Attachment 4

Peach Bottom Atomic Power Station, Units 2 and 3

NRC Docket Nos. 50-277 and 50-278

Revise Technical Specifications Definition for RECENTLY IRRADIATED FUEL

Calculation PM-1170, Revision 0, *"PBAPS Atmospheric Dispersion Factors (X/Qs) for post-FHA Ground Hatch Releases"*

ATTACHMENT 1
Design Analysis Cover Sheet

Design Analysis		Last Page No. [6] 38	
Analysis No.: [1]	PM-1170	Revision: [2]	0 Major ☒ Minor ☐
Title: [3]	PBAPS Atmospheric Dispersion Factors (χ/Qs) for post-FHA Ground Hatch Releases		
EC/ECR No.: [4]		Revision: [5]	

		Component(s): [14]	
Station(s): [7]	Peach Bottom	N/A	
Unit No.: [8]	2 and 3		
Discipline: [9]	Mech		
Descrip. Code/Keyword: [10]	EPU; AST		
Safety/QA Class: [11]	SR		
System Code: [12]	912		
Structure: [13]	N/A		

CONTROLLED DOCUMENT REFERENCES [15]

Document No.:	From/To	Document No.:	From/To
PM-1055	From		
PM-1059	From		

Is this Design Analysis Safeguards Information? [16] Yes ☐ No ☒ If yes, see SY-AA-101-106

Does this Design Analysis contain Unverified Assumptions? [17] Yes ☐ No ☒ If yes, ATI/AR#:

This Design Analysis SUPERCEDES: [18] N/A in its entirety.

Description of Revision (list changed pages when all pages of original analysis were not changed): [19]
Original Issue.

Preparer: [20]	Gopal J. Patel (NUCORE)		05/27/2014
	Print Name	Sign Name	Date
Method of Review: [21]	Detailed Review ☒ Alternate Calculations (attached) ☐ Testing ☐		
Reviewer: [22]	Mark I. Drucker (NUCORE)		05/27/2014
	Print Name	Sign Name	Date
Review Notes: [23]	Independent review ☒ Peer review ☐		

(For External Analyses Only)

External Approver: [24]			
	Print Name	Sign Name	Date
Exelon Reviewer: [25]			
	Print Name	Sign Name	Date
Independent 3rd Party Review Reqd? [26]	Yes ☒ No ☐	Jeffrey Belusko Jeffrey W Belusko 6/11/14	
Exelon Approver: [27]	Jeff Chizever	J Chizever	6/13/14
	Print Name	Sign Name	Date

Additional ITPR for physical plant layout: Amy Huber Amy E Huber 6/11/14

ATTACHMENT 1
Design Analysis Cover Sheet

Design Analysis		Last Page No. [6] 48	
Analysis No.: [1]	PM-1170	Revision: [2]	0 Major ☒ Minor ☐
Title: [3]	PBAPS Atmospheric Dispersion Factors (χ/Qs) for post-FHA Ground Hatch Releases		
EC/ECR No.: [4]		Revision: [5]	

Station(s): [7]	Peach Bottom	Component(s): [14]	
Unit No.: [8]	2 and 3	N/A	
Discipline: [9]	Mech		
Descrip. Code/Keyword: [10]	EPU; AST		
Safety/QA Class: [11]	SR		
System Code: [12]	912		
Structure: [13]	N/A		

CONTROLLED DOCUMENT REFERENCES [15]

Document No.:	From/To	Document No.:	From/To
PM-1055	From		
PM-1059	From		

Is this Design Analysis Safeguards Information? [16] Yes ☐ No ☒ **If yes, see SY-AA-101-106**

Does this Design Analysis contain Unverified Assumptions? [17] Yes ☐ No ☒ **If yes, ATI/AR#:** _____

This Design Analysis SUPERCEDES: [18] **N/A** in its entirety.

Description of Revision (list changed pages when all pages of original analysis were not changed): [19]
Original Issue.

Preparer: [20]	**Gopal J. Patel** (NUCORE)		**05/27/2014**
	Print Name	**Sign Name**	**Date**
Method of Review: [21]	Detailed Review ☒	Alternate Calculations (attached) ☐	Testing ☐
Reviewer: [22]	**Mark I. Drucker** (NUCORE)		**05/27/2014**
	Print Name	**Sign Name**	**Date**
Review Notes: [23]	**Independent review** ☒	**Peer review** ☐	
(For External Analyses Only) External Approver: [24]			
	Print Name	**Sign Name**	**Date**
Exelon Reviewer: [25]			
	Print Name	**Sign Name**	**Date**

Independent 3rd Party Review Reqd? [26] Yes ☐ No ☐

Exelon Approver: [27]			
	Print Name	**Sign Name**	**Date**

REVISION HISTORY

Revision	Description
0	Initial issue

PAGE REVISION INDEX

SHEET	REV	SHEET	REV
1	0		
2	0		
3	0		
4	0	Attachment 12.1	0
5	0	Attachment 12.2	0
6	0	Attachment 12.3	0
7	0	Attachment 12.4	0
8	0	Attachment 12.5	0
9	0		
10	0		
11	0		
12	0		
13	0		
14	0		
15	0		
16	0		
17	0		
18	0		
19	0		
20	0		
21	0		
22	0		
23	0		
24	0		
25	0		
26	0		
27	0		
28	0		
29	0		
30	0		

TABLE OF CONTENTS

1.0 PURPOSE:

The purpose of this calculation is to determine the values of 95th percentile atmospheric dispersion factors (χ/Qs) (relative concentrations) at the Peach Bottom Atomic Power Stations (PBAPS) control room (CR) air intake due to various post-Fuel Handling Accident (FHA) releases from the Ground Hatches H18, H19, H20, H21, and H23 when the secondary containment integrity is breached during the refueling outage for maintenance of the equipment located inside the secondary containment and the recently irradiated fuel is moved from the reactor core. These sets of χ/Qs are not expected to exceed more than 5.0 percent of the total hours in the meteorological data set (i.e., 95th percentile χ/Qs). These sets of χ/Q values are developed using the NRC sponsored ARCON96 computer code Reference 9.2), PBAPS site-specific hourly meteorological data (Reference 9.7), guidance in Regulatory Guide 1.194 (Reference 9.3), and the source-receptor geometry based on the as-built locations of the ground hatches and CR air intake.

2.0 METHODOLOGY:

The 95th percentile χ/Qs for CR air intake were previously established in PBAPS calculation PM-1059 (Reference 9.1, Attachment G) using the NRC-sponsored computer code ARCON96 (Reference 9.2) and 5-years (1984-1988) of PBAPS site-specific meteorological data (Reference 9.7). Some additional post-FHA release paths have been identified through various ground hatches as discussed in the preceding section. The χ/Q values for these additional ground hatch release paths are developed using the guidance provided in Regulatory Guide 1.194 (Reference 9.3) for use of the ARCON96 dispersion model. All releases are assumed to be ground level point sources. The χ/Q values are determined for the following ground hatch locations, which are shown in Figure 1:

Ground Hatch (GH) Locations & Designations (Reference 9.4 and Figure 1):

1. Unit 2 RHR Ground Hatch H18
2. Unit 2 RBCCW Ground Hatch H19
3. Unit 3 RBCCW Ground Hatch H20
4. Unit 3 RHR Ground Hatch H21
5. Unit 3 RHR Ground Hatch H23

The set of χ/Q values for ground hatch H18 bounds the release from ground hatches H17 & H33 due its shorter distance from CR air intake.

The set of χ/Q values for ground hatch H21 bounds the release from ground hatches H22 & H34 due its shorter distance from CR air intake.

The set of χ/Q values for ground hatch H23 bounds the release from ground hatch H24 due its shorter distance from CR air intake.

Unit 3 hatches H23 & H24 are mirror images of Unit 2 hatches H15 & H16 (Figure 1), but the Unit 3 hatches are located in unfavorable wind sectors (Ref. 9.15, Attachment E); therefore, the set of χ/Q values for ground hatch H23 conservatively bounds the releases from Unit 2 ground hatches H15 & H16.

2.1 Set of CR χ/Q Values for post-FHA Release from Unit 2 RHR Ground Hatch H18

The Unit 2 ground hatch (GH) H18 consists of two hatches (eastern and western) located between Columns 18 & 19.6 and Rows A & B and west of the Unit 2 reactor building (RB) (Figure 1 & Ref.

9.9.2). Both the eastern and western GH H18 are expected to be open during the refueling outage for maintenance of RHR components. The CR air intake duct is located approximately 3'-6" east of Row G at Column 21.4 (Reference 9.10.1) at an approximate elevation of 177'-6" (Section 7.1). Looking at the CR air intake configuration with respect to GH H18, the eastern hatch is closer to the CR air intake; therefore, the eastern hatch location is used to calculate the set of χ/Q values for GH H18. This set of χ/Q values for the eastern GH H18 bounds the post-FHA releases from ground hatches H17 & H33 including the western GH H18 due its shorter distance from CR air intake (see Figure 1 & Reference 9.4).

The location of the CR air intake is approximately 77'-9" inside from the Radwaste Building (RWB) west wall in the normal air supply structure with a big louver panel opening 60' x 12' (Refs. 9.10 & 9.13). Consistent with Regulatory Guide 1.194 (Reference 9.3, Section 3.4), for releases within building complexes, the shortest horizontal distance between the release point and the intake could be through intervening buildings. Therefore, shortest horizontal distance between the source (H18) and receptor CR air intake is calculated accordingly for the source-receptor geometry shown in Figure 2.

The dimensions for the geometry of this release and receptor location, are obtained from References 9.9 & 9.10. The release-receptor geometric configuration is shown in Figure 2. The receptor input data (Ref. 9.2, page 16) and source data (Ref. 9.2, page 17) required for the ARCON96 χ/Q computations are established in Section 7.1 based on the plant-specific configuration and listed underneath Figure 2.

The meteorological data required for ARCON96 input (Ref. 9.2, pages 13 through 15) are established in Reference 9.15 and used to calculate the set of χ/Q values. Five years (1984-1988) of meteorological raw hourly wind data is obtained from Reference 9.7 for Tower 1A location and configured in ARCON96 format in Reference 9.15 to be used to calculate onsite χ/Q values. As stated in RG 1.194 (Reference 9.3, Section 3.4, Note 9), the site meteorological tower wind direction sensors are generally calibrated with reference to true north (360 degrees). Analysts should use caution in measuring directions on site engineering drawings since these drawings typically incorporate a plant grid and a plant "north" that may not align with true north. The source-to-receptor directions input to ARCON96 must use the same north reference as the wind direction observations. The true north used to measure and record the PBAPS wind data is located 26^0 east of the plant north as shown in Reference 9.14. The release point location orientation with respect to the CR air intake is calculated based on the true north to be consistent with the meteorological data.

The resulting set of χ/Q values for GH H18 are listed in Section 8.1.1.

2.2 Set of CR χ/Q Values for post-FHA Release from Unit 2 RBCCW Ground Hatch H19

The Unit 2 GH H19 consists of two hatches (eastern and western) located near Column 19.6 and between Rows A & B and west of the Unit 2 RB (Figure 1 & Ref. 9.9.2). Both the eastern and western GH H19 are expected to be open during the refueling outage for maintenance of Unit 2 HPCI components. Looking at the CR air intake configuration with respect to GH H19, the eastern hatch is closer to the CR air intake; therefore, the eastern hatch location is used to calculate the set of χ/Q values for GH H19.

The dimensions for the geometry of this release and receptor location, are obtained from References 9.9 & 9.10. The release-receptor geometric configuration is shown in Figure 3. The receptor input data (Ref. 9.2, page 16) and source data (Ref. 9.2, page 17) required for the ARCON96 χ/Q computations are established in Section 7.2 based on the plant-specific configuration and listed underneath Figure 3.

As discussed in Section 2.1, the meteorological data required for ARCON96 input (Ref. 9.2, pages 13 through 15) are established in Reference 9.15 and used to calculate the set of χ/Q values.

The resulting set of χ/Q values for GH H19 are listed in Section 8.1.2.

2.3 Set of CR χ/Q Values for Post-FHA Release from Unit 3 RBCCW Ground Hatch H20

The Unit 3 GH H20 consists of two hatches (eastern and western) located near Column 21.4 and between Rows A & B and west of the Unit 3 RB (Figure 1 & Ref. 9.9.2). Both the eastern and western GH H20 are expected to be open during the refueling outage for maintenance of Unit 3 HPCI components. Looking at the CR air intake configuration with respect to GH H20, the eastern hatch is closer to the CR air intake; therefore, the eastern hatch location is used to calculate the set of χ/Q values for GH H20.

The dimensions for the geometry of this release and receptor location, are obtained from References 9.9 & 9.10. The release-receptor geometric configuration is shown in Figure 4. The receptor input data (Ref. 9.2, page 16) and source data (Ref. 9.2, page 17) required for the ARCON96 χ/Q computations are established in Section 7.3 based on the plant-specific configuration and listed underneath Figure 4.

As discussed in Section 2.1, the meteorological data required for ARCON96 input (Ref. 9.2, pages 13 through 15) are established in Reference 9.15 and used to calculate the set of χ/Q values.

The resulting set of χ/Q values for GH H20 are listed in Section 8.1.3.

2.4 Set of CR χ/Q Values for post-FHA Release from Unit 3 RHR Ground Hatch H21

The Unit 3 GH H21 consists of two hatches (eastern and western) located between Columns 21.4 and 23 and Rows A & B and west of the Unit 3 RB (Figure 1 & Ref. 9.9.2). Both the eastern and western GH H21 are expected to be open during the refueling outage for maintenance of RHR components. Looking at the CR air intake configuration with respect to GH H21, the eastern hatch is closer to the CR air intake; the eastern hatch location is used to calculate the set of χ/Q values for GH H21. This set of χ/Q values for the eastern GH H21 bounds the post-FHA releases from ground hatches H22 & H34 including the western GH H21 due its shorter distance from CR air intake (see Figure 1 & Reference 9.4).

The dimensions for the geometry of this release and receptor location, are obtained from References 9.9 & 9.10. The release-receptor geometric configuration is shown in Figure 5. The receptor input data (Ref. 9.2, page 16) and source data (Ref. 9.2, page 17) required for the ARCON96 χ/Q computations are established in Section 7.4 based on the plant-specific configuration and listed underneath Figure 5.

As discussed in Section 2.1, the meteorological data required for ARCON96 input (Ref. 9.2, pages 13 through 15) are established in Reference 9.15 and used to calculate the set of χ/Q values.

The resulting set of χ/Q values for GH H21 are listed in Section 8.1.4.

2.5 Set of CR χ/Q Values for post-FHA Release from Unit 3 RHR Ground Hatch H23

The Unit 3 GH H23 consists of two hatches (southeastern and northwestern) located between Columns 31 and 33 and Rows A & B and west of the Unit 3 RB (Figure 1 & Ref. 9.9.3). Both the southeastern and northwestern GH H23 are expected to be open during the refueling outage for early maintenance of Unit 3 RHR components. Looking at the CR air intake configuration with respect to GH H23, the southeastern hatch is closer to the CR air intake; therefore, the southeastern location is used to calculate the set of χ/Q values for GH H23. This set of χ/Q values for southeastern GH H23 bounds the post-FHA

releases from ground hatch H24 due its shorter distance from CR air intake (see Figure 1 and Refs. 9.4 & 9.9.3).

Unit 3 hatches H23 & H24 are mirror image of Unit 2 hatches H15 & H16 (Figure 1 and Ref. 9.4) but the Unit 3 hatches are located in unfavorable wind sectors (Ref. 9.15, Attachment E); therefore, the set of χ/Q values for ground hatch H23 conservatively bounds the releases from Unit 2 ground hatches H15 & H16.

The dimensions for the geometry of this release and receptor location, are obtained from References 9.9 & 9.10. The release-receptor geometric configuration is shown in Figure 6. The receptor input data (Ref. 9.2, page 16) and source data (Ref. 9.2, page 17) required for the ARCON96 χ/Q computations are established in Section 7.5 based on the plant-specific configuration and listed underneath Figure 6.

As discussed in Section 2.1, the meteorological data required for ARCON96 input (Ref. 9.2, pages 13 through 15) are established in Reference 9.15 and used to calculate the set of χ/Q values.

The resulting set of χ/Q values for GH H23 are listed in Section 8.1.5.

3.0 ACCEPTANCE CRITERIA:

The following NRC regulatory requirements and guidance in Regulatory Guide 1.194 (Ref. 9.3, Sections 2 and 3.1) are considered to determine the PBAPS onsite χ/Qs :

1. For each of the source-receptor combinations, 95th percentile χ/Qs should be determined.
2. Control room χ/Q values should generally be determined for each of the following averaging periods: 0-2 hrs, 2-8 hrs, 8-24 hrs, 24-96 hrs, and 96-720 hrs.
3. The meteorological data needed for χ/Q calculations including wind speed, wind direction, and a measure of atmospheric stability should be obtained from an onsite meteorological measurement program based on the guidance of Regulatory Guide 1.23 Revision 1 (previously issued as Safety Guide 23) that includes quality assurance provisions consistent with Appendix B to 10 CFR Part 50.
4. The size of the data set used in the χ/Q assessments should be sufficiently large such that it is representative of long-term meteorological trends at the site. The NRC staff considers 5 years of hourly observations to be representative of long-term trends at most sites.
5. The meteorological data set used in these assessments should represent hourly averages as defined in Regulatory Guide 1.23 Revision 1 (previously issued as Safety Guide 23). Data should be representative of the overall site conditions and be free from local effects such as building and cooling tower wakes, brush and vegetation, or terrain. Collected data should be reviewed to identify instrumentation problems and missing or anomalous observations.

4.0 ASSUMPTIONS:

The regulatory requirements in Regulatory Guide 1.194 (Ref. 9.3) are adopted as assumptions in the following section, which are incorporated as design inputs along with other plant-specific as-built design parameters in Section 5.0.

4.1 Meteorological Data Input General Considerations

The 5-years of PBAPS site-specific meteorological data (1984 through 1988) for Tower 1A meet the following RG 1.194, Section 3.1 requirements (Ref. 9.3). The use of Tower 1A meteorological data for evaluating postulated releases from ground level hatches was accepted by the NRC staff in the PBAPS AST License Amendments (Ref. 9.5, Section 3.3.2). See **Design Input 5.1.**

- The met data were obtained from the PBAPS meteorological monitoring tower 1A (Ref. 9.15, Section 2.2.3), which provides the wind speed, wind direction, and other measured parameters to determine the atmospheric stability based on the guidance of Regulatory Guide 1.23 (Ref. 9.15, Section 2.1 & Ref. 9.6).
- The met data program includes quality assurance provisions consistent with Appendix B to 10 CFR Part 50 (Ref. 9.11).
- Data are presented as hourly averages as defined in RG 1.23 (Ref. 9.15, Section 2.1 & Ref. 9.6).
- Tower 1A data are representative of overall site condition and are free from local effects such as building and cooling tower wakes, brush and vegetation, or terrain (Ref. 9.15, Section 2.2.3).
- The 5 years of data used in the χ/Q assessment are more than sufficient to reflect long-term site-specific meteorological trends (Ref. 9.15, Section 1.0).
- The near-ground atmosphere stability classifications for the ground level release are determined based on the vertical temperature difference (ΔT) measured between the lower and upper temperature measurement points at 33 feet and 89 feet above grade, respectively, and atmosphere stability classification criteria in ANSI/ANS-2.5 (Ref. 9.15, Sections 2.1 and 3.2.3 & Ref. 9.12).
- The met data are formatted in the text data files using the format shown in Table A-1 of RG-1.194 (Ref. 9.3 & Ref. 9.6).

4.2 Determination of Source Characteristics

The Source Data meets the following RG 1.194, Section 3.2.1 requirement. See **Design Input 5.2**.

The post-accident releases through the ground hatches are assumed to be ground level point sources (Ref. 9.3, Section 3.2.1).

The elevated (Stack) release mode and vent release mode are not used for determining the PBAPS onsite χ/Qs (Ref. 9.3, Sections 3.2.2 & 3.2.3).

4.3 Determination of CR Intake (Receptor) Characteristics

The receptor data meets the following RG 1.194, Section 3.3 requirements. See **Design Input 5.3**.

1. Ventilation System Outside Air Intake/ Dual Ventilation Outside Air Intakes

   RG 1.194 Sections 3.3.1 and 3.3.2 require that the CR ventilation system configuration with respect to accident response should be evaluated to identify the limiting and favorable intake with regard to their χ/Q values. Because of the interplay of building wake, plume rise, wind direction frequency, intake flow rate, and other parameters, it may not be possible to identify the

limiting or favorable intake by observation. The combined control room (CR) draws makeup air from the environment by one air intake (Ref. 9.10). Therefore, for each ground hatch release point, the χ/Q values are calculated for only one release source-receptor combination.

2. Dilution Credit

   The requirements in RG 1.194 Sections 3.3.2.1 through 3.3.2.4 are not applicable to PBAPS CR design because it does not have dual ventilation air intakes to allow for dilution by the flow from a second intake (Ref. 9.10).

3. Infiltration Pathways

   The typical infiltration pathways that need to be considered in establishing CR intake χ/Q values are listed in the RG 1.194 Section 3.3.3. The infiltration pathways listed in RG 1.194 Section 3.3.3 are reviewed for the assessment of CR χ/Q values in this analysis for the potential release points. The potential infiltration location(s) is not specifically identified in the latest PBAPS Tracer Gas Test Report (Ref. 9.8). The entire Control Room Emergency Ventilation System (CREVS) consists of the main control room, including the ductwork and associated air handling units (Ref. 9.8, Section 2.0). The ductwork including the fans and filtration units is located in the radwaste building (RWB) (Ref. 9.10). Therefore, the potential source of unfiltered inleakage is expected to originate across the operating fan supply duct connection upstream of the fan or filtration units in the RWB). The air intake for the CREVS is located in the RWB where the ductwork, fans, and filtration units are located. Therefore, the CR air intake χ/Q values are applied to the CR unfiltered inleakage.

4.4 Source Receptor Distance

The Source/Receptor distance meets the following RG 1.194, Section 3.4 requirement. See **Design Input 5.4**.

The source-to-receptor distance is the shortest horizontal distance between the release point and intake. The location of the CR air intake is located inside the RWB structure (Ref. 9.10). Although the ground hatch releases must meander within the intervening RWB before reaching the CR intake, the true length of the shortest path (i.e., "taut string length") is not modeled. Conservatively, the shortest straight-line horizontal distance between the release point and the CR intake through the intervening RWB structure is calculated as shown in Figures 2 through 6.

4.5 Source-Receptor Direction

The Source/Receptor Direction meets the following RG 1.194 Section 3.4 requirement. See **Design Input 5.5**.

Plot Plan Drawing C-2 (Ref. 9.14) shows that the True North is 26^0 east of Plant North (Ref. 9.15, Attachment A). Consequently the orientation of the release point with respect to receptor location requires correction for the difference between Plant North and True North. The direction input to ARCON96 is the wind direction that would carry the plume from the release point to the intake. For example, an analyst standing at the intake facing west to the release point, would enter 270 degrees; an analyst facing north, would enter 360 degrees, etc. (Ref. 9.3, Section 3.4).

4.6 Building Wake Area

The reactor building vertical cross-sectional area perpendicular to the prevailing wind directions is valid for use by ARCON96 for the high wind speed adjustment for the ground level release model (Ref. 9.3, Table A-2), as shown in **Design Input 5.6** for the PBAPS releases (Ref. 9.15, Section 2.2.1).

4.7 Release Height

The release heights for the PBAPS ground hatch release points are set to zero as they are located at the plant grade elevation 135'-0" (Ref. 9.9) and listed in **Design Input 5.7**. ARCON96 uses the value of the release height to adjust wind speed for differences between the heights of the meteorological tower instrumentation and the release, to determine the slant path for ground level releases, and to correct the off-centerline data for elevated releases (Ref. 9.3, Table A-2).

4.8 Intake Height

The actual CR air intake height of 12.96 meters above plant grade elevation of 135'-0" is listed in **Design Input 5.8.** ARCON96 uses the value of the intake height to determine the slant path for ground level releases and to correct the off-centerline data for stack release models (Ref. 9.3, Table A-2).

4.9 Surface Roughness Length

Regulatory Guide 1.194 (Ref. 9.3, Table A-2) recommends that the value of the surface roughness length used in ARCON96 to adjust wind speeds to account for differences in meteorological instrumentation height and release height should be 0.2 meters in lieu of the default value of 0.1 (Ref. 9.3, Table A-2), which is used in the analysis and listed in **Design Input 5.9.**

4.10 Minimum Wind Speed

Although, the value of the minimum wind speed used in ARCON96 to identify calm wind conditions is the code default value of 0.5 m/s (Ref. 9.3, Table A-2), the minimum wind speed of 0.2 m/s is listed in **Design Input 5.10** and is appropriate since the met tower anemometer starting threshold is approximately 0.22 m/s (i.e., 0.5 mph per Reference 9.15, Section 2.2.3) and is therefore capable of documenting wind speeds of less than 0.6 m/s.

4.11 Averaging Sector Width Constant

Regulatory Guide 1.194 (Ref. 9.3, Table A-2) recommends that the value of the averaging sector width constant used in ARCON96 to adjust wind speeds to prevent inconsistency between the centerline and sector average χ/Qs for wide plumes should be 4.3 in lieu of the default value of 4.0 (Ref. 9.3, Table A-2), which is used in the analysis and listed in **Design Input 5.11.**

4.12 Lower Measurement Height for Met Data

The lower measurement height used in ARCON96 to adjust the wind speeds for the differences between the heights of the meteorological tower instrumentation and the release (Ref. 9.3, Table A-2) is 34 feet (=10.36 meters) (Ref. 9.15, Section 2.2.4 and Attachment I) as listed in **Design Input 5.12**.

4.13 Upper Measurement Height for Met Data

The upper measurement height used in ARCON96 to adjust the wind speeds for the differences between the heights of the meteorological tower instrumentation and the release (Ref. 9.3, Table A-2) is 92 feet (= 28.04 meters) (Ref. 9.15, Section 2.2.4 and Attachment I) as listed in **Design Input 5.13.**

4.14 Wind Speed Units for Met Data

The wind speed units used in ARCON96 will be entered in units of miles per hour (mph), as listed in **Design Input 5.14,** for consistency with the units of the wind speeds in the meteorological data files (Ref. 9.7 & Ref. 9.15, Attachment I).

5.0 DESIGN INPUTS:

Parameter	Value	Reference
5.1 PBAPS Meteorological Data	1984–1988 Meteorological Data	9.7
5.2 Source Release Category		
GH H18 Release – CR Intake	Ground Level Point Source	Section 7.1
GH H19 Release – CR Intake	Ground Level Point Source	Section 7.2
GH H20 Release – CR Intake	Ground Level Point Source	Section 7.3
GH H21 Release – CR intake	Ground Level Point Source	Section 7.4
GH H23 Release – CR Intake	Ground Level Point Source	Section 7.5
5.3 Receptor Characteristics		
5.3.1 Ventilation System Configuration		
GH H18 Release – CR Intake	Single CR Intake	Figure 2
GH H19 Release – CR Intake	Single CR Intake	Figure 3
GH H20 Release – CR Intake	Single CR Intake	Figure 4
GH H21 Release – CR intake	Single CR Intake	Figure 5
GH H23 Release – CR Intake	Single CR Intake	Figure 6
5.3.2 Dilution Credit		
GH H18 Release – CR Intake	None	9.10 (CR has a single air intake, no dilution by the flow from the other intake)
GH H19 Release – CR Intake	None	
GH H20 Release – CR Intake	None	
GH H21 Release – CR intake	None	
GH H23 Release – CR Intake	None	
5.3.3 Infiltration Pathways	Unfiltered Inleakage	Section 4.3 (CR Air Intake χ/Qs are limiting)
5.4 Source-Receptor Distance		
GH H18 Release – CR Intake	37.91 m	Section 7.1 & Figure 2
GH H19 Release – CR Intake	36.72 m	Section 7.2 & Figure 3
GH H20 Release – CR Intake	28.33 m	Section 7.3 & Figure 4
GH H21 Release – CR intake	26.66 m	Section 7.4 & Figure 5
GH H23 Release – CR Intake	58.63 m	Section 7.5 & Figure 6
5.5 Source-Receptor Direction		
GH H18 Release – CR Intake	196.95^0	Section 7.1 & Figure 2
GH H19 Release – CR Intake	204.26^0	Section 7.2 & Figure 3
GH H20 Release – CR Intake	248.63^0	Section 7.3 & Figure 4
GH H21 Release – CR intake	258.25^0	Section 7.4 & Figure 5
GH H23 Release – CR Intake	305.39^0	Section 7.5 & Figure 6
5.6 Building Wake Area		
GH H18 Release – CR Intake	2,583.6 m^2	Section 7.1
GH H19 Release – CR Intake	2,583.6 m^2	
GH H20 Release – CR Intake	2,583.6 m^2	
GH H21 Release – CR intake	2,583.6 m^2	
GH H23 Release – CR Intake	2,583.6 m^2	
5.7 Release Height		
GH H18 Release – CR Intake	0.0 m	Section 7.1
GH H19 Release – CR Intake	0.0 m	
GH H20 Release – CR Intake	0.0 m	
GH H21 Release – CR intake	0.0 m	
GH H23 Release – CR Intake	0.0 m	

Parameter	Value	Reference
5.8 Intake Height CR Intake	12.96 m	Section 7.1
5.9 Surface Roughness Length	0.20 m	9.2, Table A-2
5.10 Minimum Wind Speed	0.2 m/s	9.15, Attachment I
5.11 Averaging Sector Width Constant	4.3	9.2, Table A-2
5.12 Lower Measurement Height for Met Data	10.36 m	9.15, Section 2.2.4 and Attachment I
5.13 Upper Measurement Height for Met Data	28.04 m	9.15, Section 2.2.4 and Attachment I
5.14 Wind Speed Units for Met Data	miles/hour (mph)	9.15, Attachment I

6.0 COMPUTER CODES & REGULATORY COMPLIANCE:

6.1 Computer Codes

The computer code used in this calculation has been approved for use with appropriate Verification and Validation (V&V) documentation. The computer code used in this analysis is:

ARCON96 (Ref. 9.2): This is an NRC-sponsored code approved for use in determining 95th percentile control room χ/Qs. This code implements an improved building wake dispersion algorithm; assessment of ground level, building vent, elevated, and diffuse source release modes; use of hour-by-hour meteorological observations; sector averaging; and directional dependence of dispersion conditions. This code was used by EXELON to develop onsite χ/Qs in PBAPS calculation PM-1055 (Ref. 9.15) to support AST License Amendment Nos. 269 and 273 to Operating License Nos. DPR-44 and DPR-56, respectively for PBAPS Unit 2 & 3 (Ref. 9.5). Therefore, the code is considered acceptable to be used to calculate the CR χ/Qs for ground hatch releases.

6.2 Compliance With Regulatory Requirements

As discussed in Section 4.0, Assumptions, the analysis in this calculation complies with the requirements in Regulatory Guide 1.194 (Ref. 9.3).

7.0 CALCULATIONS:

The source/receptor input parameters for ARCON96 code are calculated in the following sections based on geometry models shown in Figures 2 through 6 using the plant-specific as-built design information. Minor uncertainties in modeled distances and elevations may exist due to approximations and variation in dimensions on the different drawings. However, these uncertainties are negligible in comparison to the large distances between the various release points and the CR air intake location as shown in Figures 2 through 6. Therefore, these uncertainties have no impact on the results of analyses. The dimensions in feet are converted into meters using a conversion factor of 1 meter = 3.28 feet.

7.1 Set of CR χ/Q Values for post-FHA Release from Unit 2 RHR Ground Hatch H18

The location of GH H18 with respect to CR air intake is shown in Figure 2 (Refs. 9.9 & 9.10). The GH H18 location with respect to CR air intake is such that the southwest wind will predominantly carry effluent from the GH H18 to the CR intake. The reactor building cross-sectional area perpendicular to a southwest wind is considered for the wake diffusion. The containment wake area of 2,583.6 m^2 is already calculated in PM-1055, Revision 1 (Ref. 9.15, section 2.2.1 & Attachment I), which is used in this analysis for consistency.

The centerline of the CR intake is approximately located at Column 21.4 and 5'-6" east of Row G (Ref. 9.10) in RWB.
North-south distance between centerlines of CR intake and eastern GH H18
= North-south distance between Columns 18 & 19.6 – Distance between Column 18 & south edge of eastern GH H18 – (Width of eastern GH H18 / 2) + (North-south distance between Columns 19.6 & 21.4)
= 32'-3" (Ref. 9.9.2) – [7'-11" (Ref. 9.9.2) – (5'-8" / 2) (Ref. 9.9.2)] + (2 x 34'-9") (Ref. 9.9.2)
= 32'-3" – 10'-9" + 69'-6" = 21'-6" + 69'-6" = 91'-0"

East-West Distance between centerline of GH H18 and CR Intake
= East-west distance between Row A & B – [Distance between Row A & west edge of western GH H18 + Length of western GH H18 + Distance between western & eastern GH H18 + (Width of eastern GH H18 / 2) + Distance between Rows B & G + Distance between centerline of CR intake duct and Row G
= 30'-9" (Ref. 9.9.2) – [6'-5-1/2" + 8'-2" + 4'-10" + (8'-7" / 2) (Ref. 9.9.2)] + [24'-3" + 20'-3" + 3'-9" (Ref. 9.9.1) + 24'-0" (Ref. 9.9.4)] + [3'-6" + 48" / 2 (Ref. 9.10)]
= 30'-9" – [23'-9"] +[72'-3"] + [3'-6" + 2'-0"]
= 7'-0" + 72'-3" + 5'-6" = 7'-0" + 77'-9" = 84'-9" = 84.75'

Straight line horizontal distance between GH H18 and CR intake
= $[(91.0')^2 + (84.75')^2]^{1/2}$ = 124.35' = 37.91 m

Bottom of CR air intake = 177'-0" (Ref. 9.10.1)
One-half of CR air intake duct height = 36" / 2 = 1'-6" (Ref. 9.10.1)
Elevation of CR air intake centerline = 177'-0" + 1'-6" = 178'-6", however 177'-6" will be used for conservatism.
Grade elevation = 135'-0" (Ref. 9.9.2)
Height of CR air intake = 177'-6" – 135'-0" = 42'-6" = 12.96 m

GH H18 centerline direction with respect to CR intake
Tan θ = 84.75'/91' = 0.931, Therefore θ = Tan^{-1} 0.931 = 42.95^0

Wind direction data are recorded as the direction from which the wind blows (e.g., a wind blowing out of the south is recorded with a wind direction of 180 degrees, and a wind blowing out of the west is recorded with a direction of 270 degrees) (Ref. 9.3, Section 3.4).
Orientation of GH H18 release with respect to CR air intake, considering south wind is 180^0, and that the true north is 26^0 east of the plant north (Ref. 9.14 & Ref. 9.15, Attachment A).

Orientation = $180^0 + 42.95^0 - 26^0 = 196.95^0$

7.2 Set of CR χ/Q Values for post-FHA Release from Unit 2 RBCCW Ground Hatch H19

The location of GH H19 with respect to CR air intake is shown in Figure 3 (Refs. 9.9 & 9.10). The GH H19 location with respect to CR air intake is such that the southwest wind will predominantly carry effluent from the GH H19 to the CR intake. The reactor building cross-sectional area perpendicular to a southwest wind is considered for the wake diffusion. The containment wake area of 2,583.6 m^2 is already calculated in PM-1055, Revision 1 (Ref. 9.15, section 2.2.1 & Attachment I), which is used in this analysis for consistency.

The centerline of the CR intake is approximately located at Column 21.4 and 5'-6" east of Row G (Ref. 9.10) in RWB.
North-south distance between CR intake and centerline of eastern GH H19
= North-south distance between north edge of GH H19 & Column 19.6 + (Width of GH H19 / 2) + North-south distance between Columns 19.6 & 21.4
= (1'-6" + 1'-6") (Ref. 9.9.2) + (9'-0" / 2) (Ref. 9.9.2) + (2 x 34'-9") (Ref. 9.9.2)
= (3'-0" + 4'-6") + 69'-6" = 7'-6" + 69'-6" = 77'-0"

East-West Distance between centerline of GH H19 and CR Intake
= East-west distance between Row A & B – [Distance between Row A & west edge of western GH H19 + Length of western GH H19 + (Length of eastern GH H19 / 2)] + Distance between Rows B & G + Distance between centerline of CR intake duct and Row G
= 30'-9" (Ref. 9.9.2) – [2'-0" + (18'-6" / 2) + (18'-6"/4) (Ref. 9.9.2)] + [24'-3" + 20'-3" + 3'-9" (Ref. 9.9.1) + 24'-0" (Ref. 9.9.4)] + [3'-6" + 48"/2 (Ref. 9.10)]
= 30'-9" – [2'-0" + 9'-3" + 4'-7-1/2"] +[72'-3"] + [3'-6" + 48"/2]
= 30'-9" – 15'-10-1/2" + 72'-3" + 5'-6"
= 14'-10-1/2" + 77'-9" = 14.875'+ 77.75' = 92.625'

Straight line horizontal distance between GH H19 and CR intake
= $[(77.0')^2 + (92.625')^2]^{1/2}$ = 120.45' = 36.72 m

Height of CR air intake = 12.96 m (Section 7.1)

GH H19 centerline direction with respect to CR intake
Tan θ = 92.625'/77' = 1.203, Therefore θ = Tan^{-1} 1.203 = 50.26^0
Wind direction data are recorded as the direction from which the wind blows (e.g., a wind blowing out of the south is recorded with a wind direction of 180 degrees, and a wind blowing out of the west is recorded with a direction of 270 degrees) (Ref. 9.3, Section 3.4).
Orientation of GH H19 release with respect to CR air intake, considering south wind is 180^0, and that the true north is 26^0 east of the plant north (Ref. 9.14 & Ref. 9.15, Attachment A).

Orientation = $180^0 + 50.26^0 - 26^0 = 204.26^0$

7.3 Set of CR χ/Q Values for post-FHA Release from Unit 3 RBCCW Ground Hatch H20

The location of GH H20 with respect to CR air intake is shown in Figure 4 (Refs. 9.9 & 9.10). The GH H20 location with respect to CR air intake is such that the west-northwest wind will predominantly carry effluent from the GH H20 to the CR intake. The reactor building cross-sectional area perpendicular to a west-northwest wind is considered for the wake diffusion. The containment wake area of 2,583.6 m^2 is already calculated in PM-1055, Revision 1 (Ref. 9.15, section 2.2.1 & Attachment I), which is used in this analysis for consistency.

The centerline of the CR intake is approximately located at Column 21.4 and 5'-6" east of Row G (Ref. 9.10) in RWB.
North-south distance between CR intake and centerline of eastern GH H20
= North-south distance between south edge of GH H20 & Column 21.4 + (Width of GH H20 / 2)
= (1'-6" + 1'-6") (Ref. 9.9.2) + (9'-0" / 2) (Ref. 9.9.2)
= (3'-0" + 4'-6") = 7'-6"

East-West Distance between centerline of GH H20 and CR Intake
= East-west distance between Row A & B – [Distance between Row A & west edge of western GH H20 + Length western GH H20 + (Length of eastern GH H20 / 2)] + Distance between Rows B & G + Distance between centerline of CR intake duct and Row G
= 30'-9" (Ref. 9.9.2) – [2'-0" + (18'-6" / 2) + (18'-6"/4) (Ref. 9.9.2)] + [24'-3" + 20'-3" + 3'-9" (Ref. 9.9.1) + 24'-0" (Ref. 9.9.4)] + [3'-6" + 48"/2 (Ref. 9.10)]
= 30'-9" – [2'-0" + 9'-3" + 4'-7-1/2"] +[72'-3"] + [3'-6" + 2'-0"]
= 30'-9" – 15'-10-1/2" + 72'-3" + 5'-6"
= 14'-10-1/2" + 77'-9" = 14.875'+ 77.75' = 92.625'

Straight line horizontal distance between GH H20 and CR intake
= $[(7.5')^2 + (92.625')^2]^{1/2}$ = 92.93' = 28.33 m

Height of CR air intake = 12.96 m (Section 7.1)

GH H20 centerline direction with respect to CR intake
Tan θ = 7.5'/92.625' = 0.081, Therefore θ = Tan^{-1} 0.081 = 4.63^0
Wind direction data are recorded as the direction from which the wind blows (e.g., a wind blowing out of the south is recorded with a wind direction of 180 degrees, and a wind blowing out of the west is recorded with a direction of 270 degrees) (Ref. 9.3, Section 3.4).
Orientation of GH H20 release with respect to CR air intake, considering west wind is 270^0, and that the true north is 26^0 east of the plant north (Ref. 9.14 & Ref. 9.15, Attachment A).

Orientation = $270^0 + 4.63^0 - 26^0 = 248.63^0$

7.4 Set of CR χ/Q Values for post-FHA Release from Unit 3 RHR Ground Hatch H21

The location of GH H21 with respect to CR air intake is shown in Figure 5 (Refs. 9.9 & 9.10). The GH H21 location with respect to CR air intake is such that the west-northwest wind will predominantly carry effluent from the GH H21 to the CR intake. The reactor building cross-sectional area perpendicular to a west-northwest wind is considered for the wake diffusion. The containment wake area of 2,583.6 m^2 is already calculated in PM-1055, Revision 1 (Ref. 9.15, section 2.2.1 & Attachment I), which is used in this analysis for consistency.

The centerline of the CR intake is approximately located at Column 21.4 and 5'-6" east of Row G (Ref. 9.10) in RWB.
North-south distance between CR intake and centerline of eastern GH H21
= North-south distance between Columns 21.4 & 23 – [Distance between Column 23 & north edge of eastern GH H21 + (Width of GH H21 / 2)]
= 32'-3" (Ref. 9.9.2) – [7'-11" (Ref. 9.9.2) + (5'-8" / 2) (Ref. 9.9.2)]
= 32'-3" – 10'-9" = 21'-6"

East-West Distance between centerline of GH H21 and CR Intake
= East-west distance between Row A & B – [Distance between Row A & west edge of western GH H21 + Length of western GH H21 + Distance between western & eastern GH H21 + (Length of eastern GH H21 / 2) + Distance between Rows B & G + Distance between centerline of CR intake duct and Row G
= 30'-9" (Ref. 9.9.2) – [6'-5-1/2" + 8'-2" + 4'-10" + (8'-7" / 2) (Ref. 9.9.2)] + [24'-3" + 20'-3" + 3'-9" (Ref. 9.9.1) + 24'-0" (Ref. 9.9.4)] + [3'-6" + 48"/2 (Ref. 9.10.1)]
= 30'-9" – [23'-9"] +[72'-3"] + 5'-6"
= 7'-0" + 72'-3" + 5'-6" = 84'-9" = 84.75'

Straight line horizontal distance between GH H21 and CR intake
$= [(21.5')^2 + (84.75')^2]^{1/2} = 87.43' = 26.66$ m

Height of CR air intake = 12.96 m (Section 7.1)

GH H21 centerline direction with respect to CR intake
Tan $\theta = 21.5'/84.75' = 0.254$, Therefore $\theta = \text{Tan}^{-1}\ 0.254 = 14.25^0$
Wind direction data are recorded as the direction from which the wind blows (e.g., a wind blowing out of the south is recorded with a wind direction of 180 degrees, and a wind blowing out of the west is recorded with a direction of 270 degrees) (Ref. 9.3, Section 3.4).
Orientation of GH H21 release with respect to CR air intake, considering west wind is 270^0, and that the true north is 26^0 east of the plant north (Ref. 9.14 & Ref. 9.15, Attachment A).

Orientation = $270^0 + 14.25^0 - 26^0 = 258.25^0$

7.5 Set of CR χ/Q Values for post-FHA Release from Unit 3 RHR Ground Hatch H23

The location of GH H23 with respect to CR air intake is shown in Figure 6 (Refs. 9.9 & 9.10). The GH H23 location with respect to CR air intake is such that the north-northwest wind will predominantly carry effluent from the GH H23 to the CR intake. The reactor building cross-sectional area perpendicular to a north-northwest wind is considered for the wake diffusion. The containment wake area of 2,583.6 m^2 is already calculated in PM-1055, Revision 1 (Ref. 9.15, section 2.2.1 & Attachment I), which is used in this analysis for consistency.

The centerline of the CR intake is approximately located at Column 21.4 and 5'-6" east of Row G (Ref. 9.10) in RWB.
North-south distance between CR intake and centerline of southeastern GH H23
= North-south distance between Columns 21.4 & 31 + [(Distance between Columns 31 & 33) – Distance between centerline of GH H23 & Column 31]
= 32'-3" (Ref. 9.9.2) + (5 x 25'-11" (Ref. 9.9.3) + [25'-11" (Ref. 9.9.3) – (7'-0-1/8" + 11'-10-3/4" (Ref. 9.9.3)
= 32'-3" + 129'-7" + [25'-11" – 18'-10-7/8"]
= 161'-10" + [25'-11" – 18'-10-7/8"]

= 161.83' + [25.917' – 18.9063'] = 161.83' + 7.01' = 168.84'

East-West Distance between centerline of GH H23 and CR Intake
= East-west distance between Row A & B – [Distance between Row A & centerline of southeastern GH H23] + Distance between Rows B & G + Distance between centerline of CR intake duct and Row G
= 30'-9" (Ref. 9.9.2) – [(9'-4-3/4" + 7'-0-1/8") (Ref. 9.9.3)] + [24'-3" + 20'-3" + 3'-9" (Ref. 9.9.1) + 24'-0" (Ref. 9.9.4)] + [3'-6" + 48"/2 (Ref. 9.10.1)]
= 30-9" – [16'-4-7/8"] +[72'-3"] + 5'-6" = 14.34' + 72'-3" + 5'-6" = 92.09'

Straight line horizontal distance between GH H23 and CR intake
= $[(168.84')^2 + (92.09')^2]^{1/2}$ = 192.32' = 58.63 m

Height of CR air intake = 12.96 m (Section 7.1)

GH H23 centerline direction with respect to CR intake
Tan θ =168.84'/92.09' = 1.833, Therefore θ = Tan^{-1} 1.833 = 61.39^0
Wind direction data are recorded as the direction from which the wind blows (e.g., a wind blowing out of the south is recorded with a wind direction of 180 degrees, and a wind blowing out of the west is recorded with a direction of 270 degrees) (Ref. 9.3, Section 3.4).
Orientation of GH H23 release with respect to CR air intake, considering west wind is 270^0, and that the true north is 26^0 east of the plant north (Ref. 9.14 & Ref. 9.15, Attachment A).

Orientation = $270^0 + 61.39^0 – 26^0 = 305.39^0$

8.0 RESULTS SUMMARY & CONCLUSIONS:

8.1 Results Summary

8.1.1 CR Atmospheric Dispersion Factors (χ/Qs) Due To PBAPS Ground Hatch H18 Release:

The CR χ/Q values due to the post-accident release from the PBAPS ground hatch H18 are summarized in the following Table:

CR 95% X/Q Values
Ground Hatch H18 Release

Time Interval (hr)	CR X/Q (s/m^3)
0-2	1.48E-03
2-8	6.87E-04
8-24	2.45E-04
24-96	2.10E-04
96-720	1.65E-04
ARCON96 Run	PBH18

8.1.2 CR Atmospheric Dispersion Factors (χ/Qs) Due To PBAPS Ground Hatch H19 Release:

The CR χ/Q values due to the post-accident release from the PBAPS ground hatch H19 are summarized in the following Table:

CR 95% X/Q Values
Ground Hatch H19 Release

Time Interval (hr)	CR X/Q (s/m^3)
0-2	1.75E-03
2-8	9.51E-04
8-24	3.05E-04
24-96	2.82E-04
96-720	2.44E-04
ARCON96 Run	PBH19

8.1.3 CR Atmospheric Dispersion Factors (χ/Qs) Due To PBAPS Ground Hatch H20 Release:

The CR χ/Q values due to the post-accident release from the PBAPS ground hatch H20 are summarized in the following Table:

CR 95% X/Q Values
Ground Hatch H20 Release

Time Interval (hr)	CR X/Q (s/m^3)
0-2	5.59E-03
2-8	4.61E-03
8-24	1.63E-03
24-96	1.55E-03
96-720	1.34E-03
ARCON96 Run	PBH20

8.1.4 CR Atmospheric Dispersion Factors (χ/Qs) Due To PBAPS Ground Hatch H21 Release:

The CR χ/Q values due to the post-accident release from the PBAPS ground hatch H21 are summarized in the following Table:

CR 95% X/Q Values
Ground Hatch H21 Release

Time Interval (hr)	CR X/Q (s/m^3)
0-2	6.20E-03
2-8	5.35E-03
8-24	2.14E-03
24-96	1.84E-03
96-720	1.61E-03
ARCON96 Run	PBH21

8.1.5 CR Atmospheric Dispersion Factors (χ/Qs) Due To PBAPS Ground Hatch H23 Release:

The CR χ/Q values due to the post-accident release from the PBAPS ground hatch H23 are summarized in the following Table:

CR 95% X/Q Values
Ground Hatch H23 Release

Time Interval (hr)	CR X/Q (s/m^3)
0-2	1.58E-03
2-8	1.42E-03
8-24	6.25E-04
24-96	4.41E-04
96-720	3.86E-04
ARCON96 Run	PBH23

8.2 Conclusions

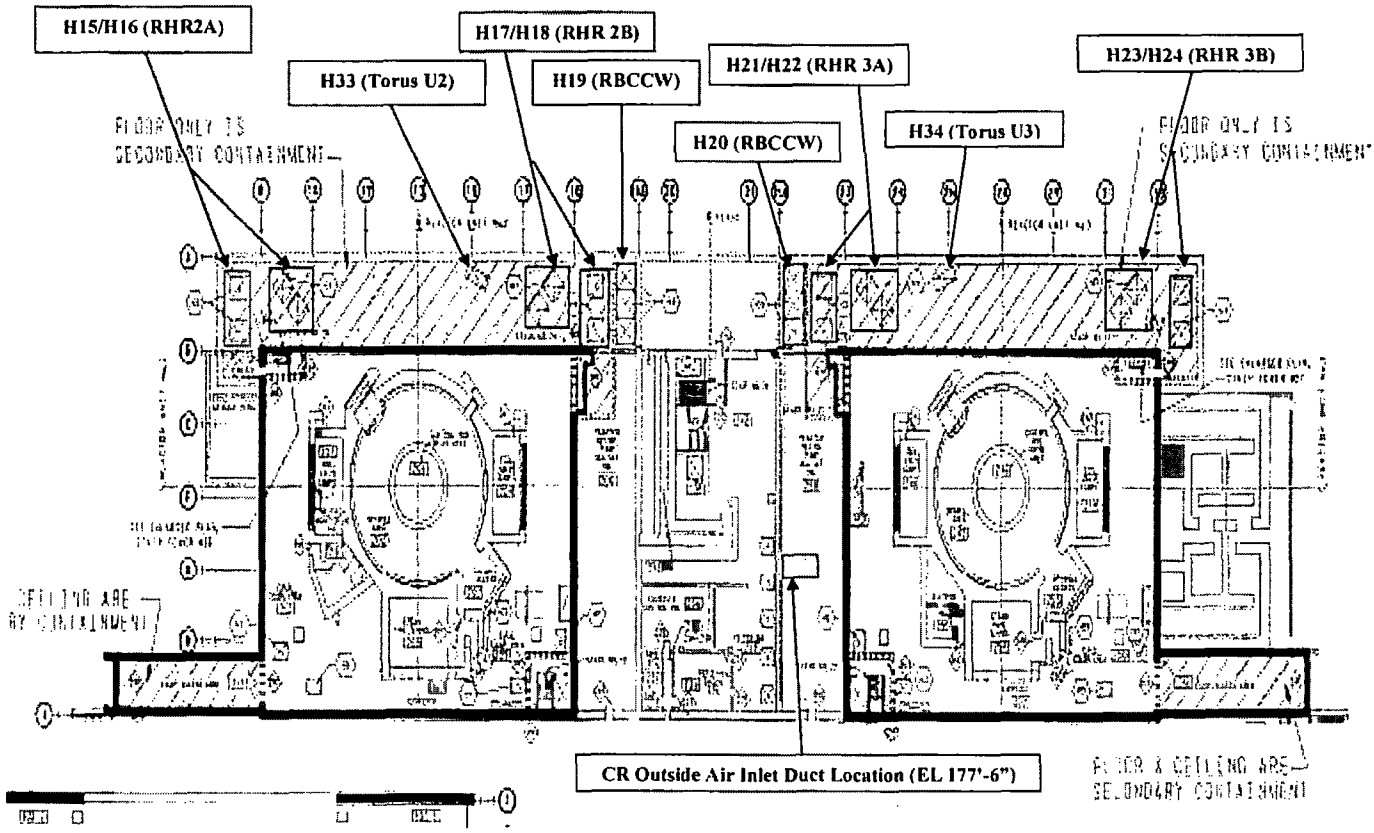
The 95th percentile atmospheric dispersion factors χ/Q values for the PBAPS control room air intake due to the post-accident releases from the ground hatches are summarized in Sections 8.1.1 through 8.1.5. The applicable χ/Q values should be used in the Fuel Handling Accident (FHA) analysis.

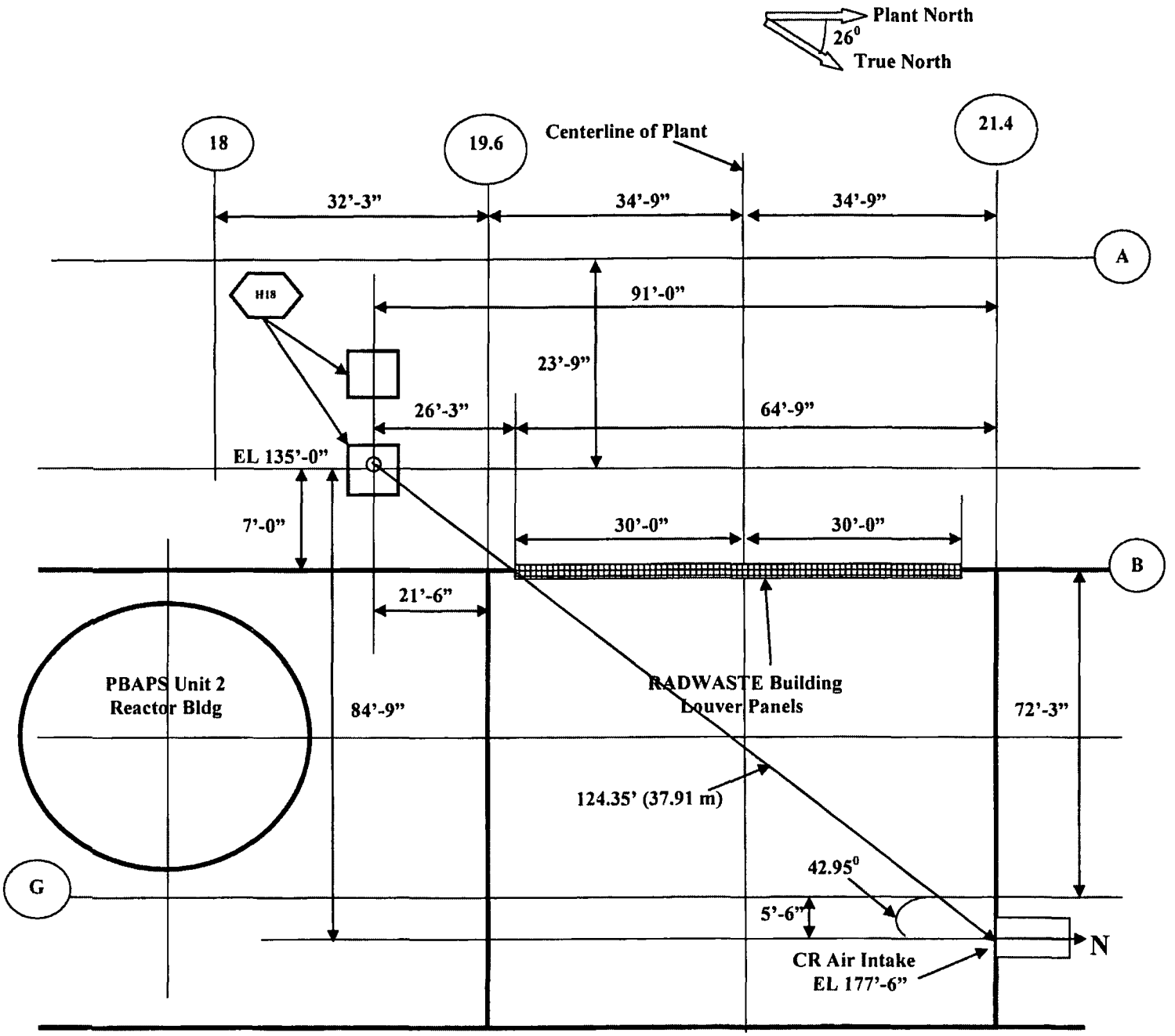
9.0 REFERENCES:

1. PBAPS Calculation No. PM-1059, Revision 5 "EAB, LPZ, and CR Doses due to Fuel Handling Accident (FHA)."
2. *Atmospheric Relative Concentrations in Building Wakes*; NUREG/CR-6331, PNNL-10521, Rev. 1; prepared by J. V. Ramsdell, Jr., C. A. Simonen, Pacific Northwest National Laboratory; prepared for U.S. Nuclear Regulatory Commission; May 1997.
3. U.S. NRC Regulatory Guide 1.194, June 2003, "Atmospheric Relative Concentrations For Control Room Radiological Habitability Assessments At Nuclear Power Plants."
4. PBAPS Architectural Drawing No. A-486, Sheet 1, Revision 8, "Barrier Plans, Elev. 135'-0."
5. Peach Bottom Atomic Power Station Amendment Nos. 269 and 273 to Renewed Facility Operating License Nos. DPR-44 and DPR-56 for the Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3. RE: Application Of Alternative Source Term Methodology; September 5, 2008 (ADAMS Accession Number ML082320257).
6. U.S. NRC Regulatory Guide 1.23, Revision 1, Meteorological Monitoring Programs for Nuclear Power Plants.
7. Peach Bottom 1984-1988 Meteorological Tower data; provided on behalf of Exelon by Pat Brennen of MES under cover letter "PBAPS Tower 1A Meteorological Data, 1983-1992", November 13, 2002.
8. PBAPS Surveillance Test ST-M-40D- 915-2, Revision 1, " Tracer Gas Testing for Control Room Envelope (CRE) Habitability (CRE Unfiltered Inleakage Testing)."
9. PBAPS Drawing Nos:
   - 9.1 S-44, Revision 37, "Reactor Building Area 7 - Plan At ELEV 135'-0"."
   - 9.2 S-55, Revision 39, "Area 9 - Reactor & Radwaste Building Plan At EL 135'-0"."
   - 9.3 S-405, Revision 26, Reactor Building Area 15 - Plan At ELEV 135'-0"."
   - 9.4 S-45, Revision 35, "Reactor Building Area 8 - Plan At ELEV 135'-0"."
10. PBAPS Drawing Nos:
    - 10.1 M-425, Revision 13, "Heating & Air Conditioning Radwaste Building Fan Room EL 165'-0" & EL181'-0" Plans."
11. 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants."
12. ANSI/ANS-2.5-1984, [Historical] Standard for Determining Meteorological Information at Nuclear Power Sites (Reaffirmed August 1990, Withdrawn 2000).
13. PBAPS Architectural Drawing Nos:
    - 13.1 A-18, Revision 12, "Reactor / Turbine Building West Elevation."
    - 13.2 A-45, Revision 6, "Louver Schedule & Details."
14. PBAPS Drawing No. C-1, Revision 21, "Site Plan."
15. PBAPS Calculation No. PM-1055, Revision 1, "Calculation of Alternative Source Term (AST) Onsite and Offsite χ/Q Values."

10.0 FIGURES:

Figure 1: Physical Location of Ground Hatches With Respect to CR Air Intake



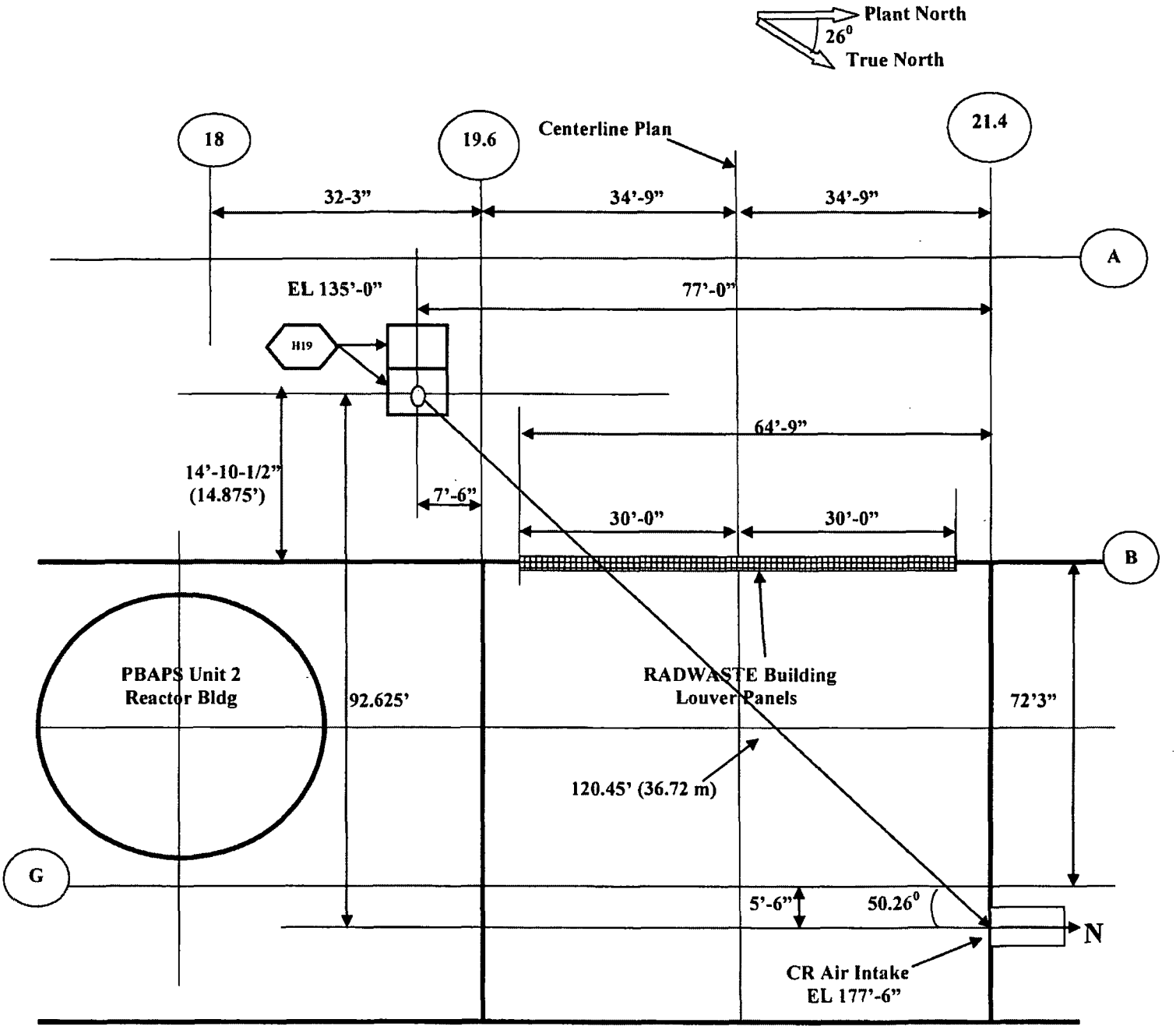


This Figure is "not to scale"

○ = Release Point □ = Receptor

FIGURE 2: PBAPS Source/Receptor Relative Locations – Ground Hatch H18/CR Air Intake

Release Point	Straight Line Length to CR Intake		Release Point Height		Direction To Source Degree	Wake Area M^2	CR Intake Height Meter
	Feet	Meter	Feet	Meter			
H18 To CR	124.35	37.91	0.0	0.0	196.95	2,583.6	12.96

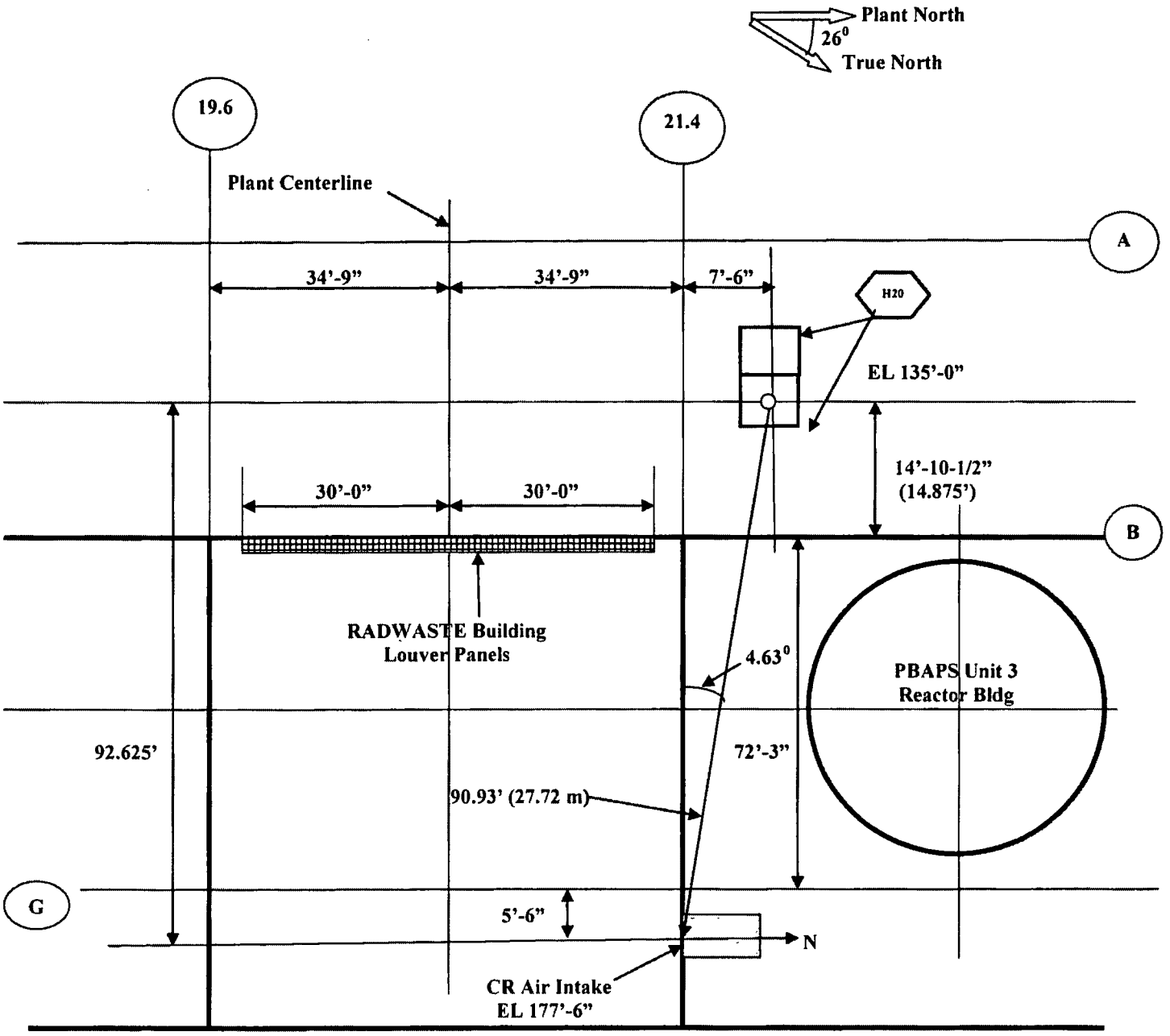


This Figure is "not to scale"

○ = Release Point □ = Receptor

FIGURE 3: PBAPS Source/Receptor Relative Locations – Ground Hatch H19/CR Air Intake

Release Point	Straight Line Length to CR Intake		Release Point Height		Direction To Source Degree	Wake Area M^2	CR Intake Height Meter
	Feet	Meter	Feet	Meter			
H19 To CR	120.45	36.72	0.0	0.0	204.26	2,583.6	12.96

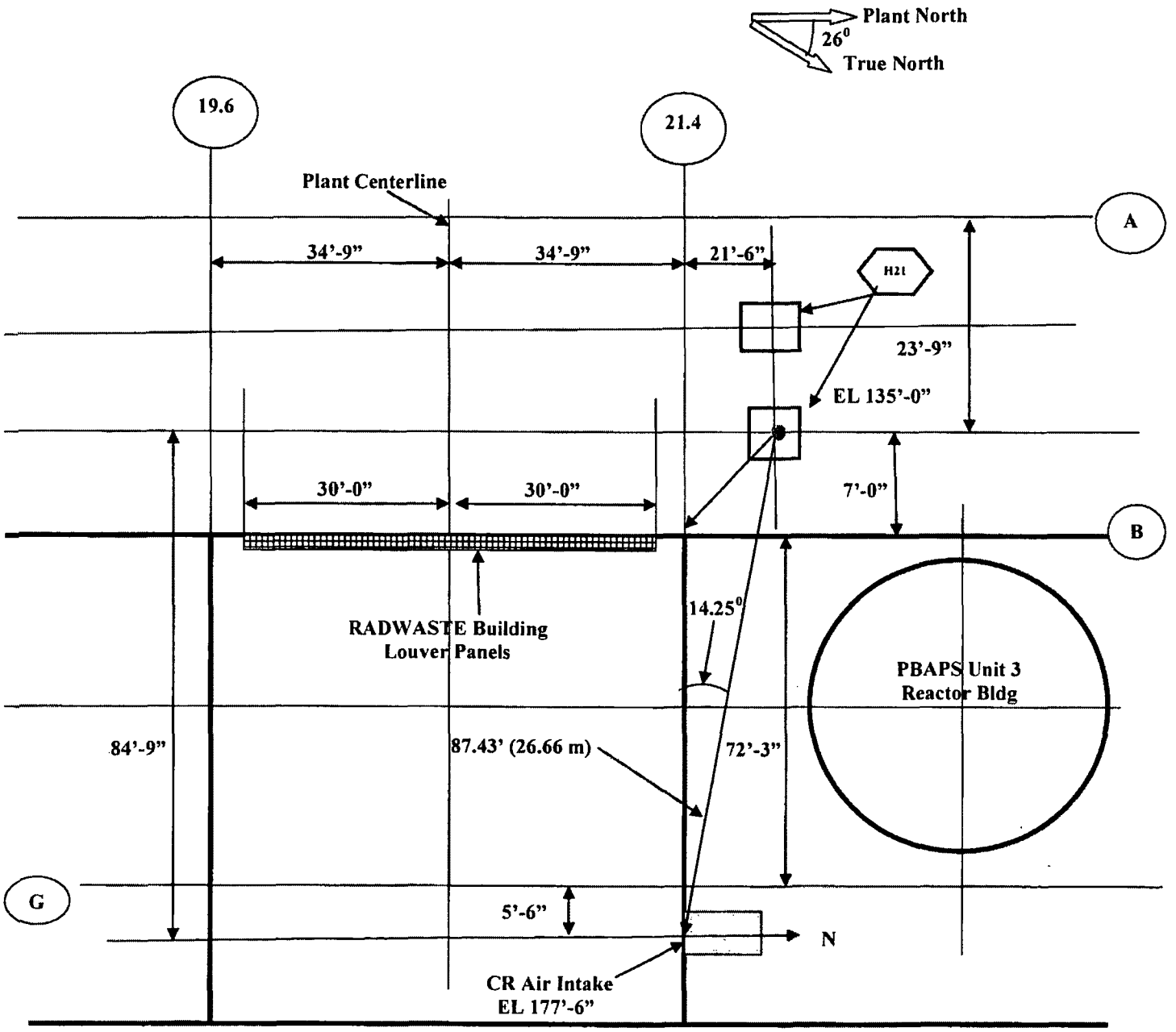


This Figure is "not to scale"

○ = Release Point □ = Receptor

FIGURE 4: PBAPS Source/Receptor Relative Locations – Ground Hatch H20/CR Air Intake

Release Point	Straight Line Length to CR Intake		Release Point Height		Direction To Source Degree	Wake Area M^2	CR Intake Height Meter
	Feet	Meter	Feet	Meter			
H20 To CR	92.93	28.33	0.0	0.0	248.63	2,583.6	12.96

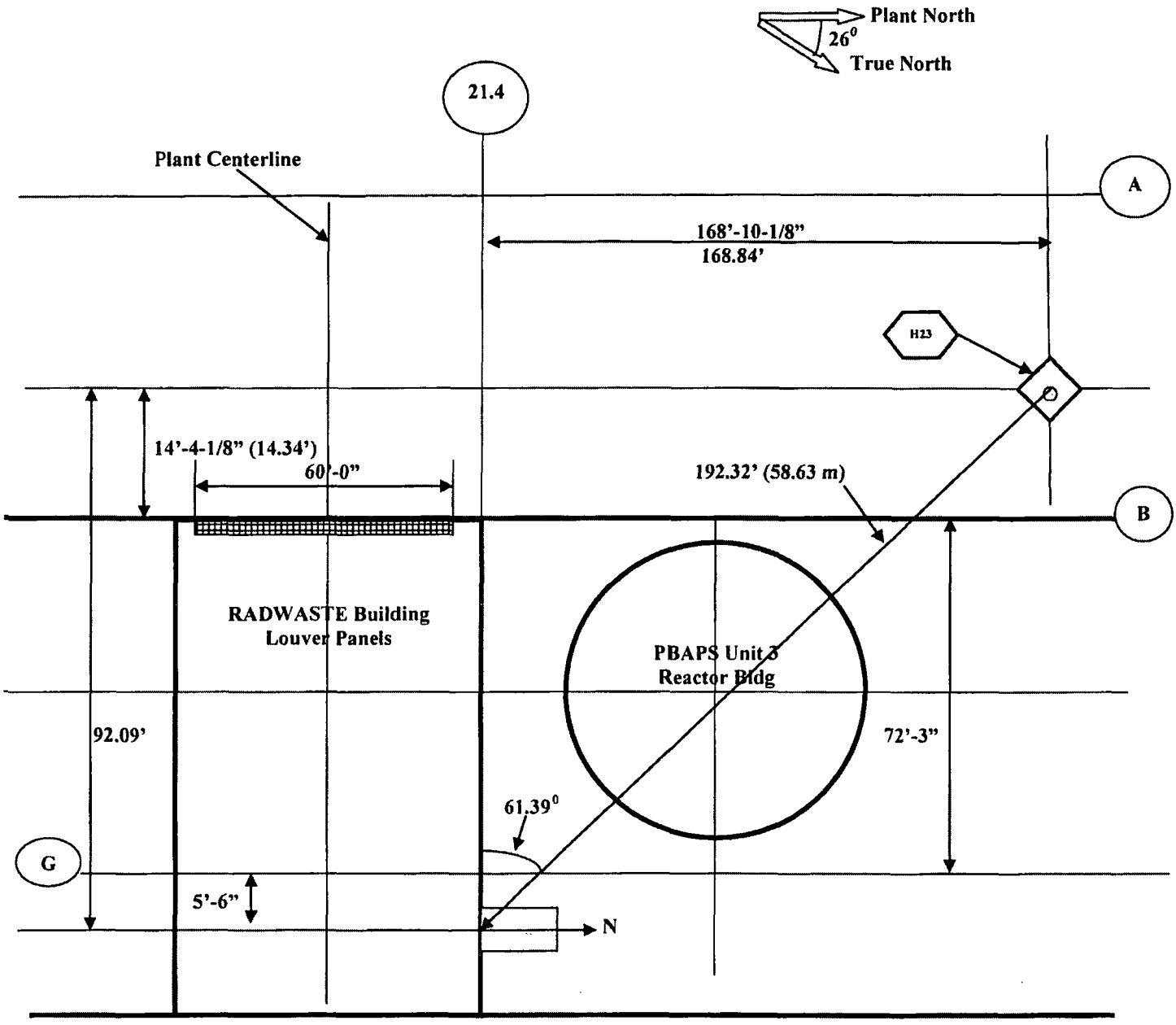


This Figure is "not to scale"

○ = Release Point □ = Receptor

FIGURE 5: PBAPS Source/Receptor Relative Locations – Ground Hatch H21/CR Air Intake

Release Point	Straight Line Length to CR Intake		Release Point Height		Direction To Source Degree	Wake Area M^2	CR Intake Height Meter
	Feet	Meter	Feet	Meter			
H21 To CR	87.43	26.66	0.0	0.0	258.25	2,583.6	12.96



This Figure is "not to scale"

○ = Release Point □ = Receptor

FIGURE 6: PBAPS Source/Receptor Relative Locations – Ground Hatch H23/CR Air Intake

Release Point	Straight Line Length to CR Intake		Release Point Height		Direction To Source Degree	Wake Area M^2	CR Intake Height Meter
	Feet	Meter	Feet	Meter			
H23 To CR	192.32	58.63	0.0	0.0	305.39	2,583.6	12.96

11.0 AFFECTED DOCUMENTS:

The following documents will be either superseded or revised:

Documents to be superseded

None

Documents to be revised

None

12.0 ATTACHMENTS:

12.1 ARCON96 Input / Output Files: PBH18
12.2 ARCON96 Input / Output Files: PBH19
12.3 ARCON96 Input / Output Files: PBH20
12.4 ARCON96 Input / Output Files: PBH21
12.5 ARCON96 Input / Output Files: PBH23

Attachment 12.1
ARCON96 Input / Output Files: PBH18

Input File

```
5
G:\ARCON96\PBMETD~1\T1AA84~1.MET
G:\ARCON96\PBMETD~1\T1AA85~1.MET
G:\ARCON96\PBMETD~1\T1AA86~1.MET
G:\ARCON96\PBMETD~1\T1AA87~1.MET
G:\ARCON96\PBMETD~1\T1AA88~1.MET
    10.36
    28.04
   2
   1
     0.00
  2583.60
     0.00
     0.00
     0.00
 197  90
    37.91
    12.96
     0.00
PBH18.log
PBH18.cfd
 .2
     0.20
     4.30
   1   2   4   8  12  24  96 168 360 720
   1   2   4   8  11  22  87 152 324 648
     0.00     0.00
n
```

Output File

```
Program Title:  ARCON96.

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

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

 NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                  e-mail: jyl1@nrc.gov
                 J. J. Hayes      Phone: (301) 415 3167
                                  e-mail: jjh@nrc.gov
                 L. A  Brown      Phone: (301) 415 1232
                                  e-mail: lab2@nrc.gov

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

 Code Documentation:  NUREG/CR-6331 Rev. 1

 The program was prepared for an agency of the United States Government. Neither
 the United States Government nor any agency thereof, nor any of their
 employees, makes any warranty, expressed or implied, or assumes any legal
 liability or responsibilities for any third party's use, or the results of such
 use, of any portion of this program or represents that its use by such third
 party would not infringe privately owned rights.

 Program Run   5/ 1/2014  at  11:38:51

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

    Number of Meteorological Data Files  =  5
    Meteorological Data File Names
      G:\ARCON96\PBMETD~1\T1AA84~1.MET
      G:\ARCON96\PBMETD~1\T1AA85~1.MET
      G:\ARCON96\PBMETD~1\T1AA86~1.MET
      G:\ARCON96\PBMETD~1\T1AA87~1.MET
      G:\ARCON96\PBMETD~1\T1AA88~1.MET

    Height of lower wind instrument (m)  =     10.4
    Height of upper wind instrument (m)  =     28.0
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =       .0
    Building Area (m^2)                  =   2583.6
    Effluent vertical velocity (m/s)     =       .00
    Vent or stack flow  (m^3/s)          =       .00
    Vent or stack radius (m)             =       .00

    Direction .. intake to source (deg)  =      197
    Wind direction sector width (deg)    =       90
    Wind direction window (deg)          =   152 - 242
    Distance to intake (m)               =     37.9
    Intake height  (m)                   =     13.0
    Terrain elevation difference (m)     =       .0

    Output file names
      PBH18.log
      PBH18.cfd

    Minimum Wind Speed (m/s)             =       .2
    Surface roughness length (m)         =       .20
    Sector averaging constant            =      4.3

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

    Expanded output for code testing not selected

    Total number of hours of data processed =  43800
    Hours of missing data                   =    464
    Hours direction in window               =   5294
    Hours elevated plume w/ dir. in window  =      0
    Hours of calm winds                     =    384
    Hours direction not in window or calm   =  37658

    DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
  AVER. PER.          1         2         4         8        12        24        96       168       360       720
  UPPER LIM.   1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02
    LOW LIM.   1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06
ABOVE RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
   IN RANGE      5678.     8093.    11449.    16544.    20705.    28461.    41197.    42402.    42343.    41983.
```

BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	37658.	35183.	31708.	26377.	22278.	14241.	1359.	136.	0.	0.
TOTAL X/Qs	43336.	43276.	43157.	42921.	42983.	42702.	42556.	42538.	42343.	41983.
% NON ZERO	13.10	18.70	26.53	38.55	48.17	66.65	96.81	99.68	100.00	100.00

95th PERCENTILE X/Q VALUES

1.48E-03	1.24E-03	1.06E-03	8.85E-04	6.90E-04	4.58E-04	2.72E-04	2.30E-04	1.97E-04	1.79E-04

95% X/Q for standard averaging intervals

0 to 2 hours	1.48E-03
2 to 8 hours	6.87E-04
8 to 24 hours	2.45E-04
1 to 4 days	2.10E-04
4 to 30 days	1.65E-04

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	4.21E-03	8.48E-04
SECTOR-AVERAGE	2.45E-03	5.19E-04

NORMAL PROGRAM COMPLETION

Attachment 12.2
ARCON96 Input / Output Files: PBH19

Input File

```
5
G:\ARCON96\PBMETD~1\T1AA84~1.MET
G:\ARCON96\PBMETD~1\T1AA85~1.MET
G:\ARCON96\PBMETD~1\T1AA86~1.MET
G:\ARCON96\PBMETD~1\T1AA87~1.MET
G:\ARCON96\PBMETD~1\T1AA88~1.MET
    10.36
    28.04
   2
   1
     0.00
  2583.60
     0.00
     0.00
     0.00
 204  90
    36.72
    12.96
     0.00
PBH19.log
PBH19.cfd
 .2
     0.20
     4.30
   1   2   4   8  12  24  96 168 360 720
   1   2   4   8  11  22  87 152 324 648
     0.00     0.00
n
```

Output File

```
 Program Title:  ARCON96.

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

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

NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyl1@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov

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

Code Documentation:  NUREG/CR-6331 Rev. 1

The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.

Program Run   5/ 1/2014  at  11:40:24

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

   Number of Meteorological Data Files  =  5
   Meteorological Data File Names
     G:\ARCON96\PBMETD~1\T1AA84~1.MET
     G:\ARCON96\PBMETD~1\T1AA85~1.MET
     G:\ARCON96\PBMETD~1\T1AA86~1.MET
     G:\ARCON96\PBMETD~1\T1AA87~1.MET
     G:\ARCON96\PBMETD~1\T1AA88~1.MET

   Height of lower wind instrument (m)  =     10.4
   Height of upper wind instrument (m)  =     28.0
   Wind speeds entered as miles per hour

   Ground-level release
   Release height (m)                   =       .0
   Building Area (m^2)                  =   2583.6
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =     204
   Wind direction sector width (deg)    =      90
   Wind direction window (deg)          =   159 - 249
   Distance to intake (m)               =    36.7
   Intake height  (m)                   =    13.0
   Terrain elevation difference (m)     =       .0

   Output file names
     PBH19.log
     PBH19.cfd

   Minimum Wind Speed (m/s)             =       .2
   Surface roughness length (m)         =       .20
   Sector averaging constant            =     4.3

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

   Expanded output for code testing not selected

   Total number of hours of data processed =  43800
   Hours of missing data                   =    464
   Hours direction in window               =   6603
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    384
   Hours direction not in window or calm   =  36349

   DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
 AVER. PER.          1         2         4         8        12        24        96       168       360       720
 UPPER LIM.   1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02
   LOW LIM.   1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06
ABOVE RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
```

IN RANGE	6987.	9687.	13353.	18881.	23431.	31287.	41731.	42513.	42343.	41983.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	36349.	33589.	29804.	24040.	19552.	11415.	825.	25.	0.	0.
TOTAL X/Qs	43336.	43276.	43157.	42921.	42983.	42702.	42556.	42538.	42343.	41983.
% NON ZERO	16.12	22.38	30.94	43.99	54.51	73.27	98.06	99.94	100.00	100.00

95th PERCENTILE X/Q VALUES

1.75E-03	1.54E-03	1.36E-03	1.15E-03	9.01E-04	5.87E-04	3.58E-04	3.14E-04	2.78E-04	2.59E-04

95% X/Q for standard averaging intervals

0 to 2 hours	1.75E-03
2 to 8 hours	9.51E-04
8 to 24 hours	3.05E-04
1 to 4 days	2.82E-04
4 to 30 days	2.44E-04

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	4.44E-03	8.89E-04
SECTOR-AVERAGE	2.59E-03	5.46E-04

NORMAL PROGRAM COMPLETION

Attachment 12.3
ARCON96 Input / Output Files: PBH20

Input File

```
5
G:\ARCON96\PBMETD~1\T1AA84~1.MET
G:\ARCON96\PBMETD~1\T1AA85~1.MET
G:\ARCON96\PBMETD~1\T1AA86~1.MET
G:\ARCON96\PBMETD~1\T1AA87~1.MET
G:\ARCON96\PBMETD~1\T1AA88~1.MET
    10.36
    28.04
   2
   1
     0.00
  2583.60
     0.00
     0.00
     0.00
 249  90
    28.33
    12.96
     0.00
PBH20.log
PBH20.cfd
 .2
     0.20
     4.30
   1   2   4   8  12  24  96 168 360 720
   1   2   4   8  11  22  87 152 324 648
     0.00      0.00
n
```

Output File

```
Program Title:  ARCON96.

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

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

NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyl1@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov

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

Code Documentation:  NUREG/CR-6331 Rev. 1

The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.

Program Run   5/ 1/2014  at  11:42:21

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

    Number of Meteorological Data Files  =  5
    Meteorological Data File Names
      G:\ARCON96\PBMETD~1\T1AA84~1.MET
      G:\ARCON96\PBMETD~1\T1AA85~1.MET
      G:\ARCON96\PBMETD~1\T1AA86~1.MET
      G:\ARCON96\PBMETD~1\T1AA87~1.MET
      G:\ARCON96\PBMETD~1\T1AA88~1.MET

    Height of lower wind instrument (m)  =     10.4
    Height of upper wind instrument (m)  =     28.0
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =       .0
    Building Area (m^2)                  =   2583.6
    Effluent vertical velocity (m/s)     =       .00
    Vent or stack flow  (m^3/s)          =       .00
    Vent or stack radius (m)             =       .00

    Direction .. intake to source (deg)  =      249
    Wind direction sector width (deg)    =       90
    Wind direction window (deg)          =   204 - 294
    Distance to intake (m)               =     28.3
    Intake height  (m)                   =     13.0
    Terrain elevation difference (m)     =       .0

    Output file names
      PBH20.log
      PBH20.cfd

    Minimum Wind Speed (m/s)             =       .2
    Surface roughness length (m)         =       .20
    Sector averaging constant            =      4.3

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

    Expanded output for code testing not selected

    Total number of hours of data processed =  43800
    Hours of missing data                =    464
    Hours direction in window            =  19849
    Hours elevated plume w/ dir. in window =     0
    Hours of calm winds                  =    384
    Hours direction not in window or calm  =  23103

    DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
   AVER. PER.          1         2         4         8        12        24        96       168       360       720
   UPPER LIM.   1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02
     LOW LIM.   1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06
```

ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	20233.	23128.	27042.	32584.	36328.	39784.	42479.	42538.	42343.	41983.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	23103.	20148.	16115.	10337.	6655.	2918.	77.	0.	0.	0.
TOTAL X/Qs	43336.	43276.	43157.	42921.	42983.	42702.	42556.	42538.	42343.	41983.
% NON ZERO	46.69	53.44	62.66	75.92	84.52	93.17	99.82	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

5.59E-03 5.43E-03 5.20E-03 4.85E-03 3.92E-03 2.71E-03 1.84E-03 1.64E-03 1.47E-03 1.40E-03

95% X/Q for standard averaging intervals

0 to 2 hours	5.59E-03
2 to 8 hours	4.61E-03
8 to 24 hours	1.63E-03
1 to 4 days	1.55E-03
4 to 30 days	1.34E-03

	HOURLY VALUE RANGE	
	MAX X/Q	MIN X/Q
CENTERLINE	7.75E-03	9.84E-04
SECTOR-AVERAGE	4.52E-03	5.74E-04

NORMAL PROGRAM COMPLETION

Attachment 12.4
ARCON96 Input / Output Files: PBH21

Input File

```
5
G:\ARCON96\PBMETD~1\T1AA84~1.MET
G:\ARCON96\PBMETD~1\T1AA85~1.MET
G:\ARCON96\PBMETD~1\T1AA86~1.MET
G:\ARCON96\PBMETD~1\T1AA87~1.MET
G:\ARCON96\PBMETD~1\T1AA88~1.MET
    10.36
    28.04
   2
   1
     0.00
  2583.60
     0.00
     0.00
     0.00
 258  90
    26.66
    12.96
     0.00
PBH21.log
PBH21.cfd
 .2
     0.20
     4.30
   1   2   4   8  12  24  96 168 360 720
   1   2   4   8  11  22  87 152 324 648
     0.00      0.00
n
```

Output File

```
Program Title:  ARCON96.

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

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

NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyl1@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov

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

Code Documentation:  NUREG/CR-6331 Rev. 1

The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.

Program Run   5/ 1/2014  at  11:44:04

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

    Number of Meteorological Data Files  =  5
    Meteorological Data File Names
      G:\ARCON96\PBMETD~1\T1AA84~1.MET
      G:\ARCON96\PBMETD~1\T1AA85~1.MET
      G:\ARCON96\PBMETD~1\T1AA86~1.MET
      G:\ARCON96\PBMETD~1\T1AA87~1.MET
      G:\ARCON96\PBMETD~1\T1AA88~1.MET

    Height of lower wind instrument (m)  =     10.4
    Height of upper wind instrument (m)  =     28.0
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =       .0
    Building Area (m^2)                  =   2583.6
    Effluent vertical velocity (m/s)     =       .00
    Vent or stack flow  (m^3/s)          =       .00
    Vent or stack radius (m)             =       .00

    Direction .. intake to source (deg)  =      258
    Wind direction sector width (deg)    =       90
    Wind direction window (deg)          =   213 - 303
    Distance to intake (m)               =     26.7
    Intake height  (m)                   =     13.0
    Terrain elevation difference (m)     =       .0

    Output file names
      PBH21.log
      PBH21.cfd

    Minimum Wind Speed (m/s)             =       .2
    Surface roughness length (m)         =       .20
    Sector averaging constant            =      4.3

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

    Expanded output for code testing not selected

    Total number of hours of data processed =  43800
    Hours of missing data                   =    464
    Hours direction in window               =  21095
    Hours elevated plume w/ dir. in window  =      0
    Hours of calm winds                     =    384
    Hours direction not in window or calm   =  21867

    DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
   AVER. PER.          1         2         4         8        12        24        96       168       360       720
   UPPER LIM.   1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02
     LOW LIM.   1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06
```

ABOVE RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IN RANGE	21469.	24182.	27891.	33084.	36621.	39905.	42479.	42538.	42343.	41983.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	21867.	19094.	15266.	9837.	6362.	2797.	77.	0.	0.	0.
TOTAL X/Qs	43336.	43276.	43157.	42921.	42983.	42702.	42556.	42538.	42343.	41983.
% NON ZERO	49.54	55.88	64.63	77.08	85.20	93.45	99.82	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

6.20E-03	6.09E-03	5.88E-03	5.56E-03	4.58E-03	3.28E-03	2.20E-03	1.97E-03	1.77E-03	1.69E-03

95% X/Q for standard averaging intervals

0 to 2 hours	6.20E-03
2 to 8 hours	5.35E-03
8 to 24 hours	2.14E-03
1 to 4 days	1.84E-03
4 to 30 days	1.61E-03

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	8.54E-03	1.06E-03
SECTOR-AVERAGE	4.98E-03	6.16E-04

NORMAL PROGRAM COMPLETION

Attachment 12.5
ARCON96 Input / Output Files: PBH23

Input File

```
5
G:\ARCON96\PBMETD~1\T1AA84~1.MET
G:\ARCON96\PBMETD~1\T1AA85~1.MET
G:\ARCON96\PBMETD~1\T1AA86~1.MET
G:\ARCON96\PBMETD~1\T1AA87~1.MET
G:\ARCON96\PBMETD~1\T1AA88~1.MET
    10.36
    28.04
   2
   1
     0.00
  2583.60
     0.00
     0.00
     0.00
 305  90
    58.63
    12.96
     0.00
PBH23.log
PBH23.cfd
 .2
     0.20
     4.30
   1   2   4   8  12  24  96 168 360 720
   1   2   4   8  11  22  87 152 324 648
     0.00     0.00
n
```

Output File

```
Program Title:  ARCON96.

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

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

NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyl1@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov

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

Code Documentation:  NUREG/CR-6331 Rev. 1

The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.

Program Run   5/ 1/2014  at  11:45:09

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

    Number of Meteorological Data Files  =  5
    Meteorological Data File Names
      G:\ARCON96\PBMETD~1\T1AA84~1.MET
      G:\ARCON96\PBMETD~1\T1AA85~1.MET
      G:\ARCON96\PBMETD~1\T1AA86~1.MET
      G:\ARCON96\PBMETD~1\T1AA87~1.MET
      G:\ARCON96\PBMETD~1\T1AA88~1.MET

    Height of lower wind instrument (m)  =     10.4
    Height of upper wind instrument (m)  =     28.0
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =       .0
    Building Area (m^2)                  =   2583.6
    Effluent vertical velocity (m/s)     =       .00
    Vent or stack flow  (m^3/s)          =       .00
    Vent or stack radius (m)             =       .00

    Direction .. intake to source (deg)  =      305
    Wind direction sector width (deg)    =       90
    Wind direction window (deg)          =  260 - 350
    Distance to intake (m)               =     58.6
    Intake height  (m)                   =     13.0
    Terrain elevation difference (m)     =       .0

    Output file names
      PBH23.log
      PBH23.cfd

    Minimum Wind Speed (m/s)             =       .2
    Surface roughness length (m)         =       .20
    Sector averaging constant            =      4.3

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

    Expanded output for code testing not selected

    Total number of hours of data processed =  43800
    Hours of missing data                   =    464
    Hours direction in window               =  18165
    Hours elevated plume w/ dir. in window  =      0
    Hours of calm winds                     =    384
    Hours direction not in window or calm   =  24787

   DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
  AVER. PER.          1         2         4         8        12        24        96       168       360       720
  UPPER LIM.   1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02
    LOW LIM.   1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06
 ABOVE RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
```

IN RANGE	18549.	21849.	26015.	30862.	34219.	39177.	42480.	42538.	42343.	41983.
BELOW RANGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZERO	24787.	21427.	17142.	12059.	8764.	3525.	76.	0.	0.	0.
TOTAL X/Qs	43336.	43276.	43157.	42921.	42983.	42702.	42556.	42538.	42343.	41983.
% NON ZERO	42.80	50.49	60.28	71.90	79.61	91.75	99.82	100.00	100.00	100.00

95th PERCENTILE X/Q VALUES

1.58E-03	1.57E-03	1.53E-03	1.46E-03	1.21E-03	9.04E-04	5.57E-04	4.81E-04	4.31E-04	4.09E-04

95% X/Q for standard averaging intervals

0 to 2 hours	1.58E-03
2 to 8 hours	1.42E-03
8 to 24 hours	6.25E-04
1 to 4 days	4.41E-04
4 to 30 days	3.86E-04

HOURLY VALUE RANGE

	MAX X/Q	MIN X/Q
CENTERLINE	2.17E-03	1.90E-04
SECTOR-AVERAGE	1.26E-03	1.11E-04

NORMAL PROGRAM COMPLETION

1st Pass Attributes – General Overview

Yes	No	Attribute
☒	☐	The purpose/scope is clear and well defined. You should be able to understand the purpose without resorting to consultation with the preparer. (4.3.2)
☒	☐	The reason or need for the product is clearly discussed. (4.3.2)
☒	☐	You possess the proper knowledge and skill sets needed for the review. If additional expertise is needed, those reviews have been scheduled to ensure that appropriate knowledgeable "experts" are utilized for reviews.
☒	☐	The Methodology is appropriate for the purpose and scope of the document, and is clearly documented.

2nd Pass Attributes – Technical Review

Yes	No	Attribute
☒	☐	Input Parameters are clearly listed, defined with source documentation.
☒	☐	The Inputs are valid and are referenced to a quality documented reference.
☒	☐	Assumptions are reasonable and well documented.
☒	☐	The Methodology is appropriate and Equations Used have been verified- Ensure proper methodology & units
☒	☐	If an Alternate Calculation Tools or Methods was used as the review method, that analysis has been attached to the final document
☒	☐	The Numerical calculations and computations have been verified correct- validate the numbers
☒	☐	The acceptance criteria is consistent with the Design Basis, Design Standards and applicable codes.
☒	☐	Does the analysis consider new potential failure modes and disposition them as appropriate? If none are indicated, is this appropriate?
☒	☐	Does the product consider the most limiting or bounding design basis conditions?
☒	☐	Are the results consistent with actual plant response and do they appear reasonable?
☒	☐	Does the conclusion clearly support the purpose as described?

3rd Pass Attributes – Administrative

Yes	No	Attribute
☒	☐	Check references- are they the correct rev
☒	☐	Check procedures used- are they the correct rev
☒	☐	Assumptions are reasonable and well documented
☒	☐	Check for Spelling Errors, Punctuation and Grammar
☒	☐	Check for simplicity and readability
☒	☐	Are the proper forms included in the document and filled out correctly
☒	☐	Check Page and Attachment Numbering
☒	☐	Right Boxes Checked on Forms
☒	☐	Proper process has been used, Major Rev, Minor Rev, EC/ECR etc.
☒	☐	Appropriate boxes are signed off or marked N/A

Reviewer: Mark Drucker 05/27/2014

Print / Signature Date