A DRAFT PROPOSAL FOR REGIONAL/URBAN MODELING TO ASSESS EIGHT-HOUR OZONE AIR QUALITY OVER PORTIONS OF THE OZONE TRANSPORT REGION

The following is a draft proposal for discussion purposes, on the type of air quality modeling needed to complete 8-hour ozone attainment demonstrations in the Northeast urban corridor or the "I-95" corridor. This proposal puts forward a number of specific recommendations that are intended as a basis for future discussion and as a means to resolve modeling issues associated with 8-hour ozone attainment demonstrations.

The EPA's NOx SIP call, resulting from the OTAG work, requires the submission of NOx SIPs by 22 states by November 1999. The emissions reductions are to occur mainly in the major stationary source sector by 2003 and through mobile source programs and the implementation of Federal programs. EPA's analysis of ozone air quality suggests that the NOx SIP will assist in the attainment of not only the 1-hour ozone NAAQS but also the 8-hour standard. Most nonattainment areas are expected to meet the standard under the design value roll-back method. However, there are expected to be areas, particularly along the northeast urban corridor or the I-95 corridor of the OTR, that will still be unable to attain the 8-hour ozone NAAQS, triggering the assignment of traditional as opposed to transitional nonattainment classifications for these areas. With traditional designation, an area must submit an attainment demonstration for the 8-hour ozone NAAQS by 2003 with monitored attainment to occur in 2010.[1] The attainment date for the 1-hour ozone NAAQS remains 2007, for severe-17 nonattainment areas.[2]

Background

All the states that have areas along the I-95 corridor have submitted their 1-hour ozone attainment demonstrations based upon the EPA suggested rollback approach. EPA has drafted modeling guidance for the 8-hour ozone NAAQS and expects to finalize it by February 1999. Indications are that there is a need for additional controls beyond the NOx SIP call for achieving the 8-hour ozone standard. Such a demonstration requires the use of a modeling domain that recognizes the regional nature of the ozone problem. The OTAG work, EPA's NOx SIP call, and the Northeast states petitions relating to Section 126 of the Clean Air Act (CAA), have demonstrated the need for a regional approach to modeling work. Regional modeling work to date has been undertaken only at a horizontal grid spacing of about 12 km, while SIP demonstrations for urban areas are recommended at a grid spacing of 12 km or finer. Also, the draft guidance suggests modeling a minimum of 10 episode days. From the OTAG experience, modeling an extended domain requires at least 3 ramp-up days with episodes often extending over 5 to 10 days. It is unclear if the 10 episode days would be continuous or not. In any event, modeling a domain as large as that used in OTAG would require selection of meteorological periods that reflect the overall build-up and decay of ozone over modeling domain.

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1. This is true for severe-17 designation, while severe-15 areas and serious areas will have an earlier attainment date.
2. Statutory deadlines for attainment in the severe-15 and serious nonattainment areas are earlier.

At present, there have been no clear guidelines as to how this modeling process is to be developed or what the roles of individual States or EPA will be. The attainment demonstration schedule requires submission of the 8-hour ozone SIPs by July 2003. With this as a background, the following schedule has been put forward as a proposal for undertaking regional/urban modeling on a cooperative basis rather

than duplicating individual State efforts within the OTR. Several key issues are outlined. Approaches are suggested for discussion purposes with the goal of achieving a consensus on the steps that must be taken to address the 8-hour ozone nonattainment problem within the OTR.

Proposed Timeline

Regardless of how the States proceed, the following proposed schedule is considered a fair representation of the activities that need to be accomplished for successful SIP submittal in the year 2003. Based on the schedule below, other OTC Committees are targeting December 2000 for completing their identification of candidate control measures and approaches. At that time, measures and approaches would need to be submitted to the OTC Modeling Committee with an estimate of each measure's potential for reducing emissions. From January through at least September 2001, the OTC Modeling Committee is expected to interact and coordinate with other OTC Committees during the modeling and analysis of candidate control measures.

Completion Date	Description
January 1999	Review of EPA's draft guidance
July 1999	Develop draft protocol for modeling and SIP submission.
July 2000	Install computer platform(s), quality assure emissions for base year modeling, quality assure meteorology.
January 20001	Initiate modeling of candiate control measures identified by OTC Committees.
July 2001	Complete base case modeling and evaluation including model performance and sensitivity simulations.
September 2001	Complete determination of future year emissions and control strategies; perform air quality assessment.
September 2002	State development of rule making.
July 2003	States submit SIP(s).

Many of the issues related to modeling are intertwined. Any decision on one issue will have repercussions on the rest. For example the selection of a modeling domain is dependent upon the degree to which regional solutions are sought. The areal extent of the modeling domain must respond to the emission reductions in the nonattainment area for which the State is required to submit a SIP. Also the selection and duration of the meteorological episodes is dependent on the areal extent of the modeling domain. The selection of the horizontal and vertical grid structure of the meteorological model should consider what is a reasonable amount of time needed to generate the requisite fields for input into the photochemical grid model. This consideration must be balanced by the need to reasonably represent ozone response to VOC and NOx emission reductions. Many of the decisions require careful assessment of the pros and cons of each option, while recognizing that undertaking a regional modeling effort and analyses requires significant resources and commitment.

Proposed Modeling Recommendations

The following recommendations are intended to help guide future discussions concerning available resources, timing, etc., and help facilitate the development of programmatic support to the overall proposal.

Recommendation for the Modeling Domain

The Committee suggests establishing a modeling domain as large as that used in OTAG. The rationale for this extended domain is that 8-hour ozone concentration levels 1) are at or above the NAAQS, and 2) have a stronger regional signature associated with them than the 1-hour NAAQS (Saravanan, New Jersey DEP, 1998). The EPA SIP call covers 22 out of the 37 political subdivisions that participated in the OTAG process and the nonattainment areas which may require mitigation measures in addition to the NOx SIP call are much the same as pre-OTAG. Depending upon the type of projection employed by the photochemical grid model(s) and the meteorological model(s), the actual areal extent of the coverage may vary. Currently at least 2 modeling systems (MM5/SAQM and RAMS/UAM-V or RAMS/CAM-x) are well known and available along with a new third system, EPA's MODELS3. Depending on which modeling system is selected, the modeling domain could be Lambert-conformal or based on a latitude/longitude system. Other models are available such as CALGRID, CIT, and URM, but have not had the same recognition as UAM-V, SAQM, CAM-x or CMAQ of MODELS3.

Assuming that any of these options are viable, this proposal recommends a modeling domain with 36/12/4 km grids. Figures 1 and 2 display the RAM/UAM-V and the MM5/SAQM systems, respectively. These domains are based on 4 km grid cells ("4-km domain"), which is of particular interest in the SIP process. The 4 km domain was selected such that the I-95 corridor is captured, as well as the upwind urban and rural areas of concern. The addition of the 4km domain required modification of the areal extent of the 12 and 36-km domains, which differs from that of OTAG. This is due to limitations of computational resources needed for the meteorological model(s) to generate meteorological fields. In the case of RAMS it would include not only the 36 and 12 km grids but also the 4km in a nested mode. For MM5 the approach was one-way nesting with inputs from the 12 km field. It should be noted that the time required to develop appropriate meteorological fields from MM5 or RAMS is a resource intensive task especially at the high resolution. Current estimates are about 15 days for 5 days of simulation on an 8-CPU system in the case of RAMS4a, while for MM5 it takes about 13 days for 1 day on a single-CPU workstation. These turn-around times are generally prohibitive and limit consideration of extended meteorological episodes at high resolution or seasonal simulations that extend to about 50 days. Unless other means are developed, this will be a critical step in the modeling process that requires careful assessment by the parties involved.

Recommendation for the Simulation Period

In order to accommodate both representative episode and non-episode days, and taking into consideration the areal extent of the modeling domain, the proposal is for modeling the month of July with about 10 days on both sides of the month. This would constitute a total of about 50 days. Often over the eastern U.S. the month of July happens to have the highest number of 1-hr and 8-hr ozone exceedances. While the number of days suggested here--50 days--might look ominous, it should be noted that OTAG modeling examined 4 episodes that covered a total of about 31 days excluding ramp-up days. Inclusion of the ramp-up days would bring the total to 42 days of modeling. Another issue that requires considerable attention is the choice of base or the current year(s) for which modeling is to be undertaken. This issue is closely intertwined with the availability of emissions data and the draft guidance on attainment demonstrations.

Recommendation for the Base Year

Another issue that requires considerable attention is the choice of base or current year(s) for which modeling is to be undertaken. This issue is closely intertwined with the availability of emissions data and the draft EPA guidance on attainment demonstrations. It is suggested that the States update their 1996

inventory in accordance with draft guidance on emission inventories along with the necessary factors for adjusting to reflect the modeling in accordance with the meteorological data. Inventories should reflect not only VOCs, CO, and NOx but also SO2, ammonia, and any other information that may be needed to proceed with the fine particulate assessment work. Current draft guidance suggests the need for the base year for ozone to be 1999, and the base year for $PM_{2.5}$ to be selected after completion of the evaluation in 2002. However, given that the States have to submit their SIPs for ozone in 2003, by all indications it appears that development of a 1999 inventory for use in the SIP process by 2000/01 is highly improbable if not an impossible task. Although it is not considered meteorologically as conducive a year for ozone, potential exists for the use 1996 inventory as a default base year since the emissions data can be prepared without further delays. Also, it is very important to coordinate with the other areas of the modeling domain as to how this issue is being addressed and if the inventories would be available in the time frame envisioned in the proposed timeline.

Recommendation for the Modeling System

As noted above, with the selection of the domain, meteorological period, and the emissions data, the modeling system is essentially defined. Depending upon the coordinate system selected either RAMS/UAM-V or RAMS/CAM-x or MM5/SAQM modeling systems can be utilized in the ozone air quality assessment. Since there is no definite bench-mark information reported on the length of time for simulation under each of the modeling systems, we see at this point no reasons to reject either one of them. We would like to undertake preliminary testing as to the merits and limitations of the systems in terms of the degree of computational run times, data preparation, data analyses, etc., to choose appropriate system(s) for this study. It is proposed that both systems be evaluated as there is no "preferred" guideline modeling system. This means development of data sets with different geographical projections. While this may be a resource intensive effort, there are no clear answers as to which path one should follow without undertaking some initial testing and the development of consensus.

Recommendation for an ad hoc Technical Committee

The Committee is forwarding draft recommendations on the main components required to undertake modeling. However, another important aspect of this activity is the need for the "three Cs"--coordination, cooperation and collaboration. This task is an extremely important one and requires a commitment among the participants. It is recommended that for the Northeast the three regional organizations--NESCAUM, MARAMA, and OTC--should pool resources to provide logistic support for the development and execution of a regional modeling exercise. The regional nature of the problem requires a significant amount of coordination and no one State or group of two or three States can shoulder such an undertaking.

It is recommended that an ad hoc technical committee be established, and that each State appoint a member to this Committee that will oversee the process. This Committee may choose to elect an individual to act as its spokesperson or main point of contact. This spokesperson would be the liaison to the other States in the modeling domain. Informal guidelines for this committee will need to be developed to function with logistic support provided by the regional organizations.

Funding and Resources

This proposal if accepted will require States to commit to both short and long term goals. In the short term, States would be committing to a process for the regional modeling needed to support 2003 SIP submissions. In the long term, the commitment might involve the issues associated with regional haze and PM_{fine}. The proposal provides for the development of regional planning and coordination to support States efforts for meeting and maintaining the 8-hr ozone NAAQS. Based upon the regional nature of the 8-hr ozone problem, no individual State has or can expend the resources that would be required for regional/urban scale modeling and analyses. An example of the magnitude of resources envisioned in

such an effort is the technical resources (e.g. emission inventory development and review, and modeling analysis) expended in the Northeast and Mid-Atlantic States under MOCA and OTAG.

The States need to seek and allocate these additional resources either collectively or individually for the development and analyses of regional/urban level ozone modeling that could be incorporated appropriately by the States in their local SIP attainment demonstration exercises. Specifically, these resources are to be targeted towards the development of the meteorological data, emissions data that would be needed for both the base/current year(s) and future year(s), application of the photochemical grid model(s) and analyses of the modeling results, as well as for archiving and documentation. Since these efforts involve extensive coordination not only within but outside of the OTR, resources should also be committed for meetings, exchange of information and external support that may be required as part of these efforts.

The Committee has already begun to explore resources at hand as well as additional resource needs, particularly for individual issue areas identified for future recommendations within this document. A general thought on resources is that with added requirements for detail (e.g. finer scale emissions, meteorological data, and model domains) and the need for faster data processing associated with models, resource needs are anticipated to increase dramatically.

In summary, the Committee recommends that the OTC States review this proposal and provide any suggestions that are consistent with the goals at hand. Also, we would like to note the long-term implications of this process, as this will directly feed into the development of the $PM_{2.5}$ and regional haze SIPs that are on the horizon as well.

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