## ATTACHMENT 1 DESIGN CALCULATION COVER SHEET

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

#### PURPOSE:

This calculation incorporates by attachment Scientech Engineering Calculation No. 17080-M-01, Rev. 0, 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.

#### **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.0 (including attachments thereto).

2. CNS Meteorology Data 1994-1998

3. Reviewer Comments and Resolutions

0	2	Original Issue	Scientech, Inc. 12/2/99	J. J. Drasler J. J. Drasler J. 2/3/99	ir N/A	18 Judian 12 10 199
Rev. No.	Status	Revision Description	Prepared By/Date	Reviewed By/Date	Independent Design Verification/Date	Approved By/Date

Status Codes

3. For Construction

2. Information Only

4. Superseded or Deleted

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# DESIGN CALCULATION CROSS REFERENCE INDEX

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Rev. I	lo: <u>0</u>	Date:	12/2/99	l	Date:	12/3/99	
Item No.			Rev. No.	PENDIN	ENDING CHANGES TO DESIGN INPUTS		
1	Burns and Roe Dwg 202	20	N45	-	DCN 99-0	534	
2	Burns and Roe Dwg 203	37	N54		none		
3	Burns and Roe Dwg 21	94	N03		none		
4	Burns and Roe Dwg 22	09	3		none		
5	Burns and Roe Dwg 22	17	N08		none		
6	Burns and Roe Dwg 40	05, Sht.2	N01		none		
7	Burns and Roe Dwg 45	06	N06		none		
8	3 CNS Met Data 1994-1998		N/A		none		
9	9 Burn & Roe Calculation, Book 4, Retrieval 00103-0487		N/A		none		
10	10 DC 94-102		0		none		
11	1 NUREG/CR-6331		1		none		
12	2 NUREG/CR-2858		1982	· · · · · · · · · · · · · · · · ·	none		
13	3 NUREG/CR-2919		1982		none		
14	NUREG/CR-5055		1988		none		
15	NUREG-0800, SRP Sec	ction 6.4	2		none		
16	Reg Guide 1.111		1977		none		
17	PNL-10286		1995	1995 none			
18	DOE/TIC-27601		1984		none		
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Rev. No: 0 Date: 12/2/99 Date: 12/3/99

Item No.	Affected Documents	Rev. No.	CHANGE Required	Action Item Tracking Number (If change is required)
1	NEDC 99-032	0	initial issue	N/A - concurrent approval
2	NEDC 99-033	0	initial issue	N/A - concurrent approval
3	NEDC 99-034	0	initial issue	N/A - concurrent approval
4	NEDC 99-035	0	initial issue	N/A - concurrent approval
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NEDC: <u>99-031</u>	Preparer: <u>S</u>	cientech, Inc.	Reviewer:	J. J. Drasler	Ø
Rev. No:0	Date:1	2/2/99	Date:	12/3/99	U 

#### PURPOSE

This calculation incorporates by attachment Scientech Engineering Calculation No. 17080-M-01, Rev. 0, 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 Desgin 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 gound 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:
  - Reactor Building Vent (for various reactor building ventilation flow rates),
     Elevated Release Point (ERP) (point release), and
     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 in 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.

The methodology was review 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.

These results and conclusions sections were review 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.

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AUTHOR/DATE: VERIETED BY/DATE: 12/2/ APPROVED Hanny A. Wagage 11/24/1999 D. Sh. J. 12/2/2/ D. St. 2 D. St. D. St. D. St. D. St. 2 D. St. D. St. D. St. 2		12/2/	, 19			

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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]

#### 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.

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SUPPLEMENTED BY CALC. NO.:	■ SAFETY-RELATED □ NON-SR □ OTHER	■ PROJECT ■ DCC □ OTHER	■ REVIEW □ ALT. ANALYSIS

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Attachment A – ARCON96 output files (71 pages)

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#### 1. Purpose of Analysis

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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]

#### 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 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.

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Section 3.2 reproduces discussion of the ARCON96 code model from the code user's manual. Section 3.3 describes different radioactive release configurations analyzed.

### 3.2 ARCON96 Modeling

#### 3.2.1 Diffusion Model

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

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

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

 $\sigma_{y}, \sigma_{z} = \text{diffusion coefficients} (m)$ 

$$U = wind speed (m/s)$$

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

$$\Sigma_{y} = (\sigma_{y}^{2} + \Delta \sigma_{y1}^{2} + \Delta \sigma_{y2}^{2})^{1/2}$$

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

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

$$\Delta \sigma_{z1}^{2} = 6.67 \text{ x } 10^{2} [1 - (1 + x/100\text{U}) \exp(-x/100\text{U})]$$
(3)

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

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

$$\Delta \sigma_{z2}^{2} = 1.17 \text{ x } 10^{-2} \text{ U}^{2} \text{ A} \left[1 - (1 + x/10 \text{ sqrt}(\text{A})) \exp(-x/10 \text{ sqrt}(\text{A}))\right]$$
(4)

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

$$\Sigma_{\rm vmax} = 2\pi x/{\rm sqrt}(12) = 1.81x$$
 (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.

#### 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:

$$CIC/Q' = 2/[sqrt(2\pi)\Sigma_z U]$$

(6)

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

$$\chi_{sa} / Q' = 2 / [sqrt(2\pi)\Sigma_z UW_s] = 0.80 / [\Sigma_z UW_s]$$
 (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  $\alpha \Sigma_{v}$ , 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  $+/-2 \Sigma_y$  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.,

$$W_{\rm smax} = 2\pi x \tag{8}$$

#### 3.2.1.3 Elevated Release Diffusion Models

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For elevated releases, the relative concentration is given by

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

where he is the effective stack height and hi 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<sub>s</sub>), the difference in terrain elevation between the stack and intake locations  $(t_s - t_i)$  and stack downwash ( $\Delta h_d$ ) by

$$h_e = h_s + (t_s - t_i) + \Delta h_d \tag{10}$$

where the stack downwash is computed as

$$\Delta h_{d} = 4r_{s}[(W_{o}/U(h_{s})) - 1.5]$$
(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.

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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

$$\chi_{sa} / Q' = \{2 / [sqrt(2\pi)\sigma_z UW_s]\} \exp [-0.5 ((h_e - h_i) / \sigma_z)^2]$$
(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:

$$E_{t} = 2.58 - 1.58 (W_{o}/U) \text{ for } 1 < W_{o}/U \le 1.5$$

$$E_{t} = 0.3 - 0.06 (W_{o}/U) \text{ for } 1.5 < W_{o}/U < 5$$
(13)

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

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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,  $\chi$  /Qs 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

$$X_{v} = [(\sigma_{0} - c)/\alpha]^{1/b}$$
(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

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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 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

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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

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

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

#### 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:

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

where N = averaging period in hours.

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

 $(\chi/Q')_{avg} = (1/N) \sum_{I=1}^{8} (\chi/Q')_{I} + \sum_{I=9}^{N} (\chi_{sa}/Q')_{I} ]$ (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

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

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 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 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.

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## 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 m<sup>3</sup>/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 crosssectional 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 crosssectional 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 m<sup>3</sup>/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.

# 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

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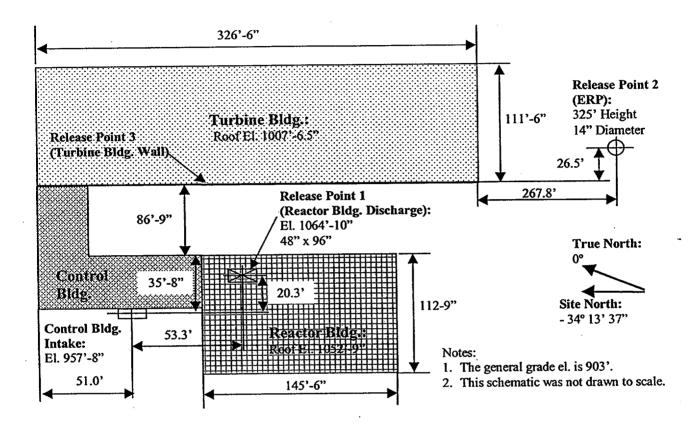


Figure 1. Schematic layout of release points and control room intake showing design input information.

- 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.
- 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 Habitablity 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.

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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

- F. N. Frankiel "Turbulent Diffusion: Mean Concentration in a Flow Field of 5.8 Homogeneous Turbulence." Advances in Applied Mechanics 3:61-107, 1953.
- NUREG-0800, Standard Review Plan, Rev. 2, July 1981: § 6.4, "Control Room 5.9 Habitability Systems,"
- CNS, Burns & Roe Drawings: 2020 Rev. N45, 2037 Rev. N54, 2209 Rev. 3, 2217 5.10 Rev. N08, 2194 Rev. 3, 4005 Rev. N01, and 4506 Rev. N06):
- J. V. Ramsdell Jr. and C. J. Fosmire, Atmospheric Dispersion Estimates in the 5.11 Vicinity of Buildings. PNL-10286. Pacific Northwest Laboratory, Richland, Washington, 1995.
- S. K. Kao, "Atmospheric Science and Power Production: Theories of Atmospheric 5.12 Transport and Diffusion," DOE/TIC-27601, D. Randerson, ed. U.S. Department of Energy, Washington, D.C. pp. 189-239,1984.
- H. Wagage, 1999, ARCON96 Software Verification Memo from to T. Bladen dated 5.13 1/25/99.
- Burns and Roe Calculation, "System Sizing, Standby Gas Treatment System," 5.14 Book 4, Retrieval 00103-0487.
- CNS Design Change 94-102. 5.15

# 6. Major Assumptions

The release height is equal to the height of the control room intake for diffuse release 6.1 cases, i.e., for release from the turbine building. This assumption is conservative 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  $\frac{\chi}{Q}$ .

- 6.2 The initial vertical diffusion coefficient,  $\Sigma_z$  is equal to the  $\frac{1}{2}$  of the height of the exposed area of the turbine building. This assumption is consistent with that used for the example problem for diffuse release in the ARCON96 manual. [5.1]
- The effective width of the area source is equal to the 1/2 of the width of the turbine 6.3 building. This assumption is consistent with that used for the example problem for diffuse release in the ARCON96 manual. [5.1]
- The initial horizontal diffusion coefficient,  $\Sigma_{y}$  is this effective width of the area source 6.4 ( $\S$  6.3) divided by 4.3. This assumption is consistent with that used for the example problem for diffuse release in the ARCON96 manual. [5.1]

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## 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 Hanry 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, 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.

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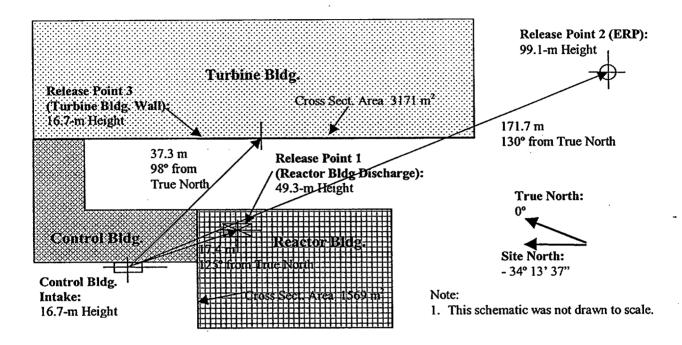


Figure 2. Schematic layout of release points and control room intake showing input data for the ARCON96 code. (Note: The height of Release Point 3 was conservatively assumed to be the same as the height of control building intake.)

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  $(0.26 \text{ m}^3/\text{s})$  was conservatively used in the calculation.

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.

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

 $\Sigma_v$  was calculated as follows:

 $\Sigma_v = (326'-6''/2)' / 4.3 = 38.0' = 11.6 \text{ m}$ 

The height of the exposed area is taken as the height of the turbine building, which is 1007'-6<sup>1</sup>/<sub>2</sub>". Plant general grade elevation is 903'. Therefore the height of the exposed area is 107.6'.  $\Sigma_z$  for units is therefore calculated as follows:

 $\Sigma_z = (1007' - 6.5'' - 903') / 2 = 52.3' = 15.9 \text{ m}.$ 

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.

#### 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  $\frac{\chi}{Q}$  compared to all the

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

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#### 11. Conclusions

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.

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# Table 1. Source Input Parameters to ARCON96

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Release Configuration	Release Point 1: Reactor Building Vent Release for Different Fractions of Design Flow Rate (f)					Release Point 2:	Release Point 3: Turbine	
	f = 0	$f = \frac{1}{4}$	$f = \frac{1}{2}$	$f = \frac{3}{4}$	f = 1	Elevated Release Point Release	Generator Building Diffuse Release	
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)		L	0.97			.18	0	
$\Sigma_{y}(m)$			0			0	11.6	
$\Sigma_{z}(m)$		÷	0		•	0	15.9	
Direction from True North- Intake to Source (deg)		125					98	
Wind Direction Sector Width (deg)	90							
Distance to Intake (m)		17.4					37.3	
Intake Height (m)					16.7			

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

Q								
Release Point	f	Duration	1994	1995	1996	1997	1998	Highest
1		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
	0	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
		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
	1/4	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
		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
	1/2	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
		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
	3/4	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
		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
	1	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
1		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	4.29E-4	4.07E-4	4.40E-4	5.24E-4	4.97E-4	5.24E-4
	1	2 - 8 hours	2.43E-4	2.48E-4	2.64E-4	2.58E-4	2.68E-4	2.68E-4
	-	8 - 24 hours	1.17E-4	1.13E-4	1.41E-4	1.37E-4	1.36E-4	1.41E-4
		1 - 4 days	7.50E-5	6.43E-5	9.18E-5	9.77E-5	9.25E-5	9.77E-5
		4 - 30 days	4.52E-5	4.33E-5	5.08E-5	8.41E-5	7.53E-5	8.41E-5

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.

Release Point 1: R	eactor Building Vent Releas	e for Fraction of Design	Flow Rate, $f = 0 \text{ w}/1994 \text{ Met. Data}2$
Release Point 1: R	eactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = 0 w/ 1995$ Met. Data4
Release Point 1: R	eactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = 0 w/ 1996$ Met. Data6
Release Point 1: R	eactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = 0 w/ 1997 Met$ . Data8
Release Point 1: R	eactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = 0 \text{ w}/ 1998 \text{ Met. Data} 10$
Release Point 1: R	eactor Building Vent Relea	e for Fraction of Design	Flow Rate, f = ¼ w/ 1994 Met. Data12
Release Point 1: R	eactor Building Vent Relea.	e for Fraction of Design	Flow Rate, f = ¼ w/ 1995 Met. Data14
Release Point 1: R	eactor Building Vent Relea	e for Fraction of Design	Flow Rate, f = ¼ w/ 1996 Met. Data16
Release Point 1: R	eactor Building Vent Relea	e for Fraction of Design	Flow Rate, f = ¼ w/ 1997 Met. Data18
Release Point 1: R	eactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = \frac{1}{2} w/ 1998$ Met. Data20
Release Point 1: R	eactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = \frac{1}{2} w/ 1994$ Met. Data22
Release Point 1: R	eactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = \frac{1}{2} w/ 1995$ Met. Data24
Release Point 1: R	eactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = \frac{1}{2} w/ 1996$ Met. Data26
Release Point 1: R	leactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = \frac{1}{2} w/ 1997$ Met. Data28
Release Point 1: R	leactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = \frac{1}{2} w/ 1998$ Met. Data30
Release Point 1: R	Reactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = \frac{3}{4} w/ 1994$ Met. Data32
Release Point 1: R	Reactor Building Vent Relea	e for Fraction of Design	Flow Rate, f = ¾ w/ 1995 Met. Data34
Release Point 1: R	Reactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = \frac{3}{4} \text{ w}/1996 \text{ Met. Data36}$
Release Point 1: R	Reactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = \frac{3}{4} \text{ w}/1997 \text{ Met. Data38}$
Release Point 1: R	leactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = \frac{3}{4} \text{ w}/1998 \text{ Met. Data40}$
Release Point 1: R	eactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = 1.0 \text{ w}/1994 \text{ Met. Data42}$
Release Point 1: R	eactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = 1.0 \text{ w}/1995 \text{ Met. Data44}$
Release Point 1: R	eactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = 1.0 \text{ w}/1996 \text{ Met. Data46}$
Release Point 1: R	Reactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = 1.0 \text{ w}/1997 \text{ Met}$ . Data48
Release Point 1: R	leactor Building Vent Relea	e for Fraction of Design	Flow Rate, $f = 1.0 \text{ w}/1998 \text{ Met. Data50}$
Release Point 2: E	Elevated Release Point Rele	ise w/ 1994 Met. Data	
Release Point 2: E	Elevated Release Point Rele	ise w/ 1995 Met. Data	
Release Point 2: E	Elevated Release Point Rele	ase w/ 1996 Met. Data	
Release Point 2: E	levated Release Point Rele	ase w/ 1997 Met. Data	
Release Point 2: E	Elevated Release Point Rele	ise w/ 1998 Met. Data	
Release Point 3: T	Curbine Generator Building	)iffuse Release w/ 1994 M	et. Data
Release Point 3: T	Curbine Generator Building	)iffuse Release w/ 1995 M	et. Data
Release Point 3: T	Curbine Generator Building	)iffuse Release w/ 1996 M	et. Data
Release Point 3: T	Curbine Generator Building	Diffuse Release w/ 1997 M	et. Data
Release Point 3: T	Curbine Generator Building	)iffuse Release w/ 1998 M	et. Data

NEDC <u>99-03/</u>ATTACH / SHEET <u>2.0</u> OF <u>90</u>

#### Page 2 of 71

#### 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.

NRC Contacts:	J. Y. Lee	Phone: (301) 415 1080
		e-mail: jyll@nrc.gov
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		e-mail: jjh@nrc.gov
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		e-mail: lab2@nrc.gov

Code	Developer:	J.	v.	Ramsdell	Phone :	(509)	372	6316
	-				e-mail:	j_ra	nsdel	ll@pnl.gov

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 <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 <u>99 031</u> ATTACH / SHEET <u>21</u> OF <u>90</u> 1r194.log 1r194.cfd

4

.5 Minimum Wind Speed (m/s) .10 Surface roughness length (m) 4.0 Sector averaging constant .00 Initial value of sigma y .00 Initial value of sigma z Expanded output for code testing not selected Total number of hours of data processed = 8760 138 Hours of missing data Hours direction in window 847 Hours elevated plume w/ dir. in window = 0 1064 Hours of calm winds Hours direction not in window or calm = 6711 DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL 168 360 720 24 96 4 8 12 AVER. PER. 2 1 1.00E-02 UPPER LIM. 1.00E-06 LOW LIM. ٥. Ο. ο. ο. 01 Ο. Ο. ο. ABOVE RANGE Ο. ٥. 8409. 8437. 8111. 7864. 8018. 6413. 7232. 3200. 4823. IN RANGE 1911. ٥. ٥. ο. ٥. ٥. Ο. ٥. BELOW RANGE Ο. ٥. Ο. ٥. ٥. ٥. ٥. 313. 3697. 1971. 1183. ZERO 6711. 5388. 8111. 8018. 8409. 8437. 8520. 8384. 8415. 8177. TOTAL X/Os 8622. 8588. 100.00 100.00 100.00 100.00 76.49 85.94 96.17 56.61 22.16 37.26 1 NON ZERO 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 95% X/Q for standard averaging intervals 3.64E-03 0 to 2 hours 7.15E-04 2 to 8 hours 5.24E-04 8 to 24 hours 1 to 4 days 4.87E-04 4 to 30 days 4.16E-04 HOURLY VALUE RANGE MAX X/Q MIN X/Q 1.07E-03 7.49E-03 CENTERLINE 6.68E-04 4.70E-03

SECTOR-AVERAGE

NORMAL PROGRAM COMPLETION

SHEET NEDC 19-031 ATTACH 4 4 ิ ค 9 Õ

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SHEET

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OF 90

NEDC

99-031 ATTACH\_

#### 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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		e-mail: jjh@nrc.gov
	L. A Brown	Phone: (301) 415 1232
		e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j\_ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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

- V	/ent	: re	lea	ıse
-----	------	------	-----	-----

Release height (m)	Ħ	49.3
Building Area (m <sup>2</sup> )	=	1569.0
Effluent vertical velocity (m/s)	a	.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

.

1r1	95.	log
1r1	95.	cfd

Minimum Win	d Speed (m/:	s)	×	.5							
Surface rou	ghness leng	th (m)	=	.10							
Sector aver	aging consta	ant	=	4.0							
	ue of sigma		-	.00							
Initial val	ue of sigma	z	=	.00							
European au	tput for co	do tectino	not selecte	A							
Expanded ou	leput for co	de testing .	not serecte	<b>A</b>							
Total numbe	r of hours	of data pro	cessed =	8760							
Hours of mi		•		1439							
	tion in wind	dow	=	710							
	ted plume w		indow =	0							
Hours of ca		,	=	926					4		
	tion not in	window or	calm =	5685							
nouro urree											
DISTRIBUTIO	N SUMMARY D	ATA BY AVER.	AGING INTER	VAL							
AVER. PER.	1	2	4	8	12	24	96	168	360	720	
UPPER LIM.	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02		1.00E-02	1.00E-02	
LOW LIM.	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	
ABOVE RANGE	0.	Ο.	ο.	ο.	ο.	0.	ο.	0.	ο.	0.	
IN RANGE	1636.	2692.	3978.	5051.	5574.	5540.	3744.	3460.	2921.	2615.	
BELOW RANGE	0.	Ο.	٥.	Ο.	ο.	٥.	ο.	٥.	0.	0.	
ZERO	5685.	4518.	3012.	1520.	853.	162.	٥.	٥.	ο.	ο.	
TOTAL X/Qs	7321.		6990.	6571.	6427.	5702.	3744.	3460.	2921.	2615.	
1 NON ZERO	22.35	37.34		76.87		97.16	100.00	100.00	100.00	100.00	
95th PERCEN	TILE X/Q VA	LUES									
	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	
			2								
95% X/Q for	standard a	veraging in	tervals								
0 to 2 hour		58E-03									
2 to 8 hour		04E-04									
8 to 24 hou		26E-04									
1 to 4 days		66E-04									
4 to 30 day	rs 3.	68E-04									
		HOURLY	VALUE RANG	E							
		MAX X/O		MIN X/Q							
CENTER	TITNE	7.47E-03		1.07E-03							
	AVERAGE	4.68E-03		6.68E-04							
SECTOR	-AVERAGE	1.005-03		0.001 04							

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

NORMAL PROGRAM COMPLETION

NEDC <u>19-031</u> ATTACH\_\_\_\_\_\_ SHEET <u>24</u> OF <u>9</u> 0F 90

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
			e-mail: jyll@nrc.gov
	J. J.	Hayes	Phone: (301) 415 3167
			e-mail: jjh@nrc.gov
	L. A	Brown	Phone: (301) 415 1232
			e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j\_ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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49.3

1569.0

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) Building Area (m^2)

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 NEDC 19-031 R ATTACH 80

4

1r196.log 1r196.cfd .5 Minimum Wind Speed (m/s) Surface roughness length (m) .10 Sector averaging constant 4.0 Initial value of sigma y .00 .00 Initial value of sigma z Expanded output for code testing not selected 8760 Total number of hours of data processed = 3128 Hours of missing data -751 Hours direction in window Hours elevated plume w/ dir. in window = 0 743 Hours of calm winds Hours direction not in window or calm = 4138 DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL 720 96 168 360 12 24 1 2 4 AVER. PER. 1.00E-02 UPPER LIM. 1.00E-06 LOW LIM. ο. ٥. ο. ٥. ٥. 0. ٥. ο. Ο. Ο. ABOVE RANGE 2531. 2196. 4053. 4387. 4232. 3029. 2953. 3256. 2295. IN RANGE 1494. ο. Ο. ο. Ο. ٥. ο. ٥. BELOW RANGE Ο. Ο. Ο. ο. ٥. 95. ٥. Ο. 996. 536. 2121. ZERO 4138. 3251. 2953. 2531. 2196. 4923. 4327. 3029. 5049. TOTAL X/Qs 5632. 5546. 5377. 100.00 100.00 100.00 80.27 89.11 97.80 100.00 & NON ZERO 26.53 41.38 60.55 95th PERCENTILE X/Q VALUES 5.63E-04 4.73E-04 4.62E-04 4.36E-03 2.92E-03 2.41E-03 1.98E-03 1.56E-03 1.03E-03 6.53E-04 95% X/Q for standard averaging intervals 4.36E-03 0 to 2 hours 1.19E-03 2 to 8 hours 5.51E-04 8 to 24 hours 5.28E-04 1 to 4 days 4.33E-04 4 to 30 days HOURLY VALUE RANGE MIN X/O 03

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

NORMAL PROGRAM COMPLETION

## Page 8 of 71

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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	J. J. Hayes	Phone: (301) 415 3167
		e-mail: jjh@nrc.gov
	L. A Brown	Phone: (301) 415 1232
		e-mail: lab2@nrc.gov

Code	Developer:	J.	v.	Ramsdell	Phone :	(509)	372	6316
	-				e-mail:	j_ra	nsde:	ll@pnl.gov

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 <sup>2</sup> )	=	1569.0
		.00
Vent or stack flow (m <sup>3</sup> /s)		.00
Vent or stack radius (m)	=	.97
Direction intake to source (deg)	34	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 NEDC <u>99-031</u>ATTACH B \_0F\_90

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1r197.log 1r197.cfd

Surface rou	nd Speed (m/s ighness lengt raging consta	:h (m)	= = = (	.5 .10 4.0						
			2	.00						
	lue of sigma Lue of sigma		-	.00						
Inicial val	tue or signa	4	-							
Expanded ou	tput for coo	de testing r	not selected	đ						
Total numbe	er of hours of	of data proc	cessed =	8760						
Hours of mi	issing data		=	553						
	ction in wind		*	795						
Hours eleva	ated plume w,	/ dir. in wi		0						
Hours of ca				1232						
Hours dired	ction not in	window or o	calm =	6180						
			ACTNO INTER	WAT						
	ON SUMMARY DI 1	ATA BI AVERA	4GING INIER	8	12	24	96	168	360	720
AVER. PER.		1.00E-02	1.00E-02	1.00E-02	1.00E-02			1.00E-02	1.00E-02	1.00E-02
UPPER LIM.	1.00E-02 1.00E-06	1.00E-02	1.00E-02	1.00E-06	1.00E-06	1.00E-06		1.00E-06	1.00E-06	1.00E-06
LOW LIM.	1.00E-06	1.002-08	0.	0.	0.	0.	0.	ο.	0.	Ο.
ABOVE RANGE	2027.	3272.	4828.	6141.	6747.	6888.	5908.	6794.	6316.	7155.
IN RANGE		3272.	4020.	0.	0.	0.	ο.	0.	ο.	Ο.
BELOW RANGE	0. 6180.	4846.	• ·		790.	117.	0.	٥.	ο.	0.
ZERO	8207.	8118.			7537.	7005.	5908.	6794.	6316.	7155.
TOTAL X/QS % NON ZERO	24.70		60.74		89.52	98.33	100.00	100.00	100.00	100.00
* NON ZERU	24.70	40.54								
95th PERCE	NTILE X/Q VA	LUES								
	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
			ş							
95% X/Q fo:	r standard a	veraging in	tervals							
0 to 2 hou:	rs 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 da	ys 3.	70E-04								
		VOIDTY	VALUE RANG	5						
		MAX X/O	VALUE RANG	MIN X/Q						
				1.07E-03						
CENTE		6.82E-03		6.68E-04						
SECTO	R-AVERAGE	4.27E-03		6.08E-04						

NORMAL PROGRAM COMPLETION

SHEET NEDC 99 031 ATTACH 26 09

#### Page 10 of 71

4

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 e-mail: jyl1@nrc.gov
	J. J.	Hayes	Phone: (301) 415 3167
	L. A	Brown	e-mail: jjh@nrc.gov Phone: (301) 415 1232 e-mail: lab2@nrc.gov

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

Code Documentation: NUREG/CR-6331 Rev. 1

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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

=	49.3
=	1569.0
-	.00
*	.00
*	. 97
Ħ	125
**	90
-	080 - 170
=	17.4
=	16.7
*	.0
	* * * *

Output file names

.

SHEET NEDC <u>99-031</u>ATTACH 2 0F 90

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1r198	.log
1r198	.cfd

Mini	mum Wind	1 Speed (m/	s)	=	. 5						
Surface roughness length (m)				=	.10						
Sector averaging constant				=	4.0						
36666	or avere	iging come									
Init	ial valu	e of sigma	v	=	.00						
		ne of sigma			.00						
			-								
Expa	nded out	put for co	de testing r	not selecte	d						
Tota	l number	r of hours	of data proc	cessed =	8760						
Hour	s of mis	ssing data		*	419						
Hour	s direct	ion in win	dow	=	946						
Hour	s elevat	ed plume w	/ dir. in wi	indow =	0						
		lm winds		*	1007						
Hour	s direct	tion not in	window or o	calm =	6388						
- T 0		ת עמגאאאניס ה	ATA BY AVER	ATNG INTER	VAL						
AVER.		N SUMMARI D	AIA 61 AVEN	4	8	12	24	96	168	360	720
			1.00E-02	-	1.00E-02						
UPPER		1.00E-02	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06
	LIM.		1.00E-06	1.002-00	1.000-00	0.	0.	0.	0.	Ο.	ο.
ABOVE		0.	3090.	4564.	5955.	6722.	7360.	7263.	7423.	7371.	7192.
	RANGE	1953.		4304.	0.	0,22.	0.	0.	0.	Ο.	0.
BELOW		0.	0.		2069.	1326.	466.	ō.	0.	0.	Ο.
	ZERO	6388.	5204.	3637.		8048.	7826.	7263.	7423.	7371.	7192.
	X/Qs	8341.	8294.	8201.		83.52	94.05	100.00	100.00	100.00	100.00
¥ NON	ZERO	23.41	37.26	55.65	/4.21	03,34	94.05	100.00	100100		
95th	PERCEN	TILE X/Q VA	LUES								
		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
			\$	1							
95¥	X/Q for	standard a	veraging in	tervals							
0 to	2 hours		82E-03								
2 to	8 hour:	-	00E-03								
8 to	24 hou:		89E-04								
1 to	4 days	6.	46E-04								
4 to	30 day:	s 7.	26E-04								
			HOURLY	VALUE RANG	E						
			MAX X/Q		MIN X/Q						
	CENTER	LINE	7.10E-03		1.07E-03						
		-AVERAGE	4.45E-03		6.68E-04						
	SECTOR	-AVERAGE	4.456-05		31000 04						

NORMAL PROGRAM COMPLETION

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4

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 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
			e-mail: jyll@nrc.gov
	J. J.	Hayes	Phone: (301) 415 3167
		-	e-mail: jjh@nrc.gov
	L. A	Brown	Phone: (301) 415 1232
			e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j\_ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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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 <sup>2</sup> )	=	1569.0
Effluent vertical velocity (m/s)	=	2.90
Vent or stack flow (m <sup>3/s</sup> )	=	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

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SHEET NEDC 92-031\_ATTACH\_1 3 0F 90

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2r194.log	
2r194.cfd	

Minimum Wind	Speed (m/s	z )	-	.5						
Surface rough			£	.10						
Sector average				4.0						
Sector average	,									
Initial value	of sigma	у	×	.00						
Initial value			#	.00						
	-									
Expanded out <u>r</u>	out for coo	le testing :	not selecte	d						
Total number	of hours of	of data proc	cessed =	8760						
Hours of miss			=	138						
Hours directi			. *	847						
Hours elevate		/ dir. in w	indow =	84						
Hours of calm				1064						
Hours directi	ion not in	window or a	calm =	6711						
DISTRIBUTION	STIMMARY D	ATA BY AVER	AGING INTER	VAL						
AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02
LOW LIM.	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06
ABOVE RANGE	0.	0.	٥.	Ο.	Ο.	٥.	0.	0.	0.	0.
IN RANGE	811.	1488.	2551.	4025.	5093.	6667.	7972.	8409.	8437.	8111.
BELOW RANGE	0.	0.	ο.	Ο.	1.	13.	Ο.	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 PERCENT	ILE X/Q VA	LUES							1.87E-04	1.61E-04
	6.72E-04	1.58E-03	1.08E-03	7.98E-04	6.48E-04	4.32E-04	2.72E-04	2.28E-04	1.8/6-04	1.010-04
			1							
95% X/Q for	standard a	veraging in	tervals							
0 to 2 hours	1.	58E-03								
2 to 8 hours		37E-04								
8 to 24 hour:		49E-04								
1 to 4 days		18E-04								
4 to 30 days		44E-04								
4 20 30 4070										
		HOURLY	VALUE RANG	3E						
		MAX X/Q		MIN X/Q				•		
CENTERL	INE	6.09E-03		6.50E-32						
SECTOR -		3.89E-03		4.07E-32						

NORMAL PROGRAM COMPLETION

.

SHEET NEDC 99-03/ ATTACH / 32 0F 70

# Page 14 of 71

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 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
				e-mail: jyll@nrc.gov
	J.	J.	Hayes	Phone: (301) 415 3167
			-	e-mail: jjh@nrc.gov
	L.	Α	Brown	Phone: (301) 415 1232
				e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j\_ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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

Vent release

Release height (m)	3	49.3
Building Area (m <sup>2</sup> )	=	1569.0
		2.90
Vent or stack flow (m <sup>3</sup> /s)	Ħ	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

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2615.

100.00

1.70E-04

1.00E-02

1.00E-06

2r195.log 2r195.cfd

Minimum Wind Surface roug			= =	.5					
Sector avera				4.0					
Initial valu			=	.00					
Initial valu	e of sigma	2	*	.00					
Expanded out	put for coo	de testing m	not selecte	đ					
Total number	of hours d	of data proc		8760					
Hours of mis	sing data		=	1439					
Hours direct			=	710					
Hours elevat		/ dir. in w		127					
Hours of cal			=	926					
Hours direct	ion not in	window or a	calm =	5685					
DISTRIBUTION				VAL 8	12	24	96	168	360
AVER. PER.	1	2	4 1.00E-02	1.00E-02	1.00E-02		1.00E-02	1.00E-02	1.00E-02
UPPER LIM.	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-06	1.00E-06	1.00E-06	1.00E-06
LOW LIM.	1.00E-06	1.00E-06 0.	1.00E-06	1.002-00	1.001-00	0.	0.	0.	0.
ABOVE RANGE	0.	1246.	2104.	3155.	3882.	4678.	3744.	3460.	2921.
IN RANGE	691.		2104.	J155. 0.	2.	37.	0.	0.	0.
BELOW RANGE	0.	0.	4886.	3416.	2543.	987.	0.	0.	0.
ZERO	6630.	5964.	4886. 6990.	6571.					2921.
TOTAL X/QS	7321.	7210.		48.01	60.43	82.69	100.00	100.00	100.00
NON ZERO	9.44	17.28	30.10	48.01	00.43	02.05	100.00	100.00	100000
95th PERCENT	TLE X/O VA	UTES							
JOIN PERCENT	8.96E-04		1.18E-03	8.70E-04	6.88E-04	4.30E-04	2.76E-04	2.35E-04	1.85E-04
	0.700 04	2.012 02							
95% X/Q for	standard a								
0 to 2 hours	. 1.	84E-03							
2 to 8 hours		47E-04							
8 to 24 hour	rs 2.	10E-04							
1 to 4 days	2.	25E-04							
4 to 30 days	s 1.	54E-04							
			VALUE RANG						
		MAX X/Q		MIN X/Q					

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

SHEET NEDC 99-031 ATTACH 34 . GF 10

# Page 16 of 71

4

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 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
		e-mail: jyll@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167
		e-mail: jjh@nrc.gov
	L. A Brown	Phone: (301) 415 1232
		e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j\_ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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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) = 10.0Height of upper wind instrument (m) = 60.0Wind 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

SHEET NEDC 97-031 50 ATTACH , P 20

2r196.log 2r196.cfd

			1-1	_	.5							
		d Speed (m			.10							
		ghness len			4.0							
Sect	or avera	aging cons	canc	Ŧ	4.0							
Init	ial valu	ue of sigm	a v	=	.00							
		ue of sigm		-	.00							
Expa	inded out	tput for c	ode testing a	not selecte	đ							
Tota	l numbe:	r of hours	of data pro		8760							
Hour	s of mis	ssing data		=	3128							
		tion in wi		=	751							
			w/ dir. in w	indow =	66							
		lm winds		=	743							
Hour	s direct	tion not i	n window or o	calm =	4138							
DIST	RIBUTIO	N SUMMARY	DATA BY AVER	AGING INTER	VAL							
AVER.	PER.	1	2	4	8	12	24		168	360	720	
UPPER	LIM.	1.00E-02		1.00E-02	1.00E-02		1.00E-02				1.00E-02	
LOW	LIM.	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06			1.00E-06	1.00E-06	
ABOVE	RANGE	٥.	0.	0.	ο.	٥.	0.	ο.	٥.	0.	ο.	
IN	RANGE	725.	1177.	1852.	2643.	3143.	3626.	3020.	2953.	2531.	2196.	
BELOW	RANGE	ο.	0.	Ο.	ο.	0.	ο.		ο.	0.	0.	
	ZERO	4907.		3525.	2406.	1780.	701.		0.	0.	0.	
TOTAL	X/Qs	5632.		5377.		4923.	4327.		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	
95+7	DERCEN	TILE X/O V	ALUES									
5500	1 1 51(050)			1.26E-03	1.05E-03	7.89E-04	5.18E-04	2.89E-04	2.48E-04	1.90E-04	1.84E-04	
		2000	4 *									
95%	X/O for	standard	averaging in									
0 to	2 hours		.98E-03									
2 to	8 hours		.41E-04									
	24 hou:		.52E-04									
1 to	0 4 days	2	.12E-04									
4 to	30 day:	s 1	.68E-04									
			HOURLY	VALUE RANG	E							
			MAX X/Q		MIN X/Q							
	CENTER	LINE	6.15E-03		7.04E-32							
	+	-AVERAGE	3.93E-03		4.41E-32							
	01010K		5.555 05									

SHEET NEDC <u>11 -031</u> ATTACH 36 ŝ 90

# Page 18 of 71

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 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
		e-mail: jyll@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167
		e-mail: jjh@nrc.gov
	L. A Brown	Phone: (301) 415 1232
		e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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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)	π	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)	Ħ	16.7
Terrain elevation difference (m)	£	.0

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2r197	.log
2r197	.cfd

Minimum Win	d Speed (m/s	5)	2	.5						
	ighness lengt		=	.10						
	aging consta			4.0						
	- j									
Initial val	ue of sigma	у	=	.00						
	ue of sigma		=	.00						
	_									
Expanded ou	tput for coo	de testing r	not selecte	đ						
Total numbe	er of hours of	of data prod	cessed =	8760						
Hours of mi		-	*	553						
	tion in wind	dow	=	795						
Hours eleva	ted plume w/	/ dir. in wi	indow =	125						
Hours of ca		•	=	1232						
Hours direc	tion not in	window or a	calm =	6180						
	ON SUMMARY DI			17AT.						
	I SUMMARI DI	AIA BI AVERA	AGING INIER	8	12	24	96	168	360	720
AVER. PER. UPPER LIM.	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02
	1.00E-02	1.00E-02	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06
LOW LIM. ABOVE RANGE	1.002-06	1.001-00	1.002-00	0.	0.	0.	0.	٥.	٥.	ο.
ABOVE RANGE IN RANGE	763.	1395.	2357.	3562.	4424.	5571.	5835.	6794.	6316.	7155.
	/63.	1395.	2357.	0.	0.	0.	58.	ο.	ο.	ο.
BELOW RANGE	7444.	6723.	5591.	4060.	3113.	1434.	15.	0.	ο.	ο.
ZERO	8207.	8118.	7948.	7622.	7537.	7005.	5908.	6794.	6316.	7155.
TOTAL X/QS % NON ZERO	9,30	17.18	29.66	46.73	58.70	79.53	99.75	100.00	100.00	100.00
& NON ZERO	9.50	17.10	27.00							
95th PERCEN	TILE X/Q VA	LUES								
	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
95% X/Q for	r standard a	veraging in	tervals							
0 to 2 hour	rs 1.3	20E-03								
2 to 8 hour	rs 5.	36E-04								
8 to 24 hou	urs 1.	95E-04								
1 to 4 days	s 1.	91E-04								
4 to 30 day	ys 1.	21E-04								
		HOURLY	VALUE RANG	E						
		MAX X/O		MIN X/O						
CENTE	RITNE	5.54E+03		7,44E-32						
	R-AVERAGE	3.54E-03		4.66E-32						
SECTO	K-AVERAGE	-01-01								

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1

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
		e-mail: jyll@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167
		e-mail: jjh@nrc.gov
	L. A Brown	Phone: (301) 415 1232
		e-mail: lab2@nrc.gov

Code	Developer:	J.	۷.	Ramsdell	Phone :	(509)	372	6316	
					e-mail:	j ra	nsdel	ll@pnl.gov	

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 <sup>2</sup> )		1569.0
Effluent vertical velocity (m/s)	=	2.90
Vent or stack flow (m <sup>3</sup> /s)	æ	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 92-031\_ATTACH\_/ SHEET\_\_\_\_\_39\_\_\_OF\_\_\_90 2r198.log

2r198.cfd Minimum Wind Speed (m/s) .5 Surface roughness length (m) .10 4.0 Sector averaging constant .00 Initial value of sigma y .00 Initial value of sigma z Expanded output for code testing not selected Total number of hours of data processed = 8760 419 Hours of missing data 946 Hours direction in window Hours elevated plume w/ dir: in window = 167 1007 Hours of calm winds Hours direction not in window or calm = 6388 DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL 96 168 360 720 2 8 12 24 AVER. PER. 1 4 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 UPPER LIM. 1.00E-02 1.00E-02 1.00E-02 1.00E-06 LOW LIM. ο. Ο. ٥. ٥. ο. 0. Ο. ٥. ABOVE RANGE Ο. Ο. 7371. 7192. 3841. 4760. 6235. 7244. 7423. 1538. 2529. IN RANGE 918. 15. ٥. ο. ο. ο. Ο. 11. Q. BELOW RANGE ٥. ο. Ο. 3288. 1580. 4. ٥. ٥. 5672. 4183. 7423. 6756. ZERO 7371. 7192. 7423. 8024. 8048. 7826. 7263. 8201. TOTAL X/Qs 8341. 8294. 100.00 100.00 100.00 30.84 47.87 59.15 79.81 99.94 \* NON ZERO 11.01 18.54 95th PERCENTILE X/Q VALUES 2.87E-04 2.65E-04 2.63E-04 1.08E-03 1.59E-03 1.16E-03 8.71E-04 6.83E-04 4.65E-04 3.25E-04 95% X/Q for standard averaging intervals 0 to 2 hours 1.59E-03 2 to 8 hours 6.30E-04 2.63E-04 8 to 24 hours 2.78E-04 1 to 4 days 2.53E-04 4 to 30 days HOURLY VALUE RANGE MIN X/Q MAX X/Q 5.70E-03 6.50E-32 CENTERLINE 4.07E-32 SECTOR - AVERAGE 3.64E-03

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 3 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
			e-mail: jyll@nrc.gov
	J. J.	Hayes	Phone: (301) 415 3167
			e-mail: jjh@nrc.gov
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			e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j\_ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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

#### Vent release

Release height (m)	=	49.3
Building Area (m <sup>2</sup> )	Ħ	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)	2	17.4
Intake height (m)	=	16.7
Terrain elevation difference (m)	*	.0

SHEET NEDC 99-031\_ATTACH\_ 1 0F 90

3r194.log 3r194.cfd

Minimum Wind Speed (m/s) .5 Surface roughness length (m) .10 Sector averaging constant 4.0 .00 Initial value of sigma y Initial value of sigma z .00 Expanded output for code testing not selected 8760 Total number of hours of data processed = 138 Hours of missing data 847 Hours direction in window 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 12 24 96 168 360 720 8 AVER. PER. 1 2 4 1.00E-02 UPPER LIM. 1.00E-06 LOW LIM. ٥. Ο. Ο. ABOVE RANGE Ο. Ο. ٥. Ο. Ο. Ο. Ο. IN RANGE 642. 1185. 2063. 3362. 4334. 5905. 7797. 8409. 8437. 8111. 107. 133. ο. ٥. Ο. BELOW RANGE Ο. Ο. ο. ٥. 31. 7403. 6457. 5022. 4050. 2165. 88. Ο. ο. ٥. ZERO 7980. 8437. 8111. TOTAL X/Qs 8622. 8588. 8520. 8384. 8415. 8177. 8018. 8409. 100.00 \* NON ZERO 7.45 13.80 24.21 40.10 51.87 73.52 98.90 100.00 100.00 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 95% X/Q for standard averaging intervals 0 to 2 hours 2.94E-04 1.18E-04 2 to 8 hours 8 to 24 hours 4.56E-05 1 to 4 days 4.26E-05 4 to 30 days 2.92E-05 HOURLY VALUE RANGE MIN X/Q MAX X/Q 3.25E-32 CENTERLINE 1.37E-03 SECTOR - AVERAGE 8.79E-04 2.04E-32

SHEET NEDC 99-031 ATTACH 4 0F 90

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Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 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 e-mail: j ramsdell@pnl.gov

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) = 10.0Height of upper wind instrument (m) = 60.0Wind 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)	Ŧ	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

SHEET NEDC 99-031\_ATTACH\_ 43 'କ | 90

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3r195.log 3r195.cfd

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Minimum W:	ind Speed (m	/s)	=	.5						
Surface ro	oughness len	gth (m)	=	.10						
Sector ave	eraging cons	tant	-	4.0						
Initial va	alue of sigm	ау	=	.00						
Initial va	alue of sigm	az	=	.00						
Expanded of	output for c	ode testing	not selecte	đ						
Total num	per of hours	of data pro	cessed =	8760						
	missing data		*	1439						
	ection in wi	ndow	-	710						
Hours ele	vated plume	w/ dir. in w	indow =	140						
Hours of	calm winds		=	926						
Hours dire	ection not i	n window or	calm ≖	5685						
DISTRIBUT	ION SUMMARY	DATA BY AVER				•		168	360	720
AVER. PER.	1	2	4	8	12	24	96	1.00E-02	1.00E-02	1.00E-02
UPPER LIM.	1.00E-02		1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02
LOW LIM.	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06		1.006-08	1.00E-00
ABOVE RANGE	0.	٥.	ο.	0.	0.	0.	0.	0.	2921.	2615.
IN RANGE	541.	986.	1696.	2627.	3328.	4200.	3659.	3460.	2921.	2015.
BELOW RANGE	٥.	Ο.	ο.	0.	8.	75.	74.	0.	0.	0. 0.
ZERO	6780.		5294.	3944.	3091.	1427.	11.	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 PERC	ENTILE X/Q V	ALUES								
	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 f	or standard	averaging in	itervals							
0 to 2 ho		.25E-04								
2 to 8 ho		.15E-04								
8 to 24 h	ours 4	.52E-05								
1 to 4 da	ув 4	.06E-05								
4 to 30 d	ays 2	.97E-05								
		NOTEL	VALUE RANG	E						
		HOOKDI								
		MAX X/Q		MIN X/Q						
CENT	ERLINE			MIN X/Q 3.25E-32 2.04E-32						

SHEET NEDC <u>99 231 ATTACH (</u> 44 0F 90

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = ½ 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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		e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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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) = 10.0Height of upper wind instrument (m) = 60.0Wind 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 NEDC 19 -031 ATTACH\_ 45 С Ч 20

3r196.log

3r196.cfd Minimum Wind Speed (m/s) .5 .10 Surface roughness length (m) 4.0 Sector averaging constant .00 Initial value of sigma y Initial value of sigma z .00 Expanded output for code testing not selected 8760 Total number of hours of data processed = 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 12 24 96 168 360 720 AVER. PER. 1 2 4 1.00E-02 1.00E-02 UPPER LIM. 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-02 1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06 1.00E-06 LOW LIM. 1.00E-06 ٥. Ο. Ο. ٥. Ο. Ο. 0. Ο. ABOVE RANGE ο. Ο. 2179. 2649. 3267. 3009. 2953. 2531. 2196. 916. 1470. IN RANGE 545. Ο. Ο. ٥. 0. BELOW RANGE ο. ο. 4. 4. 12. 18. 2262. 20. Ο. Ο. ٥. 3903. 2866. 1042. ZERO 5087. 4630. 2953. 2531. 2196. 4923. 4327. 3029. TOTAL X/Qs 5632. 5546. 5377. 5049. 75.92 99.34 100.00 100.00 100.00 \* NON ZERO 9.68 16.52 27.41 43.24 54.05 95th PERCENTILE X/Q VALUES 2.89E-04 2.19E-04 1.72E-04 1.12E-04 5.91E-05 5.04E-05 3.90E-05 3.78E-05 4.47E-04 3.58E-04 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 4.15E-05 1 to 4 days 3.45E-05 4 to 30 days HOURLY VALUE RANGE MAX X/Q MIN X/Q CENTERLINE 1.45E-03 3.25E-32 SECTOR-AVERAGE 9.28E-04 2.04E-32

SHEET NEDC 97-031 3 \_ATTACH\_\_ ู่ ค 80

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

June 25, 1997 11:00 a.m. Date:

NRC Contacts:	J. Y. Lee	Phone: (301) 415 1080
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	J. J. Hayes	Phone: (301) 415 3167
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	L. A Brown	Phone: (301) 415 1232
		e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j\_ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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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 <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)	æ	080 - 170
Distance to intake (m)		17.4
Intake height (m)	=	16.7
Terrain elevation difference (m)	*	.0

SHEET NEDC 99-031 ATTACH 47 ່ ຊ 90

3r197.log 3r197.cfd

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Minimum Wind	d Speed (m/	s)	=	.5						
Surface roug			*	.10						
Sector aver	aging const	ant	=	4.0						
Initial val			=	.00						
Initial value	ue of sigma	2	=	.00						
Expanded ou	tput for co	de testing :	not selecte	d	i.					
Total number	r of hours	of data pro	cessed =	8760						
Hours of mi	ssing data	-	=	553						
Hours direc	tion in win	dow	=	795						
Hours eleva	ted plume w	/ dir. in w	indow =	156						
Hours of ca			=	1232						
Hours direc	tion not in	window or	calm =	6180						
DISTRIBUTIO		משא עם השה	ACTNO INTER	WAT.						
AVER. PER.	N SOMMARI D. 1	2	4 4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02
LOW LIM.	1.00E-02	1.00E-02	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06
ABOVE RANGE	1.002-08	1.002-00	0.	0.	0.	0.	0.	0.	ο.	Ο.
IN RANGE	580.	1076.	1854.	2915.	3723.	4870.	5748.	6763.	6316.	7155.
BELOW RANGE	580. 0.	0.	6.	5.	13.	63.	37.	31.	ο.	0.
ZERO	7627.	7042.	6088.	4702.	3801.	2072.	123.	0.	Ο.	ο.
TOTAL X/Os	8207.	8118.	7948.	7622.		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
¥ NON ZERU	7.07	13.25	23.40	20.21	49.57		2			
95th PERCEN	TILE X/Q VA	LUES								
	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
			\$							
95% X/Q for	standard a	veraging in	tervais							
0 to 2 hour	s 2.	52E-04								
2 to 8 hour	s 1.	07E-04								
8 to 24 hou	rs 4.	22E-05								
1 to 4 days	3.	71E-05								
4 to 30 day	в 2.	57E-05								
		NOTET	VALUE RANG	36						
		MAX X/Q	VALUE RANG	MIN X/Q						
				3.25E-32						
CENTER	LINE	1.37E-03		3.235-32						

2.04E-32

CENTERLINE SECTOR-AVERAGE 1.37E-03 8.79E-04

SHEET NEDC 99-031 ATTACH 48 Я Г 90 ~

# Page 30 of 71

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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	J. J.	Hayes	e-mail: jjh@nrc.gov
	L. A	Brown	Phone: (301) 415 1232
			e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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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) = 10.0Height of upper wind instrument (m) = 60.0Wind 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)	π	.97
Direction intake to source (deg)	=	125
Wind direction sector width (deg)	π	90
Wind direction window (deg)	=	080 - 170
Distance to intake (m)	=	17.4
Intake height (m)	π	16.7
Terrain elevation difference (m)	×	.0

SHEET NEDC 99-031 ATTACH t a 0F 90

3r198.log 3r198.cfd

Minimum Win	d Speed (m/s	3)		.5						
Surface rou	ghness lengt	:h (m)	=	.10						
Sector aver	aging consta	ant		4.0						
Initial val	ue of sigma	У	=	.00						
Initial val	ue of sigma	z	π	.00						
Expanded ou	tput for coo	de testing r	not selecte	d						
Total numbe	r of hours d	of data proc	cessed =	8760						
Hours of mi		-	=	419					1	
Hours direc	tion in wind	dow	=	946					:	
Hours eleva	ted plume w,	/ dir. in wi	indow =	194						
Hours of ca			=	1007						
Hours direc	tion not in	window or a	calm =	6388						
	N SUMMARY DI							1.00	200	720
AVER. PER.	1	2	4	8	12	24	96	168	360	
UPPER LIM.		1.00E-02				1.00E-02		1.00E-02	1.00E-02	
LOW LIM.	1.00E-06	1.00E-06	1.00E-06	1.00E-06		1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06
ABOVE RANGE	ο.	0.	ο.	Ο.	ο.	0.	ο.	0.	0.	0.
IN RANGE	696.	1194.	2003.	3150.	4003.	5452.	7096.	7423.	7371.	7192.
BELOW RANGE	ο.	Ο.	3.	1.	8.		115.	Ο.	0.	0.
ZERÔ	7645.	7100.	6195.	4873.	4037.	2323.	52.	ο.	0.	0.
TOTAL X/Os	8341.	8294.	8201.	8024.	8048.	7826.			7371.	7192.
NON ZERO	8.34	14.40	24.46	39.27	49.84	70.32	99.28	100.00	100.00	100.00
ASTA DEPCEN	TILE X/Q VA	LIES								
Joen Percer	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
	51250 01	\$								
95% X/Q for	standard a	veraging int	tervals							
0 to 2 hour	s 3.1	25E-04								
2 to 8 hour	s 1.1	21E-04								
8 to 24 hou	irs 5.3	20E-05								
1 to 4 days		08E-05								
4 to 30 day		67E-05								
		HOURLY	VALUE RANG	E						

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

SHEET NEDC 12-031 ATTACH ( 5 ู่ ค 90

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 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 e-mail: jyll@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167 e-mail: jjh@nrc.gov
	L. A Brown	Phone: (301) 415 1232 e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j\_ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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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)	2	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)	z	080 - 170
Distance to intake (m)	=	17.4
Intake height (m)	*	16.7
Terrain elevation difference (m)		.0

SHEET NEDC 99-03/ ATTACH 5 ୍ମିକ do 10

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4r194	.log
4r194	.cfd

			<i>,</i> ,		-							
		Speed (m/		=	.5 .10							
		hness leng		-								
Secto	r avera	ging const	ant	*	4.0							
Taiti	<u>_1 1</u>	e of sigma		Ŧ	.00							
		e of sigma		-	.00							
INICI	ai vaiu	e or signe	. 2	-								
Expan	ded out	put for co	de testing a	not selecte	đ							
Total	number	of hours	of data prod	cessed =	8760							
		sing data			138							
Hours	direct	ion in wir	ndow	*	847							
Hours	elevat	ed plume w	<pre>v/ dir. in w:</pre>	indow =	121							
Hours	of cal	m winds			1064							
			n window or (	calm =	6711							
DISTR	IBUTION	SUMMARY I	DATA BY AVER				<b>.</b> .			200	720	
AVER.	PER.	1	2	4	8	12	24	96	168	360		
UPPER	LIM.	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03		1.00E-03	1.00E-03	1.00E-03	
LOW	LIM.	1.00E-07		1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	
ABOVE R	ANGE	ο.	Ο.	ο.	0.	0.	0.	0.	0.	0.	0.	
IN R	ANGE	481.	892.	1575.	2630.	3497.	5132.	7618.	8401.	8437.	8111.	
BELOW R	ANGE	Ο.	ο.	Ο.	ο.	0.	0.	25.	0.	0.	0.	
	ZERO	8141.	7696.	6945.	5754.	4918.	3045.	375.	8.	0.	0.	
TOTAL	X/Qs	8622.	8588.	8520.			8177.		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	PERCENT	ILE X/Q V		1.34E-04	9.24E-05	7.43E-05	5.10E-05	3.10E-05	2.56E-05	2.10E-05	1.79E-05	
		6.16E-05	1.78E-04	1.346-04	9.246-05	7.436-05	5.102-05	5.104-05	2.000 00	21202 00		
054 Y	10 500	or and ard	averaging in	l Fervala								
954 A	/Q 101	scandard o	averaging in	cervarb								
0 to	2 hours	1	.78E-04									
2 to	8 hours	6	.39E-05									
	24 hour		.03E-05									
	4 days		.43E-05							•		
	30 days	1	.59E-05									
	•											
				VALUE RANG								
			MAX X/Q		MIN X/Q							
	CENTERL	INE	7.66E-04		2.22E-32							
	SECTOR -	AVERAGE	5.04E-04		1.39E-32							

	MAX X/Q	
CENTERLINE	7.66E-04	
SECTOR - AVERAGE	5.04E-04	

# Page 34 of 71

Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 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
			e-mail: jyll@nrc.gov
	J. J	. Hayes	Phone: (301) 415 3167
			e-mail: jjh@nrc.gov
	L. A	Brown	Phone: (301) 415 1232
			e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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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 <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 NEDC 99-031 5 ATTACH\_/ 0F 90

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4r1	95	.log
4r1	95	.cfd

	nd Speed (m/s		=	.5						
	ighness lengt		*	.10						
Sector aver	aging consta	ant	=	4.0						
Initial val	lue of sigma	v	=	.00						
	lue of sigma		=	.00						
Expanded ou	tput for co	de testing :	not selecte	đ						
Total numbe	er of hours of	of data pro-	cessed =	8760					÷	
Hours of mi	issing data		<b>=</b> .	1439						
Hours direc	ction in wind	dow	=	710						
Hours eleva	ated plume w,	/ dir. in w	indow =	155						
Hours of ca	alm winds		=	926						
Hours direc	tion not in	window or	calm =	5685						
DISTRIBUTIC	ON SUMMARY DA	ATA BY AVER	AGING INTER	VAL						
AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	
LOW LIM.	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07
ABOVE RANGE	Ο.	ο.	0.	Ο.	0.	ο.	0.	0.	0.	0.
IN RANGE	422.	772.	1341.	2145.	2805.	3750.	3592.	3454.	2921.	2615.
BELOW RANGE	0.	Ο.	0.	٥.	Ο.	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 PERCEN	NTILE X/Q VA	LUES								
	1.04E-04	1.97E-04	1.41E-04	1.01E-04	8.04E-05	5.10E-05	3.102-05	2.75E-05	2.13E-05	1.94E-05
95% X/O for	r standard a		tervals							
<i>JJ N</i> /Q 201			•••							
0 to 2 hour		97E-04								
2 to 8 hour		89E-05								
8 to 24 hou		61E-05								
1 to 4 days		43E-05								
4 to 30 day	ys 1.	76E-05								
		HOURLY	VALUE RANG							
		MAX X/Q		MIN X/Q						
CENTER	RLINE	7.60E-04		2.35E-32						
SECTOR	R-AVERAGE	4.99E-04		1.47E-32						

CENTERLINE	7.60E-
SECTOR - AVERAGE	4.99E-

NORMAL PROGRAM COMPLETION

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Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 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
		e-mail: jyll@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167
		e-mail: jjh@nrc.gov
	L. A Brown	Phone: (301) 415 1232
		e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j\_ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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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) = 10.0Height of upper wind instrument (m) = 60.0Wind 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)	18	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

SHEET NEDC <u>Mr-031</u> ATTACH\_ 53 ์ คุ 3

4r196.log

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4r196.cfd										
Minimum Wind S	oeed (m/s	3)	-	.5						
Surface roughn			æ	.10						
Sector averagi			7	4.0						
Initial value	of sigma	v	=	.00						
Initial value			=	.00						
Expanded outpu	t for cod	le testing r	not selecte	d						
Total number o	f bours o	of data proc	- heese	8760						
Hours of missi		i data pro-	=	3128						
Hours direction		low	-	751						
Hours elevated			indow -	93						
Hours of calm		uir. m w.	=	743						
Hours direction				4138						
Hours direction	n not in	window of c		4130						
DISTRIBUTION S						24	96	168	360	720
AVER. PER.	1	2	4	8	12	1.00E-03			1.00E-03	
••••		1.00E-03	1.00E-03	1.00E-03					1.002-07	
		1.00E-07			1.00E-07			1.00E-07	1.0012-07	0.
ABOVE RANGE	٥.	0.	Ο.	0.	0.	0.	0.		2531.	2196.
IN RANGE	426.	730.	1214.		2322.	3022.	2993.	2953.		2198.
BELOW RANGE	ο.	Ο.	ο.	0.	0.	0. 1305. 4327.	0.	0.	o.	
ZERO	5206.	0. 4816. 5546.	4163.	3196.	2601.	1305.	36.	0.	0.	0.
TOTAL X/Qs	5632.	5546.	5377.	5049.		4327.	3029.		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 PERCENTIL	E X/Q VAI	LUES								
		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
95% X/Q for st	andard av	ہ veraging int								
0 to 2 hours	2 1	L3E-04								
2 to 8 hours		L9E-05								
8 to 24 hours		12E-05								
		29E-05								
1 to 4 days									•	
4 to 30 days	1.8	37E-05								
			VALUE RANG							
		MAX X/Q		MIN X/Q						
CENTERLIN	Е	7.92E-04		2.22E-32						
SECTOR-AV	ERAGE	5.22E-04		1.39E-32						

NORMAL PROGRAM COMPLETION

NEDC <u>99.031</u> ATTACH <u>1</u> SHEET <u>56</u> OF <u>90</u>

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Release Point 1: Reactor Building Vent Release for Fraction of Design Flow Rate, f = 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
		e-mail: jyll@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167
		e-mail: jjh@nrc.gov
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		e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j\_ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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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) 90 080 - 170 Wind direction window (deg) 17.4 Distance to intake (m) Intake height (m) 16.7 Terrain elevation difference (m) .0

SHEET NEDC 99-031\_ATTACH\_1 2 \_0F<u>90</u>

•

4r197.log 4r197.cfd

	nd Speed (m/:		=	.5							
	ughness leng		=	.10							
Sector aver	raging consta	ant	-	4.0							
									•		
Initial val	lue of sigma	У	=	.00							
Initial val	lue of sigma	2	=	.00							
Expanded ou	utput for co	de testing n	not selecte	đ							
Total numbe	er of hours (	of data prod	cessed =	8760							
Hours of mi	issing data	-	=	553							
Hours dired	ction in wind	dow	2	795							
	ated plume w		indow =	175							
	alm winds			1232							
	ction not in			6180							
DISTRIBUTIO	ON SUMMARY D	ATA BY AVER	AGING INTER	VAL							
AVER. PER.	1	2	4	8	12	24	96	168	360	720	
UPPER LIM.	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	
LOW LIM.	1.00E-07		1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	
ABOVE RANGE	0.	0.	٥.	ο.	ο.	Ο.	Ο.	٥.	Ο.	0.	
IN RANGE	429.	798.	1405.	2295.	3021.	4271.	5608.	6766.	6316.	7155.	
BELOW RANGE	0.	0.	4.	8.	10.	14.		٥.	ο.	ο.	
ZERO	7778.	7320.	6539.	5319.	4506.	2720.	300.	28.	ο.	ο.	
TOTAL X/Qs	8207.	8118.	7948.	7622.	7537.	7005.		6794.	6316.	7155.	
* NON ZERO	5.23		17.73			61.17	94.92		100.00	100.00	
1 HOR 25KO	2.25	2.05									
95th REPORT	NTILE X/O VA	LUES									
Joen ronem			1.17E-04	8.05E-05	6.28E-05	4.30E-05	2.59E-05	2.11E-05	1.73E-05	1.53E-05	
	1.050 05	1.202 01									
95% X/0 for	r standard a										
, , , , , , , , , , , , , , , , , , ,											
0 to 2 hou:	rs 1.	33E-04									
2 to 8 hour		32E-05									
8 to 24 hou		42E-05									
1 to 4 days		02E-05									
4 to 30 day	-	37E-05									
4 LO 30 UA	ys 1.	214-03									
		HOURLY	VALUE RANG	E							
		MAX X/O		MIN X/Q							
CENTE	DLINE	6.90E-04		2.22E-32							
		4.50E-04		1.39E-32							
SECTO	R-AVERAGE	4.505-04		1.374-34							

NORMAL PROGRAM COMPLETION

SHEET NEDC 99-03 ( ATTACH / 8 . ក្ព 90

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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	t.	Lee	Phone: (301) 415 1080 e-mail: jyll@nrc.gov
	J. J	J.	Hayes	Phone: (301) 415 3167
	L. A	ł	Brown	e-mail: jjh@nrc.gov Phone: (301) 415 1232
		-		e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j\_ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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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) = 10.0Height of upper wind instrument (m) = 60.0Wind 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^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

SHEET NEDC 99-031 ATTACH 50 ์ ค 90

4r198.log 4r198.cfd

	d Speed (m/s		-	. 5						
	ghness lengt		=	.10						
Sector aver	aging consta	int	=	4.0						
Initial val	ue of sigma	у	-	.00						
Initial val	ue of sigma	z	=	.00						
Expanded ou	tput for cod	le testing r	not selecte	đ						
Total numbe	r of hours o	of data proc	cessed =	8760						
Hours of mi	ssing data		=	419						
Hours direc	tion in wind	low	-	946						
Hours eleva	ted plume w/	/ dir. in wi		217						
Hours of ca				1007	•					
Hours direc	tion not in	window or o	calm =	6388						
DISTRIBUTIO	N SUMMARY DA	ATA BY AVERA	AGING INTER	VAL						
AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03		1.00E-03	1.00E-03	1.00E-03	
LOW LIM.	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07
ABOVE RANGE	0.	ο.	Ο.	· 0.	0.	Ο.	٥.	0.	0.	ο.
IN RANGE	538.	929.	1581.	2580.	3391.	4881.	7035.	7423.	7371.	7192.
BELOW RANGE	٥.	Ο.	Ο.	Ο.	ο.	0.	15.	٥.	0.	0.
ZERO	7803.	7365.	6620.	5444.	4657.	2945.	213.	0.	0.	0.
TOTAL X/Qs	8341.	8294.	8201.	8024.	8048.	7826.		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 PERCEN	TILE X/Q VAN	LUES								
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		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
95% X/Q for	standard av	veraging int	tervals						•	
0 to 2 hour	·a 1.8	83E-04								
2 to 8 hour		02E-05								
8 to 24 hou		91E-05								
1 to 4 days		89E-05								
4 to 30 day		76E-05								
		HOURLY	VALUE RANG	E						
		MAX X/Q		MIN X/Q						

7.60E-04 2.22E-32 CENTERLINE 1.39E-32 4.99E-04 SECTOR-AVERAGE

NORMAL PROGRAM COMPLETION

SHEET NEDC 99-031\_ATTACH\_ 60 \_0F\_90

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### 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
			e-mail: jyll@nrc.gov
	J. J.	Hayes	Phone: (301) 415 3167
			e-mail: jjh@nrc.gov
	L. A	Brown	Phone: (301) 415 1232
			e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j\_ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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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 60.0 Height of upper wind instrument (m) = Wind speeds entered as miles per hour Vent release 49.3 Release height (m) Building Area (m<sup>2</sup>) 1569.0 Effluent vertical velocity (m/s) 11.70 34.90 Vent or stack flow (m<sup>3</sup>/s) Vent or stack radius (m) .97 125 Direction .. intake to source (deg) 90 Wind direction sector width (deg) 080 - 170 Wind direction window (deg) Distance to intake (m) 17.4 16.7 Intake height (m) Terrain elevation difference (m) .0

SHEET NEDC 99-031\_ATTACH\_ 0 20

5r194.log 5r194.cfd Minimum Wind Speed (m/s) .5 Surface roughness length (m) .10 Sector averaging constant 4.0 .00 Initial value of sigma y 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 138 847 Hours direction in window 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 1.00E-03 1.00E-03 1.00E-03 1.00E-03 1.00E-03 1.00E-03 UPPER LIM. 1.00E-03 1.00E-03 1.00E-03 1.00E-03 1.00E-07 LOW LIM. 1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07 1.00E-07 ABOVE RANGE ο. ο. Ο. ٥. ٥. 0. ٥. Ο. ο. Ο. IN RANGE 1088. 1854. 2501. 4007. 7072. 8091. 8437. 8111. 335. 618. BELOW RANGE ο. ο. Ο. ο. 13. 21. ٥. ο. Ο. Ο. ZERO 8287. 7970. 7432. 6530. 5901. 4149. 946. 318. Ο. ٥. TOTAL X/Qs 8588. 8520. 8384. 8415. 8177. 8018. 8409. 8437. 8111. 8622. \* NON ZERO 12.77 22.11 29.88 49.26 88.20 96.22 100.00 100.00 3.89 7.20 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 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	

SHEET NEDC 98-031 ATTACH 62 . ទ្ព 3

### 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
		e-mail: jyll@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167
		e-mail: jjh@nrc.gov
	L. A Brown	Phone: (301) 415 1232
		e-mail: lab2@nrc.gov

Code	Developer:	J.	٧.	Ramsdell	Phone:	(509)	372	6316
					e-mail:	j_ran	nsde:	l@pnl.gov

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) Direction .. intake to source (deg) = 125 Wind direction sector width (deg) 080 - 170 Wind direction window (deg)

Distance to intake (m) × 17.4 Intake height (m) 16.7 Terrain elevation difference (m) . 0 -

Output file names

SHEET NEDC 79-03 (ATTACH\_ 63 0F 90

5r195.log 5r195.cfd

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				_						
	d Speed (m/s		=	.5						
	ghness lengt		=	.10						
Sector aver	aging consta	ant	=	4.0						
Initial val	ue of sigma	У	-	.00						
	ue of sigma		*	.00						
Expanded ou	tput for coo	de testing r	not selecte	đ						
Total numbe	r of hours d	of data prod	cessed =	8760						
Hours of mi	ssing data	-	=	1439						
Hours direc	tion in wind	dow	×	710					•	
Hours eleva	ted plume w,	/ dir. in wi	indow =	172						
Hours of ca	lm winds		=	926						
Hours direc	tion not in	window or o	calm ≖	5685						
DISTRIBUTIO	N SUMMARY D	ATA BY AVER	GING INTER	VAL						
AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	
LOW LIM.	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07
ABOVE RANGE	ο.	Ο.	Ο.	ο.	٥.	0.	ο,	٥.	ο.	ο.
IN RANGE	311.	574.	1004.	1655.	2213.	3123.	3534.	3452.	2921.	2615.
BELOW RANGE	ο.	٥.	Ο.	ο.	2.	4.	0.	0.	0.	ο.
ZERO	7010.	6636.	5986.	4916.	4212.	2575.	210.	8.	0.	ο.
TOTAL X/Qs	7321.	7210.	6990.	6571.	6427.	5702.		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 PERCEN	TILE X/Q VAL	LUES								
	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
95% X/Q for	standard a	veraging in	ervals							
0 to 2 hour		06E-05								
2 to 8 hour		86E-05								
8 to 24 hou	-	58E-05								
1 to 4 days		39E-05								
4 to 30 day		01E-05								
4 CO 30 GAY	5 1.	016-05								
			VALUE RANG							
		MAX X/Q		MIN X/Q						
CENTER		5.36E-04		1.59E-32						
SECTOR	-AVERAGE	3.56E-04		9.99E-33						
	CONDUCTION									

NORMAL PROGRAM COMPLETION

NEDC 99-031 SHEET 64 ATTACH ្ណុ 90

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### 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
		e-mail: jyll@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167
		e-mail: jjh@nrc.gov
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		e-mail: lab2@nrc.gov

Code	Developer:	J.	٧.	Ramsdell	Phone :	(509)	372	6316	
	-				e-mail:	j_ra	msde:	ll@pnl.go	vc

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) = 10.0Height of upper wind instrument (m) = 60.0Wind 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
· •	=	17.4 16.7

5r196.log 5r196.cfd

Minimum Win	d Speed (m/	s)	=	.5	•		, i				
Surface rou	ighness leng	th (m)	-	.10							
Sector aver	aging const	ant	=	4.0							
Initial wal	ue of sigma	v	-	.00							
	ue of sigma		-	.00							
initial var	ue or argun	2	-								
Expanded ou	tput for co	de testing :	not selecte	d							
Total numbe	r of hours	of data pro	cessed =	8760							
Hours of mi			=	3128							
Hours direc	tion in wind	dow	=	751							
	ted plume w	/ dir. in w	indow =	103							
Hours of ca			=	743							
Hours direc	tion not in	window or (	calm =	4138							
	N SUMMARY D		AGING INTER	VAL							
AVER. PER.	1	2	4	8	12	24	96	168	360	720	
UPPER LIM.	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03		1.00E-03	
LOW LIM.	1.00E-07		1.00E-07		1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	
ABOVE RANGE	0.	ο.	ο.	٥.	0.	٥.	0.	0.	0.	0.	
IN RANGE	289.	507.	870.	1393.	1781.	2439.	2921.	2953.	2531.	2196.	
BELOW RANGE	0.	0.	Ο.	0.	25.	37.	30.	0.	0.	0.	
ZERQ	5343.	5039.	4507.	3656.			78.	٥.	ο.	٥.	
TOTAL X/Qs	5632.	5546.	5377.		4923.			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 PERCEN	TILE X/Q VA	LUES									
	1.68E-05	1.11E-04	1.02E-04	7.05E-05	5.57E-05	3.68E-05	1.85E-05	1.52E-05	1.192-05	1.05E-05	
95% X/O for	standard a	veraging in	tervals								
0 to 2 hour		11E-04									
2 to 8 hour		69E-05									
8 to 24 hou		00E-05									
1 to 4 days		25E-05									
4 to 30 day	s 9.2	27E-06									
			VALUE RANG	_							
		MAX X/Q		MIN X/Q							
CENTER		5.44E-04		1.59E-32							
SECTOR	-AVERAGE	3.62E-04		9.99E-33	•						

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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
		e-mail: jyl1@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167
		e-mail: jjh@nrc.gov
	L. A Brown	Phone: (301) 415 1232
		e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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

#### Vent release 49.3 Release height (m) Building Area (m<sup>2</sup>) 1569.0 11.70 Effluent vertical velocity (m/s) 34.90 Vent or stack flow (m<sup>3</sup>/s) Vent or stack radius (m) .97 Direction .. intake to source (deg) 125 Wind direction sector width (deg) 90 080 - 170 Wind direction window (deg) Distance to intake (m) 17.4 16.7

Intake height (m) = Terrain elevation difference (m) =

SHEET NEDC 98-031 ATTACH 67 \_ OF 90

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5r197.log 5r197.cfd

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	d Speed (m/s ghness lengt aging consta	-h (m)	-	.5 .10 4.0						
	ue of sigma		=	.00						
Initial val	ue of sigma	2	=	.00						
Expanded ou	tput for coo	le testing :	not selecte	4						
Total numbe	r of hours of	of data pro	cessed =	8760						
Hours of mi				553						
	tion in wind	low	=	795						
Hours eleva	ted plume w,	/ dir. in w:	indow =	190						
Hours of ca	lm winds			1232						
Hours direc	tion not in	window or (	calm =	6180						
DISTRIBUTIO	N SIMMARY D	ATA BY AVER	AGING INTER	VAL.						
AVER. PER.	1 30/12/11/1 2/	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03
LOW LIM.	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07
ABOVE RANGE	0.	0.	ο.	Ο.	0.	Ο.	0.	ο.	ο.	0.
IN RANGE	289.	539.	975.	1655.	2227.	3414.	5356.	6717.	6316.	7155.
BELOW RANGE	0.	Ο.	Ο.	Ο.	36.	27.	0.	0.	0.	ο.
ZERO	7918.	7579.	6973.		5274.	3564.	552.	77.	٥.	Ο.
TOTAL X/Qs	8207.	8118.	7948.	7622.	7537.	7005.		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 PERCEN	TILE X/Q VA	LUES								
	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 a	veraging in	tervals							
0 to 2 hour	s 4.	87E-05								
2 to 8 hour		69E-05								
8 to 24 hou	rs 1.:	23E-05								
1 to 4 days	9.	18E-06								
4 to 30 day	rs 7.	00E-06								
		HOURTY	VALUE RANG	Е						
		MAX X/Q		MIN X/Q						

1.66E-32 5.01E-04 CENTERLINE 1.04E-32 3.31E-04 SECTOR-AVERAGE

NORMAL PROGRAM COMPLETION

## Page 50 of 71

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 e-mail: jyll@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167
	L. A Brown	e-mail: jjh@nrc.gov Phone: (301) 415 1232
		e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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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 <sup>2</sup> )		1569.0
Effluent vertical velocity (m/s)	=	11.70
Vent or stack flow (m <sup>3/s</sup> )	=	34.90
Vent or stack radius (m)	=	.97
Direction intake to source (deg)	2	125
Wind direction sector width (deg)	*	90
Wind direction window (deg)	#	080 - 170
Distance to intake (m)	π	17.4
Intake height (m)	±	16.7
Terrain elevation difference (m)	×	.0

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5r198.log 5r198.cfd

Minimum Win	nd Speed (m/	s)	=	.5						
	ighness leng		=	.10						
	aging const		=	4.0						
Tritial val	ue of sigma	v		.00						
	ue of sigma.		-	.00						
Inicial Val	ue or signa	2	-							
Expanded ou	tput for co	de testing :	not selecte	ed						•
Total numbe	er of hours	of data pro	cessed =	8760						
Hours of mi	ssing data		=	419						
Hours direc	tion in win	dow	=	946						
Hours eleva	ited plume w	/ dir. in w	indow =	239						
Hours of ca	lm winds		*	1007						
Hours direc	tion not in	window or	calm =	6388						
DISTRIBUTIO	N SUMMARY D	ATA BY AVER	AGING INTER	VAL						
AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03
LOW LIM.	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07
ABOVE RANGE	0.	0.	0.	0,	0.	0.	٥.	٥.	Ο.	Ο.
IN RANGE	360.	636.	1114.	1890.	2545.	3860.	6579.	7381.	7371.	7192.
BELOW RANGE	0.	0.	0.	0.	5.	4.	Ο.	0.	0.	٥.
ZERO	7981.	7658.	7087.	6134.	5498.	3962.	684.	42.	Ο.	ο.
TOTAL X/Qs	8341.		8201.	8024.	8048.	7826.		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
AST DEDCEN	TILE X/O VA	LIFS								
Joen Parcar	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
95% X/Q for	standard a	veraging in								
0 to 2 hour		39E-05								
2 to 8 hour		83E-05								
8 to 24 hou		27E-05								
1 to 4 days		38E-05								
4 to 30 days		29E-05								
4 LO 30 day	·s 1.	276-03								
		HOURLY	VALUE RANG	E						
		MAX X/O		MTN X/O						

	1000101	VADOD	10-11-0 LD	
	MAX X/Q			MIN X/Q
CENTERLINE	5.36E-04			1.59E-32
SECTOR-AVERAGE	3.56E-04			9.99E-33
		MAX X/Q CENTERLINE 5.36E-04	MAX X/Q CENTERLINE 5.36E-04	CENTERLINE 5.36E-04

NORMAL PROGRAM COMPLETION

SHEET NEDC 99-031 ATTACH\_ 70 0F 90

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## 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 e-mail: jyll@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167 e-mail: jjh@nrc.gov
	L. A Brown	Phone: (301) 415 1232 e-mail: lab2@nrc.gov

Code	Developer:	J.	۷.	Ramsdell	Phone :	(50	9)	372	6316	
	-								ll@pnl.gov	1

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)	Ξ	99.1
Building Area (m <sup>2</sup> )	=	.0
Effluent vertical velocity (m/s)	×	2.62
Vent or stack flow (m <sup>3</sup> /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

SHEET NEDC 99-031 ATTACH . ទា | 90

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r294	.log
r294	.cfd

Minimum W	ind Speed (m	/s)	=	.5						
	oughness len		*	.10				•		
Sector av	eraging cons	tant	Ħ	4.0						
Initial v	alue of sigm	a y	-	.00				,		
	alue of sigm		-	.00						
Expanded	output for c	ode testing	not selecte	đ						
Total num	ber of hours	of data pro	cessed =	8760						
	missing data		=	112						
	ection in wi		в	571						
Hours ele	vated plume	w/ dir. in w	indow =	744						
	calm winds		=	879						
	ection not i	n window or	calm =	7198						
DISTRIBUT	ION SUMMARY	DATA BY AVER	AGING INTER	VAL						
AVER. PER.			4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05
LOW LIM.		1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09
ABOVE RANGE		0.	Ο.	Ο.	0.	ο.	0.	Ο.	0.	0.
IN RANGE		144.	231.	377.	468,	405.	1013.	1540.	2401.	3012.
BELOW RANGE		٥.	27.	91.	214.	855.	2456.	3589.	4179.	4068.
ZERO		8475.	8303.	7977.	7794.	7018.	4683.	3280.	1857.	1031.
TOTAL X/Qs		8619.	8561.	8445.	8476.	8278.	8152.	8409.	8437.	8111.
* NON ZERO			3.01	5.54	8.05	15.22	42.55	60.99	77.99	87.29
95th PERC	ENTILE X/Q V	ALUES								
	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.452-09	1.00E-09	1.08E-08	9.95E-09	8.91E-09	6.30E-09
95% X/Q f	or standard		tervals							
0 to 2 ho	urs 1	.00E-09								
2 to 8 ho		.00E-09								
8 to 24 h		.00E-09								
1 to 4 da		.40E-08								
4 to 30 d		.62E-09								
		HOURLY	VALUE RANG	E						
		MAX X/Q		MIN X/Q						
CENT	ERLINE	1.62E-06		2.43E-29						
	OR-AVERAGE	1.01E-06		1.38E-29						
SECI	ON NYERROE	x.010 00								

NORMAL PROGRAM COMPLETION

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### 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
		e-mail: jyll@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167
		e-mail: jjh@nrc.gov
	L. A Brown	Phone: (301) 415 1232
		e-mail: lab2@nrc.gov

Code	Developer:	J.	ν.	Ramsdell	Phone :	(509	372	6316
	-							ll@pnl.gov

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

Elevated release		
Release height (m)	*	99.1
Building Area (m <sup>2</sup> )	=	.0
Effluent vertical velocity (m/s)	=	2.62
Vent or stack flow (m <sup>3</sup> /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

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				_						
	d Speed (m/		±	.5						
	ghness leng		=	.10						
Sector aver	aging const	ant	=	4.0						
Initial val	ue of sigma	У	=	.00						
Initial val	ue of sigma	z	2	.00						
Expanded ou	tput for co	de testing :	not selecte	đ						
Total numbe	r of hours	of data pro	cessed =	8760						
Hours of mi				4845						
	tion in win	dow		254						
Hours eleva	ted plume w	/ dir. in w	indow =	380						
Hours of ca	lm winds		=	425						
Hours direc	tion not in	window or	calm =	3236						
DISTRIBUTIC	N SUMMARY D	ATA BY AVER	AGING INTER	VAL						
AVER. PER.	1	2	4	8	12	24	96	168	360	720
UPPER LIM.	1.00E-05	1.00E-05	1.00E-05	1.00E-05			1.00E-05	1.00E-05	1.00E-05	1.00E-05
LOW LIM.	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09
BOVE RANGE	٥.	ο.	0.	ο.	٥.	ο.	0.	Ο.	0.	0.
IN RANGE	37.	65.	96.	137.	141.	113.	192.	301.	352.	117.
ELOW RANGE	ο.	Ο.	14.	41.	119.	327.	477.	539.	754.	636.
ZERO	3878.	3793.	3645.	3387.		2705.	1544.	1073.	642.	416.
TOTAL X/Qs	3915.	3858.	3755.	3565.	3485.			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 PERCEN	TILE X/Q VA	LUES								
	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	3.70E-09	3.59E-09	1.73E-09	1.10E-09
95% X/O for	standard a	veraging in	tervals							
		00E-09								
0 to 2 hour 2 to 8 hour		00E-09								
8 to 24 hou		00E-09								
1 to 4 days		60E-09								
		95E-10								
4 to 30 day	<b>15</b> 6.	326-10								
			VALUE RANG							
		MAX X/Q		MIN X/Q						
CENTER	LINE AVERAGE	MAX X/Q 1.62E-06 1.01E-06		MIN X/Q 2.43E-29 1.38E-29						

NORMAL PROGRAM COMPLETION

SHEET NEDC <u>99-03/</u>ATTACH\_ 74 , F 80

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### 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
		e-mail: jyll@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167
		e-mail: jjh@nrc.gov
	L. A Brown	Phone: (301) 415 1232
		e-mail: lab2@nrc.gov

Code	Developer:	J.	٧.	Ramsdell	Phone :	(509)	372 -	6316
	-							l@pnl.gov

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

Elevated release

Release height (m)	=	99.1
Building Area (m^2)	Ħ	.0
Effluent vertical velocity (m/s)		2.62
Vent or stack flow (m <sup>3</sup> /s)	=	.26
Vent or stack radius (m)	π	.18
Direction intake to source (deg)	R	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

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Minimum Win	d Speed (m/s	3)	*	.5						
Surface rou	ghness lengt	:h (m)	=	.10						
Sector aver	aging consta	ant	=	4.0						
Initial val	ue of sigma	У	=	.00						
Initial val	ue of sigma	z	*	.00						
Expanded ou	tput for cod	le testing p	not selecte	d						
Total numbe		of data proc	cessed =	8760						
Hours of mi			-	1594						
Hours direc				495						
Hours eleva		dir. in w	indow =	696						
Hours of ca			*	751						
Hours direc	tion not in	window or a	calm =	5920						
DISTRIBUTIO					12	24	96	168	360	720
AVER. PER.	1	2	4	1 007 05		1.00E-05	1.00E-05	1.00E-05	1.00E-05	
UPPER LIM.	1.00E-05			1.00E-05 1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09
LOW LIM.	1.00E-09	1.00E-09	1.00E-09	1.002-09	1.002-09	1.006-09	1.002-05	0.	0.	0.
ABOVE RANGE	0.	0.	0.		488.	543.	979.	1744.	1775.	1672.
IN RANGE	113.	196.	286.	414.	488.	646.	728.	824.	873.	909.
BELOW RANGE	0.	0.	39.	115.	257. 5466.	4205.	1904.	1231.		26.
ZERO	7053.	6835.	6441.	5729.				3799.		
TOTAL X/QB	7166.	7031.	6766.	6258.	11.99	22.04	47.27	67.60	87.19	99.00
NON ZERO	1.58	2.79	4.80	8.45	11.99	22.04	47.27	07.00	07.15	22.00
95Ch PERCEN	TILE X/Q VAI 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
	1.002-09	1.005-09	1.005-09	2.210.07	1.170 00					
953 X/0 for	standard a	veraging in	tervals							
<b>JJI</b> N/Q LOL	ocumula a									
0 to 2 hour	s 1.0	00E-09								
2 to 8 hour	s 2.	61E-09								
8 to 24 hou	rs 5.1	97E-08						· * .		
1 to 4 days	9.	B3E-09								
4 to 30 day		21E-09								
-										
			VALUE RANG							
				MTM V/O						

	noonar	
	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 NEDC \_\_\_\_\_ATTACH\_\_\_\_ 76 \_ OF <u><u></u> *QO*</u>

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## 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
			e-mail: jyl1@nrc.gov
	J. J.	Hayes	Phone: (301) 415 3167
		-	e-mail: jjh@nrc.gov
	L. A	Brown	Phone: (301) 415 1232
			e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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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 <sup>2</sup> )	=	.0
Effluent vertical velocity (m/s)	*	2.62
Vent or stack flow (m <sup>3</sup> /s)	-	.26
Vent or stack radius (m)	*	.18
Direction intake to source (deg)	×	130
Wind direction sector width (deg)	m	90
Wind direction window (deg)	=	085 - 175
Distance to intake (m)	*	171.7
Intake height (m)	=	16.7
Terrain elevation difference (m)	=	.0

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Minimum Win	nd Speed (m/	в)	=	.5						
	ighness leng		=	.10						
Sector aver	aging const	ant	*	4.0						
Initial val	ue of sigma	у		.00						
Initial val	ue of sigma.	z	=	.00						
Expanded ou	itput for co	de testing :	not selecte	d .						
Total numbe	er of hours	of data pro	cessed =	8760	•					
Hours of mi			=	398						
Hours direc	tion in win	dow	=	520						
Hours eleva	ated plume w	/ dir. in w	indow =	811						
Hours of ca	alm winds		=	869						
Hours direc	ction not in	window or	calm =	6973						
DISTRIBUTIO	ON SUMMARY D		AGING INTER							720
AVER. PER.	1	2	4	8	12	24	96	168	360	1.00E-05
UPPER LIM.	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05		1.00E-05	1.00E-05	1.00E-05
LOW LIM.	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	
ABOVE RANGE	ο.	ο.	Ο.	ο.	Ο.	0.	0.	0.	0.	0.
IN RANGE	120.	206.	323.	496.	605.	615.	1490.	2796.	4300.	5652.
BELOW RANGE	ο.	0.	25.	99.	252.	862.	1558.	1723.	2261.	1838.
ZERO	8242.	8101.	7850.	7394.	7083.	6075.	3536.	2717.	1013.	574. 8064.
TOTAL X/Qs	8362.	8307.	8198.	7989.	7940.	7552.	6584.	7236.	7574.	
% NON ZERO	1.44	2.48	4.24	7.45	10.79	19.56	46.29	62.45	86.63	92.88
95th PERCEN	NTILE X/Q VA									0 600 00
	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
95% X/O for	r standard a	veraging in	tervals							
0 to 2 hour		00E-09								
2 to 8 hour	·	53E-09								
8 to 24 hou		32E-08								
	-	03E-08								
1 to 4 days		21E-09								
l to 4 days 4 to 30 day	ys 8.	210-09								
	γs 8.	HOURLY	VALUE RANG							
4 to 30 day	-	HOURLY MAX X/Q	VALUE RANG	MIN X/Q						
	-	HOURLY	VALUE RANG							

NORMAL PROGRAM COMPLETION

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NEDC <u>99-031</u> ATTACH\_1\_\_\_\_\_ SHEET <u>78</u> OF <u>70</u>

## 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
		e-mail: jyll@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167
	-	e-mail: jjh@nrc.gov
	L. A Brown	Phone: (301) 415 1232
		e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j\_ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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

Elevated release		
Release height (m)	Ŧ	99.1
Building Area (m <sup>2</sup> )	-	.0
		2.62
Vent or stack flow (m <sup>3</sup> /s)	*	.26
Vent or stack radius (m)	=	.18
Direction intake to source (deg)	Ŧ	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

NEDC <u>99-03(</u>ATTACH\_<u>(</u> SHEET <u>79</u> OF <u>90</u> r298.log r298.cfd

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720

Ο.

5721.

1708.

8098.

78.91

1.79E-08

669.

1.00E-05

1.00E-09

360

Ο.

5023.

814.

2594.

8431.

69.23

1.00E-05

1.00E-09

.5 Minimum Wind Speed (m/s) .10 Surface roughness length (m) 4.0 Sector averaging constant .00 Initial value of sigma y .00 Initial value of sigma z Expanded output for code testing not selected Total number of hours of data processed = 8760 233 Hours of missing data Hours direction in window 609 822 Hours elevated plume w/ dir. in window = Hours of calm winds 840 Hours direction not in window or calm = 7078 DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL 96 168 2 4 8 12 24 AVER. PER. 1 1.00E-05 1.00E-05 1.00E-05 1.00E-05 UPPER LIM. 1.00E-05 1.00E-05 1.00E-05 1.00E-05 1.00E-09 1.00E-09 1.00E-09 1.00E-09 1.00E-09 1.00E-09 1.00E-09 LOW LIM. 1.00E-09 ο. ٥. Ο. ο. ο. ο. ABOVE RANGE Ο. Ο. 3218. 932. 2236. 707. IN RANGE 108. 194. 311. 519. 1220. 574. 1041. BELOW RANGE 21. 59. 167. ٥. Ο. 4325. 3425. 8419. 7634. 7366. 6527. 8285. 8053. ZERO 8240. 8033. 7602. 7863. 8212. TOTAL X/Qs 8527. 8479. 8385. 43.11 56.44 10.61 18.75 7.04 % NON ZERO 1.27 2.29 3.96 95th PERCENTILE X/Q VALUES 1.88E-08 1.67E-08 4.06E-08 4.35E-08 2.59E-08 1.00E-09 1.00E-09 1.00E-09 2.24E-09 95% X/Q for standard averaging intervals 1.00E-09 0 to 2 hours 2.65E-09 2 to 8 hours 8 to 24 hours 6.41E-08 2.00E-08 1 to 4 days 1.66E-08 4 to 30 days

	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 NEDC 99-031 ATTACH 80 ្ណ 90

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
		e-mail: jyl1@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167
		e-mail: jjh@nrc.gov
	L. A Brown	Phone: (301) 415 1232
		e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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Program Run 9/20/1999 at 08:25:06, .

\*\*\*\*\*\* 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 <sup>2</sup> )	*	3171.0
Effluent vertical velocity (m/s)	=	.00
Vent or stack flow (m <sup>3</sup> /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

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NORMAL PROGRAM COMPLETION

Minimum Wir	nd Speed (m/s	;)	=	.5						
Surface rou	ighness lengt	.h (m)	=	.10						
Sector aver	aging consta	int	± 4	4.0						
	• •									
Initial val	ue of sigma	У		1.60						
Initial val	lue of sigma	z	= 1	5.90						
Expanded ou	itput for cod	le testing r	not selecte	1						
Total numbe	er of hours o	of data proc	cessed =	8760						
Hours of mi		•	=	138						
	ction in wind	low	=	1558						
	ated plume w/		indow =	0						
Hours of Ca			=	33						
	ction not in	window or o	calm =	7031						
	ON SUMMARY DA	ATA BY AVERA	AGING INTER	VAL 8	12	24	96	168	360	720
AVER. PER.	1	2	4	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03
UPPER LIM.	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07
LOW LIM.	1.00E-07	1.00E-07	1.00E-07 0.	1.006-07	1.001-0,	0.	0.	0.	0.	ο.
ABOVE RANGE	0.	0.	2531.	3308.	3950.	5131.	7760.	8409.	8437.	8111.
IN RANGE	1591.	1982. 0.	2531.	JJ08. 0.	0.	0.	0.	0.	ο.	0.
BELOW RANGE	0.	6606.	5989.	5076.	4465.	3046.	258.	ο.	0.	ο.
ZERO	7031.	8588.	8520.	8384.	8415.	8177.	8018.	8409.	8437.	8111.
TOTAL X/Qs	8622.	23.08	29.71	39.46	46.94	62.75	96.78	100.00	100.00	100.00
* NON ZERO	18.45	23.08	29.71	35.40	40.24	02000				
95th PERCE	NTILE X/Q VA	LUES								
	4.29E-04	3.55E-04	3.23E-04	2.89E-04	2.37E-04	1.75E-04	9.992-05	8.69E-05	6.26E-05	5.25E-05
95% X/Q fo:	r standard av	veraging in	cervais							•
0 to 2 hou:	rs 4.:	29E-04								
2 to 8 hou:	rs 2	43E-04								
8 to 24 ho	urs 1.	17E-04								
1 to 4 day	s 7.	50E-05								
4 to 30 da		52E-05								
		NOIBLA	VALUE RANG	F						
		MAX X/O	ADOR MANG	MIN X/Q						
		6.76E-04		6.90E-05						
CENTE		4.24E-04		4.32E-05						
SECTO	R-AVERAGE	4.246-04		4.320-03						

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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 e-mail: jyl1@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167 e-mail: jjh@nrc.gov
	L. A Brown	Phone: (301) 415 1232 e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j\_ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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Program Run 9/20/1999 at 08:25:15,

\*\*\*\*\*\* 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 <sup>2</sup> )	×	3171.0
	=	.00
Vent or stack flow (m <sup>3/s</sup> )	*	.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

NEDC <u>97-031</u> ATTACH <u>1</u> SHEET <u>83</u> OF <u>90</u>

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r395.log r395.cfd

Minimum Wi	nd Speed (m/	s)	=	.5							
	ughness leng		=	.10							
	raging const.		=	4.0							
	•••										
Initial va	lue of sigma	У		1.60							
	lue of sigma		= 1	5.90							
Expanded o	output for co	de testing i	not selecte	a							
<b></b>	er of hours	of data pro	ressed +	8760							
	hissing data	or data pro-		1439							
	ction in win	ർറം		1258							
	vated plume w		indow =	0							
Hours of C		,	*	20							
	ction not in	window or	calm =	6043							
mourb drie											
DISTRIBUTI	ON SUMMARY D	ATA BY AVER	AGING INTER	VAL							
AVER. PER.	1	2	4	8	12	24	96	168	360	720	
UPPER LIM.	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	
LOW LIM.	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	
ABOVE RANGE	ο.	ο.	ο.	ο.	Ο.	0.	0.	0.	0.	0.	
IN RANGE	1278.	1555.	1927.	2371.	2752.	3243.	3465.	3460.	2921.	2615.	
BELOW RANGE	ο.	ο.	٥.	ο.	٥.	0.	0.	0.	0.	0.	
ZERÔ	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 PERCE	ENTILE X/Q VA		3.19E-04	2.88E-04	2.34E-04	1.71E-04	9.11E-05	7.56E-05	5.47E-05	4.97E-05	
	4.07E-04	3.43E-04		2.000-04	2.346-04	1.715 04	21112 02				
OF YO FO	or standard a		¥ tervals								
334 A/Q LC	Si Scandara a										
0 to 2 hou	urs 4.	07E-04									
2 to 8 hou	1 <b>rs</b> 2.	48E-04									
8 to 24 ho	ours 1.	13E-04									
1 to 4 day	/s 6.	43E-05									
4 to 30 da	ays 4.	33E-05									
			VALUE RANG	F							
		MAX X/Q	VADUS ANNO	MIN X/Q							
<u></u>		6.76E-04		7.45E-05							
	ERLINE			4.67E-05							
SECTO	OR-AVERAGE	4.24E-04		4.0/6-00							

NORMAL PROGRAM COMPLETION

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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
			e-mail: jyl1@nrc.gov
	J. J.	Hayes	Phone: (301) 415 3167
		-	e-mail: jjh@nrc.gov
	L. A	Brown	Phone: (301) 415 1232
			e-mail: lab2@nrc.gov

Code	Developer:	J.	v.				6316 ll@pnl.gov
				e-mail:	 _rai	msae.	riebur.60v

Code Documentation: NUREG/CR-6331 Rev. 1

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Program Run 9/20/1999 at 08:25:21

\*\*\*\*\*\*\* 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 <sup>2</sup> )	=	3171.0
Effluent vertical velocity (m/s)	=	.00
Vent or stack flow (m <sup>3</sup> /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

SHEET NEDC 99-031 28 ATTACH\_ ់ ភ្ន 8

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SHEET 86

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NEDC 99-03 (\_\_\_\_\_ATTACH\_\_\_\_\_

r396.log r396.cfd

				_						
Minimum Wind			-	.5						
Surface rough	ness lengt	h (m)	=	.10						
Sector averag	ging constant	nt	*	4.0						
Initial value	of sigma	y	* 1	1.60						
Initial value			= 1	.5.90						
			_							
Expanded outp	out for cod	e testing m	not selecte	d						
Total number		f data proc	cessed =	8760						
Hours of miss			F	3128						
Hours directi	ion in wind	ow		1056						
Hours elevate		dir. in w	indow =	0						
Hours of calm			-	49						
Hours directi	ion not in	window or (	calm ≖	4527						
DISTRIBUTION	SUMMARY DA	TA BY AVER	AGING INTER	RVAL					200	720
AVER. PER.	1	· 2	4	8	12	24	96	168	360	1.00E-03
	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03					
LOW LIM.		1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07			1.00E-07	1.00E-07
ABOVE RANGE	0.	0.	ο.	ο.	٥.	0.		0.	0.	0.
IN RANGE	1105.	1327.	1599.	1896.	2177.	2617.	2840.	2953.	2531.	2196.
BELOW RANGE	0.	0.	0.	٥.	ο.	0.	0.	0.	ο.	0.
ZERO	4527.	4219.	3778.	3153.	2746.	1710.	189.	0.	0.	0.
TOTAL X/Qs	5632.	5546.	5377.		4923.	4327.	3029.	2953.	2531.	2196.
NON ZERO	19.62	23.93	29.74		44.22	60.48	93.76	100.00	100.00	100.00
95th PERCENT			2 265 04	3.08E-04	2.59E-04	1 978-04	1.18E-04	7.54E-05	8.99E-05	5.97E-05
	4.40E-04	• • • • • • • •	3.35E-04	3.086-04	2.392-04	1.976-04	1.105 04			
95% X/Q for s	standard av	eraging in	tervals							
0 to 2 hours	4.4	0E-04								
2 to 8 hours	2.6	4E-04								
8 to 24 hours	s 1.4	1E-04								
1 to 4 days		8E-05								
4 to 30 days		8E-05								
-		HOUDIN	VALUE RAN	GE						
•		MAX X/O		MIN X/Q						
CENTER	TMP	6.65E-04		8.08E-05						
CENTERL	AVERAGE	4.17E-04		5.06E-05						
SECTOR-	AVERAGE	3.1/6-04		5.002 05						
RMAL PROGRAM C	OMPLETION									

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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

June 25, 1997 11:00 a.m. Date:

NRC Contacts:	J. Y. Lee	Phone: (301) 415 1080
		e-mail: jyll@nrc.gov
	J. J. Hayes	Phone: (301) 415 3167
		e-mail: jjh@nrc.gov
	L. A Brown	Phone: (301) 415 1232
		e-mail: lab2@nrc.gov

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

Code Documentation: NUREG/CR-6331 Rev. 1

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Program Run 9/20/1999 at 08:25:32,

\*\*\*\*\*\*\* 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		
		16.7
Release height (m)	-	
Building Area (m^2)	=	3171.0
Effluent vertical velocity (m/s)	=	.00
Vent or stack flow (m <sup>3</sup> /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

SHEET NEDC 99-031 20 ATTACH\_/\_\_\_\_\_OF\_\_\_90

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r397	.log
r397	.cfd

Minimum W	ind Speed (m	/s)	*	.5						
	oughness len		-	.10						
	eraging cons		= 4	1.0						
000001 4.										
Initial v	alue of sigm	a y	= 11	L.60						
	alue of sigm		= 19	5.90						
Expanded	output for c	ode testing :	not selected	1						
Total num	ber of hours	of data pro	cessed = 8	3760						
	missing data		=	553						
	ection in wi		= `	1364						
		w/ dir. in w	indow =	0						
	calm winds	•	=	293						
		n window or	calm = 0	6550						
nours ar										
DISTRIBUT	TON SUMMARY	DATA BY AVER	AGING INTER	VAL						
AVER. PER.			4	8	12	24	96	168	360	720
UPPER LIM.		1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	
LOW LIM.			1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07
ABOVE RANGE			Ο.	٥.	٥.	ο.	0.	0.	0.	0.
IN RANGE			2465.	3028.	3521.	4284.	5557.	6787.	6316.	7155.
BELOW RANGE		ο.	0.	ο.	Ο.	٥.	0.	ο.	0.	0.
ZER			5483.	4594.	4016.	2721.	351.	7.	0.	0.
TOTAL X/Q			7948.	7622.	7537.	7005.	5908.	6794.	6316.	7155.
NON ZER			31.01	39.73	46.72	61.16	94.06	99.90	100.00	100.00
6 HOR 2210										
95th PER	CENTILE X/Q V	ALUES								
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	5.24E-04		3.64E-04	3.25E-04	2.69E-04	2.00E-04	1.23E-04	1.14E-04	9.56E-05	8.93E-05
			۱.							
95% X/O	for standard	averaging in	tervals							
		-								
0 to 2 h	ours 5	5.24E-04								
2 to 8 h	ours 2	2.58E-04								
8 to 24		L.37E-04								
1 to 4 d		9.77E-05								
4 to 30		3.41E-05								
		HOURLY	VALUE RANG							
		MAX X/Q		MIN X/Q						
CEN	TERLINE	6.76E-04		9.85E-05						
SEC	TOR - AVERAGE	4.24E-04		6.17E-05						

CENTERLINE	6.76E-
SECTOR - AVERAGE	4.24E-

NORMAL PROGRAM COMPLETION

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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
			e-mail: jyll@nrc.gov
	J. J.	Hayes	Phone: (301) 415 3167
			e-mail: jjh@nrc.gov
	L. A	Brown	Phone: (301) 415 1232
			e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell Phone: (509) 372 6316 e-mail: j\_ramsdell@pnl.gov

Code Documentation: NUREG/CR-6331 Rev. 1

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Program Run 9/20/1999 at 08:25:39,

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

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

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

Vent release

Release height (m)	=	16.7
Building Area (m <sup>2</sup> )		3171.0
Effluent vertical velocity (m/s)	=	.00
Vent or stack flow (m <sup>3</sup> /s)	=	.00
Vent or stack radius (m)	Ħ	.00
Direction intake to source (deg)	×	098
Wind direction sector width (deg)	F	90
Wind direction window (deg)	×	053 - 143
Distance to intake (m)	=	37.3
Intake height (m)	*	16.7
Terrain elevation difference (m)		.0

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r398.log r398.cfd

	DR-AVERAGE	4.24E-04		4.41E-05						
0	RLINE	MAX X/Q 6.76E-04		MIN X/Q 7.04E-05						
		HOURLY	VALUE RANG							
4 to 30 da	iys 7.	53E-05								
1 to 4 day	-	25E-05								
8 to 24 hc		36E-04								•
2 to 8 hou		68E-04								
0 to 2 hou		97E-04								
95% X/Q fo	er standard a	veraging in								
95th PERCE	NTILE X/Q VA 4.97E-04	3.86E-04	3.53E-04	3.25E-04	2.70E-04	1.99E-04	1.19E-04	1.05E-04	9.24E-05	8.11E-05
¥ NON ZERÓ	21.03	26.51	33.80	43,47	51.25	61.67	33,40	22.10	100.00	
TOTAL X/Qs	8341.	8294.	8201.	8024.	8048.	7826. 67.67	7263. 95.46	99.16	100.00	100.00
ZERO	6587.	6095.	5429.	4536.	3923.	2530. 7826.	7263.	7423.	7371.	7192.
BELOW RANGE	Ο.	Ο.	0.	0.	0.	0.	0. 330.	62.	o. o.	· 0.
IN RANGE	1754.	2199.	2772.	3488.	4125.	5296.	6933.	/361.	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	0.
ABOVE RANGE	0.	0.	0.	0.	0.	0.	0. 6933.	7361.	7371.	7192.
LOW LIM.	1.00E-07		1.00E-07	1.00E-07	1.00E-07			1.005-07	1.001-07	0.
UPPER LIM.	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03 1.00E-07	1.00E-03	1.00E-03	1.00E-07	1.00E-07
AVER. PER.	1	2	4	8	12	1.00E-03	1.00E-03		1,00E-03	1.00E-03
	ON SUMMARY D			VAL	10	24	96	168	360	720
Hours dire	ction not in	window or (	calm =	6587						
Hours of C	alm winds		3	21						
Hours elev	ated plume w,	/ dir. in w	indow =	0						
Hours dire	ction in wind	dow		1733						
	er of hours ( issing data	or data prot	=	419						
	utput for coo			8760						
	lue of sigma									
Initial va	lue of sigma	У		1.60 5.90						
Sector ave:	raging consta	ant	= 4	4.0						
	ughness lengt		=	.10						
Minimum Wi	nd Speed (m/s	5)	<b>12</b>	.5						

NORMAL PROGRAM COMPLETION

SHEET NEDC 99-031 ATTACH 1 90 0F 90