**Section 291.206 Dispersion Modeling**

a) Several dispersion models are available for determining the annual and short-term impacts of pollutant emissions on ambient air quality. The dispersion models which are available from the Agency for use in annual analyses are the Climatological Dispersion Model (CDM) and the Climatological Dispersion Model revised by the Agency (Revised CDM). The Agency model available for short-term analyses is the Air Quality Short-Term Model (AQSTM) developed by the Agency's Division of Air Pollution Control. All of these models are based on the Gaussian diffusion equation and utilize the Brigg's plume rise formulae.

b) Facilities utilizing the models mentioned in subsection (a) to perform the attainment and maintenance analyses do not need to submit a description of the dispersion and plume rise formulae utilized. If a facility chooses to use dispersion models and plume rise formulae other than those listed above, then the following information shall be submitted to the Agency in support of the techniques which are selected:

1) A complete computer program listing of the model;

2) A detailed description of all model equations;

3) A model flow chart; and

4) A justification for the use of such model and equations.

c) Annual Analysis. The basic objective of the annual dispersion analysis is to determine the maximum ground-level concentrations of sulfur dioxide and total suspended particulate for comparison with annual air quality standards.

1) The location of pollutant sources in each facility within the study area shall be accurately identified so that their relative positions can be input to the dispersion model.

2) For the attainment portion of the annual analysis, the average annual controlled emission rate from each source in the base year and the annual meteorological parameters determined for the base year shall be utilized. Both the controlled source emission rates and the meteorological parameters should be valid for the same one-year period.

3) The annual analysis for the 1980 projection year and for other projection years as deemed necessary by the applicant must be conducted utilizing projected annual average emissions for the year analyzed and the mean annual meteorological paramters which have been determined based on historical data from a period of at least five consecutive years.

d) Short-Term Analysis. For short term analyses, ground-level concentrations should be determined for periods of time associated with those meterorological conditions giving rise to maximum ground-level concentrations, considering the actual physical stack height and diameter and operating characteristics of the facilities.

1) Consistent with the annual modeling, the location of the various pollutant emission sources in each facility affecting the study area must be accurately identified.

2) The applicant shall identify those operating conditions leading to the maximum emissions of sulfur dioxide and/or particulate matter. Specific operating schedules may be considered in order to determine a reasonable maximum controlled emission rate for each source affecting the study area (i.e., it is recognized that all sources may not operate at their maximum levels during the same time period).

e) Maximum grid point spacing used in the models shall be 1 kilometer for comparison with annual standards and 0.1 kilometer for short-term modeling.

f) The contribution to the point of maximum concentration shall be calculated for each source of sulfur dioxide (SO2) or total suspended particulate (TSP) within the study area. Sulfur dioxide or TSP ambient air quality monitoring data may be utilized to assist in establishing background concentrations. Such air quality data should have been collected for a minimum of 1 year and should be consistent with the ambient air quality monitoring portion of these procedures.

g) There are several meteorological situations which might cause sufficiently elevated ground-level concentrations to threaten the short-term ambient air quality standards. The following potentially adverse meteorological or physical conditions shall be considered as a minimum when performing the short-term modeling analyses:

1) Trapping conditions (for comparison with the 3-hour SO2 standard and the 24-hour SO2 and TSP standard).

A) Mixing height equal to the height of maximum plume rise for that source at the subject facility or within the study area such that the maximum ground-level concentration is achieved.

B) Wind speed equal to 4.4 meters per second at a height of 10 meters above ground-level.

C) Atmospheric stability equal to B (unstable).

D) Wind direction equal to that direction which aligns the emission sources so as to maximize the ground-level concentrations.

E) Calculate the maximum 1-hour ground-level concentration using the dispersion model.

F) Calculate the minimum 3-hour ground-level SO2 concentration by taking the 1-hour concentration in subsection (E) above times 0.80.

G) Calculate the maximum 24-hour concentration by taking ¼ of the hourly concentration calculated in subsection (E) above.

2) Neutral stability with moderate to high winds (for comparison with the 3-hour SO(2) standard and the 24-hour SO2 and TSP standard).

A) Mixing height equal to 1200 meters.

B) Stability class equal to D (neutral).

C) Determine the wind direction which aligns the emission sources such as to maximize the ground-level concentration of the actual source configuration.

D) Determine the critical wind speed (i.e., the wind speed which produces the maximum ground-level concentration).

E) Calculate the maximum 1-hour ground-level concentration using the dispersion model (including background).

F) Calculate the maximum 3-hour ground-level SO2 concentration by taking the 1-hour concentration in subsection (E) above times 0.80.

G) Calculation of the 24-hour ground-level concentration requires an examination of actual meteorological conditions collected in the study area. One technique for calculating the 24-hour ground-level concentration from the 1-hour concentration is explained on page 38 of the Workbook of Atmospheric Dispersion Estimates. The method makes the assumption that the plume is uniformly distributed in the crosswind direction within a down-wind sector of 22.5° and may be utilized when critical wind speed, persistent wind direction, and neutral stability occur for 16 hours or greater. The 24-hour concentration is obtained by multiplying the resulting sector concentration by t/24, where t is the number of hours within a 24-hour period during which the above meteorological conditions actually occur.

3) Inversion break-up fumigation (for comparison with the 3-hour SO2 standard).

A) Assume that the mixing height is located at ground-level at the beginning of the 3-hour period for which the maximum ground-level concentration is being calculated. Allow the mixing height to rise at a rate of 4.88 meters per minute.

B) Assume an atmospheric stability class of E (stable) above the height of the inversion and B (unstable) below the inversion.

C) Assume a wind speed of 4.4 meters per second at a height of 10 meters above ground-level.

D) Determine the wind direction which aligns the emission sources such as to maximize the ground-level concentration for the actual source configuration.

E) Calculate the concentration profile downwind of the facility at 20 minute intervals. That is, calculate the height of the mixing layer at 20-minute intervals using the rate of rise given in subsection (A) above. Nine 20-minute average concentrations should be calculated to yield the 3-hour maximum ground-level concentration.

F) If the Agency's AQSTM is used to calculate the ground-level concentration under the fumigation situation, the maximum concentration will be that concentration computed at a distance of at least x = 4.4 tm where x is equal to downwind distance in meters, and tm is equal to the time in seconds required to eliminate the inversion from the physical stack height to the height of the plume rise.

4) Any other meteorological conditions experienced in the vicinity of the subject facility or physical characteristics of the facility or its surroundings which, in the opinion of the applicant might reasonably be expected to produce maximum ground-level concentrations in excess of those calculated using the considerations outlined in subsection (g)(1)-(3).

5) If meteorological information specific to the subject facility is available, then such data may be used to modify the procedures outlined in subsection (g)(1)-(4), as appropriate. However, such meteorological information must have been collected:

A) At the site of the subject facility and should be sufficient to determine wind speed, wind direction, stability class and mixing height; and

B) During a field study having a minimum duration of one year. Such a meteorological field study should meet the requirements outlined in these procedures.

6) All dispersion models utilized for the annual and short-term analyses should be calibrated, if possible, with base year ambient air quality monitoring data.

h) The minimum requirement for model validation shall be the computation of a regression equaltion (linear, stepwise or non-linear, as appropriate) for observed concentrations vs. the concentrations calculated by the dispersion model (plus background).

1) Short-term concentrations should be grouped for like-meteorological conditions (considering the synoptic meteorological situation).

2) The regression equation should be applied to each calculated concentration (plus background) for the appropriate meteorological situations.

3) The listing of monitored concentrations should be submitted in support of the proposed emission limitation.

4) Practical displays of calculated vs. observed concentrations should be submitted in addition to correlation coefficients and standard errors of estimate.

5) As deemed necessary by the applicant, additional statistical tests may be used to evaluate the dispersion modeling results.