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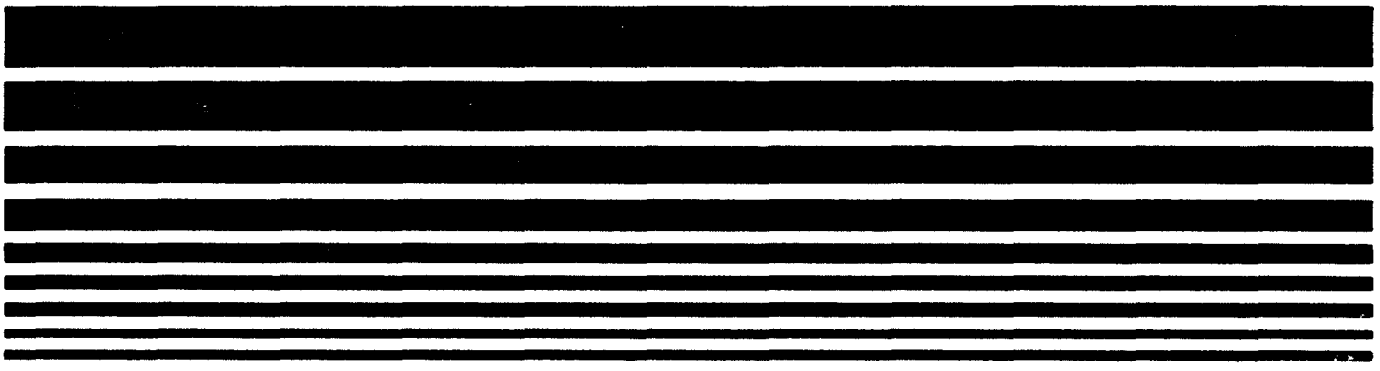
Summary of Public Comments and EPA Responses

on the Draft Report

The Role of Ozone Precursors in Tropospheric Ozone Formation and Control



SUMMARY OF PUBLIC COMMENTS AND EPA RESPONSES

on the Draft Report

THE ROLE OF OZONE PRECURSORS IN TROPOSPHERIC OZONE FORMATION AND CONTROL

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

July 1993

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SECTION 1 - GENERAL COMMENTS AND RESPONSES

Introduction and Overview

The draft Section 185B Report entitled The Role of Ozone Precursors in Tropospheric Ozone Formation and Control underwent a 30 day public review and comment period as announced in the February 26, 1993 Federal Register. Comments were submitted by Trade organizations, major corporations, the Department of Energy and one member of the National Academy of Science's (NAS) Committee on Tropospheric Ozone. Those who submitted comments are identified below in Section 2.

The EPA appreciates the contributions to the Section 185B Report provided by the commenters. Taken together, they reflect a deep understanding of the complex issues underlying the ozone control issue, and help to foster a useful dialogue directed toward developing the most effective precursor control strategies.

The commenters agree in principle with the basic tenets in the EPA draft Report, but have requested more specifics in response to their concerns and an expansion of the EPA Report beyond one of capsulating the NAS Report (Attachment 2). Five general comments which represent most of the concerns raised are presented with a subsequent response immediately below in this Section. Section 2 provides more specific responses to individual comments.

Comment 1: The commenters request information on how the agency proposes to incorporate emerging scientific findings and data into the regulatory process.

Response: The policy and scientific programs within the ozone program area share similar objectives (e.g., the abatement of ambient ozone), but often do not operate on coincident time scales. Regulatory time scales are governed by discrete legislative mandates which generally are on faster tracks than research programs. For example, the November, 1994 SIP submittal date (CAA Section 182c) is a statutory requirement dictating completion of technical analyses in 1994. There is no date earmarked for which "quality science" arrives. Scientific information emerges on a continuum which is incorporated in the regulatory process in a stepwise manner.

Policy and regulatory decisions will be based on the best information available, consistent with the intent of Congress as reflected in the 1990 CAA requirements.

There will always be a lag in incorporating new science into regulatory policy. The challenge is to minimize this lag and accelerate the incorporation of quality science and information in the policy making process. The five steps outlined below are being pursued by the agency to the extent resources and legislative mandates permit. These steps are designed to improve the scientific underpinnings of the ozone control program in a manner that effectively incorporates new information without regulatory delay:

1. Recognizing that the 1994 SIPs reflect the most credible applications within existing resource and time and scientific constraints, we must focus on future efforts to assess accuracy of the SIPs and provide for appropriate adjustments.

2. Establish adequate ambient monitoring programs for evaluating the success of VOC and NOx control program effectiveness (see comment 2).

3. Perform special intensive studies in highly polluted areas lacking such analyses, such as the Northeast U.S.

4. Because public sector resources are lacking, areas have developed "private/public partnerships" to optimize available resources and pool support for advanced field and modeling studies. Such efforts should be encouraged and expanded.

5. Encourage justified "mid-course" corrections to the SIP for ozone nonattainment areas.

Comment 2: The EPA Report acknowledges many concerns and outlines programs/steps/recommendations toward resolving problems without sufficient evidence of commitment.

Response: The Section 185B Report includes several explicit program initiatives addressing the shortcomings noted by the NAS Report. These include, among others, the Photochemical Assessment Measurement Station (PAMS) program, the 1990 emission inventory development, and the reassessment of the ozone research program. While acknowledging that additional efforts are needed (e.g., securing support for PAMS and initiating special intensive studies), the EPA is constrained by resource limitations and CAA-mandated time frames. One strategy to deal with these constraints is discussed above within the context of mid-course corrections and private/public partnerships. Recommendations discussed in the Report have been or currently are being transformed into several initiatives, examples including:

1. EPA commitment to fund PAMS has increased from $4 million to $6 million for FY 94. However, funding for full implementation of the network will cost well over $20 million/year after 1994. Funding commitments beyond FY-94 levels have yet to be secured. PAMS is noted throughout the 185B Report as a major element of EPA's response to shortcomings identified by the NAS.

2. start of the public/private cooperative COAST Study along the Texas Gulf Coast,

3. participation of industry, academia and States to assist EPA in developing the Coordinated North American Research Strategy for Tropospheric Ozone,

4. EPA participation in the industry-funded Regional Model Evaluation Study evaluating performance and behavior of current grid models on several model domains,

5. exploring development of private/public partnerships to enhance the PAMS system and initiate intensive study in the Northeast, and

6. EPA's $1 million ozone nonattainment research initiative for FY-93.

Comment 3: By failing to incorporate specific policy recommendations, the EPA Report does not adequately extend or complement the NAS Study.

Response: The Section 185B provision in the CAA provided explicit direction on the scope of topics to be addressed in the Report. Those topics are technical in nature, and the Report reflects a synthesis of the technical perspectives and program activities addressing tropospheric ozone control.

In other sections of the CAA, Congress directed the EPA to develop policy and technical guidance to address related topics. For example, Section 182(c) and Section 182(f) require development of EPA guidance to address NOx substitution and exemption demonstrations, respectively. These documents either are under development or available. The EPA also has issued the Title I General Preamble and NOx Preamble supplement to provide direction on NOx/ozone control policy issues. Several additional NOX/ozone guidance documents, including direction on available control technology (ACT), are and will be available to address policy issues.

Comment 4: The EPA Report concurs with most NAS Findings, yet fails to justify the limited, deterministic use of models to address the probabilistic form of the ozone standard.

Response: The justification for using gridded photochemical models to demonstrate attainment is based on the Section 182(c)(2)(A) CAA provision requiring such application. Air quality models are used in this way to satisfy requirements of the CAA. The EPA acknowledges the difficulties associated with applying deterministic techniques to stochastic events. In addition to dealing with a probabilistic standard, the governing photochemical processes (i.e., meteorological and emissions events) behave stochastically as well. Thus, are we applying the modeling tools in an appropriate manner? The EPA UAM regulatory application guidance (EPA, 1991) requires that the simulated ground-level ozone fields have values of 0.12 ppm or less in every grid cell for every selected episode day. The National Ambient Air Quality Standard (NAAQS) for ozone is violated when observed ozone exceeds .12 ppm on average more than once per year. The modeling requirement appears more restrictive because of the resource constraints inherent in complex model applications. Generally, a handful of episode days are simulated (the guidance requires a minimum of three) whereas the observational set encompasses days within several ozone seasons. Thus, a statistical approach is constrained by the number of days simulated and a conservative, deterministic method is followed.

The deterministic approach is intended to provide a "best estimate" given currently available data bases, models and resources. The procedure includes provision for diagnostic analyses and model sensitivity tests. These tests can be used to help prioritize future data collection and model development efforts. Use of results to help define regulatory measures provides needed incentives for the public and private sector to invest in improving data bases and modeling techniques.

Further, the EPA guidance allows alternative demonstration proposals. Conceivably, those willing and capable of modeling a set of days suitably robust for statistical attainment demonstrations are not discouraged from doing so. On the other hand, the EPA believes that the resource requirements to model a statistically adequate set of days are beyond the capabilities of most State and local agencies and therefore sets a reasonable minimum number of required modeling days.

The explicit use of models for demonstrating attainment is questioned by some in the modeling community. The model/data uncertainty concerns and the form of the standard are substantive issues. In addition, the strong focus on the attainment demonstration might inadvertently prevent using the full capabilities of the modeling system. Nonetheless, the model can

be used to assess the relative benefits of various control scenarios, perform exposure and cost/benefits analyses, assess other impact on other pollutant species and averaging times, and a multitude of other analyses. Again, unrestricted use of the model is not discouraged; although, in being responsive to the CAA provisions, the EPA's focus has necessarily been on the attainment demonstration. In part because of the amended CAA's requirements, gridded photochemical model applications have increased ten fold or more. The technical community at large is challenged to take advantage of this fact in performing the analyses and attendant interpretations to broaden both the scope of information development and knowledge transfer to decision makers.

Comment 5: Given the delay between release of the NAS Report (December, 1991) and the Report to Congress (1993), the EPA Report should include recent ozone trends data from 1989 - 1992 which show increasing progress toward attainment.

Response: The ozone data from 1989 - 1991 do indeed show reduced levels, especially with respect to 1988. However, the three year period from 1989 - 1991 is too short to discern any long term, meaningful trend linking air quality improvement with emissions reductions. Thus, it is premature to associate "progress towards attainment" with the recent ozone data. Nevertheless, we agree that these recent data should be included and have modified Section 3.2 of the EPA Report accordingly. Ozone trends data through 1991 are reported in EPA's recent Air Quality Trends Report (EPA, 1992).

SECTION 2 - INDIVIDUAL COMMENTS AND RESPONSES

Several commenters indicated favorable agreement with most of the themes and statements in the 185B Report. For example, the commenters agreed with the area-specific approach, emphasized throughout the Report, for determining the most effective mix of NOx and VOC controls. Only those comments requiring responses are addressed in this Section. The following sequence of comments reflects the chronological order of submissions received by the EPA.

Distilled Spirits Council of the U.S.

Comment: The report does not endorse strongly enough a shift away from VOC controls.

Response: The Report purposely provides no endorsement of unilateral precursor control applied everywhere, and advocates area-specific analyses to determine the best mix of precursor controls. Recent evidence indicates that NOx reductions may be of greater use than believed previously in the design of control programs. VOC reductions also are expected to reduce ozone in many areas. The CAA requires all areas classified moderate and above to meet the RFP VOC reduction requirements. These requirements allow substitution of NOx controls for VOC reductions to meet RFP goals after 1996.

Comment: The report does not endorse the incremental reactivity scheme.

Response: Reactivity is considered explicitly in the modeling demonstrations, limited by the extent to which the existing chemical mechanisms resolve individual compound reaction characteristics. Thus, a modeling demonstration focusing on "more reactive" VOC emissions conceivably could demonstrate the same benefits as a demonstration requiring more total VOC reductions applied uniformly over all VOC classes. The major advantage of this approach is that the modeling exercise takes account of environmental conditions affecting the relative reactivity of various classes of compounds.

Gas Research Institute(GRI)

Comment: Corroborative monitoring techniques should be pursued to provide independent checks of models and control strategy decisions.

Response: Corroborative monitoring techniques are being pursued through various avenues. These avenues include the PAMS program; and other initiatives under the Southern Oxidant Study (SOS), in cooperation with the GRI, internal EPA research programs, and others. Currently, the EPA is exploring the feasibility of applying derivatives of the Australian Smog Production Algorithms (SPA) (Johnson and Quigley, 1989) to ambient precursor and ozone data to develop spatial mappings of an area's relative ozone sensitivity to NOx or VOC reductions.

Deterministic grid-models are the best tool for 1) characterizing the physical and chemical processes underlying ozone formation and control, and 2) simulating the effects on air quality from future-year precursor control strategies. The recent efforts from the SOS and SPA program are extending the use of ambient data to provide additional indicators of an area's ozone sensitivity to NOx or VOC control. Although the ambient approaches are qualitative in nature, they have the potential for improving confidence that the model's predicted precursor control direction is correct. Furthermore, the ambient techniques may ultimately be easy to apply and may provide a fast screening assessment to determine whether or not a NOx- or VOC-weighted control strategy is appropriate. The ambient approaches under development are promising, but the conditions under which they can be applied and limitations understood must be established.

Chevron

Comment: The need for case-by-case analyses and better data bases should be restated in the Executive Summary.

Response: The Report does not include a standard Executive Summary, but contains overview (Section 2) and end-of-text Summary Sections where these thoughts are expressed.

Comment: The Report oversimplifies complex issues (i.e., NOx and VOC chemistry).

Response: The NAS Report (Attachment 2) includes detail beyond the EPA Report on relevant atmospheric chemistry processes. The EPA overview in Section 2 also has been criticized as too complex. The intent of the overview is to present a concise set of facts as a lead-in to the controversy underlying the NOx/VOC issue.

Comment: We agree in principle with many of the themes and text of the Report; however, it provides no specifics on program limitations.

Response: Currently, sufficient funding does not exist within EPA to improve the technical underpinnings of the ozone program to the level implied by the NAS Report. We agree with many NAS findings, encourage activities such as private/public partnerships, but do not commit to actions that can not be backed by available or foreseeable resources.

Explicit recognition of program limitations often is overlooked. This is unfortunate since knowledge of what programs cannot accomplish facilitates future improvements. The Report emphasizes the positive expectations from agency programs and does not dwell on limitations. Again, the 185B Report includes the NAS Report, which points out numerous limitations of model and data base systems which are intrinsic to the ozone programs. The EPA Report discusses major efforts like PAMS, ROM and UAM modeling and emission inventory programs geared to address many of the concerns raised. However, current routine regulatory efforts are not designed to:

* develop research-grade episodic emission inventories for air quality model evaluation,

* provide adequate horizontal and vertical spatial coverage of ozone and precursor concentrations to fully characterize boundary conditions required for model input,

* provide precise, low concentration NOx and NOy data which are important for characterizing ambient chemistry (with respect to strategy analysis) in rural and some urban areas,

* push development of advanced modeling techniques which address physical and chemical limitations of current models, and

* characterize uncertainty in the model application process.

These and other limitations are best addressed through tightly-focused special intensive programs which can develop the necessary resources. The EPA encourages and participates intensive program initiatives like the Southern Oxidant Study (SOS), Lake Michigan Ozone Study (LMOS) and the COAST study. Although EPA's base programs lack the resources to commit to additional intensive efforts, an approach for developing additional initiatives is described above in Section 1.

Comment: The PAMS program is insufficient to meet stated objectives and lacks flexibility; individual scoping studies are needed for each area prior to network establishment.

Response: The PAMS program will operate as a routine nationally-based program collecting long term measurements for the primary purpose of tracking ozone precursor reductions and monitoring the success of emission control measures. Some, but not all, modeling objectives will be met. Type 2 sites will be phased in first; they are designed to provide data reflecting representative area-wide emission trends slightly downwind of center city locations. A priority is placed on establishing the type 2 sites to develop a base line reference frame before implementation of programs such as Reformulated Fuels. Scoping studies are recommended, indeed necessary, precursors of special intensive studies complementing modeling. However, the PAMS program can not satisfy the modeling objectives that intensive programs typically address. Those gaps should be met with special studies in areas. Given these concerns, at this time scoping studies are not required for PAMS. The EPA is concerned about PAMS support beyond 1994. Full implementation of PAMS will require more than $20 Million per year. While the base $6 Million to establish Type 2 sites in several cities appears firm for FY-1994, continued funding at this base level and beyond for post-1994 is far from solid.

Alternative PAMS network plan submittals are allowed under the enhanced ozone monitoring regulation. In developing the basic PAMS requirements and in reviewing alternative Plans, EPA will consider the following when reviewing alternative network submittals:

* the potential for providing a robust statistical data base for trends analysis,

* the ability to characterize atmospheric chemistry changes due to future strategies and programs, and

* comprehensive speciated and temporal data over the initial 1 or 2 years to justify possible subsequent scaling down of sampling and measurement frequencies.

Comment: More cooperation with transportation agencies is required to interface transportation models with air quality models.

Response: Transportation demand models often are used to derive more resolved vehicle miles travelled (VMT) and speed data estimates in the modeling application. Unfortunately, travel demand models generally are not designed with emphasis on meeting air quality modeling objectives. Some progress has been made in carbon monoxide (CO) modeling through the EPA/Federal Highway Administration (FHA) CO intersection Modeling workgroup, and the joint participation of EPA and FHA in the NAS intersection air quality modeling Panel. Activities like those should be established for ozone modeling purposes.

Comment: Comments alluding to the "high cost of intensive studies" should be countered with comments discussing the "high costs of misplaced controls."

Response: Congress, through the 1990 CAA, set a time table for regulatory action requiring the 1994 SIPs to be based on photochemical grid models utilizing the best available information. Potentially large economic benefits through control strategy optimization might be derived from comprehensive intensive studies. This factor is one of the primary reasons that EPA encourages such efforts. The prospect for misplaced controls is a strong motivator for improving the monitoring and modeling efforts.

Comment: The grid models like EPA's regulatory Urban Airshed Model (UAM) are not appropriate for demonstrating attainment.

Response: The grid models are the best available tools to conduct ozone strategy analyses. As discussed above in Section 1 (Comment 4), models are limited in their accuracy for demonstrating attainment, but no superior alternative exists. The issue is the concept of demonstrating attainment, not the use of gridded models. In addition, the use of gridded photochemical models is required by Section 182(c) of the CAA.

Comment: Delete the ROMNET discussion to avoid further acceptance of the Regional Oxidant Model (ROM) as a regulatory tool.

Response: The Section 185B Report addresses the science and technical efforts underlying ozone regulatory programs. Accordingly, the ROMNET study plays an important role in summarizing hypothesized regional-scale effects of NOx and VOC reductions on ozone. Furthermore, the NAS panel made it clear that they relied heavily on ROM results in the discussion of NOx and VOC control effectiveness. However, only urban-scale models such as the UAM have the required resolution of emission sources to adequately assess NOx and VOC control effects for particular urban areas.

Comment: The State Implementation Plan (SIP) time frames are not compatible with time required to improve the underlying science and data bases.

Response: Congress through the 1990 CAA has set a time table for regulatory action via the 1994 SIPs that will be based on the best available information. This comment is addressed above in Section 1, comment 1.

Comment: The Report should discuss phasing of controls to reduce total exposure.

Response: The Report discusses in Section 3 use of the grid models for conducting exposure analyses and sequential phasing of controls. The model formulation allows for an assortment of analyses. The phasing issue is related directly to the discussion on the basic effects on ozone from reducing NOx and/or VOC in Section 2 of the EPA Report. NOx reductions have the

potential to accelerate[1] the ozone formation process in regions of elevated NOx (e.g., central urban areas and in vicinity of major NOx sources). Thus, the greatest benefits from NOx control are likely downwind, with relatively modest decreases, or even increases in ozone occurring near major sources of NOx. Consequently, NOx controls have the potential to impart disproportionate benefits from an exposure assessment perspective. Proper phasing of controls potentially can lessen accumulated population exposure over time. For example, implementation of VOC controls initially might reduce near-field (i.e., close to emission sources or central downtown locations) ozone so that subsequent NOx reductions produce less cumulative exposure. As discussed above in Section 1, the EPA guidance only requires the model results to be analyzed in the context of reducing peak ozone to 0.12 ppm or less by the attainment year. Model users are not discouraged from performing analyses addressing exposure and phased control.

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[1] The accelerated ozone formation is partly explained by an initial reduction in hydroxyl radical (which drives much of the hydrocarbon related ozone formation) removal through reaction with nitrogen di-oxide, as well a loss of NO to scavenge ozone directly.

American Petroleum Institute

Comment: Policy should be integrated into the Report.

Response: This comment is addressed above in Section 1.

Comment: How will evolving science be incorporated into the regulatory program?

Response: This comment is addressed above in Section 1.

Comment: Private/Public partnerships should be developed to improve the information base.

Response: Private/Public partnerships are discussed above, in Section 1. The EPA encourages these partnerships. Although the EPA is exploring various opportunities, serious commitments beyond project committee participation[2] and information exchange, with the exception of the Southern Oxidant Study, have yet to be made. The EPA is examining technical, legal and program implementation issues related to use of public/private partnerships to improve technical data bases. These preliminary investigations need to be completed to define the scope and limitations in using public/private partnerships prior to developing a large scale commitment to this approach.

Comment: There is no justification for assuming ROM or the UAM are credible when applied with routine data.

Response: EPA has devoted considerable time and attention to the development of emission inventories. Current inventory efforts are discussed at length in Section 3 of the EPA Report. Recognizing the shortage of ambient air quality data for model input use, the Regional Oxidant Modeling (ROM) program is designed to provide air quality inputs to the UAM. A distinction exists between "credible" and "accurate." The EPA believes the ROM and UAM applications with available data are highly credible. The model data bases and forthcoming results are and will be subject to large uncertainty which can translate to inaccuracies in both model performance and prediction of control strategy impacts. Nevertheless, the CAA requires application of models using current data bases for the 1994 SIPs. The "credibility" concern magnifies the importance of programs like PAMS and special intensive studies.

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[2] For example, the Regional Ozone Modeling for Northeast Transport-2 (ROMNET2) External Review Workgroup, the industry funded Regional Model Evaluation Study and industry participation in assisting EPA in developing a long term ozone research plan.

Comment: The development/application of corroborative ambient techniques is encouraged.

Response: This comment is addressed above at the beginning of Section 2.

Comment: The ozone regulatory program relies too heavily on peak ozone as a determining metric.

Response: This comment is discussed above in Section 1 under Comment 4 and in the Section 2 responses to Chevron.

Comment: The potential for NOx reductions with alternative fuels is speculative.

Response: The EPA presents a balanced and brief summary of an unclear issue. It simply states that "...there exist **possibilities** with alternative fuels for reductions of both VOC and NOx that do not exist with gasoline." Thus, the current uncertainty about whether or not alternative fuel use will result in NOx reductions is clearly conveyed.

The API states that CNG and alcohol vehicles normally have NOx emissions equal to or higher than gasoline vehicles. Actually, the existing data are highly variable, with some vehicles showing lower NOx as well. In fact, Chrysler Corporation recently certified a CNG van at 0.02 grams/mile NOx with the California Air Resources Board (Geiss and Burkmyre, 1992). In addition, a 1976 study using an experimental single-cylinder engine demonstrated that extremely low NOx emissions are possible with methanol when the extended lean misfire limit of methanol is fully utilized (Koenig et al., 1976).

Comment: More coordination with other Federal Offices is needed to address multi-faceted technical issues.

Response: A related comment regarding cross-fertilization with transportation agencies is discussed above in the Chevron comments. Certainly other bodies of information exist in agencies which would reduce duplication and enhance the analysis efforts. The model application process itself relies on a broad assortment of demographic and economic information, in addition to the basic emissions and aerometric data. Actually, the coordination at the State and local agency level is probably more important than Federal Office coordination to tailor needs to specific areas.

Comment: The specification of "minimum data bases" for model applications is not addressed.

Response: EPA has devoted considerable time and attention to the development of emission inventories. Current inventory efforts are discussed at length in Section 3 of the EPA Report. Recognizing the shortage of ambient air quality data for model input use, the Regional Oxidant Modeling (ROM) program is designed to provide air quality inputs to the UAM. However, minimum data bases are not specified in EPA guidance nor in the Section 185B Report because the requirement for performing timely SIP submittals based on model demonstrations supersedes the status/quality of available data bases.

General Motors

Comment: It is a misconception that past programs required only VOC controls; motor vehicle NOx reductions should be acknowledged.

Response: The commenter is correct. Fleet average motor vehicle NOX emissions were reduced about 55% from 1975 to 1990. Additional reductions are anticipated in response to the mobile source provisions of the 1990 CAA. Tier I light duty vehicle standards will reduce new car NOx emissions from 1.0 g/mile to 0.4 g/mile beginning with 1994 models, and Tier II (if adopted) to 0.2 g/mile beginning with 2004 models. New heavy duty diesel engine NOx emissions were reduced from 6 to 5 g/bhp-hr in 1991, and will be reduced to 4 g/bhp-hr in 1998. Other programs expected to impart NOx emission benefits include enhanced/high technology Inspection and Maintenance (with associated mechanic training), transportation controls and onboard diagnostics.

Despite progress in motor vehicle NOx emissions, total NOx emissions from all sources generally were not reduced (because of increased growth and activity) over the last several years.

Comment: Evidence exists suggesting that VOC controls are effective in reducing ozone as recent data show decreasing ozone with decreasing ambient VOC levels.

Response: The ozone data from 1989 - 1991 show reduced levels, especially with respect to 1988. Ozone trends data through 1991 are reported in EPA's recent Air Quality Trends Report (EPA, 1992). The recent ozone data open up a wealth of interesting speculation relevant to the NOx versus VOC reduction issue. For instance, analysis of limited ambient VOC data and combined VOC/NOx ratios in the Northeast indicate a downward trend over the same period (Wolff and Korsog, 1992; Zealewsky et al., 1992). These reduced ozone levels coincide with implementation of reduced vapor pressure (RVP) reductions starting in 1989. Lower RVP leads to a reduction in evaporative VOC emissions from motor vehicles and gasoline storage and transfer operations.

However, little if any confirmatory evidence supports the view that RVP reductions effected lower ozone levels in the early 1990's. The period 1988 - 1991 is too short to discern any meaningful cause-effect relation among emission reductions and air quality. The effects of meteorology are not accounted for in a cursory look at recent ozone trends. The shorter the trend period, the greater the chance that meteorology has a large impact on ozone trends data. In particular, the summer of 1988 is on record as one of the driest and hottest, prime conditions for producing high ozone levels. The recent summers have been

different in character, either wetter, cooler or both, from 1988. In fact, if 1988 were removed from the ozone trends data (page 3-5, EPA Report), only slow progress toward attainment can be seen over the 10 year record from 1982 - 1991. Thus, it is premature to associate recent RVP reductions with reduced ozone levels in a cause-effect context.

The EPA welcomes confirmation that RVP reductions produced measurable benefits. The current round of SIP modeling should provide additional insight on the benefits of the RVP programs. In addition to the environmental benefit, evidence that VOC reductions are beneficial supports the Report's thesis lacking endorsement of unilateral (NOx or VOC only) precursor control applied everywhere. Further, the fact that an area responds to VOC control does not preclude NOx control being equally or more effective in the same area.

Comment: The Report does not extend beyond the NAS study.

Response: This issue is discussed above in Section 1 under Comment 3.

Comment: The Report must acknowledge recent ozone trends and improvement toward attainment.

Response: This issue is discussed above in Section 1 under Comment 5.

Comment: The grid models are not appropriate for demonstrating attainment.

Response: This issue is discussed above in Sections 1 (comment 4) and 2 (response to Chevron).

Aerodyne Research (Charles Kolb of NAS Committee)

Comment: The Research Section (3.10) of the EPA Report is filled with protestaions of good faith which hopefully are indicative of more effective EPA actions in the tropospheric ozone area. A main concern is whether EPA will actually close the gap between what is promised and future deeds in the research area.

Response: EPA's Office of Research and Development (ORD) is sensitive to the concerns raised about our research program and, as a result, we convened a group of 140 senior scientists representing a cross-section of disciplines and public and private organizations to develop a coordinated, national research program. The cost of such a program ranges from $600 million to $1 billion over the next 10 years.

To ensure that the highest priority research initiatives are undertaken, public and private sector partnerships are essential to supply the necessary funding. Only with this type of cooperation can the gap be closed between the work that is needed to address the ozone problem and the research that is actually undertaken.

Comment: EPA has not pursued research on analytical techniques for speciated VOC and claims too much contribution to measurement science.

Response: In the area of ambient pollutant measurement, EPA has recognized two distinct needs: a measurement data base for studying and assessing air pollution problems, and a need for accuracy and precision of the requisite measurement methods. Although there has been an emphasis on the first, significant research and development efforts in the ambient VOC measurement and VOC emission analysis areas have been conducted or sponsored by EPA. Examples include: the effort conducted by the Hydrocarbon Measurement, Technology, and Standards Group within the EPA-sponsored Southern Oxidants Study, and additional efforts being commenced in reaction to the stimulus raised by the NRC Report. Recognizing that the on-going research activities are not adequate for achieving the goals identified by the NRC Committee, EPA is developing a coordinated North American research strategy for tropospheric ozone, which addresses among other critical issues the need for more definitive VOC methodology and measurements. This strategy currently is undergoing Agency and external review and, contingent upon funding, the reviewer's concerns will be addressed.

Chemical Manufacturing Association

Comment: Only superficial evaluation of grid models has been conducted by EPA, and the models require more thorough development of supporting data bases to provide even directionally correct ozone responses to precursor control.

Response: The EPA has sponsored numerous model evaluations with urban scale grid-models, especially the Urban Airshed Model (UAM) over the past 20 years. A comprehensive model evaluation was performed on the UAM using the RAPS-St. Louis urban field study database during the late 1970's. This database represented the most complete set of urban air quality measurements for ozone and its precursors for the time. Subsequent operational model evaluations for ozone for urban areas, such as Tulsa, Denver, Philadelphia, and New York were performed using the routine AIRS ozone monitoring data, sometimes supplemented with locally-obtained data. The EPA is now participating in applying the UAM to the most contemporary urban field study databases obtained during the more recent SCAQS (Los Angeles) and LMOS (Chicago) field studies. These databases contain observations not only for ozone, but also for individual nitrogen and hydrocarbon species, as well as comprehensive meteorological measurements, and will enable thorough diagnostic testing of the UAM in a manner that has been difficult to achieve previously.

The Regional Oxidant Model (ROM) also has been subjected to on-going model evaluations from its inception in the early 1980's. The first truly regional field experiment to obtain model evaluation databases was performed in the eastern U.S. during the summers of 1979 and 1980 (NEROS/NECRMP project). The ROM was diagnostically analyzed with ozone, nitrogen oxides, and hydrocarbon data from this database. Subsequent operational model evaluations were conducted using AIRS ozone data for regional episodes during the summer of 1985, the base year of the last NAPAP emissions inventory, and 1988, the last year of widespread chronic high ozone concentrations across the region. Currently the ROM is undergoing diagnostic evaluation exercises using the LMOS Lake Michigan airshed database from the summer of 1991 which contains ozone and precursor data at the surface as well as aloft from aircraft observations. Emerging data from the EPA-sponsored Southern Oxidants Study (1991-1995) will also be used for diagnostic ROM evaluations in the southeast U.S.

Coastal Corporation

Comment: Less complex, easy-to-use models need to be developed for the regulated community.

Response: Less complex models offer the advantages of performing multiple simulations with reduced resources. Prior to the 1990 CAAA, the physically simplistic EKMA approach was the most widely applied ozone regulatory model. The move toward using grid models in the regulatory program generally is considered a major improvement. Models like EKMA and derivatives of grid-based models with simplified chemistry are valuable tools for performing an array of investigative analyses. In addition, various plume models which treat individual sources and incorporate photochemistry have been developed. Access to an assortment of less complex photochemical models is available through EPA or private contractors. These "screening" approaches have limitations relative to complex area-wide models (like the UAM) which the EPA requires for most regulatory applications.

Comment: The report should address policy aspects.

Response: This issue is discussed above in Section 1, comment 3.

Comment: Reasonable timing should be provided for control implementation with phasing of controls on major sources first.

Response: A State submitting a SIP needs to demonstrate attainment for specific attainment years. This approach does not preclude phased implementation of controls up to the attainment year.

Comment: The declassification process is too time consuming.

Response: This topic is beyond the technical scope of the 185B Report.

Comment: Additional monitoring efforts are encouraged.

Response: This topic is addressed throughout the Report and this Attachment.

Comment: Poor timing exists between SIP and research needs.

Response: This issue is addressed in Section 1, comment 1 above.

American Gas Association

(see comments and responses for Coastal, above)

Interstate Natural Gas Association

(see comments and responses for Coastal, above)

Electric Power Research Institute

Comment: Screening models can be developed to provide comprehensive cost/benefit analyses.

Response: The use of screening approaches and the expansion of analyses to address cost/benefits, and other measures, is discussed above in Section 1 (comment 4) and Section 2 (response to Coastal).

Pacific Gas and Electric

Comment: The ozone trends in CA indicate that ozone levels generally are higher during weekend periods. We suspect that this is due to a reduction of NOx emissions on weekends, particularly the loss of concentrated NOx during morning and afternoon rush hours.

Response: Assuming these trends are statistically significant, this observed "weekend" effect is indicative of the complexities associated with NOx control issues. Evidently, the rate of progress in reducing ozone in certain California locations has been greater for weekends than weekdays. The elevated weekend ozone may be due to a variety of changes in the temporal and spatial distribution of precursors. Moderate reductions in NOx emissions can increase ozone in some locations; this is one of several plausible explanations for the observed increases. An evaluation of weekend effects is best conducted through modeling by accounting for weekend specific emission changes. The existence of this weekend effect offers an opportunity to conduct population exposure impact assessments, to the extent that weekend and weekday activity patterns differ.

Department of Energy

Comment: The economic risks of proceeding with uncertain models/data bases merit development of a more realistic SIP timetable.

Response: This issue has been addressed above throughout Attachment 3. Congress, through the 1990 CAA, was clear in setting the current SIP time schedules. The schedule requires SIP submittals in most areas by November, 1994.

Comment: Where is the 182(f) guidance describing the exemption demonstration procedures?

Response: The NOx exemption guidance is being developed separately from the Section 185B Report. This guidance is discussed above in Section 1 (comment 3).

Comment: The SIP schedule is not practical given poor data bases, and need for additional research.

Response: see comments throughout this Attachment.

Comment: The 1989-1992 ozone data for trends should be added.

Response: A discussion of ozone trends data through 1991 has been added to Section 3.2 of the EPA Report.

Comment: The overall summary of technology is accurate; however, additional results are available that are not presented in Attachment 2.

Response: Due to time and budget restraints, Attachment 2 will not be updated. More current information and data are contained in the alternative control techniques (ACT) documents that were or will be issued for various source categories from 1991 to September 1993.

Comment: Generation of NO_x is exponentially proportional to temperature and square root dependent on oxygen concentration.

Response: This detailed information is included in the various ACT documents referred to above.

Comment: Section 2.1.4.1 does not address the different selective catalytic reduction configurations.

Response: This information is included in the various ACT documents.

Comment: Burners out of service and biased burner firing should be considered as NO_x controls for coal fired utility boilers.

Response: These controls are evaluated in the utility boilers ACT document.

Comment: Peak values of 55 to 65% shown for low NO_x burners with overfire air or advanced overfire air are optimistic. 50% is a practical maximum relative to a properly tuned boiler. Operating at lower emission levels lead to operational problems such as boiler corrosion and increases in unburnt carbon and carbon monoxide emissions.

Response: Based on limited data, the emission reduction for low NO_x burners with overfire air varies from 30-65% (Attachment 2, page 3-9). The specific emission reduction is heavily dependent on site specific parameters such as boiler design and operating characteristics such as firing configuration, furnace size and heat release rate, type of fuel used, boiler capacity factor and condition of existing equipment.

Comment: Various data are available for retrofits that had no problems with unburned carbon, carbon monoxide or boiler slagging.

Response: These data are included in the utility boiler ACT document.

Comment: Water or steam injection is an attractive alternative for industrial, commercial and institutional boilers.

Response: This technique is included in the non-utility boiler ACT document.

Comment: NO_x generation from the transportation sector is not discussed.

Response: As noted in the introduction, Attachment 2 only addresses NO_x controls for stationary sources. A brief discussion of motor vehicle NOx control techniques is provided in Section 4 of the primary Report.

Comment: Advanced combustion techniques such as AFBC, PFBC and coal gasification are not discussed.

Response: These processes are included in the utility boiler ACT document.

Comment: Combined NO_x-SO_2 controls are largely overlooked.

Response: The scope of the Report was limited to basic availability and extent of NOx control technologies to address the specific CAA Section 185B requirements.

Comment: No cost information is provided. Integrating reduction capability over boiler population to estimate current extent of controls or to project potential control levels is not done.

Response: The scope of the Report was limited to basic availability and extent of NOx control technologies to address the specific CAA Section 185B requirements. These subject areas are covered in detail in the various ACT documents.

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16 ABSTRACT

This Report is Attachment 3 of the CAA Section 185B Report entitled, The Role of Ozone Predcursors in Tropospheric Ozone Formation and Control. It includes a summary of comments and EPA responses based on a 30 day review of the draft Section 185B Report.

17 KEY WORDS AND DOCUMENT ANALYSIS

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