Modeling Protocol

Guidelines

Kansas Department of Health and Environment
Bureau of Air - Modeling Group

November 2016

The intent of the modeling protocol is to provide the regulatory agency with the technical procedures that will be followed in the modeling demonstration of the Air Quality Impact Assessment (AQIA). This protocol should follow the available modeling guidance including Appendix W- Guideline on Air Quality Models[1], any pertinent guidance memoranda and specific requests from the local regulatory agency. A complete modeling protocol will expedite the review of an AQIA by ensuring that modeling runs performed by the applicant are in accordance with established Kansas Department of Health and Environment (KDHE) guidelines.

Once a modeling protocol is submitted to the KDHE's Bureau of Air (BOA), it will be reviewed and comments/approval will be provided. The modeling protocol will also be shared with the U.S. Environmental Protection Agency (EPA) Region VII and their comments will be included in our response.

The main elements of a modeling protocol are as follows:

I.   Project Description

1) Brief description of the proposed project with focus on the air emission units
2) Summary of emissions (Potential to emit, PTE)
3) Location of the proposed project including:
    a. Full size plan for the project
    b. Aerial or satellite images
    c. Universal Transverse Mercator (UTM) coordinates for the center of the facility. The center of the facility should be determined by the air emission sources. For example, a power plant would have the center of the facility as the main stack, or in the case of a facility with more than one main emission unit, the centroid of the emission units. Applicants should use the North American Datum 83 (NAD 83) in all coordinates
    d. UTM coordinates for all corners of the fenceline at the facility
    e. A three-dimensional (3D) rendering of the facility with buildings and sources is a useful but optional element of the modeling protocol

II.   Modeling Applicability Assessment

The applicant should determine the estimated emissions for the proposed project and compare those to the significant emission rates (SERs). The pollutants that exceed the SERs must undergo a Prevention of Significant Deterioration (PSD) review. This review includes a modeling demonstration for all applicable averaging periods to ensure the protection of the National Ambient Air Quality Standards (NAAQS) and any applicable PSD increments, shown in the following table.

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[1] http://www.epa.gov/scram001/guidance/guide/appw_05.pdf

PSD Significant Emission Rates (SERs)[2]

Pollutant	SER (tons/year)
Carbon Monoxide (CO)	100
Nitrogen Oxides (NO_X)	40
Sulfur Dioxide (SO_2)	40
Particulate Matter less than 2.5 microns ($PM_{2.5}$)	10
Particulate Matter less than 10 microns (PM_{10})	15
Total Particulate Matter	25
Ozone (volatile organic compounds)	40
Lead	0.6

III.   Model Inputs

1) Sources
   a. All emission sources need to be identified and described including:
      (1) Stack coordinates (NAD 83) and elevation
      (2) Stack exit diameter
      (3) Exit temperature
      (4) Exit velocity
      (5) Emission rates
   b. Because emission rates and stack parameters can vary over a range of operating conditions, the modeling analysis must also consider various operating load scenarios for a proposed project. Section 8.1.2 of Appendix W[3] recommends that an assessment of both full load and partial load conditions for emission units be performed to determine the worst-case effect on ground receptors. For the short term NAAQS, only emissions scenarios that are continuous enough or frequent enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations need to be considered[4].
   c. Any other alternate or variable scenario needs to be properly described and defined in this section.
   d. Good Engineering Practice (GEP) stack heights. All proposed and/or existing stack height(s) greater than the formula good engineering practice (GEP) stack height(s) should be modeled using a stack height equal to the formula GEP stack height(s).

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[2] For a complete list please refer to KAR 28-19-350 and 40 CFR 52.21(b)(23)(i)

[3] https://www.epa.gov/scram/clean-air-act-permit-modeling-guidance#appw

[4] https://www3.epa.gov/scram001/guidance/clarification/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf

2) Buildings
The applicant will be required to perform a building downwash analysis using the latest version of the [Building Profile Input Program (BPIP-PRIME)](#)[5]. Thus, the applicant should include a discussion of buildings and structures to be included in the modeling analysis to determine downwash parameters.

3) Non-Regulatory Default Options
   a. The U.S. EPA considers the use of parallel processing a non-default option[6]. Thus, if the applicant will be using a parallelized version of AERMOD for the modeling demonstrations, a formal request needs to be included with the modeling protocol.
   b. Use of Plume Volume Molar Ratio Method (PVMRM) and Ozone Limiting Method (OLM) options for modeling the conversion of NO_X emissions to NO_2 are also considered non-regulatory default options. As a result of their non-regulatory-default status, pursuant to Sections 3.1.2.c, 3.2.2.a, and A.1.a(2) of Appendix W, application of AERMOD with the OLM or PVMRM option is no longer considered a "preferred model" and, therefore, requires justification and approval by the U.S. EPA regional office on a case-by-case basis. Thus, should the applicant pursue either of these two options, a formal request needs to be included with the modeling protocol. This request should include the NO_2/NO_X in-stack ratios to be used along with the justification for their use. The NO_2/NO_X ambient equilibrium rate should also be addressed. These requests will be sent to the U.S. EPA Region VII since approval of such can only be granted by the U.S. EPA regional office.

IV.   Urban/Rural Determination

National Land Cover Data (NLCD) may be used in combination with aerial imagery, Google Earth, and population data to determine if an area is urban or rural. This determination is specified in [AERMOD](#)[7] to account for the dispersive nature of the "convective-like" boundary layer that forms during nighttime conditions due to the urban heat island effect. For more information please refer to the KDHE Guidance Document on Urban versus Rural Determination.

V.   Terrain

Digital terrain data should be included in all AERMOD modeling analyses. The applicant should use the latest version of AERMAP[8] (currently 11103) to process terrain data. AERMAP supports two types of elevation input data: 1) Digital Elevation Model (DEM) elevation data in

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[5] https://www3.epa.gov/ttn/scram/7thconf/iscprime/useguide.pdf

[6] https://www3.epa.gov/scram001/guidance/clarification/Clarification%20on%20Reg.%20Status%20of%20Prop.%20Versions%20of%20AERMOD.pdf

[7] https://www3.epa.gov/ttn/scram/7thconf/aermod/aermod_implmtn_guide_3August2015.pdf

[8] https://www3.epa.gov/ttn/scram/models/aermod/aermod_userguide.zip

the United States Geological Survey (USGS) DEM format, and 2) National Elevation Dataset (NED) data in GeoTIFF format.

1arc-second (approximately 30 meter resolution) NED files from the USGS are the preferred option for elevation input data since they are a newer type of elevation data that is actively being quality assured and updated. Furthermore, AERMAP was specifically designed to process NED data accessible through the Multi-Resolution Land Characteristics Consortium (MRLC)[9]. Make sure to download GeoTIFF format. 1/3 arc-second (approximately 10 meter resolution) is also available through the USGS Seamless Data Server and applicants may choose to use this finer resolution. However, keep in mind that the processing times for AERMAP will be increased significantly.

DEM elevation data is available in a 7.5 minute and 1 degree resolution. This type of data is not the preferred option to be used with AERMAP, but under special circumstances its use may be approved by KDHE/BOA.

VI. Meteorological Data

KDHE will normally supply preprocessed meteorological (met) data for the latest 5 years. The KDHE Guidance Document on Meteorological Data Processing Using AERMET should be followed in cases where there is a compelling reason to have the applicant process the met data. The latest versions of AERMET (currently 15181), AERMINUTE (currently 15272) and AERSURFACE (currently 13016) must be used in either case.

VII. Receptors

Receptor grids should begin at the facility fenceline and extend sufficiently outward to identify the maximum impacts from both the *onsite* and *offsite* emission sources for each pollutant and pollutant averaging period evaluated. Receptors inside the defined fenceline do not need to be included as long as there is a physical barrier (e.g., a fence) preventing the public from gaining access to that area. Based on the U.S. EPA's definition of ambient air[10] the source must also own and control the land or property before an area may be exempted from *ambient air* analyses. Thus, make note that the fenceline used for the modeling demonstration may be different from the property line of the facility.

The grid resolution recommended is based on the SO_2 designation memo[11] as shown in the table below. A different grid spacing may be accepted on a case-by-case basis for receptors beyond 10,000 meters. Also, additional receptors (a finer grid) may be requested around maximum receptors.

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[9] http://www.mrlc.gov or http://www.mrlc.gov/viewerjs/ or http://www.mrlc.gov/finddata.php

[10] https://www.epa.gov/sites/production/files/2015-07/documents/leaseair.pdf

[11] https://www.epa.gov/sites/production/files/2016-06/documents/20150320so2designations.pdf

Distance from Facility Boundary (meters)	Receptor Spacing (meters)
Fenceline to 1000	50
1,000 to 2,000	100
2,000 to 10,000	250
> 10,000	500

VIII. Additional Impact Air Quality Analysis

PSD permit applicants are required to conduct additional impact analyses for each pollutant subject to PSD and which will be emitted by the proposed new or modified source(s). The additional impact analysis evaluates the impacts of air, ground, and water pollution on soils, vegetation, and visibility caused by any increase in emissions of any regulated pollutant from the source or modification under review, and from associated growth.

The modeling protocol should include information on how the following additional impacts analysis will be addressed:
1) Visibility impairment
   The visibility impairment analysis consists of a Level I, Level II, or Level III screening procedure using the VISCREEN or PLUVUE II model. If the Level I analysis indicates a potential visibility impairment, a Level II analysis is then conducted and, if necessary, a Level III analysis. The U.S. EPA document Workbook for Plume Visual Impact Screening and Analysis[12] will provide more specific guidance and examples. The applicant should identify in this section areas of potential visibility concerns for the proposed project, including federal Class I and Class II areas.
2) Soil and vegetation
   The analysis of soil and vegetation air pollution impacts should be based on an inventory of the soil and vegetation types found in the impact area. This inventory should include all vegetation with any commercial or recreational value, and may be available from conservation groups, State agencies, and universities. The U.S. EPA document 450/2-81-078, A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals, provides more specific guidance, screening procedures, pollutant sensitivities, etc.
3) Growth
   The applicant should explain how they will perform a projection of the associated industrial, commercial, and residential source growth that will occur in the area due to the source, and an estimate of the air emissions generated by this growth. Significant increases in human population and associated activities (e.g., road traffic, other industrial growth) may contribute to airshed pollution. The net growth in population and ancillary support activities should be quantified and discussed in the AQIA.

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[12] https://www3.epa.gov/scram001/userg/screen/WB4PlumeVisualOCR.pdf

IX.   Submission

You can submit the modeling protocol to this email: KDHE.BOAmodeling@ks.gov

or to this address:
KDHE/BOA
1000 SW Jackson, Suite 310
Topeka, KS 66612-1366