Tennessee Division of Air Pollution Control Dispersion Modeling Guidance

Developed by the Special Projects, SIP, Regulatory Development and Modeling Section of the Air Pollution Control Division in the Tennessee Department of Environment and Conservation

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The State of Tennessee uses National Ambient Air Quality Standards (NAAQS) and Acceptable Ambient Levels (AALs) to ensure that air quality is maintained, through the ambient monitoring as well as ambient prediction (modeling) activities of the Division. The state of Tennessee may require externally provided air quality dispersion modeling submittals from industries seeking to obtain Air Pollution Control construction permits in order to demonstrate ambient compliance with the NAAQS standards for criteria pollutants defined by USEPA (Criteria Air Pollutants | US EPA) as well as the State AALs for air toxic pollutants defined by the USEPA NESHAPS program (Initial List of Hazardous Air Pollutants with Modifications | US EPA).

Specifically, the TAPCD uses dispersion modeling analyses in combination with Tennessee's AALs for certain toxic air contaminants, and several NAAQS for federally designated criteria air pollutants, to protect air quality in the state, by requiring dispersion modeling analyses through the following two main programs:

1. Prevention of Significant Deterioration (PSD) and Non-attainment New Source Review (NNSR) for new and modified emission sources of criterial pollutants, as well as State Implementation Plan (SIP) revisions for existing sources near areas of measured or modeled pollutant concentrations which exceed NAAQS levels.
2. Air Toxics related to HCl and HF emissions to test for compliance with AAL's prescribed in TDEC APCD Rule 1200-03-03-.03(1)(b) and (c).

Dispersion modeling analyses are used to simulate the dispersion of emitted pollutants from industrial facilities to estimate probable pollutant concentrations (i.e., impacts) at geographical points in the community air downwind of a facility's boundary (referred to as "ambient air"). The predicted impacts

are then compared to the corresponding AALs and NAAQS to ensure that the air quality will not be threatened by newly proposed or significantly modified industrial facilities before they are issued a permit. Dispersion modeling analyses must demonstrate that predicted impacts from new emission sources coupled with natural background pollutant concentrations will remain less than the corresponding AALs and NAAQS before their impacts can be considered Acceptable Ambient Concentrations (AACs) to issue a construction permit.

Air Quality (AQ) dispersion models typically use emission data along with meteorological information to produce such predictions. Additional informational components utilized may be measurements of nearby structures to compute cavity and wake effects, the chemistry of air emissions and topographical features in the relevant area.

The review of all dispersion modeling analyses is conducted by the Special Projects, SIP, Regulatory Development and Modeling Section staff (a.k.a. Regulatory Development and Complex Sources) of the Tennessee Air Pollution Control Division (TAPCD) in the Tennessee Department of Environment and Conservation (TDEC).

The largest proposed industrial facilities (a.k.a. major sources) are covered by the federal programs administered by the states and some local air pollution agencies in cooperation with USEPA. These federal programs issue air pollution control permits through the Non-Attainment New Source Review (NNSR) program for sources in Non-Attainment Areas (NAAs) and Prevention of Significant Deterioration (PSD) for sources in attainment areas. NAAs are areas in a state or subdivision (often individual or clusters of counties) where the measurement of criteria air pollutants by state and local ambient air pollutant monitoring programs indicate that pollutant concentration levels exceed one of the NAAQS standards, while attainment areas are those areas where pollutant measurements show that levels are at or below the NAAQS. To protect air quality, Tennessee's permitting programs only issue major source permits after dispersion modeling analyses demonstrate that the proposed or modified source will not significantly cause or contribute to poor air quality.

Major source industries must provide dispersion modeling analyses which demonstrate that proposed new or modified facilities will not significantly degrade air quality prior to permitting. These modeling analyses are reviewed by TAPCD as well as USEPA and Federal Land Managers (FLMs) at the National Park Service (NPS), US Forest Service (USFS), and US Fish and Wildlife Service (USFWS). State permitting actions and dispersion modeling analyses are reviewed by USEPA for uniformity and approved after the FLMs provide input and expertise for protecting sensitive air quality resources in nearby national parks, national forests, and wildlife sanctuaries.

Major source modeling analyses must also include an analysis of impacts on secondary pollution created by precursor pollutants whenever the proposed emission of any precursor pollutant is significant. Significant emissions of nitrogen oxide (NOx) or sulfur dioxide (SO_2) gases are precursor pollutants which chemically react in the atmosphere to form fine particulate pollution ($PM_{2.5}$), while significant emissions of nitrogen oxide (NOx) or Volatile Organic Compound (VOC) gases are precursors to the formation of ground-level ozone pollution (O_3). Proposed significant increases in any of these precursor pollutants should be evaluated using Tennessee's guidance for use of Modeled Emission Rates for Precursors (MERPs) or a refined modeling analysis using USEPA approved Photochemical Models (see https://www.epa.gov/scram/photochemical-air-quality-modeling).

Modeling Analyses for NNSR & PSD

For PSD (40 CFR 52.21) air dispersion modeling, three important references include:

1. Guideline on Air Quality Models (40 CFR 51, Appendix W) –
   At USEPA's web-site at: https://www.epa.gov/scram/clean-air-act-permit-modeling-guidance ,
   in the Federal Register at: https://www.epa.gov/sites/default/files/2020-09/documents/appw_17.pdf
   and in the Code of Federal Regulations at: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-51/appendix-Appendix%20W%20to%20Part%2051
2. New Source Review Workshop Manual (DRAFT, 1990) - https://www.epa.gov/nsr/nsr-workshop-manual-draft-october-1990
3. Air Quality Dispersion Modeling - Preferred and Recommended Models - https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models
4. Tennessee Guidance on the Use of MERPs - apc_TN Guidance on the Use of EPAs MERPs to Account for Secondary Formation in Tennessee_11222019.pdf

The promulgation of the AERMOD modeling system in November 2005 as an EPA 'preferred refined air dispersion model' requires the use of AERMOD (without substantial, site/situation-specific justification for use of another model) to evaluate design contaminant concentrations in the ambient air within 50 kilometers of the source for federal programs (including PSD and NNSR) after December 8, 2006. Site/situation-specific justifications for use of an alternate model need to be submitted to Region IV EPA for primary approval, with a copy to the TAPCD Permitting Program.

Modeling guidance beyond that contained in the guideline documents above can be found on the EPA SCRAM web site (listed above) as model user's guides, Model Clearinghouse Memos and/or Determinations, Public Forum discussions, etc. TAPCD modeling staff should approve use of guidance not contained in the guideline documents.

Modeling Protocols

Modeling protocols should be prepared by the applicant for all PSD & NNSR modeling studies as well as SIP modeling studies provided by industries and their consultants. Such protocols allow the Tennessee Air Pollution Control Division (TN APCD) to comment on modeling techniques in advance of significant modeling resource expenditure on the part of the applicant. At a minimum, PSD modeling protocols should contain:

1. Listing of the models proposed to be used (including version number or last-modification date);
2. Description of the proposed receptor array(s), including the extent of staggered receptor densities, confirmation that elevations will be derived for each receptor, and a description of that process;
3. Description of how downwash effects will be handled;
4. Description of the site, such as site size, site geographic setting, surrounding land use, height of the tallest building on site or a BPIP-PRM input file, nearest city, county in which located;
5. Description of any complex terrain within 50 km of the site;
6. Listing of the facility total (in tons-per-year) of each criteria pollutant emitted, and a listing of the net tons-per-year proposed to be emitted from the project to be modeled;
7. Distances to all the Class I areas within 300 km, and the modeling techniques, models, and data sources to be used to assess Class I area impacts of the project;
8. Description of the process by which an off-site facility emissions inventory will be prepared, if necessary;
9. Description of the process by which Class II visibility issues will be addressed;
10. Description of the process by which an ozone impacts analysis may be conducted;

11. Description of any efforts to assess air toxics impacts, including derivation of Acceptable Ambient Concentrations (AACs); and
12. Description of the meteorological data to be used in the modeling.

Meteorological Data for AERMOD Modeling

Model ready meteorological data (a.k.a. met-data) for refined modeling may be obtained by contacting the division's modeling staff contacts. The names of these contacts and their contact information can be found below and at: Air Modeling - State Modeling Contacts | US EPA https://www.epa.gov/scram/air-modeling-state-modeling-contacts#region4.

The applicant should discuss the project with the TAPCD's dispersion modeling staff, providing the project Latitude and Longitude, city, county, and address. Model ready met-data is generally updated annually by the state contacts to include the latest 5-year met-data set for primary NWS-FAA met stations across the state. It is available upon request to the state.

Just as it is important to consult the state modeling contacts to reach agreement on which models and strategies should be used to predict impacts before analysis begins, met-data consensus is also critical to using the best most appropriate data science available in permitting decisions for the state. Company representatives are encouraged to consult with the division's modeling contacts to arrive at a consensus as to which kind of met data should be used (on-site data, representative airport data, or prognostic data), before analysis on a permit application project commences to avoid approval issues after the application is submitted. Consultation with state modelers often resolves important decisions on which airport site or prognostic data would be most representative for a modeling project, as well as how equipment should be sited, and data should be collected in the case of on-site met-data.

TAPCD will consult with the permit applicant to decide on the most appropriate Met-data set to use for each analysis and will provide their latest National Weather Service met-data for a representative site if it is appropriate for the project. After TAPCD provides the applicant with AERMOD ready meteorological data, the applicant should use AERSURFACE to complete a comparison between the surface characteristics of the area surrounding the facility and those around the meteorological station. As part of the protocol submittal, the applicant should identify and justify the meteorological data set selected that most closely matches the site geography and average surface roughness value at the project site.

Receptor Data for Modeling

Model receptors will be processed in the Universal Transverse Mercator (UTM) coordinate system with the current version of AERMAP to develop terrain elevations and critical slope parameters. Digital Elevation Model (DEM) data or National Elevation Data (NED in the GeoTIFF format) may be downloaded by U.S.G.S. 7.5-minute quadrangle set from https://apps.nationalmap.gov/downloader/. Model receptors should generally be spaced 50 meters apart along and near the project property boundary, with the receptor density declining to 100 meters from each other until the location of the maximum impact is identified. Model receptors at 100-m spacing should extend outward from the facility at least 2 km in all directions to ensure that the maximum impact is identified. If the maximum impact is not discovered in the 50-meter grid surrounding the property, then more refined modeling runs should then be provided in areas with the highest impacts using a more-refined 50-meter grid spacing (since the design concentration should be determined to the nearest 50 m).

Building Downwash Dimensions

Whenever structures within the project boundary influence the downwash of a plume, the structures should be analyzed in conjunction with emission points, using the most recent version of the Building Profile and Input Program (BPIP), which calculates building dimension parameters for in AERMOD (BPIP-Prime). These building dimensions should generally be using in refined modeling analysis.

Modeling Review and Approval

Review of modeling submitted for these programs will be expedited by the accompanying submittal of:

1) Spreadsheets showing the calculation of modeled ground-level concentrations, including receptor coordinates, elevations and hill heights, building downwash parameters including building dimensions with stack base elevations along with building floor and roof elevations (in cases were downwash was assessed), air contaminant emission rates, with all stack parameters "H_s, T_s, V_s, D_s, UTM zone, UTM Easting and Northing coordinates for all sources, building & tier corners, property corners as well as datum references (NAD83 preferred).
2) All of the model processor and sub-processor version numbers should be provided in any modeling submittal
3) The standard ASCII text modeling files produced by commercial AERMOD processors and sub processors containing:
    a) .DTA input file
    b) .SFL and .PFL surface and upper air met files
    c) .SUM summary output files

Contact Information

For further information, please contact Haidar AlRawi or Richard Smrz in the TNAPCD's Special Projects, SIP and Regulatory Development Program via their e-mail or phone below.

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