and Elevated Release Point (ERP) using the ARCON96 computer code. [5.1]

Revision 1 of this calculation was made to satisfy an NRC request which was made during the resolution of NRC Request for Additional Information. The NRC requested changing the calculation of the initial diffusion coefficients for diffuse releases to building dimensions divided by a factor of 6.

**Results**

Of the five years of meteorological data considered (1994 through 1998), no single year stands out with higher values of  $\frac{\chi}{Q}$  compared to all the other years. Three different release configurations were analyzed: reactor building vent release, elevated release point release, and turbine building diffuse release. The reactor building vent release case was analyzed by parametrically varying the rate of release through the reactor building vent. Table 2 summarizes the results. The highest values of  $\frac{\chi}{Q}$  from all the years for each case during the five time periods are given in the last column of table 2. It is recommended that these "highest" values of  $\frac{\chi}{Q}$  be used in performing design basis dose analysis.

SUPERSEDED BY REV.	QUALITY CLASS	DISTRIBUTION	VERIFICATION METHOD
SUPPLEMENTED BY CALC. NO.:	<input checked="" type="checkbox"/> SAFETY-RELATED <input type="checkbox"/> NON-SR <input type="checkbox"/> OTHER	<input checked="" type="checkbox"/> PROJECT <input checked="" type="checkbox"/> DCC <input type="checkbox"/> OTHER	<input checked="" type="checkbox"/> REVIEW <input type="checkbox"/> ALT. ANALYSIS

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Attachment A – ARCON96 output files (71 pages)

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## 1. Purpose of Analysis

The objective of this analysis is to determine the atmospheric dispersion factors ( $\frac{\lambda}{Q}$  values) for

Cooper Nuclear Station (CNS) control room intake for release of radionuclides from the Reactor Building, Turbine Building, and Elevated Release Point (ERP) using the ARCON96 computer code. [5.1]

Revision 1 of this calculation was made to satisfy an NRC request which was made during the resolution of NRC Request for Additional Information. The NRC requested changing the calculation of the initial diffusion coefficients for diffuse releases to building dimensions divided by a factor of 6.

## 2. Intended Use of Analysis Results

The results of this analysis are to be used to perform control room habitability analysis for CNS following different design basis accidents.

## 3. Technical Approach

### 3.1 Introduction

The relative concentrations of radionuclides due to hypothetical releases from the containment were assessed using the ARCON96 computer code. [5.1] The basic diffusion model implemented in the ARCON96 code is a straight-line Gaussian model that assumes the release rate is constant for the entire period of release. This assumption is made to permit evaluation of potential effects of accidental releases without having to specify a complete release sequence.

ARCON96 permits evaluation of ground level, vent, and elevated releases. Building wake effects are considered in the evaluation of relative concentrations from ground-level releases. Vent releases are treated as a mixed ground level and elevated release. The proportions of the mixture are determined by the ratio between the effluent vertical velocity and the release height wind speed. Elevated releases are treated with corrections for downwash and differences in terrain elevation between the stack and the control room intake.

ARCON96 calculates relative concentrations using hourly meteorological data. It then combines the hourly averages to estimate concentrations for periods ranging in duration from 2 hours to 30 days. Wind direction is considered as the averages are formed. As a result, the averages account

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for persistence in both diffusion conditions and wind direction. Cumulative frequency distributions are prepared from the average relative concentrations. Relative concentrations that are exceeded no more than five percent of the time (95<sup>th</sup> percentile relative concentrations) are determined from the cumulative frequency distributions for each averaging period. The relative concentrations from five standard averaging periods used in control room habitability assessments are calculated from the 95<sup>th</sup> percentile relative concentrations.

Section 3.2 reproduces discussion of the ARCON96 code model from the code user's manual. Section 3.3 describes the calculation of initial diffusion coefficients for diffuse releases. Section 3.4 describes different radioactive release configurations analyzed.

**3.2 ARCON96 Modeling**

**3.2.1 Diffusion Model**

The ARCON96 code implements a straight-line Gaussian diffusion model. The basic model for a ground-level release is:

$$\chi/Q = [1/(\pi\sigma_y\sigma_zU)] \exp[-0.5(y/\sigma_y)^2] \tag{1}$$

where  $\chi/Q$  = relative concentration (concentration divided by release rate) [(ci/m<sup>3</sup>) / (ci/s)]

$\sigma_y, \sigma_z$  = diffusion coefficients) (m)

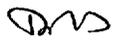
U = wind speed (m/s)

y = distance from the center of the plume (m)

This equation assumes that the release is continuous, constant, and of sufficient duration to establish a representative mean-concentration. It also assumes that the ground reflects the material being released. Diffusion coefficients are typically determined from atmospheric stability and distance from the release point using empirical relationships. A diffusion coefficient parameterization from the NRC PAVAN [5.2] and XOQDOQ [5.3] codes is used for  $\sigma_y$  and  $\sigma_z$ .

**3.2.1.1 Diffusion Coefficient Adjustments for Wakes and Low Wind Speeds**

To estimate diffusion in building wakes, composite wake diffusion coefficients,  $\Sigma_y$  and  $\Sigma_z$ , replace  $\sigma_y$  and  $\sigma_z$ . The composite wake diffusion coefficients are defined by

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$$\Sigma_y = (\sigma_y^2 + \Delta\sigma_{y1}^2 + \Delta\sigma_{y2}^2)^{1/2} \quad (2)$$

$$\Sigma_z = (\sigma_z^2 + \Delta\sigma_{z1}^2 + \Delta\sigma_{z2}^2)^{1/2}$$

where  $\sigma_y$  and  $\sigma_z$  are the normal diffusion coefficients,  $\Delta\sigma_{y1}$  and  $\Delta\sigma_{z1}$  are the low wind speed corrections, and  $\Delta\sigma_{y2}$  and  $\Delta\sigma_{z2}$  are the building wake corrections. These corrections are described and evaluated in Ramsdell and Fosmire. [5.11] The form of the low wind speed corrections is

$$\Delta\sigma_{y1}^2 = 9.13 \times 10^5 [1 - (1 + x/1000U) \exp(-x/1000U)] \quad (3)$$

$$\Delta\sigma_{z1}^2 = 6.67 \times 10^2 [1 - (1 + x/100U) \exp(-x/100U)]$$

where  $x$  is the distance from the release point to the receptor, in meters, and  $U$  is the wind speed in meters per second. It is appropriate to use the slant range distance for  $x$  because these corrections are made only when the release is assumed to be at ground level and the receptor is assumed to be on the axis of the plume. The diffusion coefficient corrections that account for enhanced diffusion in the wake have a similar form. These corrections are

$$\Delta\sigma_{y2}^2 = 5.24 \times 10^{-2} U^2 A [1 - (1 + x/10 \sqrt{A}) \exp(-x/10 \sqrt{A})] \quad (4)$$

$$\Delta\sigma_{z2}^2 = 1.17 \times 10^{-2} U^2 A [1 - (1 + x/10 \sqrt{A}) \exp(-x/10 \sqrt{A})]$$

where  $A$  is the cross-sectional area of the building in square meters.

An upper limit is placed on  $\Sigma_y$  as a conservative measure. This limit is the standard deviation associated with a concentration uniformly distributed across a sector with width equal to the circumference of a circle with radius equal to the distance between the source and receptor. This value is

$$\Sigma_{y\max} = 2\pi x / \sqrt{12} = 1.81x \quad (5)$$

The model described in equations 1 through 4 is a replacement for the dispersion model in the procedure for control room habitability assessment developed by Murphy and Campe. [5.4] Earlier building wake diffusion model studies conducted for the NRC showed that the Murphy-Campe model did not predict the variations of the concentrations in the vicinity of buildings particularly well. [5.5, 5.6] The studies also showed that one of the primary reasons was that it overpredicted concentrations during low wind speed conditions. The code described above overcomes these problems.

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### 3.2.1.2 Sector-Average Diffusion Model

Equations 1 through 4 are appropriate for estimating relative concentrations for 1-hour periods. A sector-average relative concentration model is used to estimate concentrations for periods after the initial 0 - 8-hour period. Integrating the concentrations across the normal plume model to obtain a crosswind-integrated concentration, CIC, derives the sector-average plume model as follows:

$$CIC/Q' = 2 / [\text{sqrt}(2\pi)\Sigma_z U] \quad (6)$$

The relative concentration is then calculated by dividing  $CIC/Q'$  by the width of the sector,  $W_s$ ,

$$\chi_{sa} / Q' = 2 / [\text{sqrt}(2\pi)\Sigma_z U W_s] = 0.80 / [\Sigma_z U W_s] \quad (7)$$

In most cases, the sector width is defined as the width of a 22.5-degree sector, which is a function of the distance downwind. This procedure works well except for small distances in unstable atmospheric conditions. In unstable atmospheric conditions the procedure gives sector average concentrations that are greater than the centerline concentration at small distances. This problem can be avoided by redefining the definition of the sector width. For the ARCON96 code, the sector width is the larger of  $\alpha\Sigma_y$ , where  $\alpha$  is a numerical constant with a value of 4, and  $\pi x/8$ , where  $x$  is the distance between the source and receptor. Values of  $\alpha$  in the range 4 and 6 are reasonable. The default value of 4 used in the code was selected to be conservative.

Approximately 95% of the material in a Gaussian plume is within  $\pm 2 \Sigma_y$  of the plume axis. To be consistent with the centerline model, and to be conservative, the sector width is limited to a maximum value. This maximum value is the circumference of a circle with a radius equal to the distance between the source and receptor; i. e.,

$$W_{smax} = 2\pi x \quad (8)$$

### 3.2.1.3 Elevated Release Diffusion Models

For elevated releases, the relative concentration is given by

$$\chi/Q' = [1/(\pi\sigma_y\sigma_z U)] \exp[-0.5(y/\sigma_y)^2] \exp[-0.5((h_e - h_i)/\sigma_z)^2] \quad (9)$$

where  $h_e$  is the effective stack height and  $h_i$  is the height of the intake. Wake corrections are not made to diffusion coefficients used in calculating concentrations in elevated plumes. Effective stack height is determined from the actual stack height ( $h_s$ ), the difference in terrain elevation between the stack and intake locations ( $t_s - t_i$ ) and stack downwash ( $\Delta h_d$ ) by

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$$h_e = h_s + (t_s - t_i) + \Delta h_d \quad (10)$$

where the stack downwash is computed as

$$\Delta h_d = 4r_s[(W_o/U(h_s)) - 1.5] \quad (11)$$

and  $r_s$  is the radius of the stack,  $W_o$  is the vertical velocity of the effluent, and  $U(h_s)$  is the wind speed at stack height. A release is considered elevated if the actual stack height is more than 2.5 times the height of structures in the immediate vicinity of the stack. Plume rise is not considered in calculating effective stack height in ARCON96.

The sector-average model is used in calculating relative concentrations for elevated releases for averaging periods longer than 8 hours. The sector-average plume model for elevated releases may be derived in the same manner as the sector-average plume for ground-level releases. It is

$$\chi_{sa}/Q' = \{2/[\text{sqrt}(2\pi)\sigma_z U W_s]\} \exp[-0.5((h_e - h_i)/\sigma_z)^2] \quad (12)$$

### 3.2.1.4 Vent Release Diffusion Model

ARCON96 treats vent releases in addition to ground level and elevated releases. A vent release is a release that takes place through a rooftop vent with an uncapped vertical opening. The treatment of these releases depends on the vertical velocity of the effluent and the wind speed at roof height. If the vertical velocity ( $W_o$ ) is more than 5 times the wind speed ( $U$ ), the release is treated as an elevated release with a stack height equal to the height of the vent. If the vertical velocity is less than the wind speed, the release is treated as a ground-level release. Finally, if the vertical velocity is less than 5 times the wind speed but greater than the wind speed, the release is treated as a mixed-mode release based on the discussion in Regulatory Guide 1.111 [5.7] and the implementation in XOQDOQ. [5.3]

The relative concentration for a mixed-mode release is a weighted average of the relative concentrations for elevated and ground level releases. The weights for the mixed-mode release are determined as follows. An entrainment coefficient,  $E_t$ , is determined for those hours when  $W_o/U$  is between one and five:

$$E_t = 2.58 - 1.58 (W_o/U) \text{ for } 1 < W_o/U \leq 1.5 \quad (13)$$

$$E_t = 0.3 - 0.06 (W_o/U) \text{ for } 1.5 < W_o/U < 5$$

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The weight given to the concentration from the ground-level plume is  $E_t$ , and the weight given to the elevated plume is  $1 - E_t$ .

### 3.2.1.5 Area Source Diffusion Model

The diffusion models incorporated in ARCON96 are Gaussian models that assume that the release is from a point source. This assumption is reasonable for receptors (e.g., control room air intakes) that are "far downwind" from the release location. For area sources or a group of closely spaced release points, "far downwind" may be defined in terms of a characteristic dimension associated with the source or combination of sources, although the selection of the characteristic dimension is subjective. For an area source the characteristic dimension could be the square root of the area. Similarly, for a group of closely spaced release points, the characteristic dimension could be the radius of a circle that just encompasses the release points. If the distance between the source and the receptor is greater than about ten times the characteristic dimension of the source, a point source approximation is generally acceptable. If, however, the distance between the source and receptor is less than ten times the characteristic dimension,  $\chi/Q_s$  calculated with point source models will be too large because the models do not account for the finite dimensions of the source.

In ARCON96 one may specify initial horizontal and vertical diffusion coefficients that are related to the characteristic dimensions of a source. The area source adjustment is made to the point source diffusion coefficients.

The ARCON96 code uses the initial diffusion coefficients to determine the distance from the center of the real source to the virtual point source located upwind of the real source. The distance from the virtual point source to the center of the area source (virtual distance,  $X_v$ ) is

$$X_v = [(\sigma_0 - c)/\alpha]^{1/b} \quad (14)$$

where  $\sigma_0$  is the initial diffusion coefficient, and  $\alpha$ ,  $b$  and  $c$  are functions of stability. Virtual distances are calculated for both horizontal and vertical diffusion. It is unlikely that these two distances will be the same. The distances used in calculating  $\sigma_y$  and  $\sigma_z$  (the effective distances,  $x_c$ ) are the sums of actual distance and the virtual distance.

### 3.2.2 Calm Winds

ARCON96 treats calm wind diffusion explicitly. The common derivation of the Gaussian plume model involves assumptions that eliminate the portion of the solution of the diffusion equation that describes diffusion when the winds speed approaches zero. An alternative, equally

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reasonable, derivation has been published by Frenkiel. [5.8] The basic assumptions in the derivation are that the diffusion coefficients are proportional to standard deviations of the wind fluctuations and the time following release. Kao describes Frankiel's model. [5.12] Concentrations calculated by Frenkiel's model have a local minimum at  $U = 0$ . The concentration increases until it reaches a maximum at  $U = 1$  m/s, and then it decreases as the  $U$  continues to increase. At high wind speeds, the concentration decreases proportional to  $1/U$  as in the usual formulation of the Gaussian plume model. The exact wind speed at which the maximum occurs is a function of distance between source and receptor. It occurs at lower wind speeds for small distances.

The diffusion model described by equation 1 has approximately the same behavior at low wind speeds as the Frenkiel model when the low wind speed corrections given by equation 3 are applied to the normal diffusion coefficients. Therefore, ARCON96 uses equation 1 with the low wind speed correction for calm wind conditions. Winds are defined as calm when the wind speed falls below the minimum speed defined for the meteorological data. The minimum speed is used for calculations when the wind speeds are calm. This assumption yields concentrations that are within a few percent of the maximum for all distances.

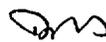
Wind direction is not considered during calm winds. In all cases of calm winds the receptor is assumed to be directly downwind of the release point. This assumption is conservative because it substitutes non-zero values of  $\chi/Q$  for values that would normally be zero if wind direction were considered.

### 3.2.3 Vent/Stack Flow

The diffusion equations presented in § 3.2.1 and 3.2.2 assume point sources. Use of these equations to calculate concentrations at receptors near short stacks and vents can result in physically unreal concentration estimates. The concentrations calculated at the receptors can be higher than the concentrations in the stack or vent. ARCON96 limits the concentrations at receptors by allowing the user to specify the volumetric flow through the stack. Given an initial concentration estimate calculated using the equations previously described, relative concentrations corrected for stack flow, are calculated as

$$(\chi/Q')^* = 1/[1/(\chi/Q') + F] \quad (15)$$

where  $(\chi/Q')^*$  is the corrected relative concentration and  $F$  is the volumetric flow rate through the vent/stack.

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### 3.2.4 Exposure Window

In computing average relative concentrations at the intake, ARCON96 assumes that material travels directly from the release point to the intake if the wind direction is within a window specified by the user. The wind direction window is based on the direction from the intake to the release point and the angular width of the window. The default width of the window is  $90^\circ (\pm 45^\circ)$  from the line between the release point and the intake).

### 3.2.5 Averaging Methods

Average relative concentrations are computed as running mean values. Overlapping mean values are used in compiling the  $\chi/Q$  cumulative frequency distributions. For periods 8 hours or less in duration, the average is based entirely on  $\chi/Q$  values calculated using the centerline model:

$$(\chi/Q')_{\text{avg}} = (1/N) \sum_{i=1}^N (\chi/Q')_i \quad (16)$$

where  $N$  = averaging period in hours.

For longer periods, the averages include both centerline and sector-average ( $\chi/Q$ )s. They are calculated as:

$$(\chi/Q')_{\text{avg}} = (1/N) [\sum_{i=1}^8 (\chi/Q')_i + \sum_{i=9}^N (\chi_{\text{sa}}/Q')_i] \quad (17)$$

### 3.2.6 Relative Concentrations for Standard Intervals

Standard Review Plan 6.4 [5.9] and various regulatory guides related to estimation of consequences of radionuclide releases following an accident require relative concentration estimates for various periods following the start of release. ARCON96 calculates concentrations for the following standard periods: 0 to 2 hours, 2 to 8 hours, 8 to 24 hours, 1 to 4 days, and 4 to 30 days. These values are calculated from the 95<sup>th</sup> percentile average relative concentrations. The larger of the 1- and 2-hour average relative concentration is used for the 0-to-2-hour period. Average relative concentrations for the 2- to 8-hour period are calculated as

$$(\chi/Q')_{\text{avg}_{95}}(2 \text{ to } 8 \text{ hr}) = [8 (\chi/Q')_{\text{avg}_{95}}(0 \text{ to } 8 \text{ hr}) - 2 (\chi/Q')_{\text{avg}_{95}}(0 \text{ to } 2 \text{ hr})]/6 \text{ hr} \quad (18)$$

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where  $\chi / Q'$  avg95 (0 to 8hr) and  $\chi / Q'$  avg95 (0 to 2 hr) are 95th percentile average values for 8 and 2 hours, respectively. The 6 hours in the denominator is the length of the averaging period. Relative concentrations for the remaining standard periods are calculated in the same manner.

### 3.3 Initial Diffusion Coefficients

Consistent with ARCON96 code manual, Calculation 17080-M-01, Rev. 0 defined the initial horizontal and vertical diffusion coefficients,  $\Sigma_y$  and  $\Sigma_z$ , as given by equations 19 and 20. [5.1, 5.16]

$$\Sigma_y = \frac{w}{8.6} \quad (19)$$

$$\Sigma_z = \frac{h}{2} \quad (20)$$

where  $w$  and  $h$  are building width and height.

However, NRC Request of Additional Information recommended using the diffusion coefficients given by equations 21 and 22, which were also used in reference 5.17.

$$\Sigma_y = \frac{w}{6} \quad (21)$$

$$\Sigma_z = \frac{h}{6} \quad (22)$$

This analysis (Rev. 1) used equations 21 and 22 to calculate the initial diffusion coefficients for the Turbine Building diffuse release.

### 3.4 Different Release Configurations Analyzed

The ARCON96 code was used to calculate dispersion factors for three release points: the reactor building roof discharge vent (release point 1), the elevated release point (ERP) (release point 2), and the turbine building wall adjacent to the control room (release point 3). The reactor building roof discharge vent is a release point for activity in the secondary containment during the time period that the RB ventilation system is still in operation. The reactor building vent release case

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was analyzed by parametrically varying the rate of release through the reactor building vent. The ERP is used to discharge post-accident (loss-of-coolant accident and fuel handling accident) release via the standby gas treatment system (SGTS). The turbine building wall is a diffuse release point for the activity that passes through the main steam lines and is released to the environment via the turbine building.

#### 4. Design-Input Information

The input data consists of meteorological data, and source geometry data relative to the source and receptors.

- 4.1 The RB maximum vent design flow is at 74,000 cfm ( $34.9 \text{ m}^3/\text{s}$ ) at  $t=0$ , which drops to zero when the fan trips and the flow coasts down (CNS, Burns & Roe Drawing 2020 Rev. N45).
- 4.2 Figure 1 shows the following for the reasons given (CNS, Burns & Roe Drawings: 2209 Rev. 3, 2217 Rev. N08, 2194 Rev. N03, 4005 Rev. N01, 2037 Rev. N54, and 4506 Rev. N06): [5.10]
- Dimensions for calculating the orientation (angle) and the distance between release points and the control room intake.
  - Elevations of release points and general grade elevation to calculate height of release points.
  - Elevation of the control room intake to calculate its height above grade elevation
  - Turbine and reactor building dimensions and roof elevations to calculate the cross-sectional areas of the buildings in order to model building wake effects.
  - Height of the elevated release point.
  - Cross-sectional dimensions of reactor building and ERP vents to calculate cross-sectional areas, which are used to calculate, release velocities.
  - Difference between the true north and the site north directions to calculate orientation angles between release points and the control room intake with respect to the true north direction.
- 4.3 The minimum stack (ERP) flow is 552 cfm ( $0.26 \text{ m}^3/\text{s}$ ) which occurs during SGTS operation. This is approximately equal to the evacuation flow rate of the refueling floor. [5.14] It is conservative to use this flow rate because it is significantly lower than the SGTS flow rate of 1780 cfm. [5.15]
- 4.4 Meteorological data for the five-year period 1994 through 1998 were obtained from the onsite meteorological program.

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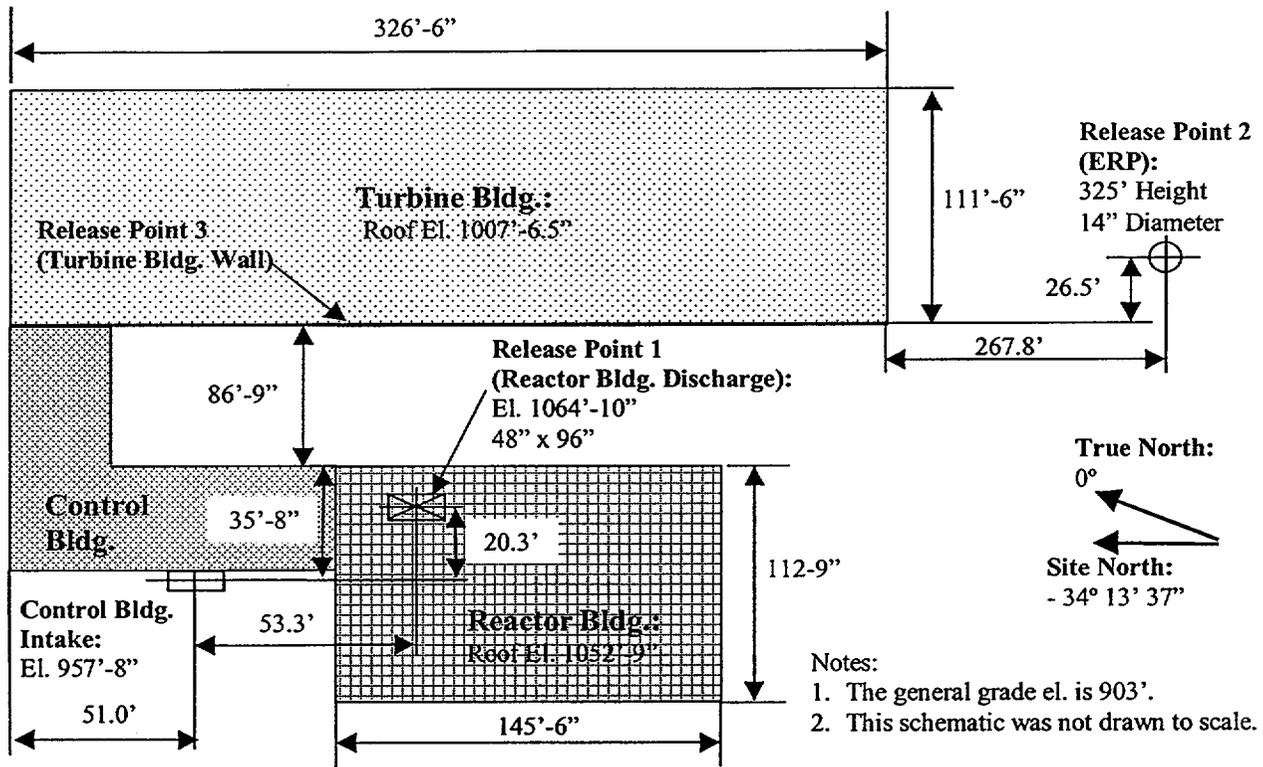


Figure 1. Schematic layout of release points and control room intake showing design input information.

## 5. References

- 5.1 J. V. Ramsdell Jr. and C. A. Simonen, "Atmospheric Relative Concentrations in Building Wakes," NUREG/CR-6331, PNNL-10521, Revision 1, U.S. Nuclear Regulatory Commission, Washington, D.C., 1997.
- 5.2 T. J Bander, PAVAN: An Atmospheric Dispersion Program for Evaluating Design Basis Accident Releases of Radioactive Materials from Nuclear Power Stations, NUREG/CR-2858, U.S. Nuclear Regulatory Commission, Washington D.C., 1982
- 5.3 J. F Sagendorf, J. T. Goll, and W. F. Sandusky. 1982. XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Releases at Nuclear Power Stations. NUREG/CR-2919, U.S. Nuclear Regulatory Commission, Washington, D.C.

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- 5.4 K. G. Murphy and K. M. Campe, "Nuclear Power Plant Control Room Ventilation System Design for Meeting General Criterion 19," Proceedings of the 13th AEC Air Cleaning Conference, August 12-15, 1974, San Francisco, California. CONF-740807, U.S. Atomic Energy Commission, Washington, D.C.
- 5.5 J. V Ramsdell Jr, "Atmospheric Diffusion for Control Room Air Habitability Assessments," NUREG/CR-5055, U.S. Nuclear Regulatory Commission, Washington, D.C., 1988
- 5.6 J. V. Ramsdell Jr, Diffusion in Building Wakes for Ground-Level Releases. Atmospheric Environment 24B: 377-388, 1990.
- 5.7 U.S. Nuclear Regulatory Commission, Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors. Regulatory Guide 1.111, Revision 1. U.S. Nuclear Regulatory Commission, Washington, D.C., 1977
- 5.8 F. N. Frankiel "Turbulent Diffusion: Mean Concentration in a Flow Field of Homogeneous Turbulence." Advances in Applied Mechanics 3:61-107, 1953.
- 5.9 NUREG-0800, Standard Review Plan, Rev. 2, July 1981: § 6.4, "Control Room Habitability Systems,"
- 5.10 CNS, Burns & Roe Drawings: 2020 Rev. N45, 2037 Rev. N54, 2209 Rev. 3, 2217 Rev. N08, 2194 Rev. 3, 4005 Rev. N01, and 4506 Rev. N06):
- 5.11 J. V. Ramsdell Jr. and C. J. Fosmire, Atmospheric Dispersion Estimates in the Vicinity of Buildings. PNL-10286. Pacific Northwest Laboratory, Richland, Washington, 1995.
- 5.12 S. K. Kao, "Atmospheric Science and Power Production: Theories of Atmospheric Transport and Diffusion," DOE/TIC-27601, D. Randerson, ed. U.S. Department of Energy, Washington, D.C. pp. 189-239, 1984.
- 5.13 H. Wagage, 1999, ARCON96 Software Verification Memo from to T. Bladen dated 1/25/99.
- 5.14 Burns and Roe Calculation, "System Sizing, Standby Gas Treatment System," Book 4, Retrieval 00103-0487.
- 5.15 CNS Design Change 94-102.
- 5.16 Calculation 17080-M-01, Rev. 0, " $\frac{\lambda}{Q}$  Values for Control Room Intake Using ARCON96."
- 5.17 SER for Amendment No. 215 to Facility Operating License No. DPR-50, Three Mile Island Nuclear Station, Unit No. 1, Docket No. 50-289, 8/24/99.

## 6. Major Assumptions

- 6.1 The release height is equal to the height of the control room intake for diffuse release cases, i.e., for release from the turbine building. This assumption is conservative

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because the actual release can occur at a higher elevation, which vary from the floor to the roof of the turbine building, resulting in lower values of  $\frac{\lambda}{Q}$ .

## 7. Computer Codes and Computer Used

The ARCON96 computer code was used as the basis for the analyses for this report. The code was obtained from the Energy Science and Technology Software Center and was provided on two IBM compatible floppy disks. The program was installed and executed on a Dell Inspiron 3000 computer running a Windows NT Version 4.0 operating system as currently assigned to Harry Wagage (owned by Matrix Leasing, no. 210158). Satisfactory operation of the ARCON96 code on this computer has been confirmed by verification. [5.13]

## 8. Detailed Calculations

### 8.1 Meteorological Data

The meteorological data used in this assessment were provided by Cooper Nuclear Station. These data have been obtained from the 100-meter onsite meteorological tower at Cooper and represent hourly averages for wind speed, wind direction, and stability class. The data were compiled for the five-year period 1994 through 1998. Wind speed and wind direction data were obtained from the 10-meter level and associated stability class was determined from temperature differential between the 10-meter and 60-meter levels for the vent and diffuse release cases. Wind speed and wind directions were obtained from the 100-meter level and associated stability class was determined from temperature differential between the 10-meter and 100-meter levels for the stack release case. Data was formatted in accordance with the description provided in § 4.4.2 of ARCON96. ARCON96 is capable of running one year of meteorological data. Consequently, each of the five years of data was used in the analysis.

### 8.2 Source Geometry

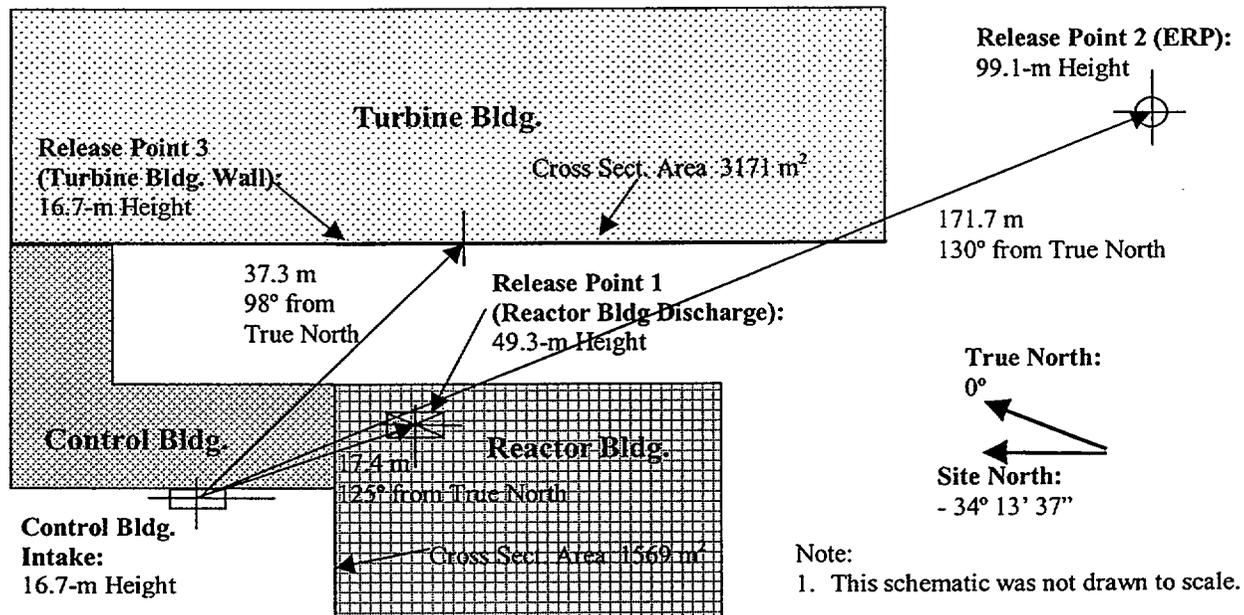
Figure 2 gives a schematic layout of release points and control room intake showing input data for the ARCON96 code. Data shown on figure 2 were calculated using those shown on figure 1.

The above diagram and source geometry used in this assessment was obtained from CNS, Burns & Roe drawings 2209 Rev 3, 2217 Rev N08, 2194 Rev N03, and 4506 Rev N06. [5.10] The ARCON 96 code requires the following source configuration information: vent release height,

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building area, effluent vertical velocity, vent or stack flow, vent or stack radius, direction from true north from the control room intake to the source, distance to the control room intake from the source, and the control room intake height. [5.1] It is indicated in CNS drawing 2209 Rev 3 that the reactor building vent is not capped; however, the fans are tripped during an FHA and the flow could coast down to zero before the discharge damper is closed, effectively reducing the flow to zero. The effect of the coast down of the fan is modeled by parametrically changing the flow rate.



**Figure 2. Schematic layout of release points and control room intake showing input data for the ARCON96 code. (Note: The height of Release Point 3 was conservatively assumed to be the same as the height of control building intake.)**

The minimum stack (ERP) flow is 552 cfm (0.26 m<sup>3</sup>/s) which occurs during SGTS operation (§ 4.3). As seen from equation 15, a lower stack flow would result in a higher value for  $\frac{\chi}{Q}$ .

Therefore, the lower bound of stack flow of 552 cfm (0.26 m<sup>3</sup>/s) was conservatively used in the calculation.

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The building area as used in ARCON96 controls the distance downwind at which the wake effect will exist and has influence on containment dispersion. For this analysis the turbine building structure was used. This is conservative since other adjacent structures will enhance the effect of the wake and ensure greater dispersion. As presented in the ARCON96 manual a characteristic length representing the distance the wake effect will be felt is determined as the square root of the building area. [5.1] Considering the cross-sectional area of the turbine building, the control room intake locations are clearly within the wake zones of the respective containment structure. The input calculation of area presented below is for the purposes of satisfying the input requirements of ARCON96 and providing a somewhat real estimate of containment cross-sectional area.

Reference-angles and distances between the intake and release were obtained from the referenced drawings.

$\Sigma_y$  was calculated using equation 21 as follows:

$$\Sigma_y = (326' - 6'') / 6 = 54.4' = 16.6 \text{ m}$$

The height of the exposed area is taken as the height of the turbine building, which is 1007'-6½". Plant general grade elevation is 903'. Therefore the height of the exposed area is 107.6'.  $\Sigma_z$  for units is therefore calculated using equation 22 as follows:

$$\Sigma_z = (1007' - 6.5'' - 903') / 6 = 17.4' = 5.3 \text{ m.}$$

Table 1 presents a list of source input parameters for the above cases. The input parameters for the reactor building vent release case (release point 1) are given for different fractions of design flow rate (f).

## 9. Computer Input and Output

Attachment-A gives computer output files, which list the input files at the beginning.

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## 10. Summary of results

Meteorological data obtained from the onsite meteorological program for the five-year period 1994 through 1998 were used. ARCON96 was run for each of the five years and incorporating the source-input data presented in Table 1. Of the five years meteorological data considered (1994 through 1998), no single year stands out with higher values of  $\frac{\lambda}{Q}$  compared to all the

other years. Table 2 lists the  $\frac{\lambda}{Q}$  values calculated for different cases as discussed in § 3. The

highest values of  $\frac{\lambda}{Q}$  from all the years for each case during the five time periods are given in the

last column of table 2. It is recommended that these "highest" values of  $\frac{\lambda}{Q}$  be used in performing design basis dose analysis.

## 11. Conclusions

Of the five years of meteorological data considered (1994 through 1998), no single year stands out with higher values of  $\frac{\lambda}{Q}$  compared to all the other years. Three different release

configurations were analyzed: reactor building vent release, elevated release point release, and turbine building diffuse release. The reactor building vent release case was analyzed by parametrically varying the rate of release through the reactor building vent. Table 2 summarizes

the results. The highest values of  $\frac{\lambda}{Q}$  from all the years for each case during the five time periods

are given in the last column of table 2. It is recommended that these "highest" values of  $\frac{\lambda}{Q}$  be used in performing design basis dose analysis.

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Table 1. Source Input Parameters to ARCON96

Release Configuration	Release Point 1: Reactor Building Vent Release for Different Fractions of Design Flow Rate (f)					Release Point 2: Elevated Release Point Release	Release Point 3: Turbine Generator Building Diffuse Release
	f = 0	f = 1/4	f = 1/2	f = 3/4	f = 1		
Vent Release Height (m)	49.3					99.1	16.7
Bldg., X-sect. Area (m <sup>2</sup> )	1569					0	3171
Effluent Vertical Velocity (m/s)	0.0	2.9	5.9	8.8	11.7	2.62	0
Stack Flow (m <sup>3</sup> /s)	0.0	8.7	17.5	26.2	34.9	.26	0
Stack Radius (m)	0.97					.18	0
$\Sigma_y$ (m)	0					0	16.6
$\Sigma_z$ (m)	0					0	5.3
Direction from True North- Intake to Source (deg)	125					130	98
Wind Direction Sector Width (deg)	90						
Distance to Intake (m)	17.4					171.7	37.3
Intake Height (m)	16.7						

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Table 2.  $\frac{\chi}{Q}$  Values Calculated by ARCON96 for Different Release/Intake Cases

Release Point	f	Duration	1994	1995	1996	1997	1998	Highest
1	0	0 - 2 hours	3.64E-3	3.58E-3	4.36E-3	3.32E-3	3.82E-3	4.36E-3
		2 - 8 hours	7.15E-4	8.04E-4	1.19E-3	8.40E-4	1.00E-3	1.19E-3
		8 - 24 hours	5.24E-4	5.26E-4	5.51E-4	5.09E-4	6.89E-4	6.89E-4
		1 - 4 days	4.87E-4	4.66E-4	5.28E-4	4.90E-4	6.46E-4	6.46E-4
		4 - 30 days	4.16E-4	3.68E-4	4.33E-4	3.70E-4	7.26E-4	7.26E-4
	1/4	0 - 2 hours	1.58E-3	1.84E-3	1.98E-3	1.20E-3	1.59E-3	1.98E-3
		2 - 8 hours	5.37E-4	5.47E-4	7.41E-4	5.36E-4	6.30E-4	7.41E-4
		8 - 24 hours	2.49E-4	2.10E-4	2.52E-4	1.95E-4	2.63E-4	2.63E-4
		1 - 4 days	2.18E-4	2.25E-4	2.12E-4	1.91E-4	2.78E-4	2.78E-4
		4 - 30 days	1.44E-4	1.54E-4	1.68E-4	1.21E-4	2.53E-4	2.53E-4
	1/2	0 - 2 hours	2.94E-4	3.25E-4	4.47E-4	2.52E-4	3.25E-4	4.47E-4
		2 - 8 hours	1.18E-4	1.15E-4	1.42E-4	1.07E-4	1.21E-4	1.42E-4
		8 - 24 hours	4.56E-5	4.52E-5	5.84E-5	4.22E-5	5.20E-5	5.84E-5
		1 - 4 days	4.26E-5	4.06E-5	4.15E-5	3.71E-5	6.08E-5	6.08E-5
		4 - 30 days	2.92E-5	2.97E-5	3.45E-5	2.57E-5	5.67E-5	5.67E-5
	3/4	0 - 2 hours	1.78E-4	1.97E-4	2.13E-4	1.33E-4	1.83E-4	2.13E-4
		2 - 8 hours	6.39E-5	6.89E-5	9.19E-5	6.32E-5	7.02E-5	9.19E-5
		8 - 24 hours	3.03E-5	2.61E-5	3.42E-5	2.42E-5	2.91E-5	3.42E-5
		1 - 4 days	2.43E-5	2.43E-5	2.29E-5	2.02E-5	2.89E-5	2.89E-5
		4 - 30 days	1.59E-5	1.76E-5	1.87E-5	1.37E-5	2.76E-5	2.76E-5
1	0 - 2 hours	7.12E-5	9.06E-5	1.11E-4	4.87E-5	8.39E-5	1.11E-4	
	2 - 8 hours	5.03E-5	4.86E-5	5.69E-5	4.69E-5	4.83E-5	5.69E-5	
	8 - 24 hours	1.53E-5	1.58E-5	2.00E-5	1.23E-5	1.27E-5	2.00E-5	
	1 - 4 days	1.34E-5	1.39E-5	1.25E-5	9.18E-6	1.38E-5	1.39E-5	
	4 - 30 days	8.29E-6	1.01E-5	9.27E-6	7.00E-6	1.29E-5	1.29E-5	
2	-	0 - 2 hours	1.00E-9	1.00E-9	1.00E-9	1.00E-9	1.00E-9	1.00E-9
		2 - 8 hours	1.00E-9	1.00E-9	2.61E-9	2.53E-9	2.65E-9	2.65E-9
		8 - 24 hours	1.00E-9	1.00E-9	5.97E-8	2.32E-8	6.41E-8	6.41E-8
		1 - 4 days	1.40E-8	4.60E-9	9.83E-9	1.03E-8	2.00E-8	2.00E-8
		4 - 30 days	5.62E-9	6.95E-10	9.21E-9	8.21E-9	1.66E-8	1.66E-8
3	-	0 - 2 hours	8.16E-4	7.71E-4	8.43E-4	9.27E-4	9.54E-4	9.54E-4
		2 - 8 hours	4.51E-4	4.53E-4	4.82E-4	4.67E-4	4.93E-4	4.93E-4
		8 - 24 hours	2.17E-4	2.10E-4	2.69E-4	2.35E-4	2.43E-4	2.69E-4
		1 - 4 days	1.42E-4	1.21E-4	1.65E-4	1.59E-4	1.72E-4	1.72E-4
		4 - 30 days	8.43E-5	8.25E-5	9.43E-5	1.43E-4	1.36E-4	1.43E-4

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 0 w/ 1994 Met. Data..... 2

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 0 w/ 1995 Met. Data..... 4

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 0 w/ 1996 Met. Data..... 6

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 0 w/ 1997 Met. Data..... 8

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 0 w/ 1998 Met. Data.... 10

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ¼ w/ 1994 Met. Data.... 12

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ¼ w/ 1995 Met. Data.... 14

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ¼ w/ 1996 Met. Data.... 16

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ¼ w/ 1997 Met. Data.... 18

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ¼ w/ 1998 Met. Data.... 20

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ½ w/ 1994 Met. Data.... 22

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ½ w/ 1995 Met. Data.... 24

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ½ w/ 1996 Met. Data.... 26

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ½ w/ 1997 Met. Data.... 28

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ½ w/ 1998 Met. Data.... 30

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ¾ w/ 1994 Met. Data.... 32

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ¾ w/ 1995 Met. Data.... 34

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ¾ w/ 1996 Met. Data.... 36

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ¾ w/ 1997 Met. Data.... 38

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ¾ w/ 1998 Met. Data.... 40

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1.0 w/ 1994 Met. Data 42

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1.0 w/ 1995 Met. Data 44

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1.0 w/ 1996 Met. Data 46

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1.0 w/ 1997 Met. Data 48

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1.0 w/ 1998 Met. Data 50

Release Point 2: Elevated Release Point Release w/ 1994 Met. Data..... 52

Release Point 2: Elevated Release Point Release w/ 1995 Met. Data..... 54

Release Point 2: Elevated Release Point Release w/ 1996 Met. Data..... 56

Release Point 2: Elevated Release Point Release w/ 1997 Met. Data..... 58

Release Point 2: Elevated Release Point Release w/ 1998 Met. Data..... 60

Release Point 3: Turbine Generator Building Diffuse Release w/ 1994 Met. Data ..... 62

Release Point 3: Turbine Generator Building Diffuse Release w/ 1995 Met. Data ..... 64

Release Point 3: Turbine Generator Building Diffuse Release w/ 1996 Met. Data ..... 66

Release Point 3: Turbine Generator Building Diffuse Release w/ 1997 Met. Data ..... 68

Release Point 3: Turbine Generator Building Diffuse Release w/ 1998 Met. Data ..... 70

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Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 0 w/ 1994 Met. Data

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.

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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 6/29/1999 at 15:42:51

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND94.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = .00  
Vent or stack flow (m^3/s) = .00  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 22 OF 91  
NEDC 99-031-1 ATTACH 1

1r194.log  
1r194.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 = 8760  
Hours of missing data = 138  
Hours direction in window = 847  
Hours elevated plume w/ dir. in window = 0  
Hours of calm winds = 1064  
Hours direction not in window or calm = 6711

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	1911.	3200.	4823.	6413.	7232.	7864.	8018.	8409.	8437.	8111.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	6711.	5388.	3697.	1971.	1183.	313.	0.	0.	0.	0.
TOTAL X/Qs	8622.	8588.	8520.	8384.	8415.	8177.	8018.	8409.	8437.	8111.
% NON ZERO	22.16	37.26	56.61	76.49	85.94	96.17	100.00	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

	3.64E-03	2.51E-03	1.81E-03	1.45E-03	1.16E-03	8.31E-04	5.73E-04	5.26E-04	4.64E-04	4.37E-04
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95% X/Q for standard averaging intervals

0 to 2 hours	3.64E-03
2 to 8 hours	7.15E-04
8 to 24 hours	5.24E-04
1 to 4 days	4.87E-04
4 to 30 days	4.16E-04

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	7.49E-03	1.07E-03
SECTOR-AVERAGE	4.70E-03	6.68E-04

NORMAL PROGRAM COMPLETION

NEDC 99-031-1 ATTACH 1  
 SHEET 23 OF 91

## Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 0 w/ 1995 Met. Data

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 6/29/1999 at 15:42:59

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND95.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m<sup>2</sup>) = 1569.0  
Effluent vertical velocity (m/s) = .00  
Vent or stack flow (m<sup>3</sup>/s) = .00  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

NEDC 99-031 r1 ATTACH 1  
 SHEET 24 OF 91

lr195.log  
lr195.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 = 8760  
Hours of missing data = 1439  
Hours direction in window = 710  
Hours elevated plume w/ dir. in window = 0  
Hours of calm winds = 926  
Hours direction not in window or calm = 5685

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	1636.	2692.	3978.	5051.	5574.	5540.	3744.	3460.	2921.	2615.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	5685.	4518.	3012.	1520.	853.	162.	0.	0.	0.	0.
TOTAL X/Qs	7321.	7210.	6990.	6571.	6427.	5702.	3744.	3460.	2921.	2615.
% NON ZERO	22.35	37.34	56.91	76.87	86.73	97.16	100.00	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

	3.58E-03	2.63E-03	1.85E-03	1.50E-03	1.17E-03	8.50E-04	5.62E-04	4.95E-04	4.18E-04	3.94E-04
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95% X/Q for standard averaging intervals

0 to 2 hours	3.58E-03
2 to 8 hours	8.04E-04
8 to 24 hours	5.26E-04
1 to 4 days	4.66E-04
4 to 30 days	3.68E-04

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	7.47E-03	1.07E-03
SECTOR-AVERAGE	4.68E-03	6.68E-04

NORMAL PROGRAM COMPLETION

NEDC 99-031 r1 ATTACH 1  
 SHEET 25 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 0 w/ 1996 Met. Data

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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Program Run 6/29/1999 at 15:43:06

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND96.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = .00  
Vent or stack flow (m^3/s) = .00  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

NEDC 99-0311-ATTACH 1  
SHEET 26 OF 91

lr196.log  
lr196.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 = 8760  
Hours of missing data = 3128  
Hours direction in window = 751  
Hours elevated plume w/ dir. in window = 0  
Hours of calm winds = 743  
Hours direction not in window or calm = 4138

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	1494.	2295.	3256.	4053.	4387.	4232.	3029.	2953.	2531.	2196.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	4138.	3251.	2121.	996.	536.	95.	0.	0.	0.	0.
TOTAL X/Qs	5632.	5546.	5377.	5049.	4923.	4327.	3029.	2953.	2531.	2196.
% NON ZERO	26.53	41.38	60.55	80.27	89.11	97.80	100.00	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

4.36E-03 2.92E-03 2.41E-03 1.98E-03 1.56E-03 1.03E-03 6.53E-04 5.63E-04 4.73E-04 4.62E-04

95% X/Q for standard averaging intervals

0 to 2 hours 4.36E-03  
2 to 8 hours 1.19E-03  
8 to 24 hours 5.51E-04  
1 to 4 days 5.28E-04  
4 to 30 days 4.33E-04

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	7.54E-03	1.07E-03
SECTOR-AVERAGE	4.73E-03	6.68E-04

NORMAL PROGRAM COMPLETION

NEDC 99-031-1 ATTACH 1  
 SHEET 27 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 0 w/ 1997 Met. Data

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 6/29/1999 at 15:43:13

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND97.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = .00  
Vent or stack flow (m^3/s) = .00  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 28 OF 91  
NEDC 99-031 ATTACH 1

1r197.log  
1r197.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 = 8760  
Hours of missing data = 553  
Hours direction in window = 795  
Hours elevated plume w/ dir. in window = 0  
Hours of calm winds = 1232  
Hours direction not in window or calm = 6180

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	2027.	3272.	4828.	6141.	6747.	6888.	5908.	6794.	6316.	7155.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	6180.	4846.	3120.	1481.	790.	117.	0.	0.	0.	0.
TOTAL X/Qs	8207.	8118.	7948.	7622.	7537.	7005.	5908.	6794.	6316.	7155.
% NON ZERO	24.70	40.31	60.74	80.57	89.52	98.33	100.00	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES  
3.32E-03 2.43E-03 1.78E-03 1.46E-03 1.17E-03 8.26E-04 5.74E-04 5.02E-04 4.33E-04 3.97E-04

95% X/Q for standard averaging intervals

0 to 2 hours 3.32E-03  
2 to 8 hours 8.40E-04  
8 to 24 hours 5.09E-04  
1 to 4 days 4.90E-04  
4 to 30 days 3.70E-04

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	6.82E-03	1.07E-03
SECTOR-AVERAGE	4.27E-03	6.68E-04

NORMAL PROGRAM COMPLETION

NEDC 99-0311 ATTACH 1  
 SHEET 89 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 0 w/ 1998 Met. Data

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 6/29/1999 at 15:44:03

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND98.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m<sup>2</sup>) = 1569.0  
Effluent vertical velocity (m/s) = .00  
Vent or stack flow (m<sup>3</sup>/s) = .00  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 30 OF 91  
 NEDC99-031 ATTACH 1

lr198.log  
lr198.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 = 8760  
Hours of missing data = 419  
Hours direction in window = 946  
Hours elevated plume w/ dir. in window = 0  
Hours of calm winds = 1007  
Hours direction not in window or calm = 6388

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	1953.	3090.	4564.	5955.	6722.	7360.	7263.	7423.	7371.	7192.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	6388.	5204.	3637.	2069.	1326.	466.	0.	0.	0.	0.
TOTAL X/Qs	8341.	8294.	8201.	8024.	8048.	7826.	7263.	7423.	7371.	7192.
% NON ZERO	23.41	37.26	55.65	74.21	83.52	94.05	100.00	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

3.82E-03	2.71E-03	2.10E-03	1.70E-03	1.37E-03	1.03E-03	7.42E-04	7.34E-04	7.55E-04	7.28E-04
----------	----------	----------	----------	----------	----------	----------	----------	----------	----------

95% X/Q for standard averaging intervals

0 to 2 hours	3.82E-03
2 to 8 hours	1.00E-03
8 to 24 hours	6.89E-04
1 to 4 days	6.46E-04
4 to 30 days	7.26E-04

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	7.10E-03	1.07E-03
SECTOR-AVERAGE	4.45E-03	6.68E-04

NORMAL PROGRAM COMPLETION

NEDC 99-031 ATTACH 1  
 SHEET 31 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1/4 w/ 1994 Met. Data

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 6/29/1999 at 16:02:53

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND94.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = 2.90  
Vent or stack flow (m^3/s) = 8.70  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

NEDC 99-031 ATTACH 1  
SHEET 32 OF 91

2r194.log  
2r194.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 = 8760  
 Hours of missing data = 138  
 Hours direction in window = 847  
 Hours elevated plume w/ dir. in window = 84  
 Hours of calm winds = 1064  
 Hours direction not in window or calm = 6711

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	811.	1488.	2551.	4025.	5093.	6667.	7972.	8409.	8437.	8111.
BELOW RANGE	0.	0.	0.	0.	1.	13.	0.	0.	0.	0.
ZERO	7811.	7100.	5969.	4359.	3321.	1497.	46.	0.	0.	0.
TOTAL X/Qs	8622.	8588.	8520.	8384.	8415.	8177.	8018.	8409.	8437.	8111.
% NON ZERO	9.41	17.33	29.94	48.01	60.53	81.69	99.43	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

6.72E-04	1.58E-03	1.08E-03	7.98E-04	6.48E-04	4.32E-04	2.72E-04	2.28E-04	1.87E-04	1.61E-04
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95% X/Q for standard averaging intervals

0 to 2 hours	1.58E-03
2 to 8 hours	5.37E-04
8 to 24 hours	2.49E-04
1 to 4 days	2.18E-04
4 to 30 days	1.44E-04

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	6.09E-03	6.50E-32
SECTOR-AVERAGE	3.89E-03	4.07E-32

NORMAL PROGRAM COMPLETION

NEDC 99-0311 ATTACH 1  
 SHEET 33 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1/4 w/ 1995 Met. Data

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 6/29/1999 at 16:02:46

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND95.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = 2.90  
Vent or stack flow (m^3/s) = 8.70  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

NEDEC 99-03111 ATTACH 1  
SHEET 34 OF 91

2r195.log  
2r195.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 = 8760  
 Hours of missing data = 1439  
 Hours direction in window = 710  
 Hours elevated plume w/ dir. in window = 127  
 Hours of calm winds = 926  
 Hours direction not in window or calm = 5685

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	691.	1246.	2104.	3155.	3882.	4678.	3744.	3460.	2921.	2615.
BELOW RANGE	0.	0.	0.	0.	2.	37.	0.	0.	0.	0.
ZERO	6630.	5964.	4886.	3416.	2543.	987.	0.	0.	0.	0.
TOTAL X/Qs	7321.	7210.	6990.	6571.	6427.	5702.	3744.	3460.	2921.	2615.
% NON ZERO	9.44	17.28	30.10	48.01	60.43	82.69	100.00	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

	8.96E-04	1.84E-03	1.18E-03	8.70E-04	6.88E-04	4.30E-04	2.76E-04	2.35E-04	1.85E-04	1.70E-04
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95% X/Q for standard averaging intervals

0 to 2 hours	1.84E-03
2 to 8 hours	5.47E-04
8 to 24 hours	2.10E-04
1 to 4 days	2.25E-04
4 to 30 days	1.54E-04

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	6.06E-03	6.50E-32
SECTOR-AVERAGE	3.88E-03	4.07E-32

NORMAL PROGRAM COMPLETION

NEDC 99-03/11 ATTACH 1  
 SHEET 35 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1/4 w/ 1996 Met. Data

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 6/29/1999 at 16:03:07

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND96.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = 2.90  
Vent or stack flow (m^3/s) = 8.70  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 36 OF 91  
NEDC 99-0314 ATTACH 1

2r196.log  
2r196.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 = 8760  
Hours of missing data = 3128  
Hours direction in window = 751  
Hours elevated plume w/ dir. in window = 66  
Hours of calm winds = 743  
Hours direction not in window or calm = 4138

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	725.	1177.	1852.	2643.	3143.	3626.	3020.	2953.	2531.	2196.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	4907.	4369.	3525.	2406.	1780.	701.	9.	0.	0.	0.
TOTAL X/Qs	5632.	5546.	5377.	5049.	4923.	4327.	3029.	2953.	2531.	2196.
% NON ZERO	12.87	21.22	34.44	52.35	63.84	83.80	99.70	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES  
1.77E-03 1.98E-03 1.26E-03 1.05E-03 7.89E-04 5.18E-04 2.89E-04 2.48E-04 1.90E-04 1.84E-04

95% X/Q for standard averaging intervals

0 to 2 hours 1.98E-03  
2 to 8 hours 7.41E-04  
8 to 24 hours 2.52E-04  
1 to 4 days 2.12E-04  
4 to 30 days 1.68E-04

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	6.15E-03	7.04E-32
SECTOR-AVERAGE	3.93E-03	4.41E-32

NORMAL PROGRAM COMPLETION

NEDC99-031-1 ATTACH 1  
 SHEET 37 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ¼ w/ 1997 Met. Data

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 6/29/1999 at 16:03:13

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND97.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m<sup>2</sup>) = 1569.0  
Effluent vertical velocity (m/s) = 2.90  
Vent or stack flow (m<sup>3</sup>/s) = 8.70  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

NEDC 99-031-1-1 ATTACH 1  
 SHEET 38 OF 91

2r197.log  
2r197.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 = 8760  
 Hours of missing data = 553  
 Hours direction in window = 795  
 Hours elevated plume w/ dir. in window = 125  
 Hours of calm winds = 1232  
 Hours direction not in window or calm = 6180

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	763.	1395.	2357.	3562.	4424.	5571.	5835.	6794.	6316.	7155.
BELOW RANGE	0.	0.	0.	0.	0.	0.	58.	0.	0.	0.
ZERO	7444.	6723.	5591.	4060.	3113.	1434.	15.	0.	0.	0.
TOTAL X/Qs	8207.	8118.	7948.	7622.	7537.	7005.	5908.	6794.	6316.	7155.
% NON ZERO	9.30	17.18	29.66	46.73	58.70	79.53	99.75	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

6.03E-04	1.20E-03	1.04E-03	7.03E-04	5.57E-04	3.64E-04	2.35E-04	1.91E-04	1.57E-04	1.36E-04
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95% X/Q for standard averaging intervals

0 to 2 hours	1.20E-03
2 to 8 hours	5.36E-04
8 to 24 hours	1.95E-04
1 to 4 days	1.91E-04
4 to 30 days	1.21E-04

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	5.54E-03	7.44E-32
SECTOR-AVERAGE	3.54E-03	4.66E-32

NORMAL PROGRAM COMPLETION

MEDC99-0311/ATTACH 1  
 SHEET 39 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 4 w/ 1998 Met. Data

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 6/29/1999 at 16:03:20

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND98.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = 2.90  
Vent or stack flow (m^3/s) = 8.70  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 40 OF 91  
NEDC 99-031-1 ATTACH 1

2r198.log  
2r198.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 = 8760  
 Hours of missing data = 419  
 Hours direction in window = 946  
 Hours elevated plume w/ dir. in window = 167  
 Hours of calm winds = 1007  
 Hours direction not in window or calm = 6388

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	918.	1538.	2529.	3841.	4760.	6235.	7244.	7423.	7371.	7192.
BELOW RANGE	0.	0.	0.	0.	0.	11.	15.	0.	0.	0.
ZERO	7423.	6756.	5672.	4183.	3288.	1580.	4.	0.	0.	0.
TOTAL X/Qs	8341.	8294.	8201.	8024.	8048.	7826.	7263.	7423.	7371.	7192.
% NON ZERO	11.01	18.54	30.84	47.87	59.15	79.81	99.94	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES  
 1.08E-03 1.59E-03 1.16E-03 8.71E-04 6.83E-04 4.65E-04 3.25E-04 2.87E-04 2.65E-04 2.63E-04

95% X/Q for standard averaging intervals

0 to 2 hours 1.59E-03  
 2 to 8 hours 6.30E-04  
 8 to 24 hours 2.63E-04  
 1 to 4 days 2.78E-04  
 4 to 30 days 2.53E-04

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	5.70E-03	6.50E-32
SECTOR-AVERAGE	3.64E-03	4.07E-32

NORMAL PROGRAM COMPLETION

NEDC99-031-1 ATTACH 1  
 SHEET 41 OF 91

## Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1/4 w/ 1994 Met. Data

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 6/29/1999 at 16:03:26

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND94.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m<sup>2</sup>) = 1569.0  
Effluent vertical velocity (m/s) = 5.90  
Vent or stack flow (m<sup>3</sup>/s) = 17.50  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 42 OF 91  
 NEDC 99-031-1 ATTACH 1

3r194.log  
3r194.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 = 8760  
Hours of missing data = 138  
Hours direction in window = 847  
Hours elevated plume w/ dir. in window = 100  
Hours of calm winds = 1064  
Hours direction not in window or calm = 6711

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	642.	1185.	2063.	3362.	4334.	5905.	7797.	8409.	8437.	8111.
BELOW RANGE	0.	0.	0.	0.	31.	107.	133.	0.	0.	0.
ZERO	7980.	7403.	6457.	5022.	4050.	2165.	88.	0.	0.	0.
TOTAL X/Qs	8622.	8588.	8520.	8384.	8415.	8177.	8018.	8409.	8437.	8111.
% NON ZERO	7.45	13.80	24.21	40.10	51.87	73.52	98.90	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

2.62E-04	2.94E-04	1.98E-04	1.62E-04	1.23E-04	8.45E-05	5.30E-05	4.59E-05	3.69E-05	3.24E-05
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95% X/Q for standard averaging intervals

0 to 2 hours	2.94E-04
2 to 8 hours	1.18E-04
8 to 24 hours	4.56E-05
1 to 4 days	4.26E-05
4 to 30 days	2.92E-05

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	1.37E-03	3.25E-32
SECTOR-AVERAGE	8.79E-04	2.04E-32

NORMAL PROGRAM COMPLETION

NEDC99-031-1 ATTACH 1  
 SHEET 43 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1/2 w/ 1995 Met. Data

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 6/29/1999 at 16:03:35

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND95.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = 5.90  
Vent or stack flow (m^3/s) = 17.50  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 44 OF 91  
NEB099-031-ATTACH 1

3r195.log  
3r195.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 = 8760  
Hours of missing data = 1439  
Hours direction in window = 710  
Hours elevated plume w/ dir. in window = 140  
Hours of calm winds = 926  
Hours direction not in window or calm = 5685

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AV. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	541.	986.	1696.	2627.	3328.	4200.	3659.	3460.	2921.	2615.
BELOW RANGE	0.	0.	0.	0.	8.	75.	74.	0.	0.	0.
ZERO	6780.	6224.	5294.	3944.	3091.	1427.	11.	0.	0.	0.
TOTAL X/Qs	7321.	7210.	6990.	6571.	6427.	5702.	3744.	3460.	2921.	2615.
% NON ZERO	7.39	13.68	24.26	39.98	51.91	74.97	99.71	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES  
2.90E-04 3.25E-04 2.12E-04 1.67E-04 1.31E-04 8.59E-05 5.19E-05 4.35E-05 3.60E-05 3.27E-05

95% X/Q for standard averaging intervals

0 to 2 hours 3.25E-04  
2 to 8 hours 1.15E-04  
8 to 24 hours 4.52E-05  
1 to 4 days 4.06E-05  
4 to 30 days 2.97E-05

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	1.37E-03	3.25E-32
SECTOR-AVERAGE	8.79E-04	2.04E-32

NORMAL PROGRAM COMPLETION

SHEET 45 OF 91  
 NEDC99-031-ATTACH 1

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1/2 w/ 1996 Met. Data

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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Program Run 6/29/1999 at 16:03:41

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND96.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = 5.90  
Vent or stack flow (m^3/s) = 17.50  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 46 OF 91  
NEDC 99-031r ATTACH 1

3r196.log  
3r196.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 = 8760  
Hours of missing data = 3128  
Hours direction in window = 751  
Hours elevated plume w/ dir. in window = 87  
Hours of calm winds = 743  
Hours direction not in window or calm = 4138

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	545.	916.	1470.	2179.	2649.	3267.	3009.	2953.	2531.	2196.
BELOW RANGE	0.	0.	4.	4.	12.	18.	0.	0.	0.	0.
ZERO	5087.	4630.	3903.	2866.	2262.	1042.	20.	0.	0.	0.
TOTAL X/Qs	5632.	5546.	5377.	5049.	4923.	4327.	3029.	2953.	2531.	2196.
% NON ZERO	9.68	16.52	27.41	43.24	54.05	75.92	99.34	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES  
4.47E-04 3.58E-04 2.89E-04 2.19E-04 1.72E-04 1.12E-04 5.91E-05 5.04E-05 3.90E-05 3.78E-05

95% X/Q for standard averaging intervals

0 to 2 hours 4.47E-04  
2 to 8 hours 1.42E-04  
8 to 24 hours 5.84E-05  
1 to 4 days 4.15E-05  
4 to 30 days 3.45E-05

CENTERLINE	HOURLY VALUE RANGE	
	MAX X/Q	MIN X/Q
SECTOR-AVERAGE	9.28E-04	2.04E-32

NORMAL PROGRAM COMPLETION

SHEET 47 OF 91  
 NEDC 99-081-1 ATTACH 1

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1/2 w/ 1997 Met. Data

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 6/29/1999 at 16:03:46

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND97.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = 5.90  
Vent or stack flow (m^3/s) = 17.50  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 48 OF 91  
MEDC 99-031-1 ATTACH 1

3r197.log  
3r197.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 = 8760  
Hours of missing data = 553  
Hours direction in window = 795  
Hours elevated plume w/ dir. in window = 156  
Hours of calm winds = 1232  
Hours direction not in window or calm = 6180

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	580.	1076.	1854.	2915.	3723.	4870.	5748.	6763.	6316.	7155.
BELOW RANGE	0.	0.	6.	5.	13.	63.	37.	31.	0.	0.
ZERO	7627.	7042.	6088.	4702.	3801.	2072.	123.	0.	0.	0.
TOTAL X/Qs	8207.	8118.	7948.	7622.	7537.	7005.	5908.	6794.	6316.	7155.
% NON ZERO	7.07	13.25	23.40	38.31	49.57	70.42	97.92	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

	2.39E-04	2.52E-04	1.81E-04	1.43E-04	1.13E-04	7.58E-05	4.68E-05	3.98E-05	3.36E-05	2.85E-05
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95% X/Q for standard averaging intervals

0 to 2 hours	2.52E-04
2 to 8 hours	1.07E-04
8 to 24 hours	4.22E-05
1 to 4 days	3.71E-05
4 to 30 days	2.57E-05

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	1.37E-03	3.25E-32
SECTOR-AVERAGE	8.79E-04	2.04E-32

NORMAL PROGRAM COMPLETION

NEDC 99-031 ATTACH 1  
 SHEET 49 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1/2 w/ 1998 Met. Data

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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Program Run 6/29/1999 at 16:03:59

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND98.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = 5.90  
Vent or stack flow (m^3/s) = 17.50  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 450 OF 91  
NEDC99-031-1 ATTACH 1

3r198.log  
3r198.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 = 8760  
Hours of missing data = 419  
Hours direction in window = 946  
Hours elevated plume w/ dir. in window = 194  
Hours of calm winds = 1007  
Hours direction not in window or calm = 6388

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	696.	1194.	2003.	3150.	4003.	5452.	7096.	7423.	7371.	7192.
BELOW RANGE	0.	0.	3.	1.	8.	51.	115.	0.	0.	0.
ZERO	7645.	7100.	6195.	4873.	4037.	2323.	52.	0.	0.	0.
TOTAL X/Qs	8341.	8294.	8201.	8024.	8048.	7826.	7263.	7423.	7371.	7192.
% NON ZERO	8.34	14.40	24.46	39.27	49.84	70.32	99.28	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES  
3.25E-04 3.16E-04 2.18E-04 1.72E-04 1.31E-04 9.20E-05 6.86E-05 5.99E-05 5.63E-05 5.83E-05

95% X/Q for standard averaging intervals

0 to 2 hours 3.25E-04  
2 to 8 hours 1.21E-04  
8 to 24 hours 5.20E-05  
1 to 4 days 6.08E-05  
4 to 30 days 5.67E-05

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	1.29E-03	3.25E-32
SECTOR-AVERAGE	8.32E-04	2.04E-32

NORMAL PROGRAM COMPLETION

NEDC 99-031r1 ATTACH 1  
 SHEET 51 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1 w/ 1994 Met. Data

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 6/29/1999 at 16:04:05

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND94.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = 8.80  
Vent or stack flow (m^3/s) = 26.20  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 52 OF 91  
NEDC 99-031-ATTACH 1

4r194.log  
4r194.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 = 8760  
Hours of missing data = 138  
Hours direction in window = 847  
Hours elevated plume w/ dir. in window = 121  
Hours of calm winds = 1064  
Hours direction not in window or calm = 6711

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL										
AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-03									
LOW LIM.	1.00E-07									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	481.	892.	1575.	2630.	3497.	5132.	7618.	8401.	8437.	8111.
BELOW RANGE	0.	0.	0.	0.	0.	0.	25.	0.	0.	0.
ZERO	8141.	7696.	6945.	5754.	4918.	3045.	375.	8.	0.	0.
TOTAL X/Qs	8622.	8588.	8520.	8384.	8415.	8177.	8018.	8409.	8437.	8111.
% NON ZERO	5.58	10.39	18.49	31.37	41.56	62.76	95.32	99.90	100.00	100.00

95th PERCENTILE X/Q VALUES  
6.16E-05 1.78E-04 1.34E-04 9.24E-05 7.43E-05 5.10E-05 3.10E-05 2.56E-05 2.10E-05 1.79E-05

95% X/Q for standard averaging intervals

0 to 2 hours 1.78E-04  
2 to 8 hours 6.39E-05  
8 to 24 hours 3.03E-05  
1 to 4 days 2.43E-05  
4 to 30 days 1.59E-05

HOURLY VALUE RANGE		
CENTERLINE	MAX X/Q	MIN X/Q
SECTOR-AVERAGE	5.04E-04	1.39E-32

NORMAL PROGRAM COMPLETION

MEDC 99-031-ATTACH 1  
 SHEET 53 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1/4 w/ 1995 Met. Data

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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Program Run 6/29/1999 at 16:04:11

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND95.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = 8.80  
Vent or stack flow (m^3/s) = 26.20  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

NEED 99-031 ATTACH 1  
SHEET 54 OF 91

4r195.log  
4r195.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 = 8760  
Hours of missing data = 1439  
Hours direction in window = 710  
Hours elevated plume w/ dir. in window = 155  
Hours of calm winds = 926  
Hours direction not in window or calm = 5685

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-03									
LOW LIM.	1.00E-07									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	422.	772.	1341.	2145.	2805.	3750.	3592.	3454.	2921.	2615.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	6899.	6438.	5649.	4426.	3622.	1952.	152.	6.	0.	0.
TOTAL X/Qs	7321.	7210.	6990.	6571.	6427.	5702.	3744.	3460.	2921.	2615.
% NON ZERO	5.76	10.71	19.18	32.64	43.64	65.77	95.94	99.83	100.00	100.00

95th PERCENTILE X/Q VALUES  
1.04E-04 1.97E-04 1.41E-04 1.01E-04 8.04E-05 5.10E-05 3.10E-05 2.75E-05 2.13E-05 1.94E-05

95% X/Q for standard averaging intervals

0 to 2 hours 1.97E-04  
2 to 8 hours 6.89E-05  
8 to 24 hours 2.61E-05  
1 to 4 days 2.43E-05  
4 to 30 days 1.76E-05

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	7.60E-04	2.35E-32
SECTOR-AVERAGE	4.99E-04	1.47E-32

NORMAL PROGRAM COMPLETION

NEEDS 99-031-1 ATTACH 1  
 SHEET 55 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1 w/ 1996 Met. Data

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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Program Run 6/29/1999 at 16:04:18

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND96.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = 8.80  
Vent or stack flow (m^3/s) = 26.20  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 57 OF 91  
NEDG 99-031 v1 ATTACH 1

4r196.log  
4r196.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 = 8760  
Hours of missing data = 3128  
Hours direction in window = 751  
Hours elevated plume w/ dir. in window = 93  
Hours of calm winds = 743  
Hours direction not in window or calm = 4138

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-03									
LOW LIM.	1.00E-07									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	426.	730.	1214.	1853.	2322.	3022.	2993.	2953.	2531.	2196.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	5206.	4816.	4163.	3196.	2601.	1305.	36.	0.	0.	0.
TOTAL X/Qs	5632.	5546.	5377.	5049.	4923.	4327.	3029.	2953.	2531.	2196.
% NON ZERO	7.56	13.16	22.58	36.70	47.17	69.84	98.81	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

1.94E-04	2.13E-04	1.54E-04	1.22E-04	9.48E-05	6.36E-05	3.31E-05	2.81E-05	2.17E-05	2.06E-05
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95% X/Q for standard averaging intervals

0 to 2 hours	2.13E-04
2 to 8 hours	9.19E-05
8 to 24 hours	3.42E-05
1 to 4 days	2.29E-05
4 to 30 days	1.87E-05

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	7.92E-04	2.22E-32
SECTOR-AVERAGE	5.22E-04	1.39E-32

NORMAL PROGRAM COMPLETION

NEEDS 99-0314 ATTACH 1  
 SHEET 57 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1/4 w/ 1997 Met. Data

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 6/29/1999 at 16:04:26

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND97.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m<sup>2</sup>) = 1569.0  
Effluent vertical velocity (m/s) = 8.80  
Vent or stack flow (m<sup>3</sup>/s) = 26.20  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 58 OF 91  
 NEDC 99-0311 ATTACH 1

4r197.log  
4r197.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 = 8760  
Hours of missing data = 553  
Hours direction in window = 795  
Hours elevated plume w/ dir. in window = 175  
Hours of calm winds = 1232  
Hours direction not in window or calm = 6180

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-03									
LOW LIM.	1.00E-07									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	429.	798.	1405.	2295.	3021.	4271.	5608.	6766.	6316.	7155.
BELOW RANGE	0.	0.	4.	8.	10.	14.	0.	0.	0.	0.
ZERO	7778.	7320.	6539.	5319.	4506.	2720.	300.	28.	0.	0.
TOTAL X/Qs	8207.	8118.	7948.	7622.	7537.	7005.	5908.	6794.	6316.	7155.
% NON ZERO	5.23	9.83	17.73	30.22	40.21	61.17	94.92	99.59	100.00	100.00

95th PERCENTILE X/Q VALUES

1.69E-05	1.33E-04	1.17E-04	8.05E-05	6.28E-05	4.30E-05	2.59E-05	2.11E-05	1.73E-05	1.53E-05
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95% X/Q for standard averaging intervals

0 to 2 hours	1.33E-04
2 to 8 hours	6.32E-05
8 to 24 hours	2.42E-05
1 to 4 days	2.02E-05
4 to 30 days	1.37E-05

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	6.90E-04	2.22E-32
SECTOR-AVERAGE	4.50E-04	1.39E-32

NORMAL PROGRAM COMPLETION

NEEDS 99-031 r1/ATTACH 1  
 SHEET 59 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1 w/ 1998 Met. Data

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 6/29/1999 at 16:04:34

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND98.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = 8.80  
Vent or stack flow (m^3/s) = 26.20  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

NEPC 99-031 ATTACH 1  
SHEET 60 OF 91

4r198.log  
4r198.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 = 8760  
Hours of missing data = 419  
Hours direction in window = 946  
Hours elevated plume w/ dir. in window = 217  
Hours of calm winds = 1007  
Hours direction not in window or calm = 6388

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-03									
LOW LIM.	1.00E-07									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	538.	929.	1581.	2580.	3391.	4881.	7035.	7423.	7371.	7192.
BELOW RANGE	0.	0.	0.	0.	0.	0.	15.	0.	0.	0.
ZERO	7803.	7365.	6620.	5444.	4657.	2945.	213.	0.	0.	0.
TOTAL X/Qs	8341.	8294.	8201.	8024.	8048.	7826.	7263.	7423.	7371.	7192.
% NON ZERO	6.45	11.20	19.28	32.15	42.13	62.37	97.07	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

1.25E-04	1.83E-04	1.41E-04	9.85E-05	7.86E-05	5.23E-05	3.47E-05	3.13E-05	2.91E-05	2.85E-05
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95% X/Q for standard averaging intervals

0 to 2 hours	1.83E-04
2 to 8 hours	7.02E-05
8 to 24 hours	2.91E-05
1 to 4 days	2.89E-05
4 to 30 days	2.76E-05

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	7.60E-04	2.22E-32
SECTOR-AVERAGE	4.99E-04	1.39E-32

NORMAL PROGRAM COMPLETION

SHEET 61 OF 91  
 MEDC 99-031 ATTACH 1

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1.0 w/ 1994 Met. Data

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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Program Run 6/29/1999 at 15:28:35

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND94.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = 11.70  
Vent or stack flow (m^3/s) = 34.90  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 62 OF 91  
NEDC99-031 ATTACH 1

Sr194.log  
Sr194.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 = 8760  
Hours of missing data = 138  
Hours direction in window = 847  
Hours elevated plume w/ dir. in window = 145  
Hours of calm winds = 1064  
Hours direction not in window or calm = 6711

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-03									
LOW LIM.	1.00E-07									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	335.	618.	1088.	1854.	2501.	4007.	7072.	8091.	8437.	8111.
BELOW RANGE	0.	0.	0.	0.	13.	21.	0.	0.	0.	0.
ZERO	8287.	7970.	7432.	6530.	5901.	4149.	946.	318.	0.	0.
TOTAL X/Qs	8622.	8588.	8520.	8384.	8415.	8177.	8018.	8409.	8437.	8111.
% NON ZERO	3.89	7.20	12.77	22.11	29.88	49.26	88.20	96.22	100.00	100.00

95th PERCENTILE X/Q VALUES

1.00E-07	7.12E-05	7.84E-05	5.55E-05	4.20E-05	2.87E-05	1.72E-05	1.41E-05	1.12E-05	9.48E-06
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95% X/Q for standard averaging intervals

0 to 2 hours	7.12E-05
2 to 8 hours	5.03E-05
8 to 24 hours	1.53E-05
1 to 4 days	1.34E-05
4 to 30 days	8.29E-06

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	5.11E-04	1.59E-32
SECTOR-AVERAGE	3.41E-04	9.99E-33

NORMAL PROGRAM COMPLETION

NEDC99-031 r/ATTACH 1  
 SHEET 63 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1.0 w/ 1995 Met. Data

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 6/29/1999 at 15:28:43

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND95.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m<sup>2</sup>) = 1569.0  
Effluent vertical velocity (m/s) = 11.70  
Vent or stack flow (m<sup>3</sup>/s) = 34.90  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 44 OF 91  
 NEDC 99-031 ATTACH 1

5r195.log  
5r195.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 = 8760  
Hours of missing data = 1439  
Hours direction in window = 710  
Hours elevated plume w/ dir. in window = 172  
Hours of calm winds = 926  
Hours direction not in window or calm = 5685

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-03									
LOW LIM.	1.00E-07									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	311.	574.	1004.	1655.	2213.	3123.	3534.	3452.	2921.	2615.
BELOW RANGE	0.	0.	0.	0.	2.	4.	0.	0.	0.	0.
ZERO	7010.	6636.	5986.	4916.	4212.	2575.	210.	8.	0.	0.
TOTAL X/Qs	7321.	7210.	6990.	6571.	6427.	5702.	3744.	3460.	2921.	2615.
% NON ZERO	4.25	7.96	14.36	25.19	34.46	54.84	94.39	99.77	100.00	100.00

95th PERCENTILE X/Q VALUES

1.00E-07	9.06E-05	8.61E-05	5.91E-05	4.58E-05	3.02E-05	1.80E-05	1.57E-05	1.18E-05	1.11E-05
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95% X/Q for standard averaging intervals

0 to 2 hours	9.06E-05
2 to 8 hours	4.86E-05
8 to 24 hours	1.58E-05
1 to 4 days	1.39E-05
4 to 30 days	1.01E-05

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	5.36E-04	1.59E-32
SECTOR-AVERAGE	3.56E-04	9.99E-33

NORMAL PROGRAM COMPLETION

SHEET 65 OF 91  
 NEDS 99-031 ATTACH 1

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1.0 w/ 1996 Met. Data

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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Program Run 6/29/1999 at 15:28:53

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND96.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m<sup>2</sup>) = 1569.0  
Effluent vertical velocity (m/s) = 11.70  
Vent or stack flow (m<sup>3</sup>/s) = 34.90  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 46 OF 91  
 NEDS 99-031 r/ATTACH 1

Sr196.log  
Sr196.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 = 8760  
 Hours of missing data = 3128  
 Hours direction in window = 751  
 Hours elevated plume w/ dir. in window = 103  
 Hours of calm winds = 743  
 Hours direction not in window or calm = 4138

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-03									
LOW LIM.	1.00E-07									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	289.	507.	870.	1393.	1781.	2439.	2921.	2953.	2531.	2196.
BELOW RANGE	0.	0.	0.	0.	25.	37.	30.	0.	0.	0.
ZERO	5343.	5039.	4507.	3656.	3117.	1851.	78.	0.	0.	0.
TOTAL X/Qs	5632.	5546.	5377.	5049.	4923.	4327.	3029.	2953.	2531.	2196.
% NON ZERO	5.13	9.14	16.18	27.59	36.68	57.22	97.42	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

1.68E-05	1.11E-04	1.02E-04	7.05E-05	5.57E-05	3.68E-05	1.85E-05	1.52E-05	1.19E-05	1.05E-05
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95% X/Q for standard averaging intervals

0 to 2 hours	1.11E-04
2 to 8 hours	5.69E-05
8 to 24 hours	2.00E-05
1 to 4 days	1.25E-05
4 to 30 days	9.27E-06

HOURLY VALUE RANGE

CENTERLINE	MAX X/Q	MIN X/Q
SECTOR-AVERAGE	3.62E-04	9.99E-33

NORMAL PROGRAM COMPLETION

NEEDS 09-031 r ATTACH 1  
 SHEET 67 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1.0 w/ 1997 Met. Data

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 6/29/1999 at 15:29:06

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND97.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = 11.70  
Vent or stack flow (m^3/s) = 34.90  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 68 OF 91  
NEDS-09-031 r1 ATTACH 1

5r197.log  
5r197.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 = 8760  
 Hours of missing data = 553  
 Hours direction in window = 795  
 Hours elevated plume w/ dir. in window = 190  
 Hours of calm winds = 1232  
 Hours direction not in window or calm = 6180

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-03									
LOW LIM.	1.00E-07									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	289.	539.	975.	1655.	2227.	3414.	5356.	6717.	6316.	7155.
BELOW RANGE	0.	0.	0.	0.	36.	27.	0.	0.	0.	0.
ZERO	7918.	7579.	6973.	5967.	5274.	3564.	552.	77.	0.	0.
TOTAL X/Qs	8207.	8118.	7948.	7622.	7537.	7005.	5908.	6794.	6316.	7155.
% NON ZERO	3.52	6.64	12.27	21.71	30.03	49.12	90.66	98.87	100.00	100.00

95th PERCENTILE X/Q VALUES  
 1.00E-07 4.87E-05 6.34E-05 4.73E-05 3.58E-05 2.40E-05 1.29E-05 1.05E-05 8.68E-06 7.78E-06

95% X/Q for standard averaging intervals

0 to 2 hours 4.87E-05  
 2 to 8 hours 4.69E-05  
 8 to 24 hours 1.23E-05  
 1 to 4 days 9.18E-06  
 4 to 30 days 7.00E-06

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	5.01E-04	1.66E-32
SECTOR-AVERAGE	3.31E-04	1.04E-32

NORMAL PROGRAM COMPLETION

NEEDS 99-031 ATTACH 1  
 SHEET 69 OF 91

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 1.0 w/ 1998 Met. Data

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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Program Run 6/29/1999 at 13:38:01

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND98.MET

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

Vent release  
Release height (m) = 49.3  
Building Area (m^2) = 1569.0  
Effluent vertical velocity (m/s) = 11.70  
Vent or stack flow (m^3/s) = 34.90  
Vent or stack radius (m) = .97

Direction .. intake to source (deg) = 125  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 080 - 170  
Distance to intake (m) = 17.4  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 70 OF 91  
NEDC99-051/ATTACH 1

5r198.log  
5r198.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 = 8760  
Hours of missing data = 419  
Hours direction in window = 946  
Hours elevated plume w/ dir. in window = 239  
Hours of calm winds = 1007  
Hours direction not in window or calm = 6388

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-03									
LOW LIM.	1.00E-07									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	360.	636.	1114.	1890.	2545.	3860.	6579.	7381.	7371.	7192.
BELOW RANGE	0.	0.	0.	0.	5.	4.	0.	0.	0.	0.
ZERO	7981.	7658.	7087.	6134.	5498.	3962.	684.	42.	0.	0.
TOTAL X/Qs	8341.	8294.	8201.	8024.	8048.	7826.	7263.	7423.	7371.	7192.
% NON ZERO	4.32	7.67	13.58	23.55	31.68	49.37	90.58	99.43	100.00	100.00

95th PERCENTILE X/Q VALUES

1.00E-07	8.39E-05	8.47E-05	5.72E-05	4.39E-05	2.75E-05	1.72E-05	1.45E-05	1.29E-05	1.35E-05
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95% X/Q for standard averaging intervals

0 to 2 hours	8.39E-05
2 to 8 hours	4.83E-05
8 to 24 hours	1.27E-05
1 to 4 days	1.38E-05
4 to 30 days	1.29E-05

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	5.36E-04	1.59E-32
SECTOR-AVERAGE	3.56E-04	9.99E-33

NORMAL PROGRAM COMPLETION

SHEET 71 OF 91  
 NEDC 99-031r/ATTACH 1

Release Point 2: Elevated Release Point Release w/ 1994 Met. Data

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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Program Run 6/29/1999 at 13:35:34

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPELEV94.MET

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

Elevated release  
Release height (m) = 99.1  
Building Area (m^2) = .0  
Effluent vertical velocity (m/s) = 2.62  
Vent or stack flow (m^3/s) = .26  
Vent or stack radius (m) = .18

Direction .. intake to source (deg) = 130  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 085 - 175  
Distance to intake (m) = 171.7  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 72 OF 91  
NEDC 99-031r/ATTACH 1

r294.log  
r294.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 = 8760  
Hours of missing data = 112  
Hours direction in window = 571  
Hours elevated plume w/ dir. in window = 744  
Hours of calm winds = 879  
Hours direction not in window or calm = 7198

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AV. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-05									
LOW LIM.	1.00E-09									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	82.	144.	231.	377.	468.	405.	1013.	1540.	2401.	3012.
BELOW RANGE	0.	0.	27.	91.	214.	855.	2456.	3589.	4179.	4068.
ZERO	8566.	8475.	8303.	7977.	7794.	7018.	4683.	3280.	1857.	1031.
TOTAL X/Qs	8648.	8619.	8561.	8445.	8476.	8278.	8152.	8409.	8437.	8111.
% NON ZERO	.95	1.67	3.01	5.54	8.05	15.22	42.55	60.99	77.99	87.29

95th PERCENTILE X/Q VALUES

1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.45E-09	1.00E-09	1.08E-08	9.95E-09	8.91E-09	6.30E-09
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95% X/Q for standard averaging intervals

0 to 2 hours	1.00E-09
2 to 8 hours	1.00E-09
8 to 24 hours	1.00E-09
1 to 4 days	1.40E-08
4 to 30 days	5.62E-09

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	1.62E-06	2.43E-29
SECTOR-AVERAGE	1.01E-06	1.38E-29

NORMAL PROGRAM COMPLETION

NEDC 99-031 r/ATTACH 1  
 SHEET 73 OF 91

Release Point 2: Elevated Release Point Release w/ 1995 Met. Data

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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Program Run 6/29/1999 at 13:43:02

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPELEV95.MET

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

Elevated release  
Release height (m) = 99.1  
Building Area (m^2) = .0  
Effluent vertical velocity (m/s) = 2.62  
Vent or stack flow (m^3/s) = .26  
Vent or stack radius (m) = .18

Direction .. intake to source (deg) = 130  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 085 - 175  
Distance to intake (m) = 171.7  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 74 OF 91  
NEDC 99-031 ATTACH 1

r295.log  
r295.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 = 8760  
Hours of missing data = 4845  
Hours direction in window = 254  
Hours elevated plume w/ dir. in window = 380  
Hours of calm winds = 425  
Hours direction not in window or calm = 3236

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-05									
LOW LIM.	1.00E-09									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	37.	65.	96.	137.	141.	113.	192.	301.	352.	117.
BELOW RANGE	0.	0.	14.	41.	119.	327.	477.	539.	754.	636.
ZERO	3878.	3793.	3645.	3387.	3225.	2705.	1544.	1073.	642.	416.
TOTAL X/Qs	3915.	3858.	3755.	3565.	3485.	3145.	2213.	1913.	1748.	1169.
% NON ZERO	.95	1.68	2.93	4.99	7.46	13.99	30.23	43.91	63.27	64.41

95th PERCENTILE X/Q VALUES

1.00E-09	3.70E-09	3.59E-09	1.73E-09	1.10E-09						
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95% X/Q for standard averaging intervals

0 to 2 hours	1.00E-09
2 to 8 hours	1.00E-09
8 to 24 hours	1.00E-09
1 to 4 days	4.60E-09
4 to 30 days	6.95E-10

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	1.62E-06	2.43E-29
SECTOR-AVERAGE	1.01E-06	1.38E-29

NORMAL PROGRAM COMPLETION

MEDC 99031 v1 ATTACH 1  
 SHEET 75 OF 91

Release Point 2: Elevated Release Point Release w/ 1996 Met. Data

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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Program Run 6/29/1999 at 13:43:09

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPELEV96.MET

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

Elevated release  
Release height (m) = 99.1  
Building Area (m^2) = .0  
Effluent vertical velocity (m/s) = 2.62  
Vent or stack flow (m^3/s) = .26  
Vent or stack radius (m) = .18

Direction .. intake to source (deg) = 130  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 085 - 175  
Distance to intake (m) = 171.7  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

SHEET 76 OF 91  
NEDC 99-051 r1 ATTACH 1

r296.log  
r296.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 = 8760  
 Hours of missing data = 1594  
 Hours direction in window = 495  
 Hours elevated plume w/ dir. in window = 696  
 Hours of calm winds = 751  
 Hours direction not in window or calm = 5920

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-05									
LOW LIM.	1.00E-09									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	113.	196.	286.	414.	488.	543.	979.	1744.	1775.	1672.
BELOW RANGE	0.	0.	39.	115.	257.	646.	728.	824.	873.	909.
ZERO	7053.	6835.	6441.	5729.	5466.	4205.	1904.	1231.	389.	26.
TOTAL X/Qs	7166.	7031.	6766.	6258.	6211.	5394.	3611.	3799.	3037.	2607.
% NON ZERO	1.58	2.79	4.80	8.45	11.99	22.04	47.27	67.60	87.19	99.00

95th PERCENTILE X/Q VALUES

1.00E-09	1.00E-09	1.00E-09	2.21E-09	1.19E-08	4.05E-08	1.75E-08	1.71E-08	1.41E-08	1.03E-08
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95% X/Q for standard averaging intervals

0 to 2 hours	1.00E-09
2 to 8 hours	2.61E-09
8 to 24 hours	5.97E-08
1 to 4 days	9.83E-09
4 to 30 days	9.21E-09

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	1.62E-06	2.43E-29
SECTOR-AVERAGE	1.01E-06	1.38E-29

NORMAL PROGRAM COMPLETION

SHEET 77 OF 91  
 MEDS 99-031 r1 ATTACH 1

Release Point 2: Elevated Release Point Release w/ 1997 Met. Data

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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Program Run 6/29/1999 at 13:43:17

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPELEV97.MET

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

Elevated release  
Release height (m) = 99.1  
Building Area (m^2) = .0  
Effluent vertical velocity (m/s) = 2.62  
Vent or stack flow (m^3/s) = .26  
Vent or stack radius (m) = .18

Direction .. intake to source (deg) = 130  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 085 - 175  
Distance to intake (m) = 171.7  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

NEED 99-03171 ATTACH  
SHEET 78 OF 91

r297.log  
r297.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 = 8760  
Hours of missing data = 398  
Hours direction in window = 520  
Hours elevated plume w/ dir. in window = 811  
Hours of calm winds = 869  
Hours direction not in window or calm = 6973

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AV. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-05									
LOW LIM.	1.00E-09									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	120.	206.	323.	496.	605.	615.	1490.	2796.	4300.	5652.
BELOW RANGE	0.	0.	25.	99.	252.	862.	1558.	1723.	2261.	1838.
ZERO	8242.	8101.	7850.	7394.	7083.	6075.	3536.	2717.	1013.	574.
TOTAL X/Qs	8362.	8307.	8198.	7989.	7940.	7552.	6584.	7236.	7574.	8064.
% NON ZERO	1.44	2.48	4.24	7.45	10.79	19.56	46.29	62.45	86.63	92.88

95th PERCENTILE X/Q VALUES

1.00E-09	1.00E-09	1.00E-09	2.15E-09	1.69E-09	1.62E-08	1.18E-08	1.35E-08	1.26E-08	8.69E-09
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95% X/Q for standard averaging intervals

0 to 2 hours	1.00E-09
2 to 8 hours	2.53E-09
8 to 24 hours	2.32E-08
1 to 4 days	1.03E-08
4 to 30 days	8.21E-09

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	1.62E-06	2.44E-29
SECTOR-AVERAGE	1.01E-06	1.39E-29

NORMAL PROGRAM COMPLETION

SHEET 79 OF 91  
 NEDG 99-081 v1 ATTACH 1

Release Point 2: Elevated Release Point Release w/ 1998 Met. Data

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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e-mail: lab2@nrc.gov

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 6/29/1999 at 13:43:27

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPELEV98.MET

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

Elevated release  
Release height (m) = 99.1  
Building Area (m^2) = .0  
Effluent vertical velocity (m/s) = 2.62  
Vent or stack flow (m^3/s) = .26  
Vent or stack radius (m) = .18

Direction .. intake to source (deg) = 130  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 085 - 175  
Distance to intake (m) = 171.7  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names

NEBC 99-031 r/ATTACH  
SHEET 80 OF 91

r298.log  
r298.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 = 8760  
Hours of missing data = 233  
Hours direction in window = 609  
Hours elevated plume w/ dir. in window = 822  
Hours of calm winds = 840  
Hours direction not in window or calm = 7078

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-05									
LOW LIM.	1.00E-09									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	108.	194.	311.	519.	707.	932.	2236.	3218.	5023.	5721.
BELOW RANGE	0.	0.	21.	59.	167.	574.	1041.	1220.	814.	669.
ZERO	8419.	8285.	8053.	7634.	7366.	6527.	4325.	3425.	2594.	1708.
TOTAL X/Qs	8527.	8479.	8385.	8212.	8240.	8033.	7602.	7863.	8431.	8098.
% NON ZERO	1.27	2.29	3.96	7.04	10.61	18.75	43.11	56.44	69.23	78.91

95th PERCENTILE X/Q VALUES

1.00E-09	1.00E-09	1.00E-09	2.24E-09	4.06E-08	4.35E-08	2.59E-08	1.88E-08	1.67E-08	1.79E-08
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95% X/Q for standard averaging intervals

0 to 2 hours	1.00E-09
2 to 8 hours	2.65E-09
8 to 24 hours	6.41E-08
1 to 4 days	2.00E-08
4 to 30 days	1.66E-08

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	1.62E-06	2.43E-29
SECTOR-AVERAGE	1.01E-06	1.38E-29

NORMAL PROGRAM COMPLETION

SHEET 81 OF 91  
 NEEDS 99-031 ATTACH 1

Release Point 3: Turbine Generator Building Diffuse Release w/ 1994 Met. Data

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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Program Run 3/17/2000 at 09:08:39

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND94.MET

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

Vent release  
Release height (m) = 16.7  
Building Area (m^2) = 3171.0  
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) = 098  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 053 - 143  
Distance to intake (m) = 37.3  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names  
r394.log

SHEET 88 OF 91  
NEDS 99-051 ATTACH 1

r394.cfd

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

Initial value of sigma y = 16.60  
 Initial value of sigma z = 5.30

Expanded output for code testing not selected

Total number of hours of data processed = 8760  
 Hours of missing data = 138  
 Hours direction in window = 1558  
 Hours elevated plume w/ dir. in window = 0  
 Hours of calm winds = 33  
 Hours direction not in window or calm = 7031

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	1591.	1982.	2531.	3308.	3950.	5131.	7760.	8409.	8437.	8111.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	7031.	6606.	5989.	5076.	4465.	3046.	258.	0.	0.	0.
TOTAL X/Qs	8622.	8588.	8520.	8384.	8415.	8177.	8018.	8409.	8437.	8111.
% NON ZERO	18.45	23.08	29.71	39.46	46.94	62.75	96.78	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

8.16E-04	6.68E-04	6.10E-04	5.42E-04	4.45E-04	3.26E-04	1.88E-04	1.64E-04	1.17E-04	9.82E-05
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95% X/Q for standard averaging intervals

0 to 2 hours	8.16E-04
2 to 8 hours	4.51E-04
8 to 24 hours	2.17E-04
1 to 4 days	1.42E-04
4 to 30 days	8.43E-05

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	1.29E-03	1.08E-04
SECTOR-AVERAGE	8.07E-04	6.79E-05

NORMAL PROGRAM COMPLETION

MEDS 99-031 r1 ATTACH 1  
 SHEET 83 OF 91

Release Point 3: Turbine Generator Building Diffuse Release w/ 1995 Met. Data

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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Program Run 3/17/2000 at 09:08:48

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND95.MET

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

Vent release  
Release height (m) = 16.7  
Building Area (m^2) = 3171.0  
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) = 098  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 053 - 143  
Distance to intake (m) = 37.3  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names  
r395.log

SHEET 84 OF 91  
NEDC 99-031 r ATTACH 1

r395.cfd

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

Initial value of sigma y = 16.60  
 Initial value of sigma z = 5.30

Expanded output for code testing not selected

Total number of hours of data processed = 8760  
 Hours of missing data = 1439  
 Hours direction in window = 1258  
 Hours elevated plume w/ dir. in window = 0  
 Hours of calm winds = 20  
 Hours direction not in window or calm = 6043

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	1278.	1555.	1927.	2371.	2752.	3243.	3465.	3460.	2921.	2615.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	6043.	5655.	5063.	4200.	3675.	2459.	279.	0.	0.	0.
TOTAL X/Qs	7321.	7210.	6990.	6571.	6427.	5702.	3744.	3460.	2921.	2615.
% NON ZERO	17.46	21.57	27.57	36.08	42.82	56.87	92.55	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

	7.71E-04	6.48E-04	6.03E-04	5.32E-04	4.37E-04	3.17E-04	1.70E-04	1.42E-04	1.04E-04	9.42E-05
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95% X/Q for standard averaging intervals

0 to 2 hours	7.71E-04
2 to 8 hours	4.53E-04
8 to 24 hours	2.10E-04
1 to 4 days	1.21E-04
4 to 30 days	8.25E-05

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	1.29E-03	1.17E-04
SECTOR-AVERAGE	8.07E-04	7.35E-05

NORMAL PROGRAM COMPLETION

MEDC 99-031 ATTACH 1  
 SHEET 85 OF 91

Release Point 3: Turbine Generator Building Diffuse Release w/ 1996 Met. Data

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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Program Run 3/17/2000 at 09:08:55

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND96.MET

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

Vent release  
Release height (m) = 16.7  
Building Area (m^2) = 3171.0  
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) = 098  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 053 - 143  
Distance to intake (m) = 37.3  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names  
r396.log

NEED 99-031 w/ ATTACH 1  
SHEET 86 OF 91

r396.cfd

Minimum Wind Speed (m/s) = .5  
 Surface roughness length (m) = .10  
 Sector averaging constant = 4.0  
  
 Initial value of sigma y = 16.60  
 Initial value of sigma z = 5.30

Expanded output for code testing not selected

Total number of hours of data processed = 8760  
 Hours of missing data = 3128  
 Hours direction in window = 1056  
 Hours elevated plume w/ dir. in window = 0  
 Hours of calm winds = 49  
 Hours direction not in window or calm = 4527

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL										
AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	1105.	1327.	1599.	1896.	2177.	2617.	2840.	2953.	2531.	2196.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	4527.	4219.	3778.	3153.	2746.	1710.	189.	0.	0.	0.
TOTAL X/Qs	5632.	5546.	5377.	5049.	4923.	4327.	3029.	2953.	2531.	2196.
% NON ZERO	19.62	23.93	29.74	37.55	44.22	60.48	93.76	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES  
 8.43E-04 6.92E-04 6.33E-04 5.72E-04 4.83E-04 3.70E-04 2.16E-04 1.42E-04 1.61E-04 1.11E-04

95% X/Q for standard averaging intervals

0 to 2 hours 8.43E-04  
 2 to 8 hours 4.82E-04  
 8 to 24 hours 2.69E-04  
 1 to 4 days 1.65E-04  
 4 to 30 days 9.43E-05

	HOURLY VALUE RANGE	
	MAX X/Q	MIN X/Q
CENTERLINE	1.29E-03	1.27E-04
SECTOR-AVERAGE	8.07E-04	7.98E-05

NORMAL PROGRAM COMPLETION

SHEET 87 OF 91  
 NEDS 99-031 v1 ATTACH 1

Release Point 3: Turbine Generator Building Diffuse Release w/ 1997 Met. Data

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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Program Run 3/15/2000 at 14:47:46

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND97.MET

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

Vent release  
Release height (m) = 16.7  
Building Area (m^2) = 3171.0  
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) = 098  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 053 - 143  
Distance to intake (m) = 37.3  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names  
r397.log

SHEET 88 OF 91  
MEDC 99-031 v/ATTACH 1

r397.cfd

Minimum Wind Speed (m/s) = .5  
 Surface roughness length (m) = .10  
 Sector averaging constant = 4.0  
  
 Initial value of sigma y = 16.60  
 Initial value of sigma z = 5.30

Expanded output for code testing not selected

Total number of hours of data processed = 8760  
 Hours of missing data = 553  
 Hours direction in window = 1364  
 Hours elevated plume w/ dir. in window = 0  
 Hours of calm winds = 293  
 Hours direction not in window or calm = 6550

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	1657.	2009.	2465.	3028.	3521.	4284.	5557.	6787.	6316.	7155.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	6550.	6109.	5483.	4594.	4016.	2721.	351.	7.	0.	0.
TOTAL X/Qs	8207.	8118.	7948.	7622.	7537.	7005.	5908.	6794.	6316.	7155.
% NON ZERO	20.19	24.75	31.01	39.73	46.72	61.16	94.06	99.90	100.00	100.00

95th PERCENTILE X/Q VALUES

	9.27E-04	7.76E-04	6.75E-04	5.82E-04	4.73E-04	3.51E-04	2.07E-04	1.93E-04	1.61E-04	1.52E-04
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95% X/Q for standard averaging intervals

0 to 2 hours	9.27E-04
2 to 8 hours	4.67E-04
8 to 24 hours	2.35E-04
1 to 4 days	1.59E-04
4 to 30 days	1.43E-04

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	1.29E-03	1.56E-04
SECTOR-AVERAGE	8.07E-04	9.76E-05

NORMAL PROGRAM COMPLETION

NEEDS 99-031 r1 ATTACH 1  
 SHEET 89 OF 91

Release Point 3: Turbine Generator Building Diffuse Release w/ 1998 Met. Data

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 3/17/2000 at 09:09:02

\*\*\*\*\* ARCON INPUT \*\*\*\*\*

Number of Meteorological Data Files = 1  
Meteorological Data File Names  
NPGND98.MET

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

Vent release  
Release height (m) = 16.7  
Building Area (m^2) = 3171.0  
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) = 098  
Wind direction sector width (deg) = 90  
Wind direction window (deg) = 053 - 143  
Distance to intake (m) = 37.3  
Intake height (m) = 16.7  
Terrain elevation difference (m) = .0

Output file names  
r398.log

NEEDS ATTACH 1  
SHEET 90 OF 91

r398.cfd

Minimum Wind Speed (m/s) = .5  
 Surface roughness length (m) = .10  
 Sector averaging constant = 4.0  
  
 Initial value of sigma y = 16.60  
 Initial value of sigma z = 5.30

Expanded output for code testing not selected

Total number of hours of data processed = 8760  
 Hours of missing data = 419  
 Hours direction in window = 1733  
 Hours elevated plume w/ dir. in window = 0  
 Hours of calm winds = 21  
 Hours direction not in window or calm = 6587

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL

AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02									
LOW LIM.	1.00E-06									
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	1754.	2199.	2772.	3488.	4125.	5296.	6933.	7361.	7371.	7192.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	6587.	6095.	5429.	4536.	3923.	2530.	330.	62.	0.	0.
TOTAL X/Qs	8341.	8294.	8201.	8024.	8048.	7826.	7263.	7423.	7371.	7192.
% NON ZERO	21.03	26.51	33.80	43.47	51.25	67.67	95.46	99.16	100.00	100.00

95th PERCENTILE X/Q VALUES

	9.54E-04	7.28E-04	6.63E-04	6.08E-04	5.01E-04	3.65E-04	2.20E-04	1.89E-04	1.67E-04	1.47E-04
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95% X/Q for standard averaging intervals

0 to 2 hours	9.54E-04
2 to 8 hours	4.93E-04
8 to 24 hours	2.43E-04
1 to 4 days	1.72E-04
4 to 30 days	1.36E-04

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	1.29E-03	1.11E-04
SECTOR-AVERAGE	8.07E-04	6.93E-05

NORMAL PROGRAM COMPLETION

NEDC 99-031 r1 ATTACH 1  
 SHEET 91 OF 91