MODELING AND ATTAINMENT DEMONSTRATION

DRAFT CONCEPT/ISSUE PAPER

9/16/98

August 11, 1998

Current Approach for Demonstrating Attainment of Air Quality Goals for 8-hr Daily Max. Ozone, $PM_{2.5}$ and Regional Haze

In a recent "concepts" paper, we set forth an approach that attainment of the air quality goals can be demonstrated by (1) applying a modeled attainment test, or (2) applying a weight of evidence determination to conclude that attainment is likely. If the latter option is chosen, modeling results are included as one of the inputs in the weight of evidence determination.

The modeled attainment test set forth is one in which absolute model predictions are not directly used. Instead, future and current predictions are contrasted to develop "relative reduction factors" at receptor locations near each monitoring site. Site specific relative reduction factors are multiplied by monitored design values to estimate future site-specific design values. The modeled attainment test uses both ambient data and modeling information, and is consistent with the new forms of the fine particulate and ozone air quality standards. Since this attainment test only addresses locations which are monitored, the approach includes criteria for several other model outputs which, if met, provide further assurance that attainment is likely.

A weight of evidence determination consists of a core set of analyses which includes application of air quality simulation models (i.e., results of the modeled attainment test & other specified model outputs) plus other analyses of air quality, emissions and meteorological data. Additional analyses can be included.

Regardless of whether one relies on modeling results alone or a weight of evidence determination, modeling is of key importance . For ozone attainment demonstrations, we do not identify a "preferred" model, as we have done formerly. Instead, we require a set of criteria to be satisfied for any model to be accepted as the basis for an attainment demonstration. Criteria include (1) a pre-analysis of air quality data, emissions configuration and meteorological conditions to identify required attributes for the model, (2) documentation of past performance evaluations for the model proposed for use, (3) a discussion of why the proposed model is technically/scientifically appropriate for the application at hand, (4) results that show the model has been evaluated in accordance with guidance we provide and has performed satisfactorily in the application for which it is proposed, (5) evidence that the model has been scientifically peer reviewed and found acceptable in accordance with guidance in the Office of Research and Development's, *Science Policy Handbook: Peer Review*, (6) approval of its use by the appropriate U.S EPA Regional Office plus the U.S EPA Model Clearinghouse, and (7) the application is consistent with an agreed upon protocol which has been approved by the appropriate U.S. EPA Regional Office.

At this time we are considering an approach that $PM_{2.5}$ not be modeled as a single entity, but rather on a component by component basis. Further consideration of this approach is

dependent on additional work on models and comparisons to monitored PM fine data. Regional haze estimates will be made after modeling the PM components by "reconstructing" current and future extinction coefficients from current and future estimates for the PM components. We identify 5 major components: mass associated with sulfates, mass associated with nitrates, mass associated with organic carbon, mass associated with elemental carbon, and a category for other, primary PM emissions. We do not anticipate recommending a "preferred" model for secondary components (i.e., sulfates, nitrates, parts of organic carbon). Models estimating changes in these components should meet the criteria previously identified for ozone. We will likely recommend the primary component of particulate matter be modeled using the same "preferred" model(s) used for primary emissions of PM_{10}. Those wishing to use an alternative model would need to meet the previously mentioned criteria plus perform a side by side comparison with the "preferred" model. We anticipate developing guidance for comprehensive analysis for these components to evaluate attainment.

The preceding approach is the culmination of resolving each of 6 broad issues in the "concepts" paper. These are:

1) how do we account for "uncertainty" in model predictions?

2) how do we define the modeled attainment test?

3) what is the role of a modeled attainment test vis a vis a weight of evidence determination?

4) to what extent should we require actions to support a review made subsequent to the SIP submittal?

5) should "guideline" (i.e., "preferred") models be identified?

6) may different components of PM be considered using different models?

These issues are addressed in the following 6 sections. In each of the sections, we first summarize our current thinking. We next summarize the current policy/approach. For ozone, this is based on guidance prepared in 1991 and in 1996. For $PM_{2.5}$ and regional haze, this is based on guidance prepared for PM_{10} in 1987. We conclude by noting the rationale for the current thinking approach.

1. How do we account for "uncertainty" in model predictions?

A) <u>Current Thinking on New Approach</u>

1. Recognize it exists, but account for it "qualitatively" by defining a modeled attainment test which should reduce it, by requiring a review of several additional model outputs and by offering an option to perform of weight of evidence (WOE) analysis.
2. If attempts are made to quantify uncertainty, results may be considered as an optional WOE analysis provided analysis/accompanying documentation meets our criteria for these.

B) <u>Current Policy for PM_{10} and 1-hour Ozone NAAQS</u>

1) Ozone: modeled attainment test compares absolute model predictions to goal. WOE is offered, but only as a means to "back off" from some control requirements the test implies is necessary.
2) PM: Absolute modeled estimates used. WOE not mentioned, but does allow air quality model results to be overridden or tempered if receptor models present strong evidence to the contrary.

C) <u>Rational for Current Thinking on New Approach</u>

-levels of NAAQS are lower--thus, uncertainty is greater w. respect to goal
-uncertainty is less if models used in relative sense
-uncertainty associated with monitored values (now an integral part of the test) is less than absolute modeled estimates.
-precision & accuracy of monitored data are much better known than is true for modeled data
-greater emphasis placed on corroborative results rather than a single outcome.

2. How do we define the modeled attainment test?

A) <u>Current Thinking on New Approach</u>

1) Use monitored design values as an integral part of the test
2) Use models in a "relative" rather than "absolute" sense to develop relative reduction factors (RRF)
3) Multiply RRF times site specific monitored design values to estimate future design value
4) Compare future design values with NAAQS
5) Supplement test with required review of other specified model outputs

B) <u>Current Policy for PM_{10} and 1-hour Ozone NAAQS</u>

1) Use absolute model predictions, compare with level specified in NAAQS
2) Form of the NAAQS accounted for through choice of the days modeled.
3) Model must show attainment at all surface receptor sites
4) In the case of ozone, some consideration given if chosen episode is very "severe".

C) <u>Rational for Current Thinking on New Approach</u>

-form of NAAQS changed to require averaging over 3 years
-difficult to apply resource intensive models (ozone, secondary PM , regional haze) for needed periods
-test outcome can be much more readily related to the form of the NAAQS
-does not rely on a single model output & uncertainty of predictions is reduced
-models have varying degrees of success predicting different components of PM--predicting relative changes in each component provides a safeguard against prescribing inappropriate strategies

3. What is the role of the modeled attainment test vs. a Weight of Evidence determination?

A) Current Thinking on New Approach
1) State has option to consider test plus other model outputs alone or consider model results as part of the weight of evidence (WOE)

B) Current Policy for PM_{10} and 1-hour Ozone NAAQS
1) Test results can stand alone.
2) For ozone, WOE can be used to justify easing stringency of controls test implies is needed

C) Rational for Current Thinking on New Approach
-encourages consideration of evidence produced by a variety of analyses
-reduces pressure to force agreement between models and observations, possibly leading to misleading control prescriptions
-WOE used in a more balanced manner

4. To what extent should we require support for subsequent reviews as a requirement to approve an attainment demonstration?

A) Current Thinking on New Approach
1) Do not require this
2) Identify data gathering activities/analyses which could be helpful if States choose to follow-up

B) Current Policy
1) Not required

C) Rational for Current Thinking on New Approach
-Not different from current policy

5. Should "guideline" (i.e., "preferred") models be identified?

A) Current Thinking on New Approach
1) Do not identify a "preferred" model for ozone
2) Encourage use of CMAQ/MODELS3, but require this model to be subject to same criteria as other "alternative" models
3) Same approach for secondary components of $PM_{2.5}$ as for ozone
4) Applicable guideline models for primary PM_{10} emissions may be used for primary components of $PM_{2.5}$--"alternative model" would need side by side comparison w."preferred" model
5) Encourage use of consistent modeling in regional applications

B) Current Policy
1) UAMIV is the "preferred" model for ozone
2) to be accepted, an "alternative" model's performance should be compared with that of UAMIV in a side by side comparison
3) "preferred" models used for primary component of PM_{10}

4) side by side comparison required for “alternative” model to be accepted
5) secondary PM treated as “background”

C) <u>Rational for Current Thinking on New Approach</u>
-UAMIV will be 15+ years old when used for 2003 SIP revisions--much advance has occurred so that its continued use as the “preferred” model is untenable
-no other one of the newer models is clearly superior and/or more practical to use than the others (i.e., criteria for a “preferred” model in 40 CFR Part 52, Appendix W)
-CMAQ/MODELS3, while having promising potential, has not yet undergone the peer review or performance evaluation we recommend for use of “alternative” models---thus, it would be inconsistent for us to call this the “preferred” model
-although it is not discussed in the concepts paper, we intend to work toward identifying a “regulatory options” to include in the system, as subsequent experience and performance data support it
-models for ozone and secondary particulate are likely to be resource intensive--naming a “preferred” model & then having a requirement for a side by side comparison is a large impediment for using models which might be better for specific applications.
-”preferred” models for primary components of PM are not so resource intensive, so that side by side comparisons is not a prohibitive barrier to using models which are more applicable for specific situations.

6. May different components of PM be considered using different models?

A) <u>Current Thinking on New Approach</u>
1) Different models may be used to develop relative reduction factors for secondary vs. primary components of PM

B) <u>Current Policy</u>
1) A “preferred” model is used to model primary PM---secondary PM is left alone
2) Different “preferred” models may be used to address the annual vs. 24-hour NAAQS

C) <u>Rational for Current Thinking on New Approach</u>
-secondary PM is much more important for $PM_{2.5}$ than it is for PM_{10}--thus it needs to be considered more explicitly
-models for secondary PM are likely to be resource intensive--they’re not necessarily needed for primary PM
-changes in secondary and primary PM are likely to be realized through control strategies operating over greatly differing spatial scales--it may not be efficient or cost effective to use a single model.