SANDIA REPORT
SAND2021-6924
June 2021

Implementation of Additional Models into the MACCS Code for Nearfield Consequence Analysis

Daniel J. Clayton

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico
87185 and Livermore,
California 94550

Issued by Sandia National Laboratories, operated for the United States Department of Energy by National Technology & Engineering Solutions of Sandia, LLC.

Available to DOE and DOE contractors from
U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831

Telephone: (865) 576-8401
Facsimile: (865) 576-5728
E-Mail: reports@osti.gov
Online ordering: http://www.osti.gov/scitech

Available to the public from
U.S. Department of Commerce
National Technical Information Service
5301 Shawnee Rd
Alexandria, VA 22312

Telephone: (800) 553-6847
Facsimile: (703) 605-6900
E-Mail: orders@ntis.gov
Online order: https://classic.ntis.gov/help/order-methods/

National Nuclear Security Administration

ABSTRACT

The NRC's Non-Light Water Reactor Vision and Strategy report discusses the MACCS code readiness for nearfield analyses. To increase the nearfield capabilities of MACCS, the plume meander model from Ramsdell and Fosmire was integrated into MACCS and the MACCS plume meander model based on U.S. NRC Regulatory Guide 1.145 was updated. Test cases were determined to verify the plume meander model implementation into MACCS 4.1. The results using the implemented MACCS plume meander models match the comparisons with other codes and analytical calculations. This verifies that the additional MACCS plume meander models have been successfully implemented into MACCS 4.1. This report documents the verification of these model implementations into MACCS and a comparison of the results using these models.

This work was sponsored by the U.S. NRC's Office of Nuclear Regulatory Research under contract number 31310020F0032.

This page left blank

CONTENTS

LIST OF FIGURES

LIST OF TABLES

This page left blank

ACRONYMS AND DEFINITIONS

Abbreviation	Definition
AERMOD	American Meteorological Society / Environmental Protection Agency Regulatory Model
ARCON96	Atmospheric Relative Concentrations in Building Wakes
ATD	Atmospheric Transport and Dispersion
CFD	Computational Fluid Dynamics
X/Q	Normalized, ground-level, time-integrated air concentration
DOE	Department of Energy
LWR	Light Water Reactor
MACCS	MELCOR Accident Consequence Code System
NRC	Nuclear Regulatory Commission
PAVAN	Program for the Meteorological Evaluation of Non-Routine Releases from Nuclear Power Stations
QUIC	Quick Urban and Industrial Complex

This page left blank

1. INTRODUCTION

In the context of dispersion, nearfield is commonly defined as being over distance scales from those of individual buildings up to those of neighborhoods [1]. For this report, nearfield is defined to be distances for which the standard Gaussian plume and puff models have been questioned, and this is interpreted to be distances of less than 500 m, as explained below.

The Nuclear Regulatory Commission (NRC) developed a non-Light Water Reactor (LWR) vision and strategy report that discusses computer code readiness for non-LWR applications [2]. The adequacy of the MELCOR Accident Consequence Code System (MACCS) [3] in the nearfield is discussed in that report and several options for improving the capabilities are presented. MACCS is a highly flexible tool used for atmospheric transport and dispersion in which the user can choose whether to model a variety of physical phenomena, including such things as building wake effects, plume buoyancy, and plume meander. Furthermore, the user has flexibility in choosing how to model the Gaussian dispersion parameters.

The original MACCS building wake model assumes that the plume is instantaneously mixed within the turbulent wake of the building. The model assumes that this rapid mixing can be represented by a binormal distribution as described in Turner [4], who suggests that the virtual source distances be derived to represent an area source for which the concentrations at the edges of the building from which the release occurs are assumed to be 10 percent of plume centerline concentrations. Starting with MACCS2, the user can define the initial plume dimensions independent of the dimensions of the building. The MACCS2 User's Guide [5] suggests that this simple building wake model should not be used at distances closer than 500 m. This statement raises the question of whether MACCS can reliably be used to assess nearfield doses, i.e., at distances less than 500 m. Nonetheless, the Department of Energy (DOE) uses MACCS to conservatively estimate doses to collocated workers at 100 m by assuming no building wake effects (point source release) and ground-level releases [6]. Other codes based on Gaussian plume models are commonly used to estimate nearfield doses by using corrections that are intended to skew the results toward conservatism or at least toward a best estimate, depending on the purpose for the model.

Conservatism in the context of this report is based on centerline, ground-level air concentration, which translates to other results that are proportional to or depend directly on this concentration. Calculating higher centerline, ground-level air concentrations does not necessarily translate to higher values for all other consequence metrics. For example, total population dose depends not only on the ground-level air concentration, but also the locations of population centers relative to the wind direction.

Methods to estimate atmospheric transport and dispersion (ATD) in the nearfield fall into four categories: (1) field measurements, (2) wind-tunnel measurements, (3) particle tracking based on computational fluid dynamics (CFD) or simplified models to estimate the wind flow around and between buildings, and (4) empirical models. Some models bridge these categories. This report focuses on modeling approaches, as opposed to experimental approaches, to estimate nearfield air concentrations and ground deposition. However, most of the models discussed in this report have been compared with nearfield measurements to provide a perspective on the accuracy and uncertainty of the modeling approaches.

1.1. Background

The technical issue of nearfield modeling using a Gaussian plume model is not new. A summary of nearfield ATD models including building wake effects was documented for the NRC by Simpkins

[7]. This summary shows results with different methods varying by multiple orders of magnitude. An evaluation of the technical bases for the atmospheric dispersion parameter, X/Q, used to calculate onsite doses at 100 m was conducted by DOE [8]. They found that the current methodology provides a conservative estimate of X/Q at 100 m. A review of the ATD modeling for environmental radiation dose assessments at the Savannah River Site was conducted [9], which included a discussion of the validity of MACCS calculations at short distances. In the discussion of the validity of MACCS at short distances, a recommendation is made in [9] to use an area source rather than a point source to estimate doses.

To support the NRC non-LWR vision and strategy report discussion of MACCS, an additional evaluation of whether MACCS could be used to estimate nearfield air concentrations was performed by Clayton and Bixler [10]. In Clayton and Bixler [10], three codes were used for comparisons to evaluate the adequacy of MACCS in the nearfield; ARCON96 [11], AERMOD [12], and QUIC [13]. Test cases were developed to give a broad range of weather conditions, building dimensions, and plume buoyancy [10].

MACCS was run for the test cases with the Eimutis and Konicek dispersion parameter formulation [14] and the MACCS plume meander model based on NUREG/CR-2260 [15] and Regulatory Guide 1.145 [16]. Based on the comparisons of MACCS with ARCON96, AERMOD, and QUIC across the test cases, the following observations were made [10]:

- MACCS calculations configured with point-source, ground-level, nonbuoyant plumes provide conservative nearfield results that bound the centerline, ground-level air concentrations from AERMOD, ARCON96, and QUIC.
- MACCS calculations with ground-level, nonbuoyant plumes that include the effects of the building wake (area source) provide nearfield results that bound the results from AERMOD and QUIC and the results from ARCON96 at distances greater than 250 m.
- If using a point-source is too conservative and it is desired to bound the results from all three codes, another alternative is to use area source parameters in MACCS that are less than the standard values, i.e., an area source intermediate between the standard recommendation and a point source.

These options provided results from MACCS that are bounding for the test cases evaluated [10]. How to best use MACCS in the nearfield is a more complex question that touches on the uncertainty inherent in ATD models and on the degree of conservatism that is desirable for regulatory applications. This report does not attempt to address the level of conservatism that is desirable for regulatory applications.

In Clayton and Bixler [10], it was demonstrated that MACCS can be used at distances significantly shorter than 500 m downwind from a containment or reactor building (or other building from which a radioactive release occurs), contrary to the comment in the MACCS2 User's Guide [5]. However, the MACCS user needs to select the MACCS input parameters appropriately to generate results that are adequately conservative for a specific application. To increase the nearfield capabilities of MACCS, the plume meander model from ARCON96 (Ramsdell and Fosmire [17]), which accounts for both building wake effects and low wind speed plume meander, was integrated into MACCS. In addition, the MACCS plume meander model based on NUREG/CR-2260 [15] was updated to be consistent with the recommendations of Regulatory Guide 1.145 [16].

1.2. Objective

The objective of this report is to document the implementation and verification of the plume meander models added to MACCS. These additional nearfield models provide options in MACCS to simulate or bound nearfield calculations performed with other codes. The following conditions will verify the implementation of the additional models.

- The Ramsdell and Fosmire plume meander model [17] matches results from ARCON96 given the right parameterization.
- The MACCS Regulatory Guide 1.145 model [15][16] with a point source matches results from PAVAN [18] given the right parameterization.
- The MACCS Regulatory Guide 1.145 model [15][16] with the area source bounds AERMOD and QUIC results as shown in Clayton and Bixler [10] given the right dispersion parameterization.

This page left blank

2. MODEL OVERVIEW

MACCS has traditionally modeled dispersion during downwind transport using a Gaussian plume segment model. Thus, the crosswind and vertical extent of each plume segment is expressed in terms of crosswind (σ_y) and vertical (σ_z) standard deviations of the normal concentration distributions that characterize a Gaussian plume. The Gaussian equations implemented in MACCS are derived assuming that turbulent velocities are negligible compared with the mean wind speed.

During downwind transport, atmospheric turbulence causes plume segments to expand in all directions with the rate of expansion increasing when atmospheric turbulence increases. Vertical expansion of a plume is enhanced by larger values of surface roughness and constrained by the ground and by the temperature structure of the atmosphere (location of inversion layers). Crosswind spreading of the plume along the y-direction is unconstrained. The effective crosswind dimensions of a plume segment are increased by lateral meander of the plume about its centerline trajectory. Like many Gaussian plume models, MACCS assumes that turbulent velocities are small compared to the mean wind speed that transports the bulk plume and that expansion in the wind direction can therefore be neglected.

Several parameterizations are available for estimating dispersion coefficients for use with MACCS. The dispersion model parameters in MACCS are under the control of the user. MACCS should be configured by the user in an appropriate manner. For the analyses in this report, the parameterization of Eimutis and Konicek [11] is used for σ_y and σ_z and implemented via a lookup table. The Eimutis and Konicek parameterization of the Pasquill-Gifford diffusion curves is used because, unlike the Tadmor-Gur parameterization traditionally used in MACCS, it provides approximations to the vertical dispersion coefficient σ_z that match the Pasquill-Gifford curves at distances less than 500 meters from the source. The lookup table parameters are documented in Napier et al. [9] and are also shown in the MACCS input files in Appendix D. It should be noted that the meander models discussed in this report (both the Regulatory Guide 1.145 meander model and the Ramsdell and Fosmire model) were developed as adjustments to the Pasquill-Gifford diffusion curves [19][20]. The analyst should be aware of this and exercise caution if using these meander models with diffusion curves other than those based on the Pasquill-Gifford curves.

The model for building wake effects included in MACCS 4.0 is based on Turner [4] and scales the initial dimensions of the plume based on the dimensions of the building or complex of buildings from which the pollutants are emitted. The typical assumption used in MACCS is that concentrations at the horizontal edges of the building and directly above the centerline at the top of the building are 10% of the centerline plume concentration. This translates into assuming σ_y equals 0.23 times the building width and σ_z equals 0.47 times the building height immediately downstream of the building. This model is selected by setting the source to an area source with the values of σ_y and σ_z based on the building dimensions and is shown in the MACCS input files in Appendix D.

MACCS models area sources using a concept know as a “virtual” source location. A virtual source location is a release point at a hypothetical upwind location. The location of this virtual source depends on the dispersion rate model and is based on the dispersion at a specific plume location. With these boundary conditions, the dispersion rate models can calculate σ_y and σ_z according to the downwind distance from the virtual source location.

Wind shifts that can occur at time intervals less than that of the recorded weather data can result in an apparent dispersion that is greater than would be computed using dispersion curves based on measurements over a shorter time period. The apparent increase in crosswind dispersion can be significant under stable, low-wind speed conditions. This effect is known as plume meander.

Adjustment of the crosswind plume dimensions to account for plume meander can be handled in a variety of ways in MACCS. MACCS 4.0 has three plume meander models. Modifications and additions to the plume meander models for MACCS 4.1 are discussed in Sections 2.2 and 2.3. The original MACCS plume meander model (termed “OLD”), adjusts the crosswind dispersion based on the duration of the release. The “NEW” MACCS plume meander model accounts for the dependence on stability class and wind speed and is discussed further in Section 2.1. The third option is to disable the plume meander model (termed “OFF”). MACCS can further modify the dispersion through scaling factors. Scaling factors can be used for both the crosswind (YSCALE) and vertical (ZSCALE) dispersion. These scaling factors are applied in a multiplicative fashion in MACCS, in addition to the plume meander model selected. For example, if a selected plume meander model calculated a crosswind meander factor of 2.5 and the crosswind scaling factor (YSCALE) was set to 0.8, MACCS would use an aggregate crosswind meander factor of 2.0 (2.5 × 0.8) in the dispersion calculations.

2.1. MACCS 4.0 Regulatory Guide 1.145 Plume Meander Model

One of the plume meander models implemented into MACCS version 4.0 is based on NUREG/CR-2260 [15] and Regulatory Guide 1.145 [16] and accounts for the observation that the impact of plume meander depends on stability class and wind speed. The model described in Regulatory Guide 1.145 considers the effects of both building wake mixing and ambient plume meander. The MACCS version 4.0 Regulatory Guide 1.145 plume meander model is similar to the model described in Regulatory Guide 1.145 with a different approach is used at distances greater than 800 m. MACCS treats plume meander beyond 800 m by using a virtual source, similar to the way an area source is treated. The meander occurs in the first 800 m downwind, creating a broader plume at that distance. Beyond 800 m, the plume gradually approaches the size that it would have had if meander had not occurred. In the MACCS implementation, the user may specify a downwind distance other than 800 m if desired. Beyond this distance, the meander factor is set to unity and location of the virtual source is adjusted to ensure continuity in the value of σ_y.

The model described in Regulatory Guide 1.145 [16] incorporates three principal equations. The MACCS version 4.0 Regulatory Guide 1.145 plume meander model uses the area source model described in Turner [4], combined with the third equation from the Regulatory Guide 1.145 plume meander model. Essentially, the area source model is used in place of Equations 1 and 2 in the MACCS version 4.0 model.

The MACCS version 4.0 Regulatory Guide 1.145 plume meander model is defined as follows:

$$\sigma_{ym}(x) = f_{ym3} \cdot \sigma_y(x) \qquad (2\text{-}1)$$

where

$\sigma_y(x)$ = the crosswind dispersion that is evaluated without meander

$\sigma_{ym}(x)$ = the crosswind dispersion accounting for plume meander
x = the downwind distance measured from the source
f_{ym3} = the crosswind meander factor derived from Equation 3 in Regulatory Guide 1.145

Based on Regulatory Guide 1.145, the crosswind meander factor for Equation 3 is defined as follows:

$$f_{ym3} = m_i \cdot f(u) \tag{2-2}$$

where

m_i = 1 for stability classes A through C, 2 for stability class D, 3 for stability class E, 4 for stability class F and G

$f(u)$ is a function of wind speed (u) given by:

$$f(u) = 1 \qquad u \le u_i \tag{2-3}$$

$$f(u) = \frac{1}{m_i} exp\left[\left(1 - \frac{ln(u) - ln(u_1)}{ln(u_2) - ln(u_1)}\right) \cdot ln(m_i)\right] \qquad u_1 < u \le u_2 \tag{2-4}$$

$$f(u) = {}^{1}\!/_{m_i} \qquad u > u_2 \tag{2-5}$$

with u_1 and u_2 set to 2 m/s and 6 m/s, respectively. The analyst should note that this crosswind meander model is based on the assumption of a one-hour release (more accurately, a one-hour sampling/exposure duration) and can overestimate peak doses for release durations longer than one hour and can underestimate peak doses for release durations less than one hour. The MACCS 4.0 Regulatory Guide 1.145 plume meander model can be used with either an area source or a point source.

2.2. MACCS 4.1 Regulatory Guide 1.145 Plume Meander Model

For MACCS 4.1, the Regulatory Guide 1.145 plume meander model was updated to enable the incorporation of the three principal equations and to include a vertical component for consistency with other models. Equations 1 and 2 in Regulatory Guide 1.145 [16], are included to give credit for the turbulent mixing in the wake of buildings and structures in the crosswind direction. Equation 1 includes an additive term to the crosswind dispersion, while Equation 2 includes a multiplicative term. The crosswind meander factor is calculated with all three equations and the resulting values are compared. The crosswind meander factors calculated with Equations 1 and 2 are compared and the lower value of the two is selected. That value is compared with the value obtained using Equation 3 and the higher of these two is selected as the appropriate value for the crosswind meander factor. This procedure selects the more conservative (lower) value of the wake factors from Equations 1 and 2 based on local wakes and provides a mechanism to use their results if the determined factor is greater than the meander factor calculated by Equation 3. It is possible, based on building dimensions, wind speed and stability class, to use the factors calculated from all three equations at different distances in the same simulation.

The MACCS version 4.1 Regulatory Guide 1.145 plume meander model is defined as follows:

$$\sigma_{ym}(x) = \max\left[min\left(f_{ym1}, f_{ym2}\right), f_{ym3}\right] \cdot \sigma_y(x) \tag{2-6}$$

$$\sigma_{zm}(x) = f_{zm} \cdot \sigma_z(x) \tag{2-7}$$

where

$\sigma_y(x)$ = the crosswind dispersion that is evaluated without meander
$\sigma_{ym}(x)$ = the crosswind dispersion accounting for plume meander
$\sigma_z(x)$ = the vertical dispersion that is evaluated without meander
$\sigma_{zm}(x)$ = the vertical dispersion accounting for plume meander
x = the downwind distance measured from the source
f_{ym1} = the crosswind wake factor derived from Equation 1 in Regulatory Guide 1.145
f_{ym2} = the crosswind wake factor derived from Equation 2 in Regulatory Guide 1.145
f_{ym3} = the crosswind meander factor derived from Equation 3 in Regulatory Guide 1.145
f_{zm} = the vertical meander factor

The crosswind meander factors for the MACCS version 4.1 Regulatory Guide 1.145 plume meander model are defined as follows:

$$f_{ym1} = 1 + \frac{0.5 \cdot \mathrm{A}}{\pi \sigma_y(x) \sigma_z(x)} \tag{2-8}$$

$$f_{ym2} = 3 \tag{2-9}$$

$$f_{ym3} = m_i \cdot f(u) \tag{2-10}$$

where

A = the cross-sectional area of the building

m_i and $f(u)$ are defined in Section 2.1. The values of 0.5 and 3 in Equations (2-8) and (2-9) are based on recommendations in NUREG/CR-2260 [15], but can be changed by the MACCS user if desired.

The vertical meander factor for the MACCS version 4.1 Regulatory Guide 1.145 plume meander model is defined as follows:

$$f_{zm} = 1 \tag{2-11}$$

This definition of the vertical meander factor was selected for simplicity and consistency with the Regulatory Guide 1.145 model implementation in other NRC codes (e.g., PAVAN).

In the MACCS 4.1 Regulatory Guide 1.145 plume meander model, all three equations for determining the crosswind meander factor are used when specifying a point source. If an area source is selected for the analysis, MACCS will default to only using the Equation 3 crosswind meander factor calculation as was implemented in MACCS 4.0 and use the area source model to represent the results for the first two equations. For either option the meander factors are set to unity and locations of the virtual source are adjusted beyond 800 m to ensure continuity in the value of σ_y and σ_z.

2.3. Ramsdell and Fosmire Plume Meander Model

The Ramsdell and Fosmire plume meander model includes enhanced dispersion near a building at low and high wind speeds [17]. At low wind speeds, building wakes have a minimal effect and the major contributor to enhanced dispersion is plume meander. At high wind speeds, building wakes are the major contributor to enhanced dispersion. The basic concept is to replace the standard formulation for the Gaussian dispersion parameters by a three-term equation:

$$\Sigma(x) = (\sigma_0(x)^2 + \Delta\sigma_1(x)^2 + \Delta\sigma_2(x)^2)^{1/2} \tag{2-12}$$

where

$\sigma_0(x)$ = the standard function for Gaussian dispersion
$\Delta\sigma_1(x)$ = the additional dispersion from low-wind-speed phenomena, primarily plume meander
$\Delta\sigma_2(x)$ = the additional dispersion from high-wind-speed phenomena, primarily wake effects
$\Sigma(x)$ = the combined dispersion parameter to be used in Gaussian plume equation
x = the downwind distance measured from the source

The equation above is applied to both crosswind (y) and vertical (z) dispersion, which are usually represented with an additional subscript of y or z that are not shown.

For implementation into MACCS, Equation (2-12) is rearranged to calculate a meander factor for use in the calculations. The MACCS Ramsdell and Fosmire plume meander model is defined as follows:

$$\sigma_{ym}(x) = f_{ymRF} \cdot \sigma_y(x) \tag{2-13}$$

$$\sigma_{zm}(x) = f_{zmRF} \cdot \sigma_z(x) \tag{2-14}$$

where

$\sigma_y(x)$ = the crosswind dispersion that is evaluated without meander
$\sigma_{ym}(x)$ = the crosswind dispersion accounting for plume meander
$\sigma_z(x)$ = the vertical dispersion that is evaluated without meander
$\sigma_{zm}(x)$ = the vertical dispersion accounting for plume meander
f_{ymRF} = the crosswind meander factor
f_{zmRF} = the vertical meander factor

The crosswind (y) and vertical (z) meander factors are defined as follows when using the MACCS Ramsdell and Fosmire model:

$$f_{ymRF} = \left(1 + \frac{\Delta\sigma_{y1}(x)^2 + \Delta\sigma_{y2}(x)^2}{\sigma_y(x)^2}\right)^{1/2} \tag{2-15}$$

$$f_{zmRF} = \left(1 + \frac{\Delta\sigma_{z1}(x)^2 + \Delta\sigma_{z2}(x)^2}{\sigma_z(x)^2}\right)^{1/2} \tag{2-16}$$

where

$\Delta\sigma_{y1}(x)$ = the additional crosswind dispersion from low-wind-speed phenomena
$\Delta\sigma_{y2}(x)$ = the additional crosswind dispersion from high-wind-speed phenomena
$\Delta\sigma_{z1}(x)$ = the additional vertical dispersion from low-wind-speed phenomena
$\Delta\sigma_{z2}(x)$ = the additional vertical dispersion from high-wind-speed phenomena

The additional crosswind and vertical dispersion from low- and high-wind-speed phenomena have the general form of:

$$\Delta\sigma(x)^2 = 2\mathrm{r} \cdot \Delta\tau^2 \cdot \mathrm{T_\Delta}^2 \left[1 - \left(1 + \frac{x}{\mathrm{T_\Delta} \cdot \mathrm{u}}\right) \cdot \exp\left(\frac{-x}{\mathrm{T_\Delta} \cdot \mathrm{u}}\right)\right] \tag{2-17}$$

where

r = the background turbulence parameter
$\Delta\tau$ = the turbulence increment parameter
$\mathrm{T_\Delta}$ = the time scale parameter
u = the wind speed

Ramsdell and Fosmire [11] found that the low-speed turbulence increment and time scale parameters were constant, but the high-speed parameters were not. The high-speed turbulence increment and time scale parameters were determined with the following relationships:

$$\Delta\tau_2 = C_\tau \cdot u^2 \tag{2-18}$$

$$\mathrm{T}_{\Delta 2} = \frac{\alpha_T \sqrt{A}}{u} \tag{2-19}$$

where

$\Delta\tau_2$ = the high-wind speed, turbulence increment parameter
C_τ = the high-wind speed, turbulence increment coefficient
$\mathrm{T}_{\Delta 2}$ = the high-wind speed, time scale parameter
α_T = the high-wind speed, time scale coefficient
A = the cross-sectional area of the building

Applying Equation (2-17) to the crosswind and vertical directions and accounting for the high-speed functions shown in Equations (2-18) and (2-19), the additional crosswind and vertical dispersion from low- and high-wind-speed phenomena are defined as follows:

$$\Delta\sigma_{y1}(x)^2 = 2\mathrm{r}_v \Delta\tau_{v1}{}^2 \mathrm{T}_{\Delta v1}{}^2 \left[1 - \left(1 + \frac{x}{\mathrm{T}_{\Delta v1} \cdot \mathrm{u}}\right) \cdot \exp\left(\frac{-x}{\mathrm{T}_{\Delta v1} \cdot \mathrm{u}}\right)\right] \tag{2-20}$$

$$\Delta\sigma_{y2}(x)^2 = 2\mathrm{r}_v C_{\tau v}{}^2 \alpha_{Tv}{}^2 \mathrm{u}^2 \mathrm{A} \left[1 - \left(1 + \frac{x}{\alpha_{Tv} \cdot \sqrt{\mathrm{A}}}\right) \cdot \exp\left(\frac{-x}{\alpha_{Tv} \cdot \sqrt{\mathrm{A}}}\right)\right] \tag{2-21}$$

$$\Delta\sigma_{z1}(x)^2 = 2\mathrm{r}_w \Delta\tau_{w1}{}^2 \mathrm{T}_{\Delta w1}{}^2 \left[1 - \left(1 + \frac{x}{\mathrm{T}_{\Delta w1} \cdot \mathrm{u}}\right) \cdot \exp\left(\frac{-x}{\mathrm{T}_{\Delta w1} \cdot \mathrm{u}}\right)\right] \tag{2-22}$$

$$\Delta\sigma_{z2}(x)^2 = 2\mathrm{r}_w C_{\tau w}{}^2 \alpha_{Tw}{}^2 \mathrm{u}^2 \mathrm{A} \left[1 - \left(1 + \frac{x}{\alpha_{Tw} \cdot \sqrt{\mathrm{A}}}\right) \cdot \exp\left(\frac{-x}{\alpha_{Tw} \cdot \sqrt{\mathrm{A}}}\right)\right] \tag{2-23}$$

where

r_v = the crosswind, background turbulence parameter
$\Delta\tau_{v1}$ = the crosswind, low-wind speed turbulence increment parameter
$\mathrm{T}_{\Delta v1}$ = the crosswind, low-wind speed time scale parameter
$C_{\tau v}$ = the crosswind, high-wind speed turbulence increment coefficient
α_{Tv} = the crosswind, high-wind speed time scale coefficient
r_w = the vertical, background turbulence parameter
$\Delta\tau_{w1}$ = the vertical, low-wind speed turbulence increment parameter
$\mathrm{T}_{\Delta w1}$ = the vertical, low-wind speed time scale parameter
$C_{\tau w}$ = the vertical, high-wind speed turbulence increment coefficient
α_{Tw} = the vertical, high-wind speed time scale coefficient

Values for the parameters and coefficients were determined in Ramsdell and Fosmire [11] based on multiple data sets and references and are summarized in Table 2-1. These are the recommended parameters but can be changed by the MACCS user if desired.

Table 2-1. Parameter values in the MACCS Ramsdell and Fosmire plume meander model

Parameter	Value	Unit	Parameter	Value	Unit
r_v	0.655	unitless	r_w	0.584	unitless
$\Delta\tau_{v1}$	0.835	m/s	$\Delta\tau_{w1}$	0.239	m/s
$\mathrm{T}_{\Delta v1}$	1,000	s	$\mathrm{T}_{\Delta w1}$	100	s
$C_{\tau v}$	0.02	s/m	$C_{\tau w}$	0.01	s/m
α_{Tv}	10	unitless	α_{Tw}	10	unitless

The data sets used in the development of the parameters and coefficients in Table 2-1 covered a range of distances with the minimum distance of 6 m to a maximum distance of 1,200 m [21]. For consistency with the MACCS 4.1 Regulatory Guide 1.145 plume meander model, an end distance to stop using the Ramsdell and Fosmire plume meander model was implemented. In light of the data sets used in determining the above parameters, a distance less than 1,200 m is recommended. A round value of 1,000 m is used in MACCS for this distance. In the MACCS Ramsdell and Fosmire plume meander model, the meander occurs in the first 1,000 m downwind creating a broader plume at that distance. Beyond 1,000 m the meander factors are set to unity and locations of the virtual source are adjusted to ensure continuity in the value of σ_y and σ_z. In the MACCS implementation the user may specify a downwind distance other than 1,000 m, if desired.

The MACCS 4.1 Ramsdell and Fosmire plume meander model was intended to be used with a point source. Turbulent dispersion in the wake of a building is accounted for in the Ramsdell and Fosmire plume meander model through use of the high-wind-speed increment, $\Delta\sigma_2(x)$. Use of an initial area source in conjunction with the Ramsdell and Fosmire plume meander model is therefore not recommended.

3. TEST CASES

Test cases were determined to verify the plume meander model implementation into MACCS 4.1. The test cases were selected from the test cases run in the MACCS nearfield evaluation study [10]. Since the plume meander models are functions of building size, stability class and wind speed, the cases were selected to vary in those parameters. The test cases are not intended to be exhaustive, but rather to demonstrate correct implementation.

3.1. Assumptions and Limitations

The test cases consider isolated, simple buildings. This report does not attempt to discuss the application of MACCS to clusters of buildings or complex building shapes. For more information on idealized clusters of buildings and potential models the reader is directed to Hosker and Pendergrass [22]. It is assumed that the verification of the results for the test cases with isolated simple buildings provides a basis for determining the correct implementation into MACCS.

For all the test cases a surface roughness of 3 cm is used to represent grassy fields surrounding the building. This was selected to reduce potential dispersion in the vertical direction. Reduced dispersion in the vertical direction would emphasize the horizontal dispersion, potentially highlighting differences between the meander models. Winds are assumed to be perpendicular to the building face of larger dimension. The release location is assumed to be the top center of the downwind face of the building.

The two weather conditions used in the MACCS nearfield evaluation study [10] were used here as well. The first condition is a constant wind field of 4 m/s with neutral stability (Pasquill-Gifford stability class D). This condition was selected as a typical weather condition for comparison. The second condition is a constant wind field of 2 m/s with stable conditions (Pasquill-Gifford stability class F). This weather condition was selected as a reduced dispersion condition that would result in higher ground-level concentrations. Reduced nominal dispersion would emphasize the effect of the meander model, potentially highlighting differences between the meander models. Because nearfield doses are commonly evaluated at the 95th percentile for licensing applications, the weather conditions that were chosen are biased toward the stable end of the range to represent the ones more likely to represent a 95th percentile exposure.

The three building configurations used in the MACCS nearfield evaluation study [10] were used here as well. The first configuration has no building, but rather is a ground-level point source and was selected to verify the implementation of the plume meander models in the absence of confounding factors. The second configuration includes a building 20 m tall by 40 m wide by 20 m deep and was selected to represent a typical building size. The third configuration includes a building 20 m tall by 100 m wide by 20 m deep and was selected to represent a building with a more extreme width to height ratio.

The combination of the two weather conditions and three building configurations results in six test cases. Each test case was run using ARCON96, PAVAN, AERMOD, and MACCS (three times, once for each plume meander model) for the verification. The six test cases are shown below in Table 3-1.

Table 3-1. Test cases used for verification of plume meander models in MACCS

Weather	Building HxWxL (m)		
	None	20x40x20	20x100x20
4 m/s, D stability	Case 01	Case 03	Case 05
2 m/s, F stability	Case 02	Case 04	Case 06

The native treatment of the weather and building dimensions differs between the codes. The following sections discuss how the variations were implemented in each code. The discussions include the techniques used to ensure consistency in the implementation. For reference, example input files for ARCON96, PAVAN, AERMOD and MACCS are respectively provided in Appendix A through Appendix D.

3.2. Weather Conditions

ARCON96, PAVAN, and MACCS require a specification of the mean wind speed and direction and Pasquill-Gifford stability class. Thus, implementation of the specified weather conditions is straightforward for these three codes. These values are respectively shown in the input files for ARCON96, PAVAN, and MACCS in Appendix A, Appendix B, and Appendix D.

For AERMOD, the specification of weather conditions is through both a surface-weather parameter file and a vertical-profile weather parameter file. Specification of the wind speed and direction is straightforward, but there is no direct method for specifying a stability class. The weather parameters in the AERMOD input weather files related to stability class are the friction velocity (u*) and Monin-Obukhov length (L). Golder [23] contains a figure relating Pasquill-Gifford stability class and Monin-Obukhov length (see Figure 4 in [23]). This figure shows a range of values for 1/L that correspond to each stability class. The estimated value for D stability class was chosen to be near the center of the range, while the estimated value for F stability was chosen to be a similar distance from the line separating class E and F as the center of the range for class E. These estimates were selected in this manner to represent a nominal value of the range of values. Using a surface roughness (z_0) of 3 cm, values for 1/L were estimated respectively for stability classes D and F to be 0.002 m^{-1} and 0.08 m^{-1}. This corresponds to values of 500 m and 12.5 m for L.

Hanna et al. [24] provide equations for calculating friction velocity (u*) from wind speed (u), surface roughness (z_0) and Monin-Obukhov length (L) for neutrally-stable and stable conditions, shown below:

$$u^* = \frac{k \cdot u}{ln(z/z_0)} \qquad \text{for neutral stability} \qquad (3\text{-}1)$$

$$u^* = \frac{k \cdot u}{[ln(z/z_0) + 5 \cdot z/L]} \qquad \text{for stable conditions} \qquad (3\text{-}2)$$

where

k = empirical constant (0.4 unitless)
z = height that correlates to wind speed determination (10 m)

Using the above equations, the friction velocities for the 4 m/s with D stability class and 2 m/s with F stability class are calculated respectively to be 0.275 m/s and 0.082 m/s. These values for Monin-

Obukhov length and friction velocity are the same as were used in the MACCS nearfield evaluation study [10]. These values are used in the AERMOD weather files for the test cases and are shown in Appendix C.

3.3. Building Effects

Incorporating the building configurations into the analyses was straightforward. For the ARCON96 and PAVAN codes, the building dimensions are accounted for by entering a building area in the input file. For this analysis, the projected area was used assuming that the wind was perpendicular to the building face with larger dimension. Therefore, the projected area was calculated as the building height times the building width. For the ARCON96 calculation with no building, a projected area of 0 m^2 was used. For the PAVAN calculations, the option to output the results with and without a building was used to obtain the results with no building. For the 20 m by 40 m by 20 m building the projected area is 800 m^2. For the 20 m by 100 m by 20 m building the projected area is 2,000 m^2. These projected areas can be seen respectively in the ARCON96 and PAVAN input files in Appendix A and Appendix B.

For the AERMOD code, preprocessing software is used in which the full dimensions of the building are entered. The outputs from the preprocessor are the parameters to be used in the AERMOD building downwash model. For the calculations without a building, removing the downwash model parameters removes the effect of the building. The input and output from the preprocessor for the two building configurations are shown in the input files in Appendix C.

In the MACCS 4.1 calculations, the building height, width and length were directly entered into the input file. For the calculations using a point source representation (SRCMOD=PNT), these dimensions were used to calculate the cross-sectional area of the building for use in both the updated Regulatory Guide 1.145 model and the Ramsdell-Fosmire model. For the calculations with no building, building dimensions of 0 m by 1 m by 1 m were input to effectively remove the building from the calculation. For the calculations using an area source representation (SRCMOD=AREA), the building wake size was defined by the initial dispersion parameters. The initial dispersion parameters (σ_y and σ_z) are calculated based on the building width and height. The typical equations are that the initial σ_y is 0.23 times the building width and the initial σ_z is 0.47 times the building height. For the 20 m by 40 m by 20 m building an initial σ_y of 9.2 m and an initial σ_z of 9.4 m were used. For the 20 m by 100 m by 20 m building an initial σ_y of 23 m and an initial σ_z of 9.4 m were used. For the calculations with no building, an initial σ_y and σ_z of 0.1 m (minimum values allowed in MACCS) were used. These initial dispersion values can be seen in the MACCS input files shown in Appendix D. In all of the MACCS 4.1 cases, the model was run such that the plumes were calculated to be trapped, which resulted in releases at ground (z=0 m) level.

This page left blank

4. VERIFICATION RESULTS

The six test cases were run with ARCON96, PAVAN, AERMOD, and MACCS. MACCS was run three separate times for each test case, with a different plume meander model selected. Furthermore, calculations were performed for each of the six test cases using the analytical expressions for the plume meander models in Excel for an additional comparison. The results from these test cases are discussed below. In this section the trends observed for each plume meander model related to building configuration and weather condition are discussed. Comparisons between the models are discussed in the next section.

4.1. MACCS Ramsdell and Fosmire Plume Meander Model and Point Source

All six test cases were run using the Ramsdell and Fosmire plume meander model with ARCON96, MACCS, and analytical expressions. The normalized, ground-level, time-integrated air concentration (X/Q) values calculated over the first 1,000 m are compared between the two model results and the analytical calculations. The comparisons are respectively shown for Cases 01 through 06 in Figure 4-1 through Figure 4-6. As seen in the figures the results using MACCS with the MACCS Ramsdell and Fosmire Plume Meander Model match ARCON96 and the analytical expressions. This demonstrates that the Ramsdell and Fosmire plume meander model has been successfully implemented into MACCS.

When comparing across the test cases the calculated X/Q values show minimal differences with the inclusion of a building. The results show more dispersion under the neutrally-stable condition (stability class D) compared with the corresponding predictions under the stable condition (stability class F). This matches the behavior of ARCON96 noted in the MACCS nearfield evaluation study [10].

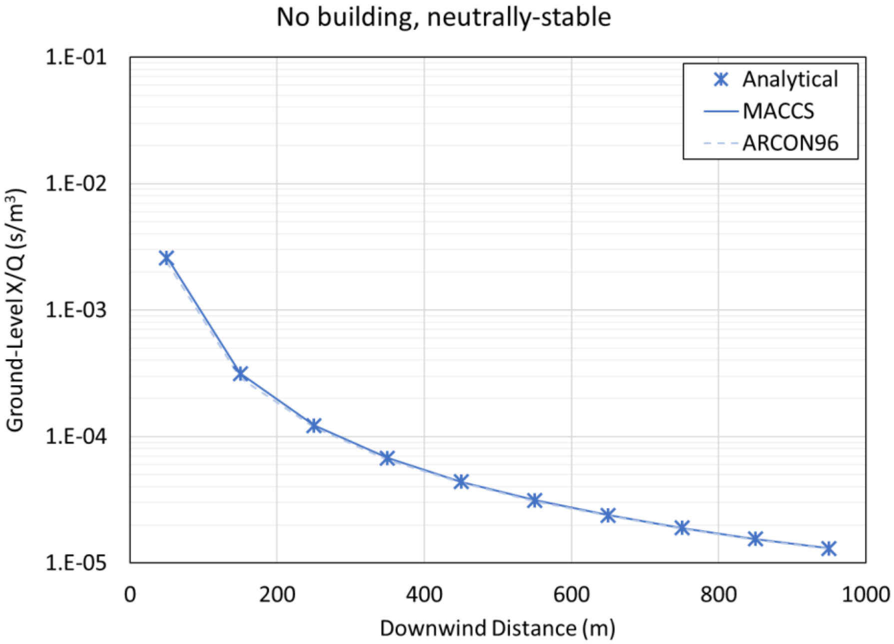

Figure 4-1. Ground-level, time-integrated X/Q versus distance calculated with ARCON96, MACCS, and analytical expressions for Case 01

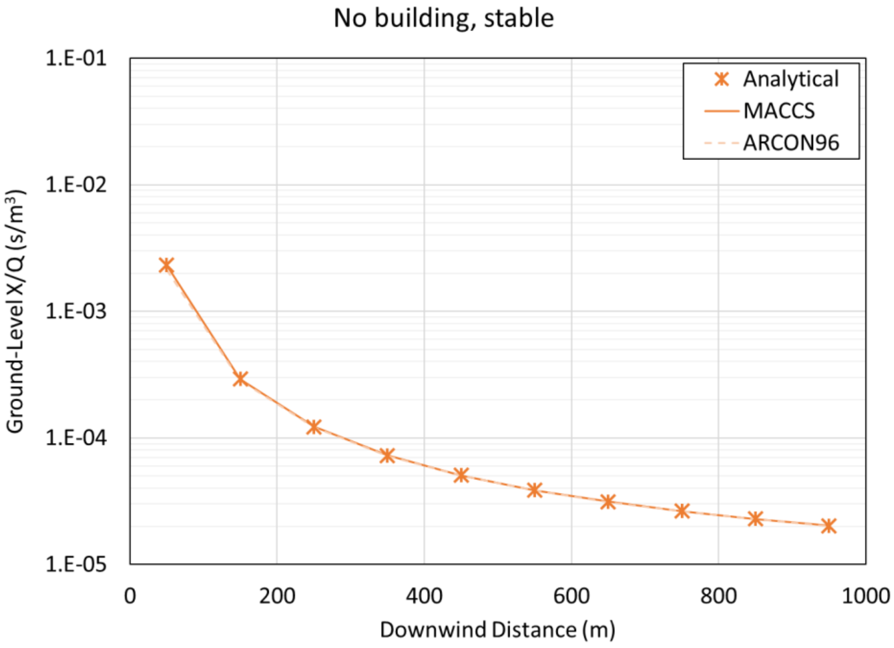

Figure 4-2. Ground-level, time-integrated X/Q versus distance calculated with ARCON96, MACCS, and analytical expressions for Case 02

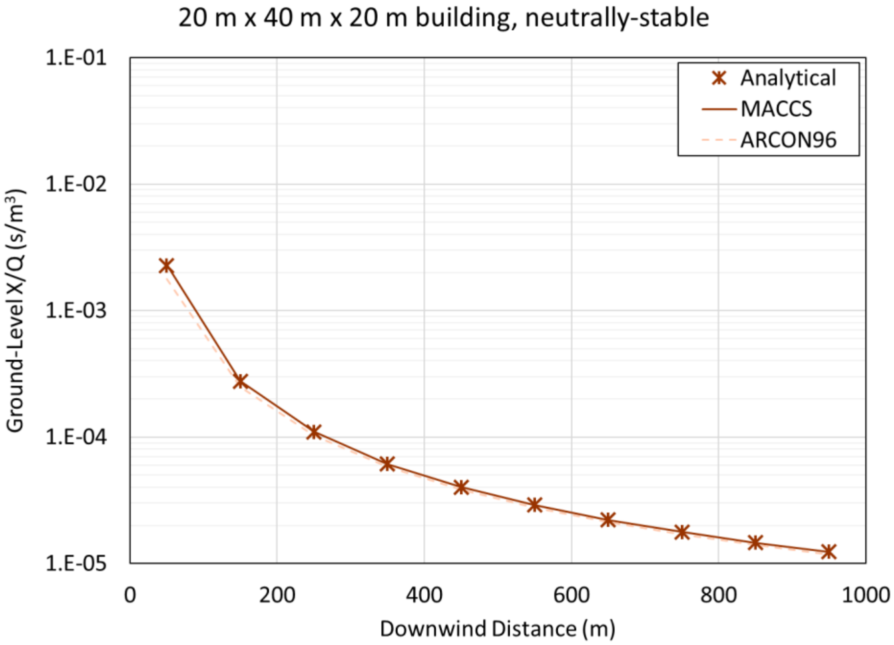

Figure 4-3. Ground-level, time-integrated X/Q versus distance calculated with ARCON96, MACCS, and analytical expressions for Case 03

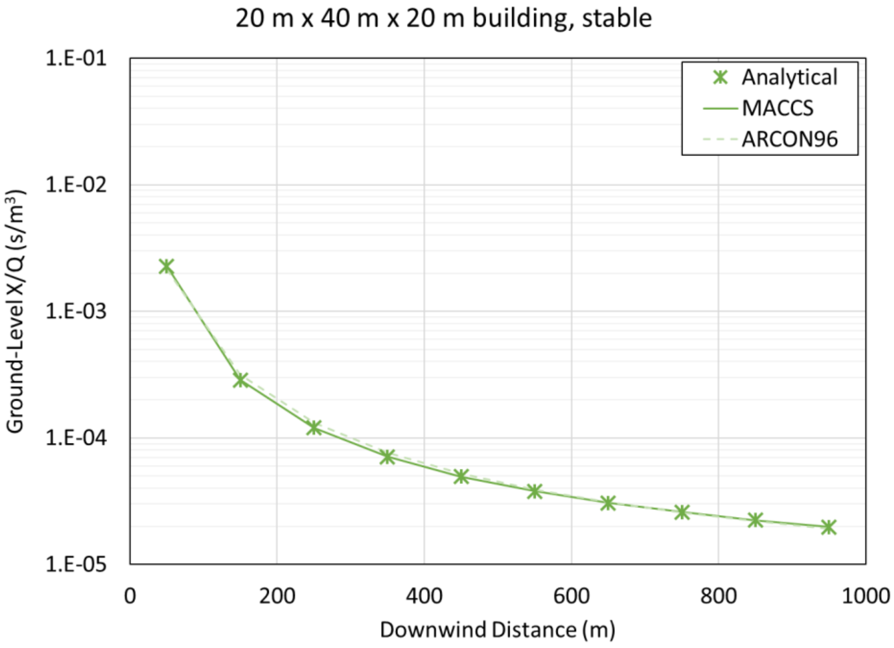

Figure 4-4. Ground-level, time-integrated X/Q versus distance calculated with ARCON96, MACCS, and analytical expressions for Case 04

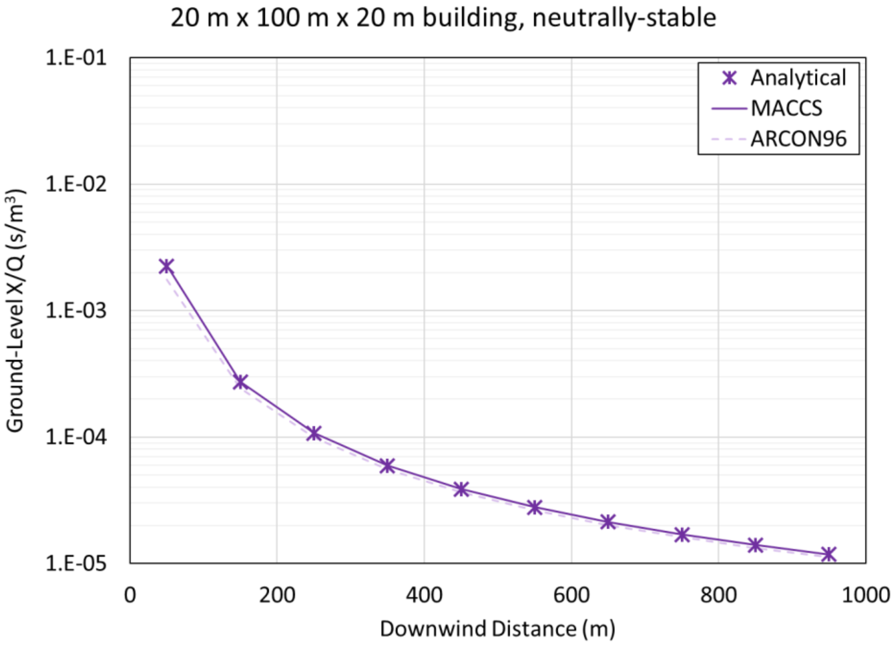

Figure 4-5. Ground-level, time-integrated X/Q versus distance calculated with ARCON96, MACCS, and analytical expressions for Case 05

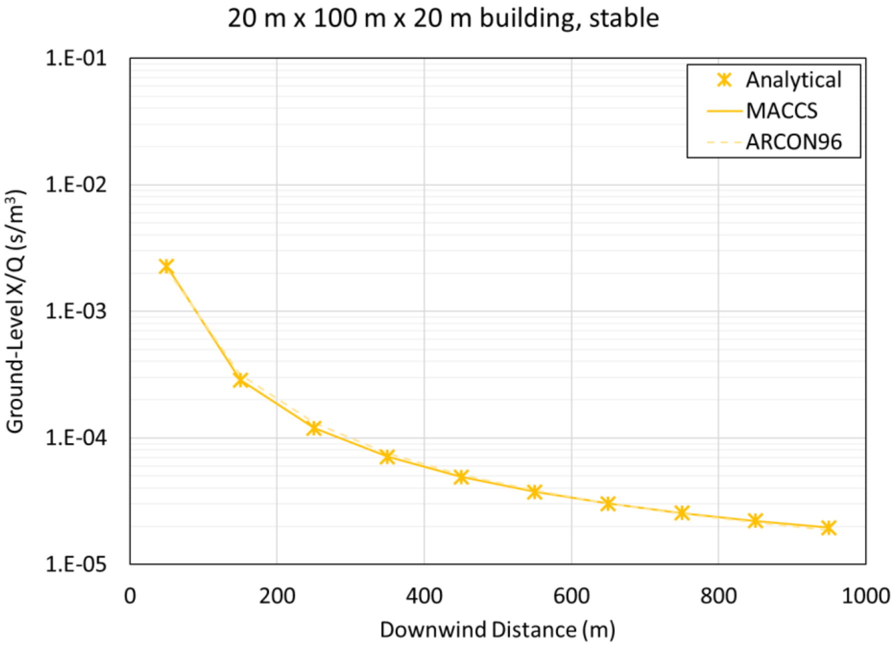

Figure 4-6. Ground-level, time-integrated X/Q versus distance calculated with ARCON96, MACCS, and analytical expressions for Case 06

4.2. MACCS Regulatory Guide 1.145 Plume Meander Model and Point Source

All six test cases were run using the full three equation version of the Regulatory Guide 1.145 plume meander model with PAVAN, MACCS, and analytical expressions. The normalized, ground-level, time-integrated air concentration (X/Q) values calculated over the first 1,000 m are compared between the two model results and the analytical calculations. The comparisons are respectively shown for Cases 01 through 06 in Figure 4-7 through Figure 4-12. As seen in the figures, the results using MACCS with the MACCS Regulatory Guide 1.145 Plume Meander Model and Point Source Model match the calculation using PAVAN and the analytical expressions. This demonstrates that the full three equation version of the Regulatory Guide 1.145 plume meander model has been successfully implemented into MACCS.

When comparing across test cases, the calculated X/Q values show minimal difference from the inclusion of a building for the stable condition (stability class F) and a notable difference from the inclusion of a building for the neutrally-stable condition (stability class D). The meander factor calculated for the stable condition (factor of 4.0) is larger than the meander factor calculated for the neutrally-stable condition (factor of 1.29) and is large enough to dominate the contribution that would come from either building size. The smaller meander factor is less than the effect of the building at close in distances and hence there are notable differences in those test cases (Case 03 and Case 05) due to the inclusion of a building. For those cases, both the PAVAN and MACCS calculations transition between all three equations as distance progresses.

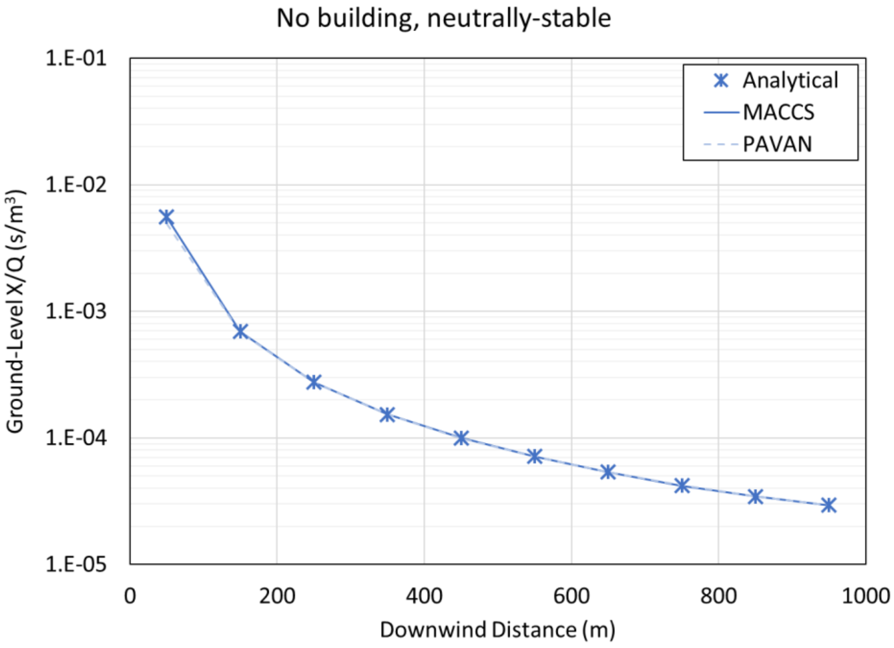

Figure 4-7. Ground-level, time-integrated X/Q versus distance calculated with PAVAN, MACCS, and analytical expressions for Case 01

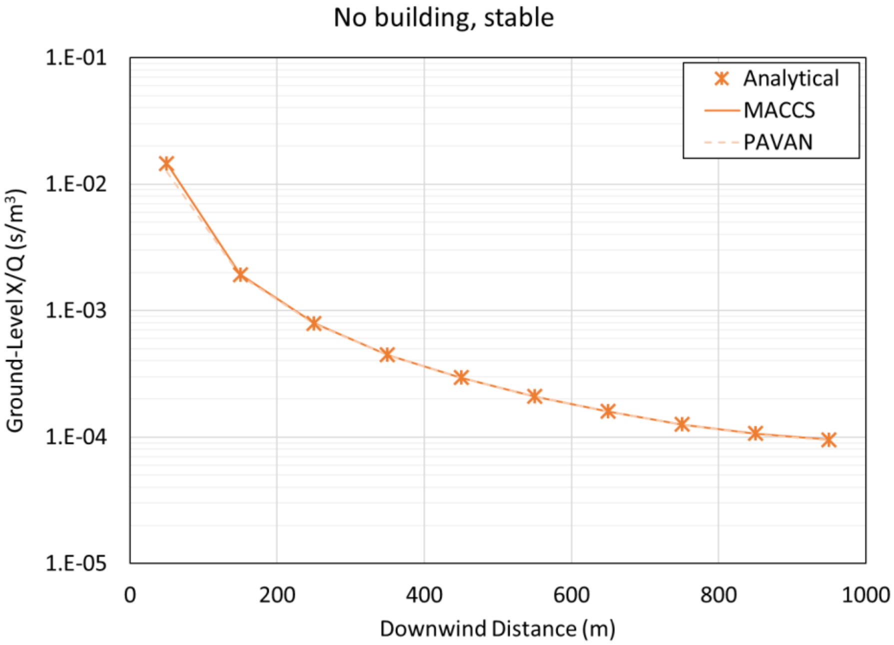

Figure 4-8. Ground-level, time-integrated X/Q versus distance calculated with PAVAN, MACCS, and analytical expressions for Case 02

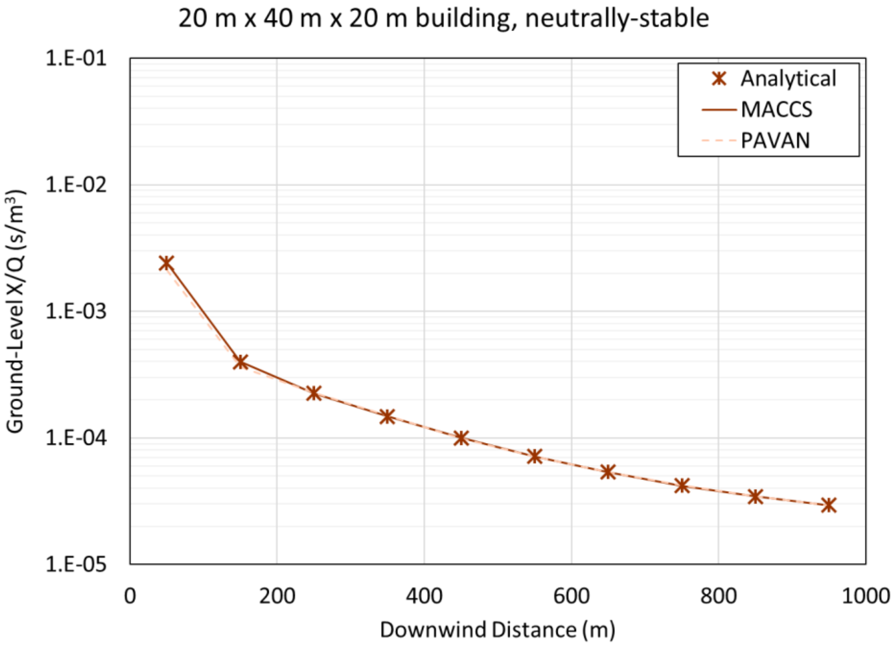

Figure 4-9. Ground-level, time-integrated X/Q versus distance calculated with PAVAN, MACCS, and analytical expressions for Case 03

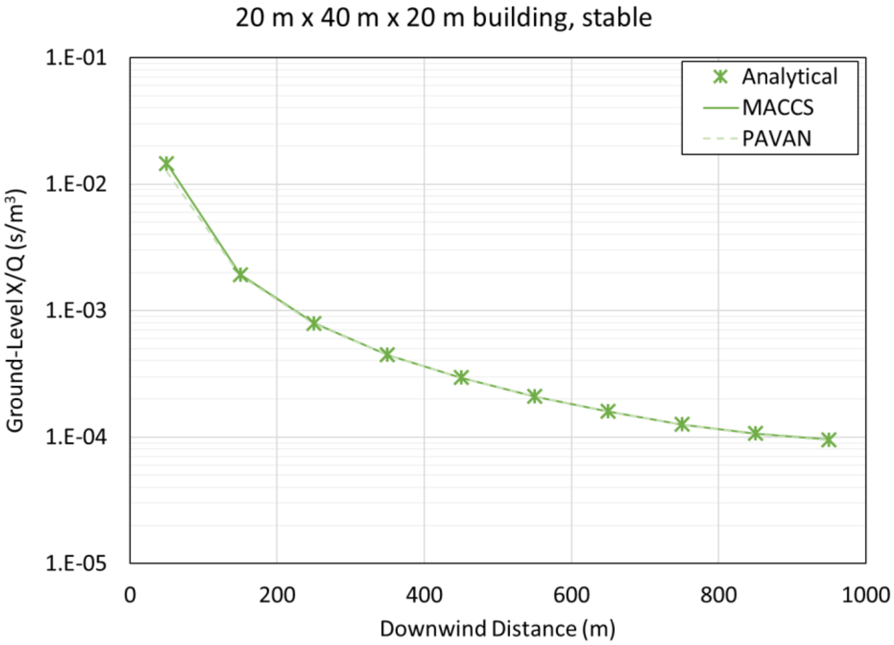

Figure 4-10. Ground-level, time-integrated X/Q versus distance calculated with PAVAN, MACCS, and analytical expressions for Case 04

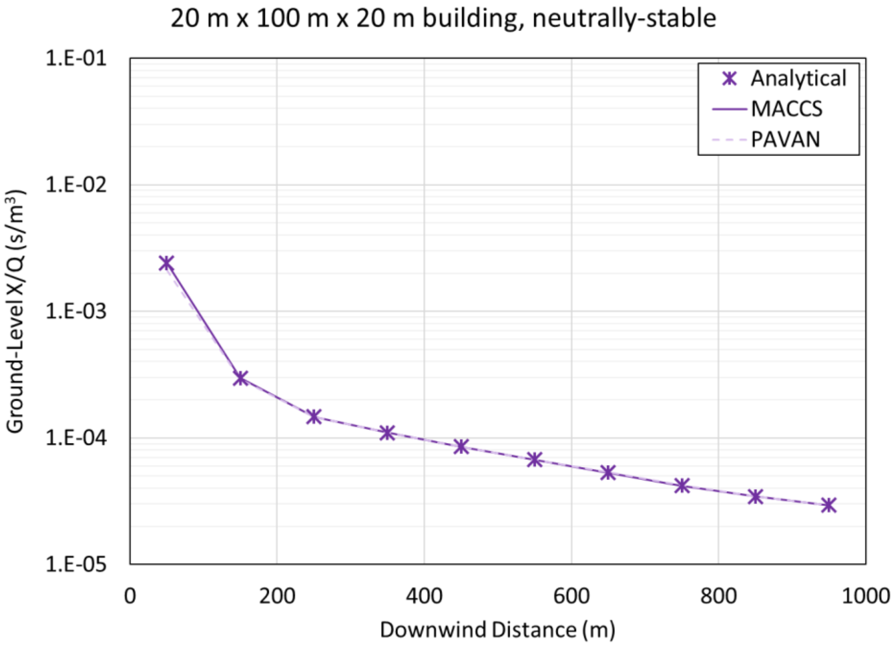

Figure 4-11. Ground-level, time-integrated X/Q versus distance calculated with PAVAN, MACCS, and analytical expressions for Case 05

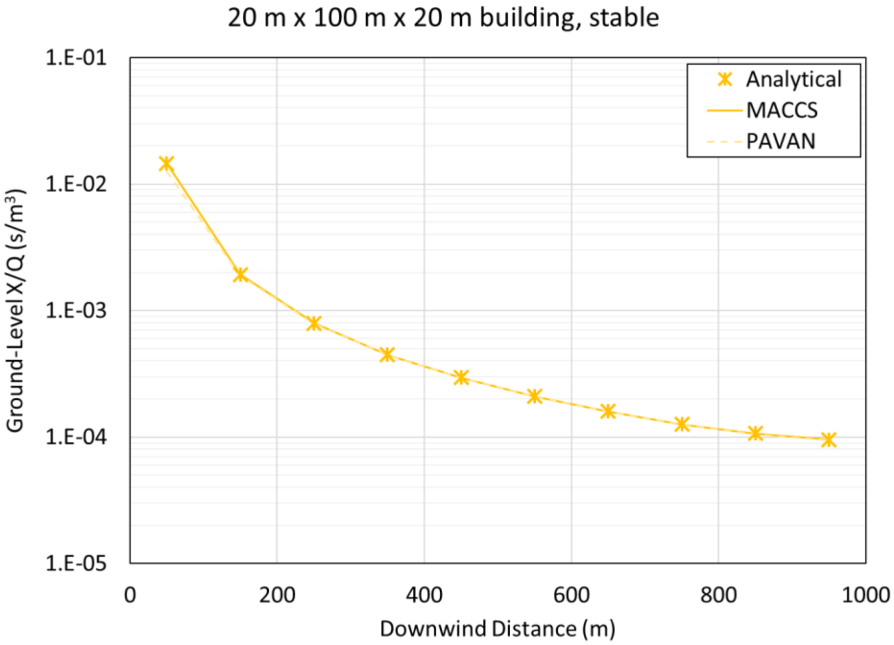

Figure 4-12. Ground-level, time-integrated X/Q versus distance calculated with PAVAN, MACCS, and analytical expressions for Case 06

4.3. MACCS Regulatory Guide 1.145 Plume Meander Model and Area Source

All six test cases were run using AERMOD, the single equation version of the Regulatory Guide 1.145 plume meander model with MACCS, and analytical expressions. Since an area source was specified, the MACCS version 4.1 Regulatory Guide 1.145 plume meander model mimics the behavior of the MACCS version 4.0 Regulatory Guide 1.145 plume meander model in that the effects of Equations 1 and 2 are represented by a virtual source location calculated from the initial area source. The normalized, ground-level, time-integrated air concentration (X/Q) values calculated over the first 1,000 m are compared between the two model results and the analytical calculations. The comparisons are respectively shown for Cases 01 through 06 in Figure 4-13 through Figure 4-18.

The AERMOD models were not implemented into MACCS 4.1. Hence, it is not expected for the MACCS calculations to match the AERMOD calculations, but rather bound the calculations including a building as was shown in the MACCS nearfield evaluation study [10]. Furthermore, the MACCS nearfield evaluation study showed that for Case 2 (no building, stable conditions), the AERMOD results are above those calculated with MACCS. This is due to the parameterization of the dispersion and plume meander incorporated in AERMOD. This same comparison is expected in this analysis too. As seen in the figures, the results using MACCS with the MACCS Regulatory Guide 1.145 Plume Meander Model and Area Source Model match the analytical expressions and bound the AERMOD calculations with a building, as was shown in the MACCS nearfield evaluation study [10]. This demonstrates that the single equation version of the Regulatory Guide 1.145 plume meander model (MACCS 4.0 implementation) has been successfully maintained into MACCS.

When comparing across the test cases, the calculated X/Q values show notable differences with the inclusion of a building. The results show more dispersion under the neutrally-stable condition (stability class D) compared with the corresponding predictions under the stable condition (stability class F). This matches the behavior of AERMOD and MACCS noted in the MACCS nearfield evaluation study [10].

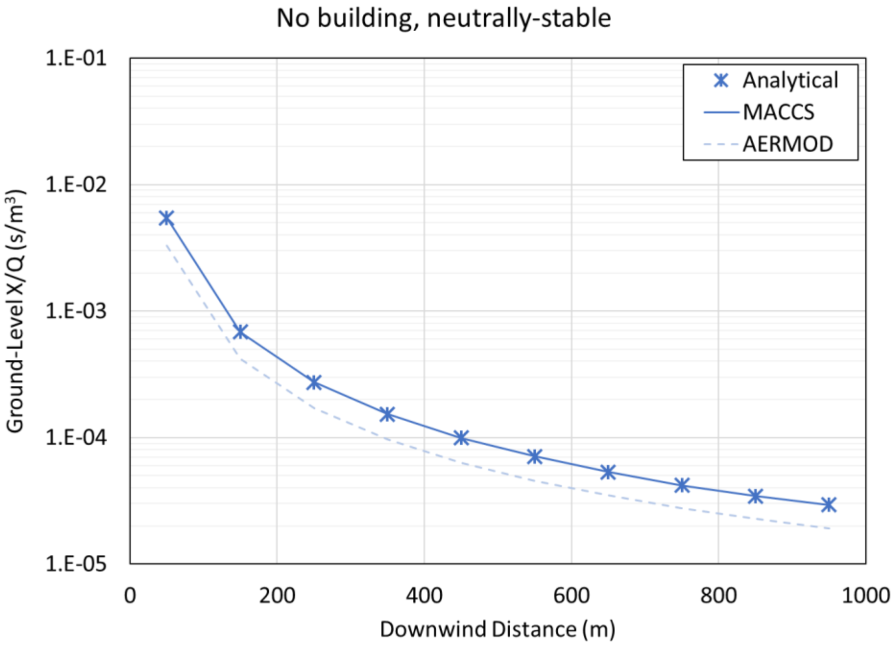

Figure 4-13. Ground-level, time-integrated X/Q versus distance calculated with AERMOD, MACCS, and analytical expressions for Case 01

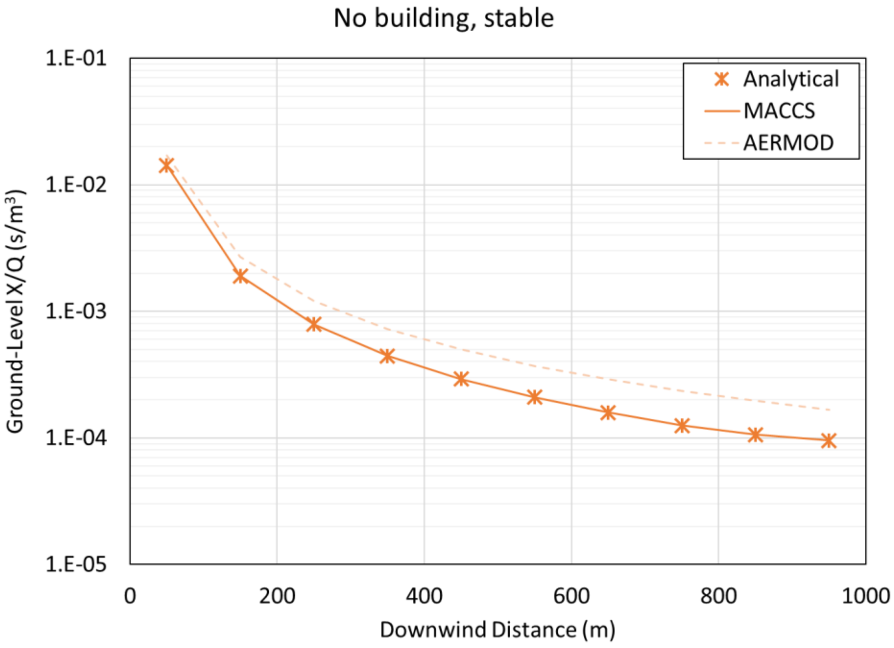

Figure 4-14. Ground-level, time-integrated X/Q versus distance calculated with AERMOD, MACCS, and analytical expressions for Case 02

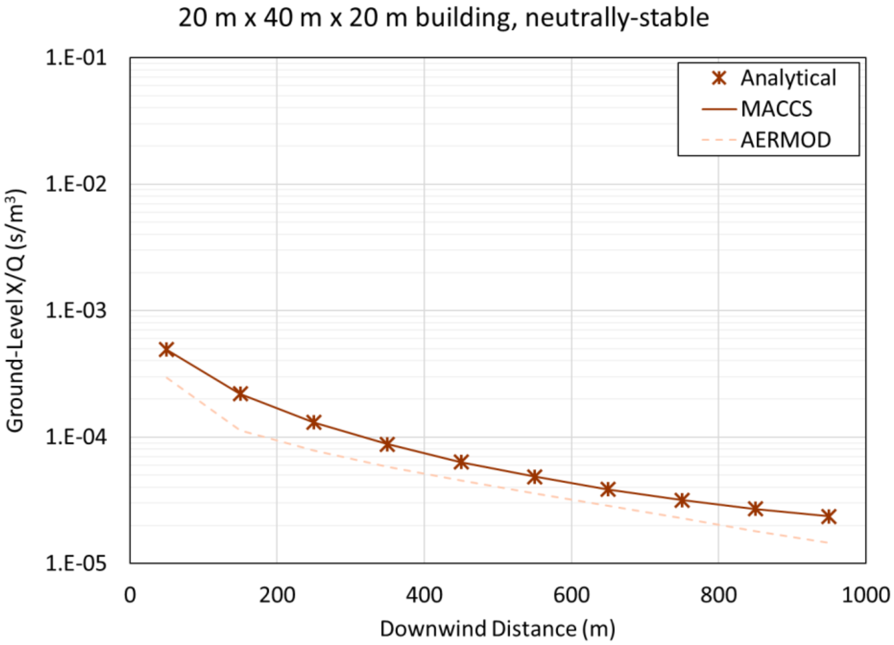

Figure 4-15. Ground-level, time-integrated X/Q versus distance calculated with AERMOD, MACCS, and analytical expressions for Case 03

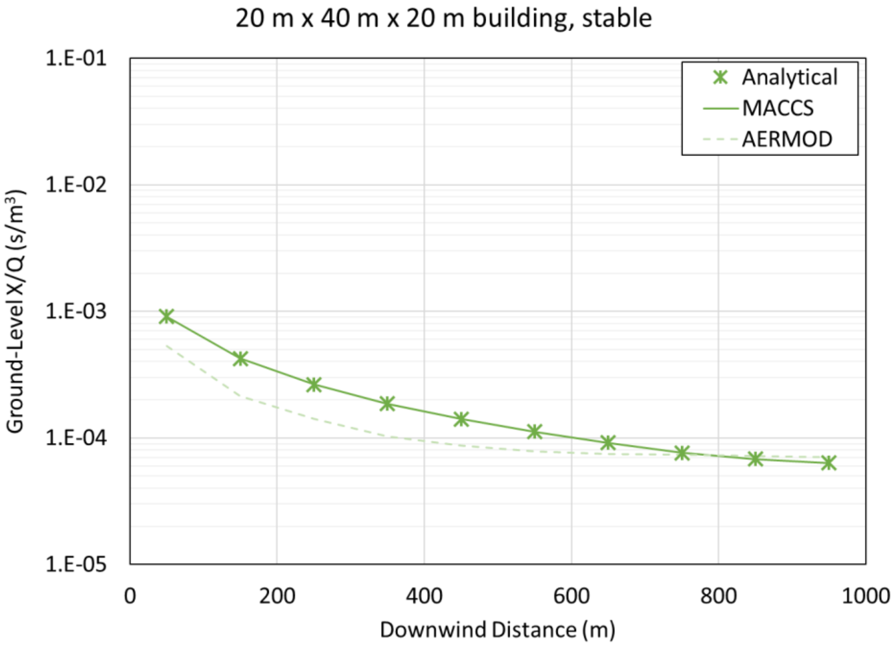

Figure 4-16. Ground-level, time-integrated X/Q versus distance calculated with AERMOD, MACCS, and analytical expressions for Case 04

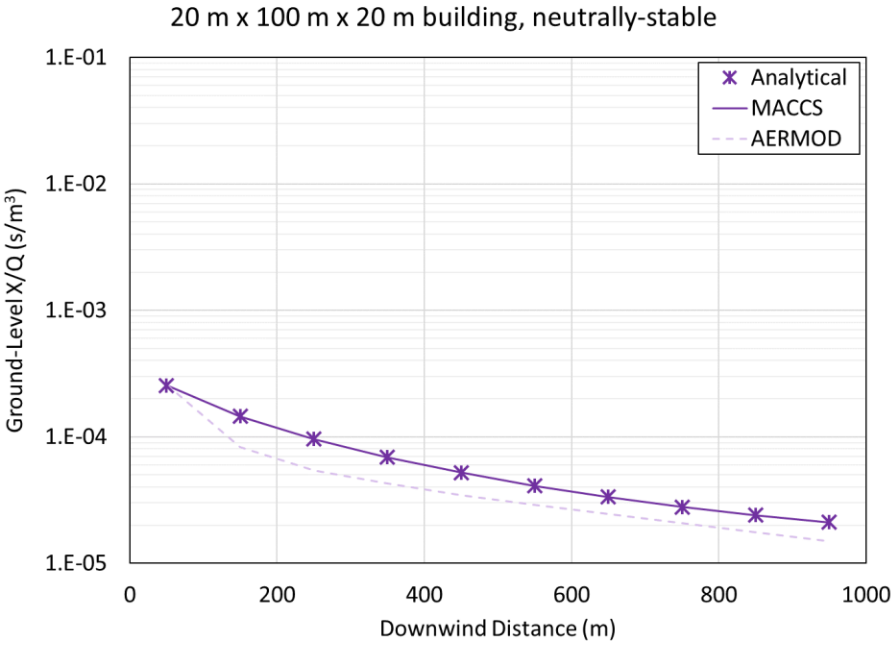

Figure 4-17. Ground-level, time-integrated X/Q versus distance calculated with AERMOD, MACCS, and analytical expressions for Case 05

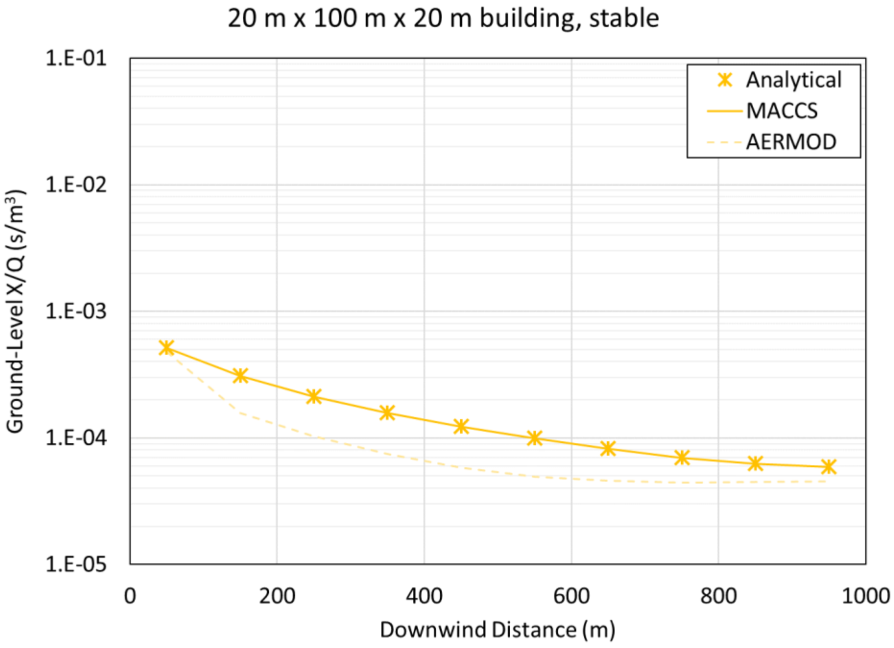

Figure 4-18. Ground-level, time-integrated X/Q versus distance calculated with AERMOD, MACCS, and analytical expressions for Case 06

This page left blank

5. MODEL COMPARISONS

With the MACCS implementation verified, an initial comparison of the models can be conducted. Comparisons of the normalized, ground-level, time-integrated air concentration (X/Q) values calculated using MACCS with the three updated plume meander models are respectively shown for the six test case conditions in Figure 5-1 through Figure 5-6. These comparisons indicate the relative trends between the models as a function of building configuration and weather condition.

As seen in Figure 5-1 and Figure 5-2, for cases with no building, the X/Q values using all three equations in the Regulatory Guide 1.145 plume meander model (Reg. Guide 1.145 Point) and the single equation version (Reg. Guide 1.145 Area) are identical and the X/Q values are consistently lower with the Ramsdell and Fosmire plume meander model. The first two equations in the full Regulatory Guide 1.145 plume meander model are modifications based on the building size and those terms are zero when there is no building. The high-wind-speed phenomena terms in the Ramsdell and Fosmire plume meander model are proportional to the building cross-sectional area and so for the test cases with no building those terms are zero. The lower values from the Ramsdell and Fosmire plume meander model are due to the low-wind-speed phenomena terms.

As seen in Figure 5-3 and Figure 5-5, for cases with a building and neutrally-stable weather conditions, the Reg. Guide 1.145 Point and Ramsdell and Fosmire X/Q values match at 50 m and then diverge with distance, with the Ramsdell and Fosmire X/Q values lower than the Reg. Guide 1.145 Point results. The Reg. Guide 1.145 Area X/Q values are lower than the Reg. Guide 1.145 Point results up to 1,000 m. The Reg. Guide 1.145 Area X/Q values are lower than the Ramsdell and Fosmire results up to 200-300 m where they then switch in order.

As seen in Figure 5-4 and Figure 5-6, for cases with a building and stable weather conditions, the Reg. Guide 1.145 Point X/Q values are larger than the other two models up to 1,000 m. The Reg. Guide 1.145 Area X/Q values are lower than the Ramsdell and Fosmire results up to 100-150 m where they then switch in order.

Comparisons out to 35 km for the three plume meander models for the six test case conditions are shown in Figure 5-7 through Figure 5-12. Examining these figures shows that the trends at 1 km (1,000 m) are maintained out to 35 km. The differences between the models diminishes with distance. At 35 km the differences between three models is less than 5% for the neutrally-stable weather condition cases and less than 10% for the stable weather condition cases.

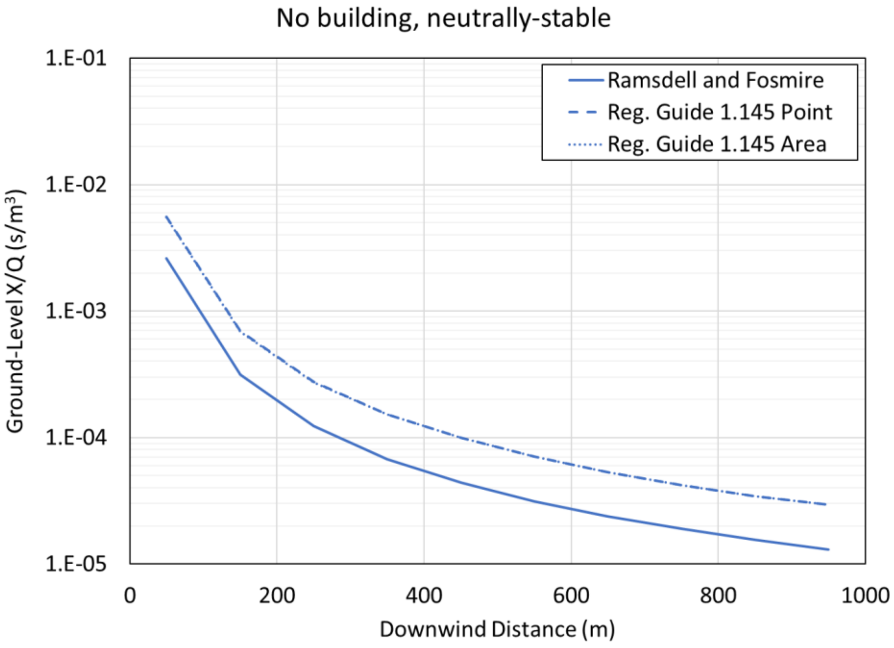

Figure 5-1. Ground-level, time-integrated X/Q versus distance calculated with MACCS using three updated plume meander models for Case 01

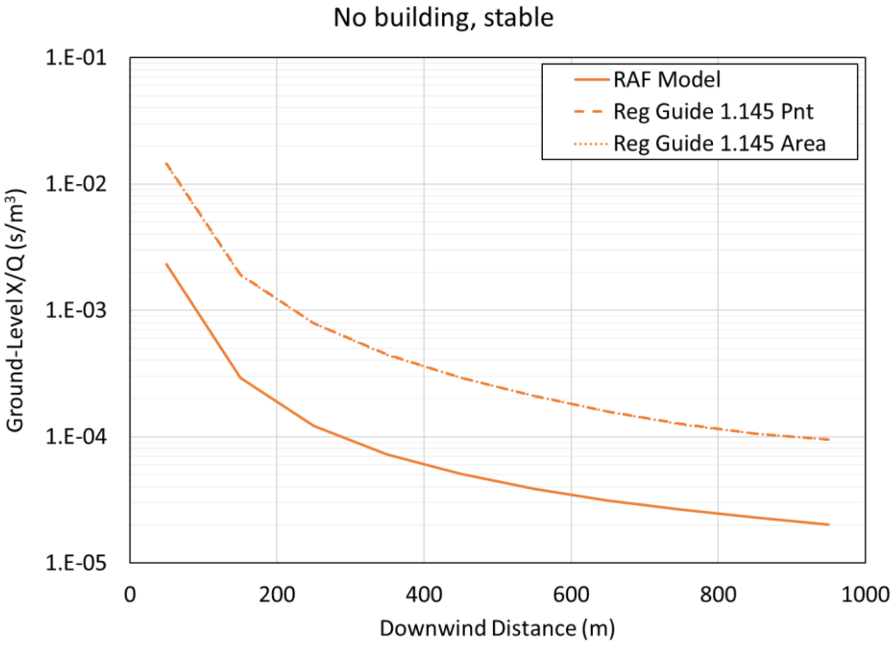

Figure 5-2. Ground-level, time-integrated X/Q versus distance calculated with MACCS using three updated plume meander models for Case 02

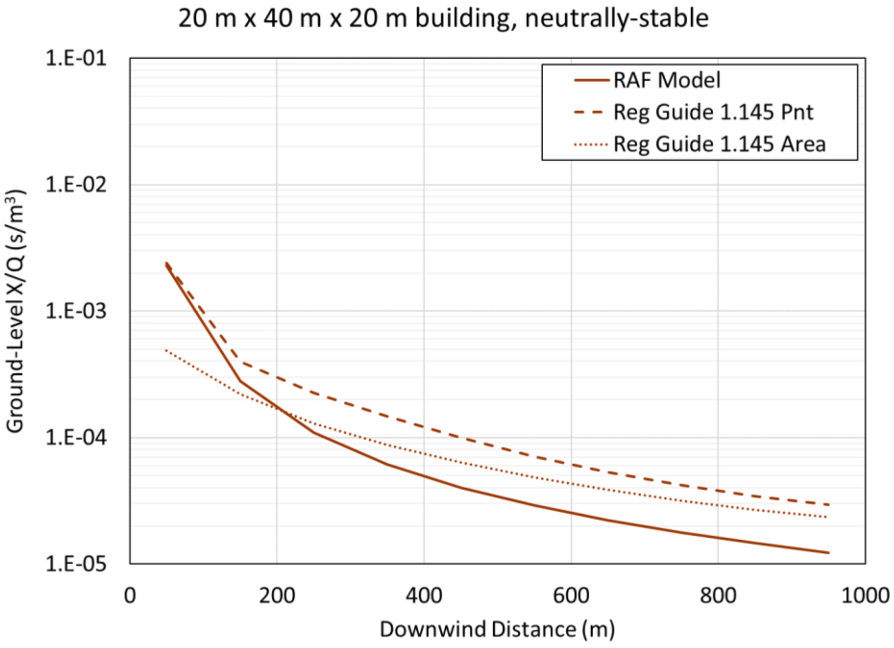

Figure 5-3. Ground-level, time-integrated X/Q versus distance calculated with MACCS using three updated plume meander models for Case 03

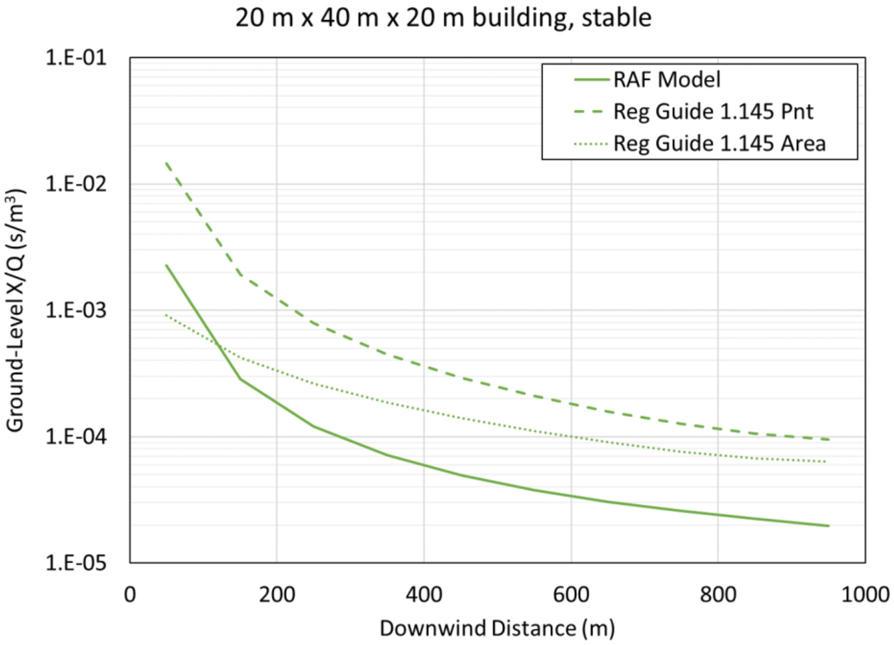

Figure 5-4. Ground-level, time-integrated X/Q versus distance calculated with MACCS using three updated plume meander models for Case 04

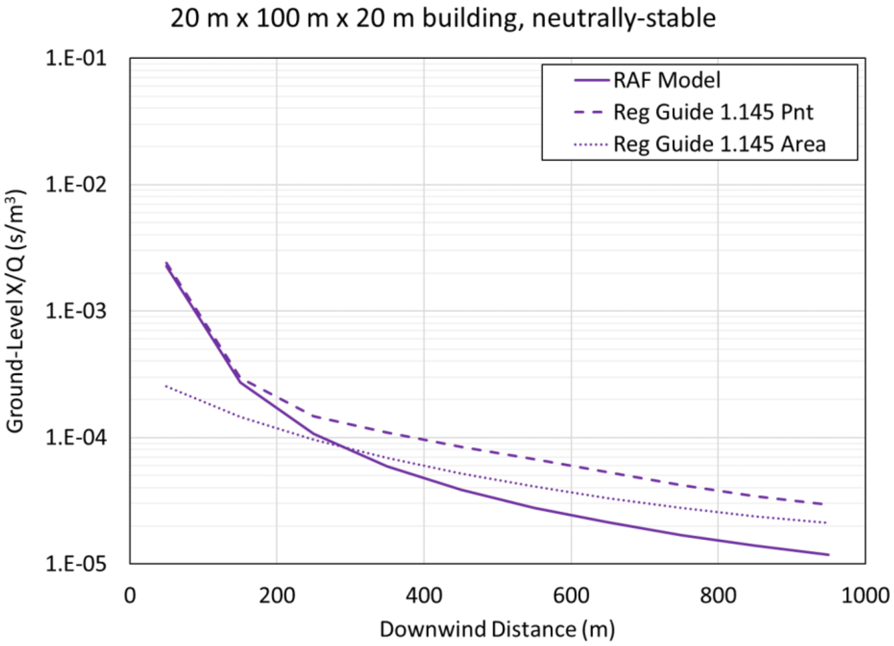

Figure 5-5. Ground-level, time-integrated X/Q versus distance calculated with MACCS using three updated plume meander models for Case 05

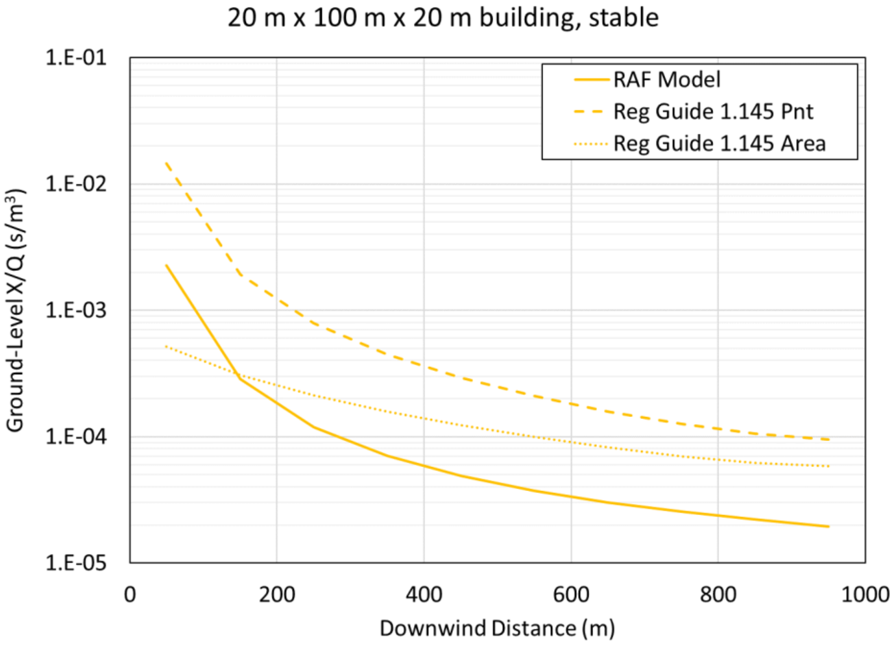

Figure 5-6. Ground-level, time-integrated X/Q versus distance calculated with MACCS using three updated plume meander models for Case 06

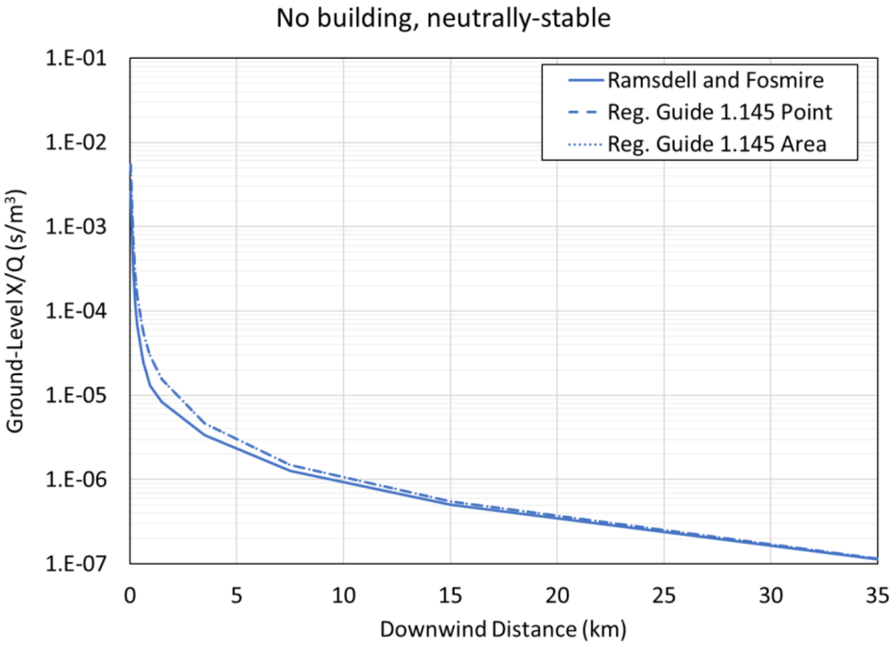

Figure 5-7. Ground-level, time-integrated X/Q versus distance out to 35 km calculated with MACCS using three updated plume meander models for Case 01

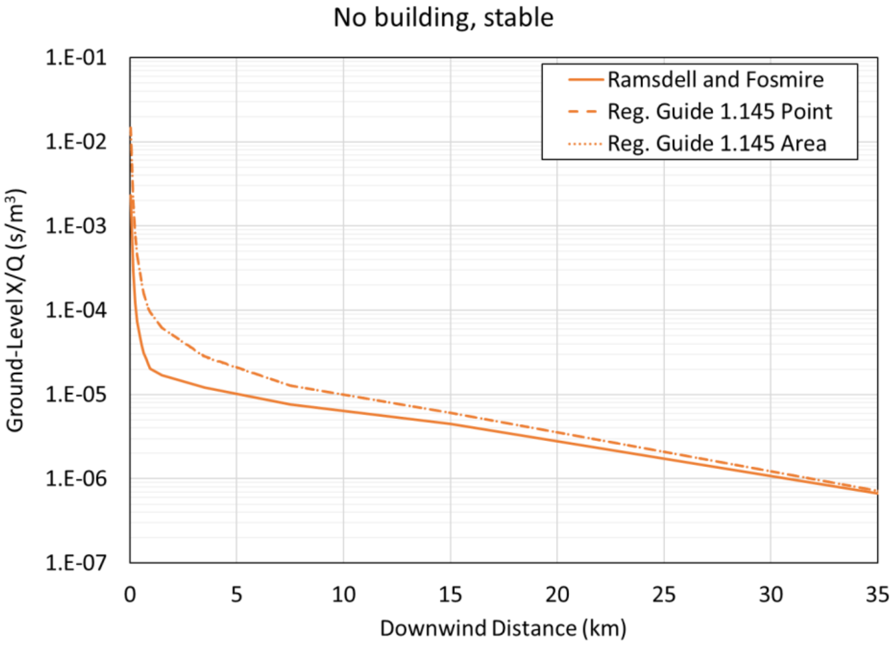

Figure 5-8. Ground-level, time-integrated X/Q versus distance out to 35 km calculated with MACCS using three updated plume meander models for Case 02

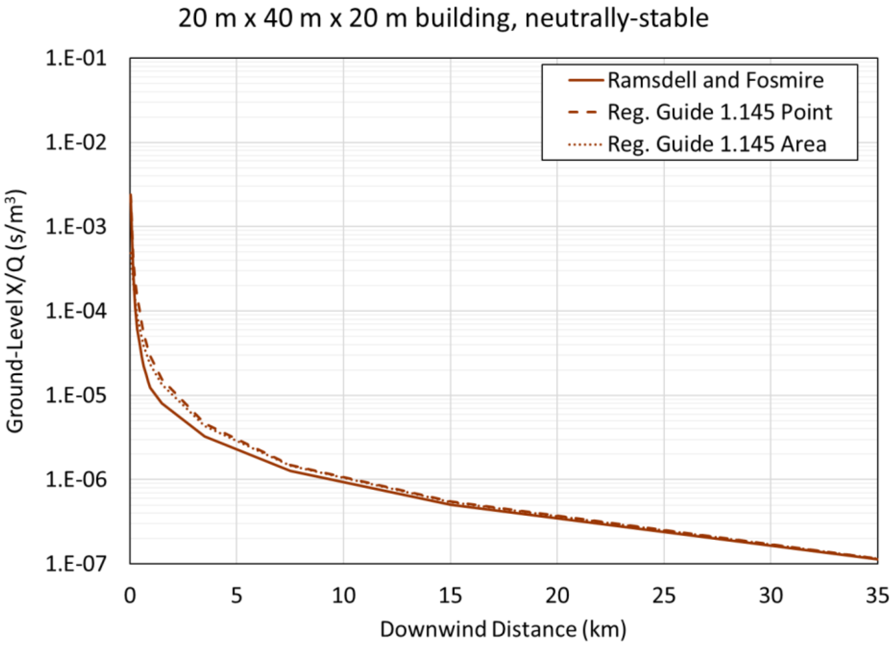

Figure 5-9. Ground-level, time-integrated X/Q versus distance out to 35 km calculated with MACCS using three updated plume meander models for Case 03

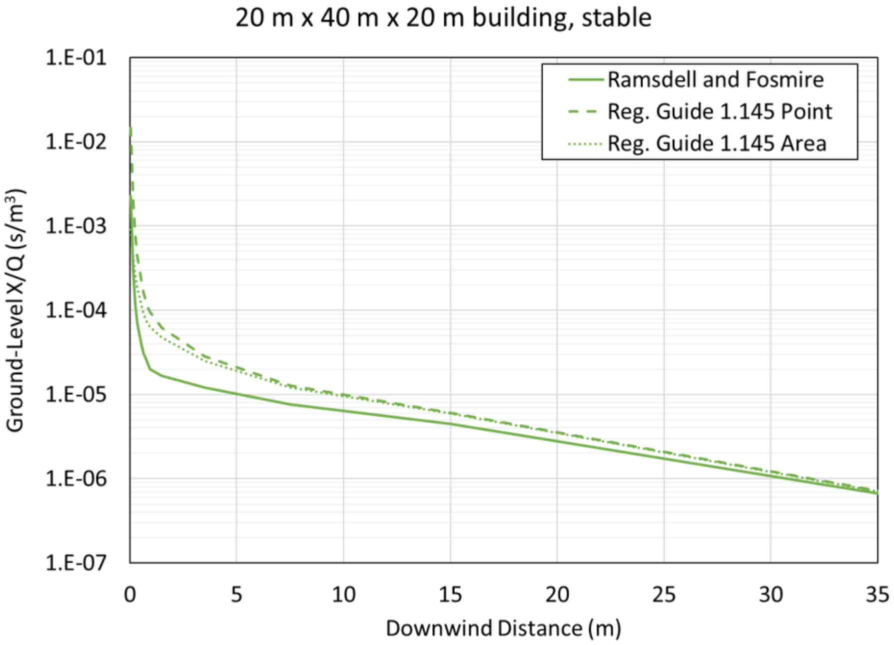

Figure 5-10. Ground-level, time-integrated X/Q versus distance out to 35 km calculated with MACCS using three updated plume meander models for Case 04

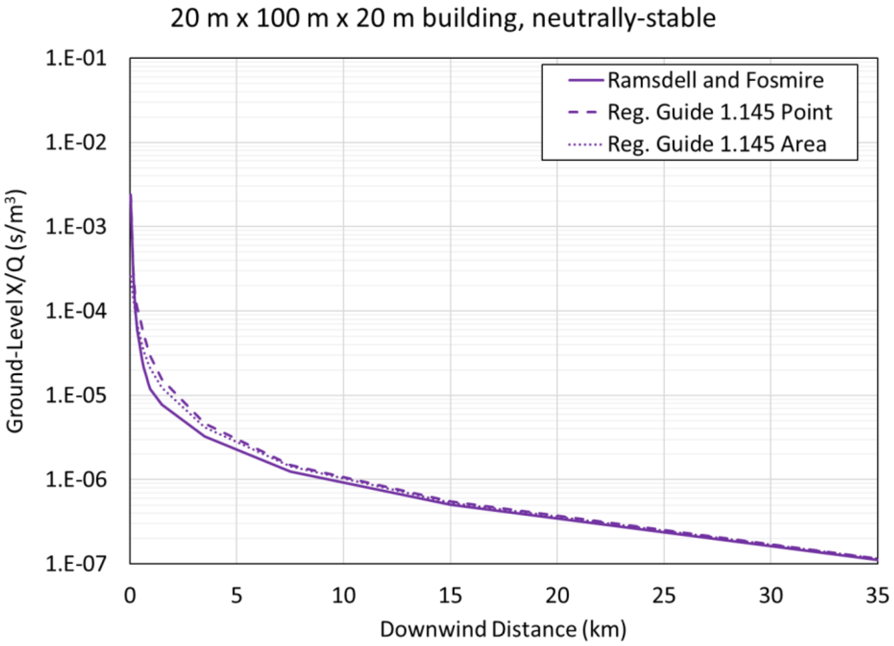

Figure 5-11. Ground-level, time-integrated X/Q versus distance out to 35 km calculated with MACCS using three updated plume meander models for Case 05

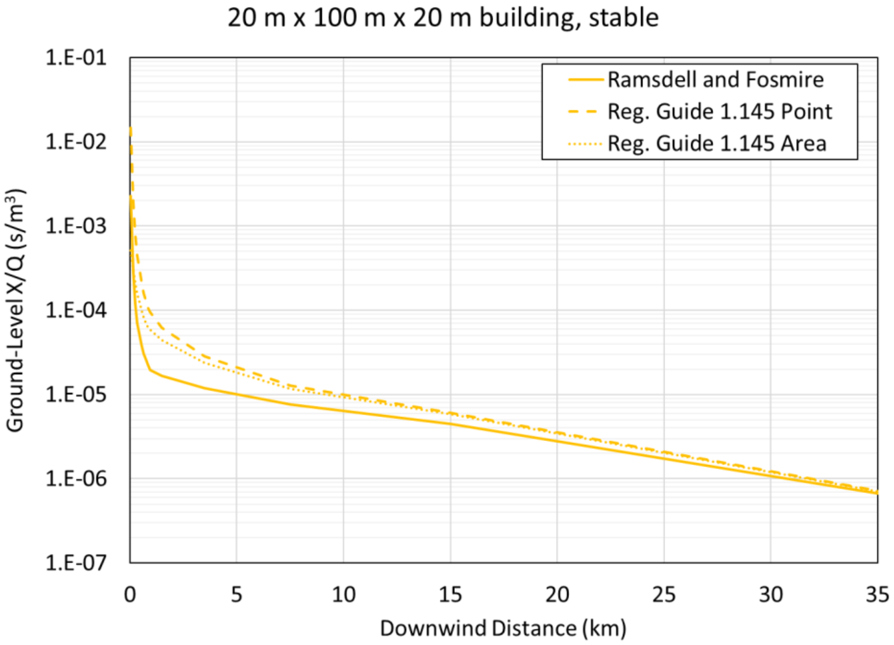

Figure 5-12. Ground-level, time-integrated X/Q versus distance out to 35 km calculated with MACCS using three updated plume meander models for Case 06

This page left blank

6. SUMMARY

An evaluation of whether MACCS could be used to estimate nearfield air concentrations was performed [10], in which ARCON96, AERMOD, and QUIC were used for comparisons to evaluate the adequacy of MACCS in the nearfield. To increase the nearfield capabilities of MACCS the plume meander model from ARCON96 (Ramsdell and Fosmire [17]) was integrated into MACCS and the MACCS plume meander model based on NUREG/CR-2260 [15] and Regulatory Guide 1.145 [16] was updated.

Test cases were determined to verify the plume meander model implementation into MACCS 4.1. They were selected to vary in building size, stability class, and wind speed. Two weather conditions were chosen. The first condition is a constant wind field of 4 m/s with neutral stability (Pasquill-Gifford stability class D). This condition was selected as a typical weather condition for comparison. The second condition is a constant wind field of 2 m/s with stable conditions (Pasquill-Gifford stability class F). This weather condition was selected as a reduced dispersion condition that would result in higher ground-level concentrations and potentially highlight differences between models. Because nearfield doses are commonly evaluated at the 95th percentile for licensing applications, the weather conditions that were chosen are biased toward the stable end of the range to represent the ones more likely to represent a 95th percentile exposure.

For building dimensions three configurations were chosen. The first configuration has no building, but rather is a ground-level point source and was selected to verify the implementation of the plume meander models in the absence of confounding factors. The second configuration includes a building 20 m tall by 40 m wide by 20 m deep and was selected to represent a typical building size. The third configuration includes a building 20 m tall by 100 m wide by 20 m deep and was selected to represent a building with a more extreme width to height ratio.

The test cases were run with ARCON96, PAVAN, AERMOD, and MACCS. MACCS was run three separate times for each test case with a different plume meander model selected. Furthermore, calculations were performed for each of the test cases using the analytical expressions for the plume meander models in Excel for an additional comparison. The results using the implemented MACCS plume meander models match the analytical expressions and corresponding alternative code run. This demonstrates that the additional MACCS plume meander models have been successfully implemented into MACCS 4.1.

Initial comparisons between the three plume meander models show that when using all three equations in the Regulatory Guide 1.145 plume meander model the X/Q values for the test cases are higher than for the other two models. Conversely, the X/Q values determined using the MACCS Ramsdell and Fosmire plume meander model are lower than the other two models except at distances of less than 200-300 m. Beyond 1 km, the three models converge with differences on the order of 5-10% at a distance of 35 km.

This page left blank

REFERENCES

[1] Y. Tominaga and T. Stathopoulos, 2016, "Ten Questions Concerning Modeling of Near-Field Pollutant Dispersion in the Built Environment," Building and Environment 105, 390-402.

[2] U.S. Nuclear Regulatory Commission (NRC), 2019, "NRC Non-Light Water Reactor (Non-LWR) Vision and Strategy, Volume 3: Computer Code Development Plans for Severe Accident Progression, Source Term, and Consequence Analysis," ML19093B404, US Nuclear Regulatory Commission, Washington D.C., April 2019. https://www.nrc.gov/docs/ML1909/ML19093B404.pdf

[3] N. Bixler, F. Walton, J. Leute, L. Eubanks, R. Haaker, and K. McFadden, 2021, "MACCS (MELCOR Accident Consequence Code System) User Guide," SAND2021-1588, Sandia National Laboratories, Albuquerque, NM.

[4] D.B. Turner, 1970, "Workbook of Atmospheric Dispersion Estimates (AP-26)". Office of Air Programs, U.S. Environmental Protection Agency, Research Triangle Park, NC.

[5] D. Chanin and M.L. Young, 1998, "Code Manual for MACCS2 – User's Guide," NUREG/CR-6613 Vol. 1, Nuclear Regulatory Commission, Washington, DC.

[6] U.S. Department of Energy (DOE), 2014, "Preparation of Nonreactor Nuclear Facility Documented Safety Analysis," DOE-STD-3009-2014, U.S Department of Energy, Washington D.C., November 2014.

[7] A.A. Simpkins, 2007, "Summary of Near-Field Methods for Atmospheric Release Modeling," ML072500257, Southwest Research Institute, San Antonio, TX, June 2007.

[8] U.S. Department of Energy (DOE), 2015, "Technical Report for Calculations of Atmospheric Dispersion at Onsite Locations for Department of Energy Nuclear Facilities," NSRD-2015-TD01, Nuclear Safety Research and Development, Washington D.C., April 2015.

[9] B.A. Napier, J.P. Rishel, and N.E. Bixler, 2011, "Final Review of Safety Assessment Issues at Savannah River Site, August 2011," PNNL-20990, Pacific Northwest National Laboratory, Richland, WA.

[10] D.J. Clayton, N.E. Bixler, 2020, "Assessment of the MACCS Code Applicability for Nearfield Consequence Analysis," SAND2020-2609, Sandia National Laboratories, Albuquerque, NM.

[11] J.V. Ramsdell Jr. and C.J. Fosmire, 1995, "Atmospheric Dispersion Estimates in the Vicinity of Buildings," PNL-10286, Pacific Northwest National Laboratory, Richland, WA.

[12] A.J. Cimorelli, S.G. Perry, A. Venkatram, J.C. Weil, R.J. Paine, R.B. Wilson, R.F. Lee, W.D. Peters, and R.W. Brode, 2005, "AERMOD: A Dispersion Model for Industrial Source Applications. Part I: General Model Formulation and Boundary Layer Characterization," American Meteorological Society, Journals Online, https://doi.org/10.1175/JAM2227.1.

[13] M. Nelson and M. Brown, 2013, "The QUIC Start Guide (v 6.0.1)," LA-UR-13-27291, Los Alamos National Laboratory, Los Alamos, NM.

[14] E.C. Eimutis, M.G. Konicek, 1972, "Derivations of Continuous Functions for the Lateral and Vertical Atmospheric Dispersion Coefficients," **Atmospheric Environment 6**, 859-863.

[15] W.G. Snell, and R.W. Jubach, 1981, "Technical Basis for Regulatory Guide 1.145, Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," NUREG/CR-2260, NUS-3854, NUS Corporation, October 1981.

[16] U.S. Nuclear Regulatory Commission (NRC), 1982, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants, Rev. 1," RG 1.145, US Nuclear Regulatory Commission, Washington D.C, November 1982 (reissued February 1983).

[17] J.V. Ramsdell Jr. and C.A. Simonen, 1997, "Atmospheric Relative Concentrations in Building Wakes," NUREG/CR-6331 Rev. 1, Nuclear Regulatory Commission, Washington, DC.

[18] T.J. Bander, 1982, "PAVAN: An Atmospheric Dispersion Program from Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations," NUREG/CR-2858, PNL-4413, Pacific Northwest National Laboratory, Richland, WA.

[19] F.A. Gifford, 1968, "An Outline of Theories of Diffusion in the Lower Layers of the Atmosphere," Chapter 3 in Meteorology and Atomic Energy - 1968, (D.H. Slade, Ed.)

[20] F.A. Gifford, 1976, "Turbulent Diffusion Typing Schemes - A Review." Nuclear Safety 17(1):68-86.

[21] J.V. Ramsdell Jr., "Atmospheric Diffusion for Control Room Habitability Assessments," NUREG/CR-5055, PNL-6391, Pacific Northwest National Laboratory, Richland, WA.

[22] R.P. Hosker and W.R. Pendergrass, "Flow and Dispersion near Clusters of Buildings," NUREG/CR-4113, Nuclear Regulatory Commission, Washington, DC.

[23] D. Golder, 1972, "Relations among Stability Parameters in the Surface Layer," Boundary-Layer Meteorology 3, 47-58.

[24] S.R. Hanna, G.A. Briggs, R.P. Hosker, Jr., 1982. "Handbook on Atmospheric Diffusion," DOE/TIC-11223.

APPENDIX A. ARCON96 INPUT FILES

Representative input files used in the evaluation of the test cases are shown below to illustrate implementation. The reader is directed to the code user manual to interpret the files.

A.1. Weather – 4D.MET

```
4D     1 1  90  40  4  90  40
4D     1 2  90  40  4  90  40
4D     1 3  90  40  4  90  40
4D     1 4  90  40  4  90  40
4D     1 5  90  40  4  90  40
4D     1 6  90  40  4  90  40
4D     1 7  90  40  4  90  40
4D     1 8  90  40  4  90  40
4D     1 9  90  40  4  90  40
4D     110  90  40  4  90  40
4D     111  90  40  4  90  40
4D     112  90  40  4  90  40
4D     113  90  40  4  90  40
4D     114  90  40  4  90  40
4D     115  90  40  4  90  40
4D     116  90  40  4  90  40
4D     117  90  40  4  90  40
4D     118  90  40  4  90  40
4D     119  90  40  4  90  40
4D     120  90  40  4  90  40
4D     121  90  40  4  90  40
4D     122  90  40  4  90  40
4D     123  90  40  4  90  40
4D     124  90  40  4  90  40
4D     2 1  90  40  4  90  40
4D     2 2  90  40  4  90  40
…
4D   36514  90  40  4  90  40
4D   36515  90  40  4  90  40
4D   36516  90  40  4  90  40
4D   36517  90  40  4  90  40
4D   36518  90  40  4  90  40
4D   36519  90  40  4  90  40
4D   36520  90  40  4  90  40
4D   36521  90  40  4  90  40
4D   36522  90  40  4  90  40
4D   36523  90  40  4  90  40
4D   36524  90  40  4  90  40
```

A.2. Weather – 2F.MET

```
2F     1 1  90  20  6  90  20
2F     1 2  90  20  6  90  20
2F     1 3  90  20  6  90  20
2F     1 4  90  20  6  90  20
2F     1 5  90  20  6  90  20
2F     1 6  90  20  6  90  20
2F     1 7  90  20  6  90  20
2F     1 8  90  20  6  90  20
2F     1 9  90  20  6  90  20
2F     110  90  20  6  90  20
2F     111  90  20  6  90  20
2F     112  90  20  6  90  20
2F     113  90  20  6  90  20
2F     114  90  20  6  90  20
2F     115  90  20  6  90  20
2F     116  90  20  6  90  20
2F     117  90  20  6  90  20
2F     118  90  20  6  90  20
2F     119  90  20  6  90  20
2F     120  90  20  6  90  20
2F     121  90  20  6  90  20
2F     122  90  20  6  90  20
2F     123  90  20  6  90  20
2F     124  90  20  6  90  20
2F     2 1  90  20  6  90  20
2F     2 2  90  20  6  90  20
…
2F   36514  90  20  6  90  20
2F   36515  90  20  6  90  20
2F   36516  90  20  6  90  20
2F   36517  90  20  6  90  20
2F   36518  90  20  6  90  20
2F   36519  90  20  6  90  20
2F   36520  90  20  6  90  20
2F   36521  90  20  6  90  20
2F   36522  90  20  6  90  20
2F   36523  90  20  6  90  20
2F   36524  90  20  6  90  20
```

A.3. Case 01 (50 m)

```
1
4D.MET
    10.0
    50.0
   1
   2
     0.00
     1.00
     0.00
     0.00
     0.00
  90  90
    50.00
     0.00
     0.00
Case01\CASE01_050.LOG
Case01\CASE01_050.CFD
 .03
     0.50
     4.00
   1   2   4   8  12  24  96 168 360 720
   1   2   4   8  11  22  87 152 324 648
     0.1    0.1
n
```

A.4. Case 02 (150 m)

```
1
2F.MET
    10.0
    50.0
   1
   2
     0.00
     1.00
     0.00
     0.00
     0.00
  90  90
   150.00
     0.00
     0.00
Case02\CASE02_150.LOG
Case02\CASE02_150.CFD
 .03
     0.50
     4.00
   1   2   4   8  12  24  96 168 360 720
   1   2   4   8  11  22  87 152 324 648
     0.1    0.1
n
```

A.5. Case 03 (250 m)

```
1
4D.MET
    10.0
    50.0
   1
   2
    20.00
   800.00
     0.00
     0.00
     0.00
  90  90
   250.00
     0.00
     0.00
Case03\CASE03_250.LOG
Case03\CASE03_250.CFD
 .03
     0.50
     4.00
   1   2   4   8  12  24  96 168 360 720
   1   2   4   8  11  22  87 152 324 648
     0.1    0.1
n
```

A.6. Case 04 (350 m)

```
1
2F.MET
    10.0
    50.0
   1
```

```
  2
   20.00
  800.00
    0.00
    0.00
    0.00
 90  90
  350.00
    0.00
    0.00
Case04\CASE04_350.LOG
Case04\CASE04_350.CFD
 .03
    0.50
    4.00
  1   2   4   8  12  24  96 168 360 720
  1   2   4   8  11  22  87 152 324 648
    0.1    0.1
n
```

A.7. Case 05 (450 m)

```
1
4D.MET
   10.0
   50.0
  1
  2
   20.00
 2000.00
    0.00
    0.00
    0.00
 90  90
  450.00
    0.00
    0.00
Case05\CASE05_450.LOG
Case05\CASE05_450.CFD
 .03
    0.50
    4.00
  1   2   4   8  12  24  96 168 360 720
  1   2   4   8  11  22  87 152 324 648
    0.1    0.1
n
```

A.8. Case 06 (550 m)

```
1
2F.MET
   10.0
   50.0
  1
  2
   20.00
 2000.00
    0.00
    0.00
    0.00
 90  90
  550.00
    0.00
    0.00
Case06\CASE06_550.LOG
Case06\CASE06_550.CFD
 .03
    0.50
    4.00
  1   2   4   8  12  24  96 168 360 720
  1   2   4   8  11  22  87 152 324 648
    0.1    0.1
n
```

This page left blank

APPENDIX B. PAVAN INPUT FILES

Representative input files used in the evaluation of the test cases are shown below to illustrate implementation. The reader is directed to the code user manual to interpret the files.

B.1. Building 20x40x20 (Case 01, 02, 03 and 04)

```
1 1  11 1
 Building 20x40x20
 10.0 METER

 NONE
   5   0
 800.  0.0 10.0 10.0
   0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   1  1  1  1  1  1  1  1  1  1  0  0  0  0  0  0
   1  1  1  1  1  1  1  1  1  1  0  0  0  0  0  0
   1  1  1  1  1  1  1  1  1  1  0  0  0  0  0  0
   1  1  1  1  1  1  1  1  1  1  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   1  1  1  1  1  1  1  1  1  1  0  0  0  0  0  0
   1  1  1  1  1  1  1  1  1  1  0  0  0  0  0  0
   1  1  1  1  1  1  1  1  1  1  0  0  0  0  0  0
   1  1  1  1  1  1  1  1  1  1  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  -1.  1.0  2.0  4.0  8.0 16.0
  50. 150. 250. 350. 450. 550. 650. 750. 850. 950.  0.0  0.0  0.0  0.0  0.0  0.0
 100. 200. 300. 400. 500. 600. 700. 800. 900.1000.  0.0  0.0  0.0  0.0  0.0  0.0
```

B.2. Building 20x100x20 (Case 01, 02, 05 and 06)

```
  1 1  11 1
 Building 20x100x20
 10.0 METER

 NONE
   5   0
2000.  0.0 10.0 10.0
   0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   1  1  1  1  1  1  1  1  1  1  0  0  0  0  0  0
   1  1  1  1  1  1  1  1  1  1  0  0  0  0  0  0
   1  1  1  1  1  1  1  1  1  1  0  0  0  0  0  0
   1  1  1  1  1  1  1  1  1  1  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   1  1  1  1  1  1  1  1  1  1  0  0  0  0  0  0
   1  1  1  1  1  1  1  1  1  1  0  0  0  0  0  0
   1  1  1  1  1  1  1  1  1  1  0  0  0  0  0  0
   1  1  1  1  1  1  1  1  1  1  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
```

```
  -1.  1.0  2.0  4.0  8.0 16.0
  50. 150. 250. 350. 450. 550. 650. 750. 850. 950.  0.0  0.0  0.0  0.0  0.0  0.0
 100. 200. 300. 400. 500. 600. 700. 800. 900.1000.  0.0  0.0  0.0  0.0  0.0  0.0
```

APPENDIX C. AERMOD INPUT FILES

Representative input files used in the evaluation of the test cases are shown below to illustrate implementation. The reader is directed to the code user manual to interpret the files.

C.1. Weather – 4D.sfc

```
   41.3N    74.0W        UA_ID: 00014735  SF_ID:    14735  OS_ID:    99999    VERSION: 15181    CCVR_Sub
88  3  1  61  1  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61  2  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61  3  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61  4  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61  5  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61  6  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61  7  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61  8  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61  9  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61 10  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61 11  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61 12  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61 13  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61 14  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61 15  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61 16  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61 17  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61 18  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61 19  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61 20  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61 21  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61 22  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61 23  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
88  3  1  61 24  -3.7  0.275 -9.000 -9.000 -999. 2000.  500.0  0.0300  1.00  1.00   4.00  270.0  10.0  282.2  10.0    0  -9.00   50.  1005.   10 NAD-OS  NoSubs
```

C.2. Weather – 4D.pfl

```
88  3  1  1    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1  1   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1  2    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1  2   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1  3    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1  3   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1  4    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1  4   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1  5    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1  5   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1  6    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1  6   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1  7    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1  7   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1  8    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1  8   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1  9    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1  9   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1 10    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1 10   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1 11    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1 11   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1 12    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1 12   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1 13    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1 13   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1 14    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1 14   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1 15    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1 15   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1 16    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1 16   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1 17    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1 17   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1 18    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1 18   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1 19    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1 19   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1 20    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1 20   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1 21    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1 21   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1 22    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1 22   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1 23    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1 23   100.0 1  270.0    4.00    8.00   99.00   99.00
88  3  1 24    10.0 0  270.0    4.00    9.00   99.00   99.00
88  3  1 24   100.0 1  270.0    4.00    8.00   99.00   99.00
```

C.3. Weather – 2F.sfc

```
    41.3N    74.0W        UA_ID: 00014735  SF_ID:    14735  OS_ID:    99999     VERSION: 15181    CCVR_Sub
88  3  1  61  1  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61  2  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61  3  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61  4  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61  5  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61  6  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61  7  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61  8  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61  9  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61 10  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61 11  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61 12  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61 13  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61 14  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61 15  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61 16  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61 17  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61 18  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61 19  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61 20  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61 21  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61 22  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61 23  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
88  3  1  61 24  -4.0  0.082 -9.000 -9.000 -999. 2000.  12.5  0.0300   1.00   1.00    2.00  270.0   10.0  282.2   10.0     0  -9.00    50.  1005.     0 NAD-OS  NoSubs
```

C.4. Weather – 2F.pfl

```
88  3  1  1     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1  1    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1  2     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1  2    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1  3     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1  3    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1  4     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1  4    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1  5     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1  5    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1  6     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1  6    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1  7     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1  7    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1  8     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1  8    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1  9     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1  9    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1 10     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1 10    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1 11     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1 11    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1 12     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1 12    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1 13     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1 13    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1 14     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1 14    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1 15     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1 15    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1 16     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1 16    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1 17     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1 17    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1 18     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1 18    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1 19     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1 19    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1 20     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1 20    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1 21     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1 21    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1 22     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1 22    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1 23     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1 23    100.0 1   270.0     2.00    12.00    99.00    99.00
88  3  1 24     10.0 0   270.0     2.00     9.00    99.00    99.00
88  3  1 24    100.0 1   270.0     2.00    12.00    99.00    99.00
```

C.5. Case 01

```
**
**    AERMOD
**

CO STARTING
   TITLEONE  Case01 4D 0MW Ground Level Point
   MODELOPT  FLAT CONC DDEP DRYDPLT
   AVERTIME  24  PERIOD
```

```
   POLLUTID  OTHER
   RUNORNOT  RUN
CO FINISHED

SO STARTING
   ELEVUNIT  METERS
   LOCATION  MAIN1   POINT  0.0  0.0  0.0

** Point Source        Mdot  Hgt   Temp  Vel   Diam
** Parameters:         ----  ----  ----  ----  ----
   SRCPARAM  MAIN1     1.0   0.0   0.0   0.0   3.0

   PARTDIAM  MAIN1 0.153 0.285 0.531 0.989  1.84  3.43  6.38  11.9  22.1  41.2
   MASSFRAX  MAIN1 0.092 0.146 0.141 0.144 0.112 0.080 0.072 0.071 0.071 0.071
   PARTDENS  MAIN1   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0

   SRCGROUP  ALL
SO FINISHED

RE STARTING
RE GRIDCART CAR1 STA
                 XYINC 50. 10 100. 0. 1 0.
RE GRIDCART CAR1 END
RE FINISHED

ME STARTING
   SURFFILE  4D_met\4D.sfc
   PROFFILE  4D_met\4D.pfl
   SURFDATA  14735  1988  ALBANY,NY
   UAIRDATA  14735  1988  ALBANY,NY
   SITEDATA  99999  1988  HUDSON
   PROFBASE  0.0  METERS
ME FINISHED

OU STARTING
   FILEFORM  EXP
   POSTFILE  24 ALL PLOT Case01\Case01.sum
OU FINISHED
```

C.6. Case 02

```
**
**    AERMOD
**

CO STARTING
   TITLEONE  Case02 2F 0MW Ground Level Point
   MODELOPT  FLAT CONC DDEP DRYDPLT
   AVERTIME  24  PERIOD
   POLLUTID  OTHER
   RUNORNOT  RUN
CO FINISHED

SO STARTING
   ELEVUNIT  METERS
   LOCATION  MAIN1   POINT  0.0  0.0  0.0

** Point Source        Mdot  Hgt   Temp  Vel   Diam
** Parameters:         ----  ----  ----  ----  ----
   SRCPARAM  MAIN1     1.0   0.0   0.0   0.0   3.0

   PARTDIAM  MAIN1 0.153 0.285 0.531 0.989  1.84  3.43  6.38  11.9  22.1  41.2
   MASSFRAX  MAIN1 0.092 0.146 0.141 0.144 0.112 0.080 0.072 0.071 0.071 0.071
   PARTDENS  MAIN1   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0

   SRCGROUP  ALL
SO FINISHED

RE STARTING
RE GRIDCART CAR1 STA
                 XYINC 50. 10 100. 0. 1 0.
RE GRIDCART CAR1 END
RE FINISHED

ME STARTING
   SURFFILE  2F_met\2F.sfc
   PROFFILE  2F_met\2F.pfl
   SURFDATA  14735  1988  ALBANY,NY
   UAIRDATA  14735  1988  ALBANY,NY
   SITEDATA  99999  1988  HUDSON
   PROFBASE  0.0  METERS
ME FINISHED

OU STARTING
   FILEFORM  EXP
   POSTFILE  24 ALL PLOT Case02\Case02.sum
OU FINISHED
```

C.7. Case 03

```
**
**    AERMOD
**

CO STARTING
   TITLEONE  Case03 4D 0MW 20x40
   MODELOPT  FLAT CONC DDEP DRYDPLT
   AVERTIME  24  PERIOD
   POLLUTID  OTHER
   RUNORNOT  RUN
CO FINISHED

SO STARTING
   ELEVUNIT  METERS
   LOCATION  MAIN1   POINT  0.0  0.0  0.0

** Point Source        Mdot  Hgt   Temp  Vel   Diam
** Parameters:         ----  ----  ----  ----  ----
   SRCPARAM  MAIN1     1.0   20.0  0.0   0.0   3.0

   PARTDIAM  MAIN1 0.153 0.285 0.531 0.989  1.84  3.43  6.38  11.9  22.1  41.2
   MASSFRAX  MAIN1 0.092 0.146 0.141 0.144 0.112 0.080 0.072 0.071 0.071 0.071
   PARTDENS  MAIN1   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0

   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDWID Main1      26.64   32.47   37.32   41.03   43.50   44.64
   BUILDWID Main1      44.43   42.87   40.00   42.87   44.43   44.64
   BUILDWID Main1      43.50   41.03   37.32   32.47   26.64   20.00
   BUILDWID Main1      26.64   32.47   37.32   41.03   43.50   44.64
   BUILDWID Main1      44.43   42.87   40.00   42.87   44.43   44.64
   BUILDWID Main1      43.50   41.03   37.32   32.47   26.64   20.00
   BUILDLEN Main1      42.87   44.43   44.64   43.50   41.03   37.32
   BUILDLEN Main1      32.47   26.64   20.00   26.64   32.47   37.32
   BUILDLEN Main1      41.03   43.50   44.64   44.43   42.87   40.00
   BUILDLEN Main1      42.87   44.43   44.64   43.50   41.03   37.32
   BUILDLEN Main1      32.47   26.64   20.00   26.64   32.47   37.32
   BUILDLEN Main1      41.03   43.50   44.64   44.43   42.87   40.00
   XBADJ    Main1     -23.17  -25.63  -27.32  -28.18  -28.18  -27.32
   XBADJ    Main1     -25.63  -23.17  -20.00  -23.17  -25.63  -27.32
   XBADJ    Main1     -28.18  -28.18  -27.32  -25.63  -23.17  -20.00
   XBADJ    Main1     -19.70  -18.79  -17.32  -15.32  -12.86  -10.00
   XBADJ    Main1      -6.84   -3.47    0.00   -3.47   -6.84  -10.00
   XBADJ    Main1     -12.86  -15.32  -17.32  -18.79  -19.70  -20.00
   YBADJ    Main1       9.85    9.40    8.66    7.66    6.43    5.00
   YBADJ    Main1       3.42    1.74    0.00   -1.74   -3.42   -5.00
   YBADJ    Main1      -6.43   -7.66   -8.66   -9.40   -9.85  -10.00
   YBADJ    Main1      -9.85   -9.40   -8.66   -7.66   -6.43   -5.00
   YBADJ    Main1      -3.42   -1.74    0.00    1.74    3.42    5.00
   YBADJ    Main1       6.43    7.66    8.66    9.40    9.85   10.00

   SRCGROUP  ALL
SO FINISHED

RE STARTING
RE GRIDCART CAR1 STA
            XYINC 50. 10 100. 0. 1 0.
RE GRIDCART CAR1 END
RE FINISHED

ME STARTING
   SURFFILE  4D_met\4D.sfc
   PROFFILE  4D_met\4D.pfl
   SURFDATA  14735  1988  ALBANY,NY
   UAIRDATA  14735  1988  ALBANY,NY
   SITEDATA  99999  1988  HUDSON
   PROFBASE  0.0  METERS
ME FINISHED

OU STARTING
   FILEFORM  EXP
   POSTFILE  24 ALL PLOT Case03\Case03.sum
OU FINISHED
```

C.8. Case 04

```
**
**    AERMOD
**

CO STARTING
   TITLEONE  Case04 2F 0MW 20x40
   MODELOPT  FLAT CONC DDEP DRYDPLT
   AVERTIME  24  PERIOD
   POLLUTID  OTHER
```

```
   RUNORNOT  RUN
CO FINISHED

SO STARTING
   ELEVUNIT  METERS
   LOCATION  MAIN1   POINT  0.0  0.0  0.0

** Point Source        Mdot  Hgt   Temp  Vel   Diam
** Parameters:         ----  ----  ----  ----  ----
   SRCPARAM  MAIN1     1.0   20.0  0.0   0.0   3.0

   PARTDIAM  MAIN1 0.153 0.285 0.531 0.989  1.84  3.43  6.38  11.9  22.1  41.2
   MASSFRAX  MAIN1 0.092 0.146 0.141 0.144 0.112 0.080 0.072 0.071 0.071 0.071
   PARTDENS  MAIN1   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0

   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDWID Main1      26.64   32.47   37.32   41.03   43.50   44.64
   BUILDWID Main1      44.43   42.87   40.00   42.87   44.43   44.64
   BUILDWID Main1      43.50   41.03   37.32   32.47   26.64   20.00
   BUILDWID Main1      26.64   32.47   37.32   41.03   43.50   44.64
   BUILDWID Main1      44.43   42.87   40.00   42.87   44.43   44.64
   BUILDWID Main1      43.50   41.03   37.32   32.47   26.64   20.00
   BUILDLEN Main1      42.87   44.43   44.64   43.50   41.03   37.32
   BUILDLEN Main1      32.47   26.64   20.00   26.64   32.47   37.32
   BUILDLEN Main1      41.03   43.50   44.64   44.43   42.87   40.00
   BUILDLEN Main1      42.87   44.43   44.64   43.50   41.03   37.32
   BUILDLEN Main1      32.47   26.64   20.00   26.64   32.47   37.32
   BUILDLEN Main1      41.03   43.50   44.64   44.43   42.87   40.00
   XBADJ    Main1     -23.17  -25.63  -27.32  -28.18  -28.18  -27.32
   XBADJ    Main1     -25.63  -23.17  -20.00  -23.17  -25.63  -27.32
   XBADJ    Main1     -28.18  -28.18  -27.32  -25.63  -23.17  -20.00
   XBADJ    Main1     -19.70  -18.79  -17.32  -15.32  -12.86  -10.00
   XBADJ    Main1      -6.84   -3.47    0.00   -3.47   -6.84  -10.00
   XBADJ    Main1     -12.86  -15.32  -17.32  -18.79  -19.70  -20.00
   YBADJ    Main1       9.85    9.40    8.66    7.66    6.43    5.00
   YBADJ    Main1       3.42    1.74    0.00   -1.74   -3.42   -5.00
   YBADJ    Main1      -6.43   -7.66   -8.66   -9.40   -9.85  -10.00
   YBADJ    Main1      -9.85   -9.40   -8.66   -7.66   -6.43   -5.00
   YBADJ    Main1      -3.42   -1.74    0.00    1.74    3.42    5.00
   YBADJ    Main1       6.43    7.66    8.66    9.40    9.85   10.00

   SRCGROUP  ALL
SO FINISHED

RE STARTING
RE GRIDCART CAR1 STA
              XYINC 50. 10 100. 0. 1 0.
RE GRIDCART CAR1 END
RE FINISHED

ME STARTING
   SURFFILE  2F_met\2F.sfc
   PROFFILE  2F_met\2F.pfl
   SURFDATA  14735  1988  ALBANY,NY
   UAIRDATA  14735  1988  ALBANY,NY
   SITEDATA  99999  1988  HUDSON
   PROFBASE  0.0  METERS
ME FINISHED

OU STARTING
   FILEFORM  EXP
   POSTFILE  24 ALL PLOT Case04\Case04.sum
OU FINISHED
```

C.9. Case 05

```
**
**    AERMOD
**

CO STARTING
   TITLEONE  Case05 4D 0MW 20x100
   MODELOPT  FLAT CONC DDEP DRYDPLT
   AVERTIME  24  PERIOD
   POLLUTID  OTHER
   RUNORNOT  RUN
CO FINISHED

SO STARTING
   ELEVUNIT  METERS
   LOCATION  MAIN1   POINT  0.0  0.0  0.0

** Point Source        Mdot  Hgt   Temp  Vel   Diam
** Parameters:         ----  ----  ----  ----  ----
   SRCPARAM  MAIN1     1.0   20.0  0.0   0.0   3.0

   PARTDIAM  MAIN1 0.153 0.285 0.531 0.989  1.84  3.43  6.38  11.9  22.1  41.2
```

```
   MASSFRAX  MAIN1 0.092 0.146 0.141 0.144 0.112 0.080 0.072 0.071 0.071 0.071
   PARTDENS  MAIN1   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0

   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDWID Main1      37.06   53.00   67.32   79.60   89.46   96.60
   BUILDWID Main1     100.81  101.95  100.00  101.95  100.81   96.60
   BUILDWID Main1      89.46   79.60   67.32   53.00   37.06   20.00
   BUILDWID Main1      37.06   53.00   67.32   79.60   89.46   96.60
   BUILDWID Main1     100.81  101.95  100.00  101.95  100.81   96.60
   BUILDWID Main1      89.46   79.60   67.32   53.00   37.06   20.00
   BUILDLEN Main1     101.95  100.81   96.60   89.46   79.60   67.32
   BUILDLEN Main1      53.00   37.06   20.00   37.06   53.00   67.32
   BUILDLEN Main1      79.60   89.46   96.60  100.81  101.95  100.00
   BUILDLEN Main1     101.95  100.81   96.60   89.46   79.60   67.32
   BUILDLEN Main1      53.00   37.06   20.00   37.06   53.00   67.32
   BUILDLEN Main1      79.60   89.46   96.60  100.81  101.95  100.00
   XBADJ    Main1     -52.71  -53.83  -53.30  -51.16  -47.46  -42.32
   XBADJ    Main1     -35.89  -28.38  -20.00  -28.38  -35.89  -42.32
   XBADJ    Main1     -47.46  -51.16  -53.30  -53.83  -52.71  -50.00
   XBADJ    Main1     -49.24  -46.98  -43.30  -38.30  -32.14  -25.00
   XBADJ    Main1     -17.10   -8.68    0.00   -8.68  -17.10  -25.00
   XBADJ    Main1     -32.14  -38.30  -43.30  -46.98  -49.24  -50.00
   YBADJ    Main1       9.85    9.40    8.66    7.66    6.43    5.00
   YBADJ    Main1       3.42    1.74    0.00   -1.74   -3.42   -5.00
   YBADJ    Main1      -6.43   -7.66   -8.66   -9.40   -9.85  -10.00
   YBADJ    Main1      -9.85   -9.40   -8.66   -7.66   -6.43   -5.00
   YBADJ    Main1      -3.42   -1.74    0.00    1.74    3.42    5.00
   YBADJ    Main1       6.43    7.66    8.66    9.40    9.85   10.00

   SRCGROUP  ALL
SO FINISHED

RE STARTING
RE GRIDCART CAR1 STA
            XYINC 50. 10 100. 0. 1 0.
RE GRIDCART CAR1 END
RE FINISHED

ME STARTING
   SURFFILE  4D_met\4D.sfc
   PROFFILE  4D_met\4D.pfl
   SURFDATA  14735  1988  ALBANY,NY
   UAIRDATA  14735  1988  ALBANY,NY
   SITEDATA  99999  1988  HUDSON
   PROFBASE  0.0  METERS
ME FINISHED

OU STARTING
   FILEFORM  EXP
   POSTFILE  24 ALL PLOT Case05\Case05.sum
OU FINISHED
```

C.10. Case 06

```
**
**    AERMOD
**

CO STARTING
   TITLEONE  Case06 2F 0MW 20x100
   MODELOPT  FLAT CONC DDEP DRYDPLT
   AVERTIME  24  PERIOD
   POLLUTID  OTHER
   RUNORNOT  RUN
CO FINISHED

SO STARTING
   ELEVUNIT  METERS
   LOCATION  MAIN1   POINT  0.0  0.0  0.0

** Point Source        Mdot  Hgt   Temp  Vel   Diam
** Parameters:         ----  ----  ----  ----  ----
   SRCPARAM  MAIN1     1.0   20.0  0.0   0.0   3.0

   PARTDIAM  MAIN1 0.153 0.285 0.531 0.989  1.84  3.43  6.38  11.9  22.1  41.2
   MASSFRAX  MAIN1 0.092 0.146 0.141 0.144 0.112 0.080 0.072 0.071 0.071 0.071
   PARTDENS  MAIN1   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0   1.0

   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDHGT Main1      20.00   20.00   20.00   20.00   20.00   20.00
   BUILDWID Main1      37.06   53.00   67.32   79.60   89.46   96.60
   BUILDWID Main1     100.81  101.95  100.00  101.95  100.81   96.60
   BUILDWID Main1      89.46   79.60   67.32   53.00   37.06   20.00
```

```
   BUILDWID Main1      37.06   53.00   67.32   79.60   89.46   96.60
   BUILDWID Main1     100.81  101.95  100.00  101.95  100.81   96.60
   BUILDWID Main1      89.46   79.60   67.32   53.00   37.06   20.00
   BUILDLEN Main1     101.95  100.81   96.60   89.46   79.60   67.32
   BUILDLEN Main1      53.00   37.06   20.00   37.06   53.00   67.32
   BUILDLEN Main1      79.60   89.46   96.60  100.81  101.95  100.00
   BUILDLEN Main1     101.95  100.81   96.60   89.46   79.60   67.32
   BUILDLEN Main1      53.00   37.06   20.00   37.06   53.00   67.32
   BUILDLEN Main1      79.60   89.46   96.60  100.81  101.95  100.00
   XBADJ    Main1     -52.71  -53.83  -53.30  -51.16  -47.46  -42.32
   XBADJ    Main1     -35.89  -28.38  -20.00  -28.38  -35.89  -42.32
   XBADJ    Main1     -47.46  -51.16  -53.30  -53.83  -52.71  -50.00
   XBADJ    Main1     -49.24  -46.98  -43.30  -38.30  -32.14  -25.00
   XBADJ    Main1     -17.10   -8.68    0.00   -8.68  -17.10  -25.00
   XBADJ    Main1     -32.14  -38.30  -43.30  -46.98  -49.24  -50.00
   YBADJ    Main1       9.85    9.40    8.66    7.66    6.43    5.00
   YBADJ    Main1       3.42    1.74    0.00   -1.74   -3.42   -5.00
   YBADJ    Main1      -6.43   -7.66   -8.66   -9.40   -9.85  -10.00
   YBADJ    Main1      -9.85   -9.40   -8.66   -7.66   -6.43   -5.00
   YBADJ    Main1      -3.42   -1.74    0.00    1.74    3.42    5.00
   YBADJ    Main1       6.43    7.66    8.66    9.40    9.85   10.00

   SRCGROUP  ALL
SO FINISHED

RE STARTING
RE GRIDCART CAR1 STA
             XYINC 50. 10 100. 0. 1 0.
RE GRIDCART CAR1 END
RE FINISHED

ME STARTING
   SURFFILE  2F_met\2F.sfc
   PROFFILE  2F_met\2F.pfl
   SURFDATA  14735  1988  ALBANY,NY
   UAIRDATA  14735  1988  ALBANY,NY
   SITEDATA  99999  1988  HUDSON
   PROFBASE  0.0  METERS
ME FINISHED

OU STARTING
   FILEFORM  EXP
   POSTFILE  24 ALL PLOT Case06\Case06.sum
OU FINISHED
```

This page left blank

APPENDIX D. MACCS INPUT FILES

Representative input files used in the evaluation of the test cases are shown below to illustrate implementation. The reader is directed to the code user manual to interpret the files.

D.1. Case 01 with MACCS Ramsdell and Fosmire Plume Meander Model

```
* File created using WinMACCS version 4.0.7 SVN:7955 3/5/2021 3:04:24 PM
*
* MACCS Cyclical File: Case01.inp
*
* Form 'Atmos Description' Comment:
* Case 01
*
* ATNAM1, identifies this MACCS calculation
RIATNAM1001         '4D weather, 0 MW, no building, ground'
*
* ACTIVITY_UNITS, model results are displayed in these units
UNITACTI001         Bq
*
* DIST_UNITS, model results are displayed in these units
UNITDIST001         km
*
* AREA_UNITS,  model results are displayed in these units
UNITAREA001         ha
*
* DOSE_UNITS,  model results are displayed in these units
UNITDOSE001         Sv
*
* NUMRAD, number of radial spatial elements
GENUMRAD001         19
*
* SPAEND, spatial endpoint distances (km)
GESPAEND001         0.1
GESPAEND002         0.2
GESPAEND003         0.3
GESPAEND004         0.4
GESPAEND005         0.5
GESPAEND006         0.6
GESPAEND007         0.7
GESPAEND008         0.8
GESPAEND009         0.9
GESPAEND010         1.
GESPAEND011         2.
GESPAEND012         5.
GESPAEND013         10.
GESPAEND014         20.
GESPAEND015         50.
GESPAEND016         100.
GESPAEND017         200.
GESPAEND018         500.
GESPAEND019         1000.
*
* NUMCOR, number of angular compass directions
GENUMCOR001         64
*
* NUMISO, number of nuclides
ISNUMISO001         1
*
* MAXGRP, number of chemical groups
ISMAXGRP001         1
*
* GRPNAM, chemical group names
ISGRPNAM001         Cesium
*
* MSMODL, multi source term model (TRUE, FALSE)
ISMSMODL001         .FALSE.
*
* WETDEP, DRYDEP, wet and dry deposition flags for each nuclide group
ISDEPFLA001         .FALSE.     .TRUE.
*
* NUMSTB, number of pseudostable radionuclides, always 0
ISNUMSTB001         0
*
* NUMSTB, number of pseudostable radionuclides
ISNUMSTB001         1
*
* NAMSTB, list of pseudostable radionuclides
ISNAMSTB001         Ba-137m
*
* NUCNAM, IGROUP, chemical group associated with each nuclide
ISOTPGRP001         Cs-137      1
*
* CWASH1, washout coefficient number one, linear factor (1/s)
WDCWASH1001         1.E-04
*
* CWASH2, washout coefficient number two, exponential factor (1/s)
WDCWASH2001         0.8
*
```

```
* NPSGRP, number of particle size groups
DDNPSGRP001             10
*
* VDEPOS, dry deposition velocities for each particle size group (m/sec)
DDVDEPOS001             5.3471E-04
DDVDEPOS002             4.9073E-04
DDVDEPOS003             6.4289E-04
DDVDEPOS004             0.0010839
DDVDEPOS005             0.0021202
DDVDEPOS006             0.0043375
DDVDEPOS007             0.0083669
DDVDEPOS008             0.013719
DDVDEPOS009             0.016988
DDVDEPOS010             0.016988
*
* NUM_DIST, number of entries in the dispersion lookup table
NUM_DIST001             57
*
* DISTANCE, SIGMA_Y_A, SIGMA_Z_A, downwind distances (m), A-stability dispersion table
A-STB/DIS01             0.1          0.046        0.022
A-STB/DIS02             0.14         0.062        0.03
A-STB/DIS03             0.2          0.086        0.043
A-STB/DIS04             0.3          0.123        0.062
A-STB/DIS05             0.4          0.16         0.081
A-STB/DIS06             0.6          0.231        0.119
A-STB/DIS07             0.8          0.299        0.156
A-STB/DIS08             1.           0.366        0.192
A-STB/DIS09             1.4          0.496        0.263
A-STB/DIS10             2.           0.684        0.367
A-STB/DIS11             3.           0.987        0.537
A-STB/DIS12             4.           1.28         0.703
A-STB/DIS13             6.           1.84         1.03
A-STB/DIS14             8.           2.39         1.34
A-STB/DIS15             10.          2.93         1.66
A-STB/DIS16             14.          3.97         2.27
A-STB/DIS17             20.          5.47         3.17
A-STB/DIS18             30.          7.89         4.63
A-STB/DIS19             40.          10.2         6.06
A-STB/DIS20             60.          14.8         8.86
A-STB/DIS21             80.          19.1         11.6
A-STB/DIS22             100.         23.4         14.3
A-STB/DIS23             140.         31.7         18.9
A-STB/DIS24             200.         43.8         28.6
A-STB/DIS25             300.         63.1         51.7
A-STB/DIS26             400.         81.9         83.4
A-STB/DIS27             600.         118.         172.
A-STB/DIS28             800.         153.         294.
A-STB/DIS29             1000.        187.         448.
A-STB/DIS30             1400.        254.         920.
A-STB/DIS31             2000.        350.         1950.
A-STB/DIS32             3000.        505.         4580.
A-STB/DIS33             4000.        655.         8360.
A-STB/DIS34             6000.        945.         19600.
A-STB/DIS35             8000.        1220.        35700.
A-STB/DIS36             10000.       1500.        57000.
A-STB/DIS37             14000.       2030.        1.15000E+05
A-STB/DIS38             20000.       2800.        2.44000E+05
A-STB/DIS39             30000.       4040.        5.69000E+05
A-STB/DIS40             40000.       5240.        1.040000E+06
A-STB/DIS41             60000.       7560.        2.430000E+06
A-STB/DIS42             80000.       9800.        4.440000E+06
A-STB/DIS43             1.00000E+05               12000.       7.080000E+06
A-STB/DIS44             1.40000E+05               16200.       1.43E+07
A-STB/DIS45             2.00000E+05               22400.       3.02E+07
A-STB/DIS46             3.00000E+05               32300.       7.07E+07
A-STB/DIS47             4.00000E+05               41900.       1.29E+08
A-STB/DIS48             6.00000E+05               60500.       3.02E+08
A-STB/DIS49             8.00000E+05               78400.       5.51E+08
A-STB/DIS50             1.000000E+06              95900.       8.79E+08
A-STB/DIS51             1.400000E+06              1.30000E+05               1.78E+09
A-STB/DIS52             2.000000E+06              1.79000E+05               3.75E+09
A-STB/DIS53             3.000000E+06              2.59000E+05               8.78E+09
A-STB/DIS54             4.000000E+06              3.35000E+05               1.6E+10
A-STB/DIS55             6.000000E+06              4.84000E+05               3.75E+10
A-STB/DIS56             8.000000E+06              6.27000E+05               6.84E+10
A-STB/DIS57             1.E+07       7.67000E+05               1.09E+11
*
* DISTANCE, SIGMA_Y_B, SIGMA_Z_B, downwind distances (m), B-stability dispersion table
B-STB/DIS01             0.1          0.034        0.019
B-STB/DIS02             0.14         0.047        0.025
B-STB/DIS03             0.2          0.064        0.035
B-STB/DIS04             0.3          0.093        0.051
B-STB/DIS05             0.4          0.12         0.067
B-STB/DIS06             0.6          0.173        0.097
B-STB/DIS07             0.8          0.225        0.127
B-STB/DIS08             1.           0.275        0.156
B-STB/DIS09             1.4          0.373        0.213
B-STB/DIS10             2.           0.514        0.296
B-STB/DIS11             3.           0.742        0.43
B-STB/DIS12             4.           0.962        0.56
B-STB/DIS13             6.           1.39         0.814
B-STB/DIS14             8.           1.8          1.06
B-STB/DIS15             10.          2.2          1.3
```

```
B-STB/DIS16             14.         2.98        1.78
B-STB/DIS17             20.         4.12        2.47
B-STB/DIS18             30.         5.94        3.59
B-STB/DIS19             40.         7.7         4.68
B-STB/DIS20             60.         11.1        6.8
B-STB/DIS21             80.         14.4        8.87
B-STB/DIS22             100.        17.6        10.9
B-STB/DIS23             140.        23.9        14.5
B-STB/DIS24             200.        32.9        20.1
B-STB/DIS25             300.        47.5        30.1
B-STB/DIS26             400.        61.6        40.6
B-STB/DIS27             600.        88.8        62.8
B-STB/DIS28             800.        115.        86.
B-STB/DIS29             1000.       141.        110.
B-STB/DIS30             1400.       191.        159.
B-STB/DIS31             2000.       263.        234.
B-STB/DIS32             3000.       380.        364.
B-STB/DIS33             4000.       493.        498.
B-STB/DIS34             6000.       710.        776.
B-STB/DIS35             8000.       921.        1060.
B-STB/DIS36             10000.      1130.       1360.
B-STB/DIS37             14000.      1530.       1960.
B-STB/DIS38             20000.      2110.       2910.
B-STB/DIS39             30000.      3040.       4530.
B-STB/DIS40             40000.      3940.       6220.
B-STB/DIS41             60000.      5680.       9700.
B-STB/DIS42             80000.      7370.       13300.
B-STB/DIS43             1.00000E+05             9020.       17000.
B-STB/DIS44             1.40000E+05             12200.      24600.
B-STB/DIS45             2.00000E+05             16900.      36400.
B-STB/DIS46             3.00000E+05             24300.      56800.
B-STB/DIS47             4.00000E+05             31500.      77900.
B-STB/DIS48             6.00000E+05             45500.      1.22000E+05
B-STB/DIS49             8.00000E+05             59000.      1.67000E+05
B-STB/DIS50             1.000000E+06            72100.      2.13000E+05
B-STB/DIS51             1.400000E+06            97700.      3.08000E+05
B-STB/DIS52             2.000000E+06            1.35000E+05             4.56000E+05
B-STB/DIS53             3.000000E+06            1.95000E+05             7.12000E+05
B-STB/DIS54             4.000000E+06            2.52000E+05             9.76000E+05
B-STB/DIS55             6.000000E+06            3.64000E+05             1.520000E+06
B-STB/DIS56             8.000000E+06            4.72000E+05             2.090000E+06
B-STB/DIS57             1.E+07      5.77000E+05             2.670000E+06
*
* DISTANCE, SIGMA_Y_C, SIGMA_Z_C, downwind distances (m), C-stability dispersion table
C-STB/DIS01             0.1         0.026       0.014
C-STB/DIS02             0.14        0.035       0.02
C-STB/DIS03             0.2         0.049       0.027
C-STB/DIS04             0.3         0.07        0.039
C-STB/DIS05             0.4         0.091       0.051
C-STB/DIS06             0.6         0.132       0.073
C-STB/DIS07             0.8         0.171       0.095
C-STB/DIS08             1.          0.209       0.116
C-STB/DIS09             1.4         0.283       0.157
C-STB/DIS10             2.          0.391       0.217
C-STB/DIS11             3.          0.563       0.314
C-STB/DIS12             4.          0.731       0.407
C-STB/DIS13             6.          1.05        0.587
C-STB/DIS14             8.          1.37        0.762
C-STB/DIS15             10.         1.67        0.932
C-STB/DIS16             14.         2.26        1.26
C-STB/DIS17             20.         3.13        1.75
C-STB/DIS18             30.         4.51        2.52
C-STB/DIS19             40.         5.84        3.27
C-STB/DIS20             60.         8.43        4.72
C-STB/DIS21             80.         10.9        6.12
C-STB/DIS22             100.        13.4        7.49
C-STB/DIS23             140.        18.1        10.2
C-STB/DIS24             200.        25.         14.1
C-STB/DIS25             300.        36.1        20.4
C-STB/DIS26             400.        46.8        26.5
C-STB/DIS27             600.        67.4        38.4
C-STB/DIS28             800.        87.4        49.9
C-STB/DIS29             1000.       107.        61.1
C-STB/DIS30             1400.       145.        83.
C-STB/DIS31             2000.       200.        115.
C-STB/DIS32             3000.       288.        166.
C-STB/DIS33             4000.       374.        216.
C-STB/DIS34             6000.       539.        313.
C-STB/DIS35             8000.       700.        406.
C-STB/DIS36             10000.      856.        498.
C-STB/DIS37             14000.      1160.       676.
C-STB/DIS38             20000.      1600.       936.
C-STB/DIS39             30000.      2310.       1350.
C-STB/DIS40             40000.      2990.       1760.
C-STB/DIS41             60000.      4320.       2550.
C-STB/DIS42             80000.      5600.       3310.
C-STB/DIS43             1.00000E+05             6850.       4060.
C-STB/DIS44             1.40000E+05             9280.       5510.
C-STB/DIS45             2.00000E+05             12800.      7630.
C-STB/DIS46             3.00000E+05             18500.      11000.
C-STB/DIS47             4.00000E+05             23900.      14300.
C-STB/DIS48             6.00000E+05             34500.      20700.
C-STB/DIS49             8.00000E+05             44800.      27000.
```

```
C-STB/DIS50         1.000000E+06              54800.       33000.
C-STB/DIS51         1.400000E+06              74200.       44900.
C-STB/DIS52         2.000000E+06              1.02000E+05               62100.
C-STB/DIS53         3.000000E+06              1.48000E+05               89900.
C-STB/DIS54         4.000000E+06              1.92000E+05               1.17000E+05
C-STB/DIS55         6.000000E+06              2.76000E+05               1.69000E+05
C-STB/DIS56         8.000000E+06              3.58000E+05               2.20000E+05
C-STB/DIS57         1.E+07       4.38000E+05               2.69000E+05
*
* DISTANCE, SIGMA_Y_D, SIGMA_Z_D, downwind distances (m), D-stability dispersion table
D-STB/DIS01         0.1          0.018        0.01
D-STB/DIS02         0.14         0.025        0.014
D-STB/DIS03         0.2          0.034        0.019
D-STB/DIS04         0.3          0.05         0.027
D-STB/DIS05         0.4          0.064        0.035
D-STB/DIS06         0.6          0.093        0.05
D-STB/DIS07         0.8          0.12         0.065
D-STB/DIS08         1.           0.147        0.079
D-STB/DIS09         1.4          0.199        0.106
D-STB/DIS10         2.           0.275        0.145
D-STB/DIS11         3.           0.397        0.208
D-STB/DIS12         4.           0.514        0.268
D-STB/DIS13         6.           0.742        0.383
D-STB/DIS14         8.           0.962        0.493
D-STB/DIS15         10.          1.18         0.601
D-STB/DIS16         14.          1.59         0.808
D-STB/DIS17         20.          2.2          1.11
D-STB/DIS18         30.          3.17         1.58
D-STB/DIS19         40.          4.12         2.04
D-STB/DIS20         60.          5.94         2.91
D-STB/DIS21         80.          7.7          3.75
D-STB/DIS22         100.         9.41         4.57
D-STB/DIS23         140.         12.8         6.29
D-STB/DIS24         200.         17.6         8.64
D-STB/DIS25         300.         25.4         12.2
D-STB/DIS26         400.         32.9         15.4
D-STB/DIS27         600.         47.5         21.2
D-STB/DIS28         800.         61.6         26.6
D-STB/DIS29         1000.        75.3         31.5
D-STB/DIS30         1400.        102.         39.9
D-STB/DIS31         2000.        141.         50.6
D-STB/DIS32         3000.        203.         65.4
D-STB/DIS33         4000.        263.         78.
D-STB/DIS34         6000.        380.         99.2
D-STB/DIS35         8000.        493.         117.
D-STB/DIS36         10000.       603.         133.
D-STB/DIS37         14000.       817.         161.
D-STB/DIS38         20000.       1130.        196.
D-STB/DIS39         30000.       1630.        244.
D-STB/DIS40         40000.       2110.        286.
D-STB/DIS41         60000.       3040.        355.
D-STB/DIS42         80000.       3940.        414.
D-STB/DIS43         1.00000E+05               4820.        466.
D-STB/DIS44         1.40000E+05               6530.        557.
D-STB/DIS45         2.00000E+05               9020.        672.
D-STB/DIS46         3.00000E+05               13000.       831.
D-STB/DIS47         4.00000E+05               16900.       967.
D-STB/DIS48         6.00000E+05               24300.       1190.
D-STB/DIS49         8.00000E+05               31500.       1390.
D-STB/DIS50         1.000000E+06              38600.       1560.
D-STB/DIS51         1.400000E+06              52300.       1860.
D-STB/DIS52         2.000000E+06              72100.       2230.
D-STB/DIS53         3.000000E+06              1.04000E+05               2760.
D-STB/DIS54         4.000000E+06              1.35000E+05               3200.
D-STB/DIS55         6.000000E+06              1.95000E+05               3950.
D-STB/DIS56         8.000000E+06              2.52000E+05               4580.
D-STB/DIS57         1.E+07       3.09000E+05               5140.
*
* DISTANCE, SIGMA_Y_E, SIGMA_Z_E, downwind distances (m), E-stability dispersion table
E-STB/DIS01         0.1          0.013        0.008
E-STB/DIS02         0.14         0.018        0.011
E-STB/DIS03         0.2          0.024        0.016
E-STB/DIS04         0.3          0.035        0.022
E-STB/DIS05         0.4          0.046        0.028
E-STB/DIS06         0.6          0.066        0.04
E-STB/DIS07         0.8          0.086        0.052
E-STB/DIS08         1.           0.105        0.063
E-STB/DIS09         1.4          0.142        0.0845
E-STB/DIS10         2.           0.196        0.115
E-STB/DIS11         3.           0.282        0.164
E-STB/DIS12         4.           0.366        0.211
E-STB/DIS13         6.           0.528        0.3
E-STB/DIS14         8.           0.684        0.385
E-STB/DIS15         10.          0.837        0.468
E-STB/DIS16         14.          1.13         0.628
E-STB/DIS17         20.          1.56         0.856
E-STB/DIS18         30.          2.26         1.22
E-STB/DIS19         40.          2.93         1.57
E-STB/DIS20         60.          4.22         2.23
E-STB/DIS21         80.          5.47         2.86
E-STB/DIS22         100.         6.69         3.48
E-STB/DIS23         140.         9.07         4.72
E-STB/DIS24         200.         12.5         6.36
```

```
E-STB/DIS25         300.         18.1         8.79
E-STB/DIS26         400.         23.4         11.
E-STB/DIS27         600.         33.8         14.8
E-STB/DIS28         800.         43.8         18.3
E-STB/DIS29         1000.        53.6         21.5
E-STB/DIS30         1400.        72.6         27.3
E-STB/DIS31         2000.        100.         34.4
E-STB/DIS32         3000.        144.         43.4
E-STB/DIS33         4000.        187.         50.5
E-STB/DIS34         6000.        270.         61.6
E-STB/DIS35         8000.        350.         70.3
E-STB/DIS36         10000.       428.         77.7
E-STB/DIS37         14000.       581.         89.8
E-STB/DIS38         20000.       801.         104.
E-STB/DIS39         30000.       1160.        122.
E-STB/DIS40         40000.       1500.        136.
E-STB/DIS41         60000.       2160.        159.
E-STB/DIS42         80000.       2800.        177.
E-STB/DIS43         1.00000E+05               3430.        191.
E-STB/DIS44         1.40000E+05               4650.        216.
E-STB/DIS45         2.00000E+05               6410.        245.
E-STB/DIS46         3.00000E+05               9250.        281.
E-STB/DIS47         4.00000E+05               12000.       310.
E-STB/DIS48         6.00000E+05               17300.       355.
E-STB/DIS49         8.00000E+05               22400.       391.
E-STB/DIS50         1.000000E+06              27400.       421.
E-STB/DIS51         1.400000E+06              37200.       470.
E-STB/DIS52         2.000000E+06              51300.       528.
E-STB/DIS53         3.000000E+06              74000.       602.
E-STB/DIS54         4.000000E+06              95900.       660.
E-STB/DIS55         6.000000E+06              1.38000E+05               752.
E-STB/DIS56         8.000000E+06              1.79000E+05               824.
E-STB/DIS57         1.E+07       2.19000E+05               884.
*
* DISTANCE, SIGMA_Y_F, SIGMA_Z_F, downwind distances (m), F-stability dispersion table
F-STB/DIS01         0.1          0.009        0.008
F-STB/DIS02         0.14         0.012        0.011
F-STB/DIS03         0.2          0.017        0.014
F-STB/DIS04         0.3          0.024        0.02
F-STB/DIS05         0.4          0.032        0.025
F-STB/DIS06         0.6          0.046        0.035
F-STB/DIS07         0.8          0.059        0.044
F-STB/DIS08         1.           0.072        0.053
F-STB/DIS09         1.4          0.0978       0.0697
F-STB/DIS10         2.           0.135        0.0932
F-STB/DIS11         3.           0.195        0.13
F-STB/DIS12         4.           0.252        0.164
F-STB/DIS13         6.           0.364        0.228
F-STB/DIS14         8.           0.472        0.288
F-STB/DIS15         10.          0.578        0.345
F-STB/DIS16         14.          0.783        0.454
F-STB/DIS17         20.          1.08         0.607
F-STB/DIS18         30.          1.56         0.845
F-STB/DIS19         40.          2.02         1.07
F-STB/DIS20         60.          2.91         1.48
F-STB/DIS21         80.          3.78         1.88
F-STB/DIS22         100.         4.62         2.25
F-STB/DIS23         140.         6.26         2.98
F-STB/DIS24         200.         8.64         3.99
F-STB/DIS25         300.         12.5         5.51
F-STB/DIS26         400.         16.2         6.89
F-STB/DIS27         600.         23.3         9.43
F-STB/DIS28         800.         30.2         11.7
F-STB/DIS29         1000.        37.          13.9
F-STB/DIS30         1400.        50.1         17.9
F-STB/DIS31         2000.        69.1         22.3
F-STB/DIS32         3000.        99.7         27.7
F-STB/DIS33         4000.        129.         31.7
F-STB/DIS34         6000.        186.         37.8
F-STB/DIS35         8000.        242.         42.4
F-STB/DIS36         10000.       296.         46.1
F-STB/DIS37         14000.       401.         52.
F-STB/DIS38         20000.       553.         58.7
F-STB/DIS39         30000.       798.         66.8
F-STB/DIS40         40000.       1030.        73.
F-STB/DIS41         60000.       1490.        82.2
F-STB/DIS42         80000.       1930.        89.1
F-STB/DIS43         1.00000E+05               2370.        94.8
F-STB/DIS44         1.40000E+05               3210.        104.
F-STB/DIS45         2.00000E+05               4420.        114.
F-STB/DIS46         3.00000E+05               6380.        126.
F-STB/DIS47         4.00000E+05               8270.        135.
F-STB/DIS48         6.00000E+05               11900.       149.
F-STB/DIS49         8.00000E+05               15500.       160.
F-STB/DIS50         1.000000E+06              18900.       168.
F-STB/DIS51         1.400000E+06              25700.       182.
F-STB/DIS52         2.000000E+06              35400.       197.
F-STB/DIS53         3.000000E+06              51100.       216.
F-STB/DIS54         4.000000E+06              66200.       230.
F-STB/DIS55         6.000000E+06              95500.       251.
F-STB/DIS56         8.000000E+06              1.24000E+05               267.
F-STB/DIS57         1.E+07       1.51000E+05               280.
*
```

```
* YSCALE, linear scaling factor for sigma-y
DPYSCALE001         1.
*
* ZSCALE, linear scaling factor for sigma-z
DPZSCALE001         1.
*
* DISPMD,  dispersion long-range model
DPDISPMD001         LRTIME
*
* CYDIST, distance for switching to long-range dispersion model (m)
DPCYDIST001         30000.
*
* CYCOEF , coefficient for crosswind dispersion (m/s)
DPCYCOEF001         0.5
*
* SCLCRW, scaling factor for entrainment of buoyant plume
PRSCLCRW001         1.
*
* SCLADP, scaling factor for the A through D stability plume rise formula
PRSCLADP001         1.
*
* SCLEFP, scaling factor for the E through F stability plume rise formula
PRSCLEFP001         1.
*
* ATNAM2, source term description
RDATNAM2001         '3600 Ci Cs-137 over 1 hour (1 Ci/s)'
*
* NUMREL, number of plumes
RDNUMREL001         1
*
* MAXRIS, index of risk-dominant plume segment
RDMAXRIS001         1
*
* REFTIM, representative time point for dispersion and radioactive decay
RDREFTIM001         0.5
*
* plume rise model  set to HEAT (DENSITY, HEAT)
RDPLMMOD001         HEAT
*
* PLHEAT, rate of heat release in each plume segment (W)
RDPLHEAT001         0.
*
* BRGSMD, Briggs plume rise model (ORIGINAL, IMPROVED)
RDBRGSMD001         IMPROVED
*
* PLHITE, height of each plume segment at release (m)
RDPLHITE001         0.
*
* PLUDUR, duration of each plume segment (s)
RDPLUDUR001         3600.
*
* PDELAY, start time of each plume segment from accident initiation (s)
RDPDELAY001         0.
*
* PSDIST, particle size distribution of each element group
RDPSDIST001         0.092     0.146     0.141     0.144     0.112     0.08      0.072     0.071     0.071     0.071
*
* CORINV, inventory of each radionuclide present at the time of accident initiation (Bq)
RDCORINV001         Cs-137    3600.
*
* CORSCA, scaling factor to adjust the core inventory
RDCORSCA001         1.
*
* APLFRC, Specifies how release fractions are applied to daughter ingrowth products (PARENT, PROGENY)
RDAPLFRC001         PARENT
*
* RELFRC, release fractions for each of the plume segments for each chemical group
RDRELFRC001         1.
*
* ENDAT1, set to TRUE if only running ATMOS
OCENDAT1001         .TRUE.
*
* IDEBUG, specifies set of debug results to report
OCIDEBUG001         3
*
* NUCOUT, name of the nuclide to be listed on the dispersion listings
OCNUCOUT001         Cs-137
*
* ATDMODL, atmospheric transport model
ISATDMODL01         GAUSSIAN
*
* ISTRDY, start day of the weather sequence
M3ISTRDY001         1
*
* ISTRHR, start hour of the weather sequence
M3ISTRHR001         1
*
* MAXHGT, determines mixing height model
M1MAXHGT001         DAY_ONLY
*
* NUM0,  used for no input, always 0
TYPE0NUMBER         0
*
```

```
* NUM0, number of results
TYPE0NUMBER          19
*
* INDREL, INDRAD, CCDF, ATMOS release and spatial interval
TYPE0OUT001          1          1          NONE
TYPE0OUT002          1          2          NONE
TYPE0OUT003          1          3          NONE
TYPE0OUT004          1          4          NONE
TYPE0OUT005          1          5          NONE
TYPE0OUT006          1          6          NONE
TYPE0OUT007          1          7          NONE
TYPE0OUT008          1          8          NONE
TYPE0OUT009          1          9          NONE
TYPE0OUT010          1          10         NONE
TYPE0OUT011          1          11         NONE
TYPE0OUT012          1          12         NONE
TYPE0OUT013          1          13         NONE
TYPE0OUT014          1          14         NONE
TYPE0OUT015          1          15         NONE
TYPE0OUT016          1          16         NONE
TYPE0OUT017          1          17         NONE
TYPE0OUT018          1          18         NONE
TYPE0OUT019          1          19         NONE
*
* NUM0_HY, used for no input, always 0
TYPE0_HYNUM          0
*
* MNDMOD, plume meander model (OLD, NEW, OFF, RAF)
PMMNDMOD001          RAF
*
* BUILDH, building height (m)
WEBUILDH001          0.
*
* METCOD, meteorological sampling model (1, 2, 3, 4, or 5)
M1METCOD001          4
*
* BNDMXH, boundary weather mixing layer height (m)
M2BNDMXH001          1500.
*
* IBDSTB, boundary weather stability class index
M2IBDSTB001          4
*
* BNDRAN, boundary weather rain rate (mm/hr)
M2BNDRAN001          0.
*
* BNDWND, boundary weather wind speed (m/sec)
M2BNDWND001          4.
*
* SRCMOD, Plume Source model set to PNT (PNT, AREA, AUTO)
RDSRCMOD001          PNT
*
* TDWMOD, Plume Trapping model set to BRGFLX (BRGBLD, BRGFLX, PRIME)
RDTDWMOD001          BRGBLD
*
* BUILDW, building width (m)
WEBUILDW001          1.
*
* BUILDL, building length (m)
WEBUILDL001          1.
*
* PHTRAP, Specifies trapped plume release height to use. (meters)
RDPHTRAP001          0.
*
* BUILDA, angle from north for width dimension (degrees)
WEBUILDA001          0.
*
* TDWAUTO, Specifies if automatically calculating the trapped/downwashed release height.
RDTDWAUTO01          .FALSE.
*
* RAFDIST, Distance to stop using Ramsdell and Fosmire meander model
PMRAFDIST01          1000.
*
* TIMSCLY1, Ramsdell and Fosmire meander model low speed y timescale parameter
PMTIMSCLY11          1000.
*
* TIMSCLZ1, Ramsdell and Fosmire meander model low speed z timescale parameter
PMTIMSCLZ11          100.
*
* TIMSCLY2, Ramsdell and Fosmire meander model high speed y timescale coefficient
PMTIMSCLY21          10.
*
* TIMSCLZ2, Ramsdell and Fosmire meander model high speed z timescale coefficient
PMTIMSCLZ21          10.
*
* BKGTRBV, Ramsdell and Fosmire meander model background v turbulence
PMBKGTRBV01          0.655
*
* BKGTRBW, Ramsdell and Fosmire meander model background w turbulence
PMBKGTRBW01          0.584
*
* TRBINCV1, Ramsdell and Fosmire meander model low speed v turbulent increment
PMTRBINCV11          0.835
*
```

```
* TRBINCW1, Ramsdell and Fosmire meander model low speed w turbulent increment
PMTRBINCW11         0.239
*
* TRBINCV2, Ramsdell and Fosmire meander model high speed v turbulent coefficient
PMTRBINCV21         0.02
*
* TRBINCW2, Ramsdell and Fosmire meander model high speed w turbulent coefficient
PMTRBINCW21         0.01
```

D.2. Case 02 with MACCS Regulatory Guide 1.145 Plume Meander Model and Point Source

```
* File created using WinMACCS version 4.0.7 SVN:7955 3/5/2021 3:03:55 PM
*
* MACCS Cyclical File: Case02.inp
*
* Form 'Atmos Description' Comment:
* Case 02
*
* ATNAM1, identifies this MACCS calculation
RIATNAM1001         '2F weather, 0 MW, no building, ground'
*
```

Identical for this section as for Case 01 above (Section D.1)

```
*
* MNDMOD, plume meander model (OLD, NEW, OFF, RAF)
PMMNDMOD001         NEW
*
* WINSP1, wind speed where the meander factor changes from constant to decreasing(m/s)
PMWINSP1001         2.
*
* WINSP2, wind speed where the meander factor reaches one (m/s)
PMWINSP2001         6.
*
* MNDIST, distance where the effect of meander begins to diminish (m)
PMMNDIST001         800.
*
* MNDFAC, plume meander factor used to calculate sigma-y
PMMNDFAC001         1.
PMMNDFAC002         1.
PMMNDFAC003         1.
PMMNDFAC004         2.
PMMNDFAC005         3.
PMMNDFAC006         4.
*
* BUILDH, building height (m)
WEBUILDH001         0.
*
* METCOD, meteorological sampling model (1, 2, 3, 4, or 5)
M1METCOD001         4
*
* BNDMXH, boundary weather mixing layer height (m)
M2BNDMXH001         1500.
*
* IBDSTB, boundary weather stability class index
M2IBDSTB001         6
*
* BNDRAN, boundary weather rain rate (mm/hr)
M2BNDRAN001         0.
*
* BNDWND, boundary weather wind speed (m/sec)
M2BNDWND001         2.
*
* SRCMOD, Plume Source model set to PNT (PNT, AREA, AUTO)
RDSRCMOD001         PNT
*
* TDWMOD, Plume Trapping model set to BRGFLX (BRGBLD, BRGFLX, PRIME)
RDTDWMOD001         BRGBLD
*
* BUILDW, building width (m)
WEBUILDW001         1.
*
* BUILDL, building length (m)
WEBUILDL001         1.
*
* PHTRAP, Specifies trapped plume release height to use. (meters)
RDPHTRAP001         0.
*
* BUILDA, angle from north for width dimension (degrees)
WEBUILDA001         0.
*
* TDWAUTO, Specifies if automatically calculating the trapped/downwashed release height.
RDTDWAUTO01         .FALSE.
*
* PSMEQ1C, Point Source Model Equation 1 Coefficient
PMPSMEQ1C01         0.5
*
* PSMEQ2C, Point Source Model Equation 2 Coefficient
PMPSMEQ2C01         3.
```

D.3. Case 03 with MACCS Regulatory Guide 1.145 Plume Meander Model and Area Source

```
* File created using WinMACCS version 4.0.7 SVN:7955 3/5/2021 3:06:40 PM
*
* MACCS Cyclical File: Case03.inp
*
* Form 'Atmos Description' Comment:
* Case 03
*
* ATNAM1, identifies this MACCS calculation
RIATNAM1001         '4D weather, 0 MW, 20x40 building'
*
```

Identical for this section as for Case 01 above (Section D.1)

```
*
* MNDMOD, plume meander model (OLD, NEW, OFF, RAF)
PMMNDMOD001         NEW
*
* WINSP1, wind speed where the meander factor changes from constant to decreasing(m/s)
PMWINSP1001         2.
*
* WINSP2, wind speed where the meander factor reaches one (m/s)
PMWINSP2001         6.
*
* MNDIST, distance where the effect of meander begins to diminish (m)
PMMNDIST001         800.
*
* MNDFAC, plume meander factor used to calculate sigma-y
PMMNDFAC001         1.
PMMNDFAC002         1.
PMMNDFAC003         1.
PMMNDFAC004         2.
PMMNDFAC005         3.
PMMNDFAC006         4.
*
* BUILDH, building height (m)
WEBUILDH001         20.
*
* SIGYINIT, initial value of sigma-y for each of the plumes (m)
SIGYINIT001         9.2
*
* SIGZINIT, initial value of sigma-z for each of the plumes (m)
SIGZINIT001         9.4
*
* METCOD, meteorological sampling model (1, 2, 3, 4, or 5)
M1METCOD001         4
*
* BNDMXH, boundary weather mixing layer height (m)
M2BNDMXH001         1500.
*
* IBDSTB, boundary weather stability class index
M2IBDSTB001         4
*
* BNDRAN, boundary weather rain rate (mm/hr)
M2BNDRAN001         0.
*
* BNDWND, boundary weather wind speed (m/sec)
M2BNDWND001         4.
*
* SRCMOD, Plume Source model set to PNT (PNT, AREA, AUTO)
RDSRCMOD001         AREA
*
* TDWMOD, Plume Trapping model set to BRGFLX (BRGBLD, BRGFLX, PRIME)
RDTDWMOD001         BRGBLD
*
* BUILDW, building width (m)
WEBUILDW001         40.
*
* BUILDL, building length (m)
WEBUILDL001         40.
*
* PHTRAP, Specifies trapped plume release height to use. (meters)
RDPHTRAP001         0.
*
* BUILDA, angle from north for width dimension (degrees)
WEBUILDA001         0.
*
* TDWAUTO, Specifies if automatically calculating the trapped/downwashed release height.
RDTDWAUTO01         .FALSE.
```

D.4. Case 04 with MACCS Ramsdell and Fosmire Plume Meander Model

```
* File created using WinMACCS version 4.0.7 SVN:7955 3/5/2021 3:04:27 PM
*
* MACCS Cyclical File: Case04.inp
*
* Form 'Atmos Description' Comment:
* Case 04
*
```

```
* ATNAM1, identifies this MACCS calculation
RIATNAM1001         '2F weather, 0 MW, 20x40 building'
*
```

Identical for this section as for Case 01 above (Section D.1)

```
*
* MNDMOD, plume meander model (OLD, NEW, OFF, RAF)
PMMNDMOD001         RAF
*
* BUILDH, building height (m)
WEBUILDH001         20.
*
* METCOD, meteorological sampling model (1, 2, 3, 4, or 5)
M1METCOD001         4
*
* BNDMXH, boundary weather mixing layer height (m)
M2BNDMXH001         1500.
*
* IBDSTB, boundary weather stability class index
M2IBDSTB001         6
*
* BNDRAN, boundary weather rain rate (mm/hr)
M2BNDRAN001         0.
*
* BNDWND, boundary weather wind speed (m/sec)
M2BNDWND001         2.
*
* SRCMOD, Plume Source model set to PNT (PNT, AREA, AUTO)
RDSRCMOD001         PNT
*
* TDWMOD, Plume Trapping model set to BRGFLX (BRGBLD, BRGFLX, PRIME)
RDTDWMOD001         BRGBLD
*
* BUILDW, building width (m)
WEBUILDW001         40.
*
* BUILDL, building length (m)
WEBUILDL001         40.
*
* PHTRAP, Specifies trapped plume release height to use. (meters)
RDPHTRAP001         0.
*
* BUILDA, angle from north for width dimension (degrees)
WEBUILDA001         0.
*
* TDWAUTO, Specifies if automatically calculating the trapped/downwashed release height.
RDTDWAUTO01         .FALSE.
*
* RAFDIST, Distance to stop using Ramsdell and Fosmire meander model
PMRAFDIST01         1000.
*
* TIMSCLY1, Ramsdell and Fosmire meander model low speed y timescale parameter
PMTIMSCLY11         1000.
*
* TIMSCLZ1, Ramsdell and Fosmire meander model low speed z timescale parameter
PMTIMSCLZ11         100.
*
* TIMSCLY2, Ramsdell and Fosmire meander model high speed y timescale coefficient
PMTIMSCLY21         10.
*
* TIMSCLZ2, Ramsdell and Fosmire meander model high speed z timescale coefficient
PMTIMSCLZ21         10.
*
* BKGTRBV, Ramsdell and Fosmire meander model background v turbulence
PMBKGTRBV01         0.655
*
* BKGTRBW, Ramsdell and Fosmire meander model background w turbulence
PMBKGTRBW01         0.584
*
* TRBINCV1, Ramsdell and Fosmire meander model low speed v turbulent increment
PMTRBINCV11         0.835
*
* TRBINCW1, Ramsdell and Fosmire meander model low speed w turbulent increment
PMTRBINCW11         0.239
*
* TRBINCV2, Ramsdell and Fosmire meander model high speed v turbulent coefficient
PMTRBINCV21         0.02
*
* TRBINCW2, Ramsdell and Fosmire meander model high speed w turbulent coefficient
PMTRBINCW21         0.01
```

D.5. Case 05 with MACCS Regulatory Guide 1.145 Plume Meander Model and Point Source

```
* File created using WinMACCS version 4.0.7 SVN:7955 3/5/2021 3:03:58 PM
*
* MACCS Cyclical File: Case05.inp
*
* Form 'Atmos Description' Comment:
* Case 05
*
```

```
* ATNAM1, identifies this MACCS calculation
RIATNAM1001               '4D weather, 0 MW, 20x100 building'
*
```

Identical for this section as for Case 01 above (Section D.1)

```
*
* MNDMOD, plume meander model (OLD, NEW, OFF, RAF)
PMMNDMOD001               NEW
*
* WINSP1, wind speed where the meander factor changes from constant to decreasing(m/s)
PMWINSP1001               2.
*
* WINSP2, wind speed where the meander factor reaches one (m/s)
PMWINSP2001               6.
*
* MNDIST, distance where the effect of meander begins to diminish (m)
PMMNDIST001               800.
*
* MNDFAC, plume meander factor used to calculate sigma-y
PMMNDFAC001               1.
PMMNDFAC002               1.
PMMNDFAC003               1.
PMMNDFAC004               2.
PMMNDFAC005               3.
PMMNDFAC006               4.
*
* BUILDH, building height (m)
WEBUILDH001               20.
*
* METCOD, meteorological sampling model (1, 2, 3, 4, or 5)
M1METCOD001               4
*
* BNDMXH, boundary weather mixing layer height (m)
M2BNDMXH001               1500.
*
* IBDSTB, boundary weather stability class index
M2IBDSTB001               4
*
* BNDRAN, boundary weather rain rate (mm/hr)
M2BNDRAN001               0.
*
* BNDWND, boundary weather wind speed (m/sec)
M2BNDWND001               4.
*
* SRCMOD, Plume Source model set to PNT (PNT, AREA, AUTO)
RDSRCMOD001               PNT
*
* TDWMOD, Plume Trapping model set to BRGFLX (BRGBLD, BRGFLX, PRIME)
RDTDWMOD001               BRGBLD
*
* BUILDW, building width (m)
WEBUILDW001               100.
*
* BUILDL, building length (m)
WEBUILDL001               100.
*
* PHTRAP, Specifies trapped plume release height to use. (meters)
RDPHTRAP001               0.
*
* BUILDA, angle from north for width dimension (degrees)
WEBUILDA001               0.
*
* TDWAUTO, Specifies if automatically calculating the trapped/downwashed release height.
RDTDWAUTO01               .FALSE.
*
* PSMEQ1C, Point Source Model Equation 1 Coefficient
PMPSMEQ1C01               0.5
*
* PSMEQ2C, Point Source Model Equation 2 Coefficient
PMPSMEQ2C01               3.
```

D.6. Case 06 with MACCS Regulatory Guide 1.145 Plume Meander Model and Area Source

```
* File created using WinMACCS version 4.0.7 SVN:7955 3/5/2021 3:06:43 PM
*
* MACCS Cyclical File: Case06.inp
*
* Form 'Atmos Description' Comment:
* Case 06
*
* ATNAM1, identifies this MACCS calculation
RIATNAM1001               '2F weather, 0 MW, 20x100 building'
*
```

Identical for this section as for Case 01 above (Section D.1)

```
*
* MNDMOD, plume meander model (OLD, NEW, OFF, RAF)
PMMNDMOD001               NEW
*
* WINSP1, wind speed where the meander factor changes from constant to decreasing(m/s)
```

```
PMWINSP1001          2.
*
* WINSP2, wind speed where the meander factor reaches one (m/s)
PMWINSP2001          6.
*
* MNDIST, distance where the effect of meander begins to diminish (m)
PMMNDIST001          800.
*
* MNDFAC, plume meander factor used to calculate sigma-y
PMMNDFAC001          1.
PMMNDFAC002          1.
PMMNDFAC003          1.
PMMNDFAC004          2.
PMMNDFAC005          3.
PMMNDFAC006          4.
*
* BUILDH, building height (m)
WEBUILDH001          20.
*
* SIGYINIT, initial value of sigma-y for each of the plumes (m)
SIGYINIT001          23
*
* SIGZINIT, initial value of sigma-z for each of the plumes (m)
SIGZINIT001          9.4
*
* METCOD, meteorological sampling model (1, 2, 3, 4, or 5)
M1METCOD001          4
*
* BNDMXH, boundary weather mixing layer height (m)
M2BNDMXH001          1500.
*
* IBDSTB, boundary weather stability class index
M2IBDSTB001          6
*
* BNDRAN, boundary weather rain rate (mm/hr)
M2BNDRAN001          0.
*
* BNDWND, boundary weather wind speed (m/sec)
M2BNDWND001          2.
*
* SRCMOD, Plume Source model set to PNT (PNT, AREA, AUTO)
RDSRCMOD001          AREA
*
* TDWMOD, Plume Trapping model set to BRGFLX (BRGBLD, BRGFLX, PRIME)
RDTDWMOD001          BRGBLD
*
* BUILDW, building width (m)
WEBUILDW001          100.
*
* BUILDL, building length (m)
WEBUILDL001          100.
*
* PHTRAP, Specifies trapped plume release height to use. (meters)
RDPHTRAP001          0.
*
* BUILDA, angle from north for width dimension (degrees)
WEBUILDA001          0.
*
* TDWAUTO, Specifies if automatically calculating the trapped/downwashed release height.
RDTDWAUTO01          .FALSE.
```

DISTRIBUTION

Email—External

Name	Company Email Address	Company Name
Jon Barr	Jonathan.Barr@nrc.gov	U.S. NRC
Keith Compton	Keith.Compton@nrc.gov	U.S. NRC
Salman Haq	Salman.Haq@nrc.gov	U.S. NRC

Email—Internal

Name	Org.	Sandia Email Address
Daniel Clayton	08855	djclayt@sandia.gov
John Fulton	08855	jdfulto@sandia.gov
Jennifer Leute	08855	jeleute@sandia.gov
Mariah Smith	08855	msmith7@sandia.gov
Technical Library	01177	libref@sandia.gov

This page left blank

This page left blank