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STATE OF ILLINOIS
Pollution Control Board

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF :	)	
	)	
PROPOSED NEW 35 ILL. ADM. CODE, SUBPART W,	)	R01-9
THE NOx TRADING PROGRAM FOR	)	
ELECTRICAL GENERATING UNITS, AND	)	(Rulemaking-Air)
AMENDMENTS TO 35 ILL. ADM. CODE 211 AND 217	)	

CAM

NOTICE

TO: Dorothy Gunn, Clerk
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph, Suite 11-500
Chicago, IL 60601

Catherine Glenn, Esq.
Hearing Officer
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph, Suite 11-500
Chicago, IL 60601

SEE ATTACHED SERVICE LIST

PLEASE TAKE NOTICE that I have today filed with the Office of the Clerk of the Pollution Control Board the TESTIMONY OF ROBERT KALEEL of the Illinois Environmental Protection Agency, a copy of which is herewith served upon you.

ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY

By: _____
Laurel Kroack
Acting Associate Counsel
Division of Legal Counsel
Bureau of Air

DATED: August 18, 2000

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Springfield, IL 62794-9276
217/782-5544

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
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PROPOSED NEW 35 ILL.ADM.CODE 217,	)	R01-9
SUBPART W, THE NOx TRADING	)	(Rulemaking – Air)
PROGRM FOR ELECTRICAL GENERATING	)	
UNITS, AND AMENDMENTS TO 35 ILL.	)	
ADM.CODE 211 AND 217.	)	

TESTIMONY OF ROBERT J. KALEEL

Qualifications

My name is Robert J. Kaleel. I am the Manager of the Modeling Unit, Air Quality Planning Section, Division of Air Pollution Control, at the Illinois Environmental Protection Agency ("Agency"), Springfield, Illinois. I have a Bachelor of Science degree in meteorology from Northern Illinois University. I have worked at the Agency for almost twenty years, and have been in my present position since 1989. I have also worked as a private consultant as a specialist in air quality modeling. As Manager of the Modeling Unit, my responsibilities include oversight of staff in the Unit who perform air quality modeling to evaluate the impact of various control measures on ambient air quality. I have been involved with the development of the ozone attainment demonstrations for both the Metro-East/St. Louis and the Lake Michigan ozone nonattainment areas.

The purpose of my testimony is to summarize the results of the modeling conducted to date to support the 1-hour ozone attainment demonstration for the Lake Michigan nonattainment area. This work is still on-going, but must be submitted to the U. S. Environmental Protection Agency ("U.S. EPA") by December of this year. I will also summarize the updated 1-hour ozone attainment demonstration recently submitted to the U.S. EPA for the Metro-East/St. Louis nonattainment area. The attainment

demonstrations for both areas rely heavily on the NOx control measures that are the subject of this rulemaking.

Background

I will begin my testimony by describing the progress made to date in improving ozone air quality in both the Lake Michigan and Metro-East/St. Louis ozone nonattainment areas. The level of the one hour National Ambient Air Quality Standard ("NAAQS") for ozone is 0.12 parts per million ("ppm") or 124 parts per billion ("ppb"). Since the form of the ozone NAAQS allows up to three exceedances of the standard over a three year period, the fourth highest value at a given location is the called the design value. If the measured design value at a given monitoring site exceeds the level of the NAAQS, then that location is considered to be in violation of the standard. Figures 1 and 2 illustrate the changes in observed ozone design values for the 1987-89 versus the 1997-99 periods in the Lake Michigan and Metro-East/St. Louis ozone nonattainment areas, respectively. As shown in the figures, the spatial extent and magnitude of ozone violations in both nonattainment areas has decreased considerably over the past 10 years. In the Lake Michigan region, there were 25 monitoring sites that violated the 1-hour ozone NAAQS in the 1987-89 period (see Figure 1). In 1997-99, only six sites still violate the NAAQS. The maximum design value, the highest of the fourth highest hourly ozone concentrations recorded at any site, has been reduced from 190 ppb in 1987-89 to 134 ppb in 1997-99. In the Metro-East/St. Louis nonattainment area, there were 13 monitoring sites that violated the 1-hour ozone NAAQS in 1987-89 (see Figure 2), but only two sites violated the NAAQS in 1997-99. The maximum design value in the area has been reduced from 156 ppb in 1987-89 to 131 ppb in 1997-99. In both areas, however, violations of the NAAQS are still observed, and attainment will not be achieved without further emission reductions.

In October 1998, U.S. EPA issued a final rulemaking, commonly called the NOx SIP Call, requiring 23 jurisdictions in the eastern half of the U.S. to reduce emissions of oxides of nitrogen ("NOx") to address ozone transport. In the NOx SIP Call, U.S. EPA relied upon the technical findings of OTAG, as well as other technical studies performed by U.S. EPA and other groups. Consistent with OTAG's recommendation, U.S. EPA

found that reducing NOx emissions on a regional basis, combined with reductions in emissions of volatile organic compounds ("VOCs") in nonattainment areas, presented the most effective means of addressing ozone nonattainment in the eastern U.S. Reducing NOx on a regional basis means that NOx emissions must be reduced over a broad, multi-state area, in both nonattainment and attainment areas, and even in states with no ozone nonattainment areas. Modeling analyses performed during OTAG demonstrated that the cumulative reduction of NOx emissions throughout the eastern U.S. has a much greater benefit in reducing ozone transport than reducing emissions only in those states with nonattainment areas.

Since 1997, Illinois has worked with the Lake Michigan Air Directors Consortium ("LADCO"), and the other Lake Michigan states, Indiana, Michigan, and Wisconsin, to refine the ozone modeling, consistent with OTAG's recommendations. LADCO initiated subregional modeling efforts in September 1997 focusing on the Midwest, based on the recommendations of OTAG. Specifically, OTAG recommended that, "States work together with U.S. EPA toward completing local SIPs, and to build on the modeling and air quality analysis work of OTAG through additional subregional modeling or air quality analyses" (OTAG "Executive Report," 1997).

Subregional modeling is necessary to assess ozone concentrations on both the local urban scale and the larger regional scale. As such, this modeling can be used to support urban area attainment demonstrations and address transport. The subregional modeling domain and grid configuration was established based on consideration of areas of high ozone concentrations in the Midwest, especially in the Lake Michigan region, and possible upwind source areas impacting these high concentration areas. The primary domain, which is referred to as Grid M, is shown in Figure 3.

The goal of LADCO's subregional modeling was to determine whether implementation of the NOx SIP Call, in conjunction with other planned emission control measures, would be sufficient to demonstrate attainment in the Lake Michigan region. Inputs were developed by LADCO for four ozone episodes: June 22-28, 1991; July 14-21, 1991; June 13-25, 1995; and July 7-18, 1995. An episode, for modeling purposes, represents the

meteorological conditions associated with high ozone concentrations in the past for a particular region. Such events generally occur under high pressure weather systems which cause clear skies, low wind speeds, and high temperatures over multi-day periods. The meteorological inputs derived for an historical episode are a predictive way to represent future ozone-conducive weather events. The selected episodes reflect a variety of meteorological conditions known to cause high ozone concentrations in the Midwest. The Agency has also worked cooperatively with the State of Missouri to develop a state-of-the art modeling system for the Metro-East/St. Louis region. The modeling for the Metro-East/ St. Louis area utilized the same model, the same modeling domain, and two of the same ozone episodes, July 1991 and July 1995, developed for the Midwestern subregion by LADCO.

UAM-V Photochemical Modeling System

The 1990 Clean Air Act Amendments established specific planning requirements for ozone nonattainment areas, including the need for a demonstration of attainment based on photochemical modeling. In general, an attainment demonstration relies on the use of air quality simulation models to show how a nonattainment area will achieve the air quality standard by its attainment date and the emission control measures necessary to achieve attainment. The modeling supporting both attainment demonstrations was performed with the Urban Airshed Model, Version V ("UAM-V"). This is the same version of the model that was used by OTAG in formulating its recommendations and by the U.S. EPA in support of the NOx SIP Call.

There are three key inputs to the UAM-V photochemical modeling system: emissions, meteorology, and boundary conditions. I will briefly discuss the development of these inputs.

UAM-V requires a regional inventory of hourly emissions estimates for VOC, NOx, and carbon monoxide ("CO"). Emissions inputs were derived using the Emission Modeling System ("EMS-95"). The EMS-95 model was designed to produce model-ready emissions inputs for the UAM-V, including point and area source emission estimates, on-road and off-road mobile source emission estimates (based on U.S. EPA's mobile source

emissions model, Mobile5b), and biogenic emissions. Biogenic emissions, which occur naturally from biological activity and vegetation, are derived from U.S. EPA's BEIS2 model. Once estimates are obtained for each of these emission categories, the EMS-95 model spatially distributes, temporally allocates, and speciates emissions for input into the UAM-V photochemical model. Emissions were prepared for the 1996 base year, and for several future-year scenarios representing each area's attainment deadlines (2003 for St. Louis and 2007 for the Lake Michigan area). The modeled emissions are consistent with the inventories contained in each State's 1996 Periodic Inventory for point and area sources, updated state transportation data, and estimates of future-year growth and control.

Meteorology is the second key input to the UAM-V photochemical modeling system. Inputs for meteorology were developed through prognostic meteorological modeling using the RAMS3, a model developed by Colorado State University. UAM-V requires 3-dimensional hourly values of winds, temperatures, pressure, water vapor, turbulence and, for some episodes, clouds and precipitation. RAMS3a is a prognostic meteorological model based on the dynamic equations that govern atmospheric motion. Meteorological data fields were developed for the four ozone episodes using RAMS3a, and the model's outputs were mapped to conform to the horizontal and vertical grid structure for UAM-V.

Boundary conditions are the third key input, used in the model to represent ozone and precursor emissions entering the Grid M modeling domain from areas upwind of the domain. For the subject attainment demonstrations, boundary conditions were developed using the UAM-V over an even larger domain (called the OTAG coarse-grid domain) as shown in conjunction with Grid M in Figure 3. Emissions data were prepared for the larger OTAG domain to represent both base and future year scenarios.

A thorough evaluation of the model's performance (i.e., its ability to replicate observed ozone concentrations for historical ozone episodes) was conducted prior to the performance of future year control strategy modeling. The model was executed for the 1996 basecase and the model's performance was evaluated by comparing observed and modeled ozone concentrations. For each nonattainment area and for each episode, the

model was shown to meet U.S. EPA's acceptance criteria before any future-year strategy evaluations were performed.

UAM-V Modeling Results

A series of UAM-V simulations were performed to evaluate various future year control scenarios. The goal of this process was to develop a control strategy that would demonstrate attainment of the 1-hour ozone NAAQS by the appropriate attainment years (2003 for St. Louis, and 2007 for the Lake Michigan area). The conclusion that attainment has been adequately demonstrated by the modeled results is based on application of specific criteria, or "tests", established by U.S. EPA. Numerous future year scenarios were developed and tested with the model for the two nonattainment areas. The modeling results for the following scenarios are relevant to the purpose of today's hearing:

1. CAA controls (including States' 15% and ROP measures, reformulated gasoline, enhanced vehicle inspection and maintenance, etc)

2. CAA controls + a rate based limit of 0.25 lb NOx/mmbtu on utilities

3. CAA controls + NOx SIP Call (0.15 lbs NOx/mmbtu emissions cap on utilities + SIP Call reduction for non-utilities)

The projected emissions in the Grid M modeling domain for these scenarios are summarized in Figure 4. From the Figure, the net effect of growth and CAA controls is a reduction of VOC emissions of about 2100 tons per day in the Grid M domain, and a reduction of NOx emissions of about 2400 tons per day compared to the 1996 base year emissions. The second future-year scenario assumed a reduction of NOx emissions from electric generating utilities in Midwestern states to a control level of 0.25 lbs NOx/mmbtu. This control level represents a reduction of NOx emissions in the Grid M modeling domain of about 2000 tons per day compared to the Clean Air Act control level. The final scenario simulates the effects of the NOx SIP Call controls. For this scenario, it is estimated that a reduction of NOx emissions in Grid M of an additional

1600 tons per day can be expected compared to the previous modeling scenario, 0.25 lb NOx/mmbtu, or a reduction of about 3,600 tons of NOx per day compared to CAA controls (see Figure 4).

The peak daily ozone concentrations predicted by the model for each scenario are shown in Figure 5 for the Lake Michigan area and Figure 6 for Metro-East/St. Louis. Results are shown for a single episode day, July 13, 1995 for the Lake Michigan area, and July 18, 1991 for Metro-East St. Louis, as an example of the results obtained for the many episode days modeled. The results shown in Figures 5 and 6, indicate that substantial reductions in ozone concentrations can be expected from implementation of mandated CAA control measures relative to the 1996 basecase. Additional ozone air quality benefits are indicated in both areas from the results of the 0.25 lb NOx/mmbtu scenario, relative to the CAA scenario. Application of the control measures contained in the NOx SIP Call provides some additional, limited air quality benefits (generally 1-3 ppb) in both the Metro-East/St. Louis and the Lake Michigan portions of the modeling domain, relative to the 0.25 lb NOx/mmbtu scenario.

It is important to note that the results for an individual episode day are not conclusive with respect to determining whether the model demonstrates attainment. Modeled exceedances indicated by the results in some future-year scenarios, do not necessarily mean that the modeling fails to demonstrate attainment. In keeping with the form of the ambient NAAQS (i.e., three exceedances are allowed at any given location over a three-year period), U.S. EPA's modeled attainment tests allow for modeled exceedances under certain conditions. In fact, the control level represented by the 0.25 lbs NOx/mmbtu scenario is considered adequate to demonstrate attainment of the 1-hour NAAQS in Metro-East/St. Louis, and is the utility control level specified in the Metro-East/St. Louis attainment demonstrations submitted in 1999 by the States of Illinois and Missouri. Although the analyses for the Lake Michigan area are not yet completed, the 0.25 lbs NOx/mmbtu control level for utilities, *may* be adequate to demonstrate attainment in the Lake Michigan area as well.

The controls contained in the NOx SIP Call are probably sufficient to demonstrate

attainment of the 1-hour NAAQS in the Lake Michigan area, although the analyses for the Lake Michigan area are not yet completed. For the Metro-East/ St. Louis area, the NOx SIP Call control levels should be more than sufficient to demonstrate attainment of the 1-hour standard and should help to maintain ozone levels in the years after the area's 2003 attainment date.

Figure 7 and 8 depict the results of all of the future year scenarios, relative to the current, monitored design values in the Lake Michigan and Metro-East/St. Louis areas, respectively. The ozone design value for an area is the highest of the fourth highest hourly peak ozone concentrations observed at any air quality monitor in that area over a three-year period. U.S. EPA has released guidance (May 1999) that provides a means for using the monitored design values in concert with model-generated data. Rather than comparing modeled peaks in an absolute way to the NAAQS, this approach uses the modeled results in a relative way, by determining the percentage change in the model's overall response across all episode days. The percent change between modeled scenarios, called the "relative reduction factor," is applied to the observed design value to derive the "adjusted design value." To show attainment, the adjusted design value must be below the ozone NAAQS. From Figures 7 and 8, the adjusted design values for both the Lake Michigan and Metro-East/St. Louis areas do not meet the NAAQS for the CAA scenario, but do meet the NAAQS using the 0.25 lbs NOx/mmbtu. The NOx SIP Call scenario provides greater benefits in both areas, with adjusted design values 1-3 ppb less than the NAAQS.

Summary

In summary, I have described the photochemical modeling analyses performed to support the updated 1-hour ozone attainment demonstrations for both the Lake Michigan and Metro-East/St. Louis nonattainment areas. The St. Louis attainment demonstration was submitted to U.S. EPA in February of this year. The Lake Michigan attainment demonstration must be submitted by December. The model, as applied to these areas, was shown by LADCO and the participating states to perform adequately to support regulatory applications.

The modeling analyses show that Clean Air Act controls alone will reduce ozone concentrations, but do not, by themselves, provide for attainment of the 1-hour NAAQS in either Metro-East/St. Louis or the Lake Michigan area. The NOx SIP Call controls, modeled in conjunction with the CAA controls, are sufficient to provide for attainment of the 1-hour NAAQS in both nonattainment areas. A less stringent control strategy, requiring a NOx limit of 0.25 lb/mmbtu on electric generating units, is sufficient to demonstrate attainment in Metro-East/St. Louis, and may be adequate for the Lake Michigan area as well.

Figure 1
Comparison of 1987-1989 and 1997-1999 1-hour Ozone Design Values within the Lake Michigan Region

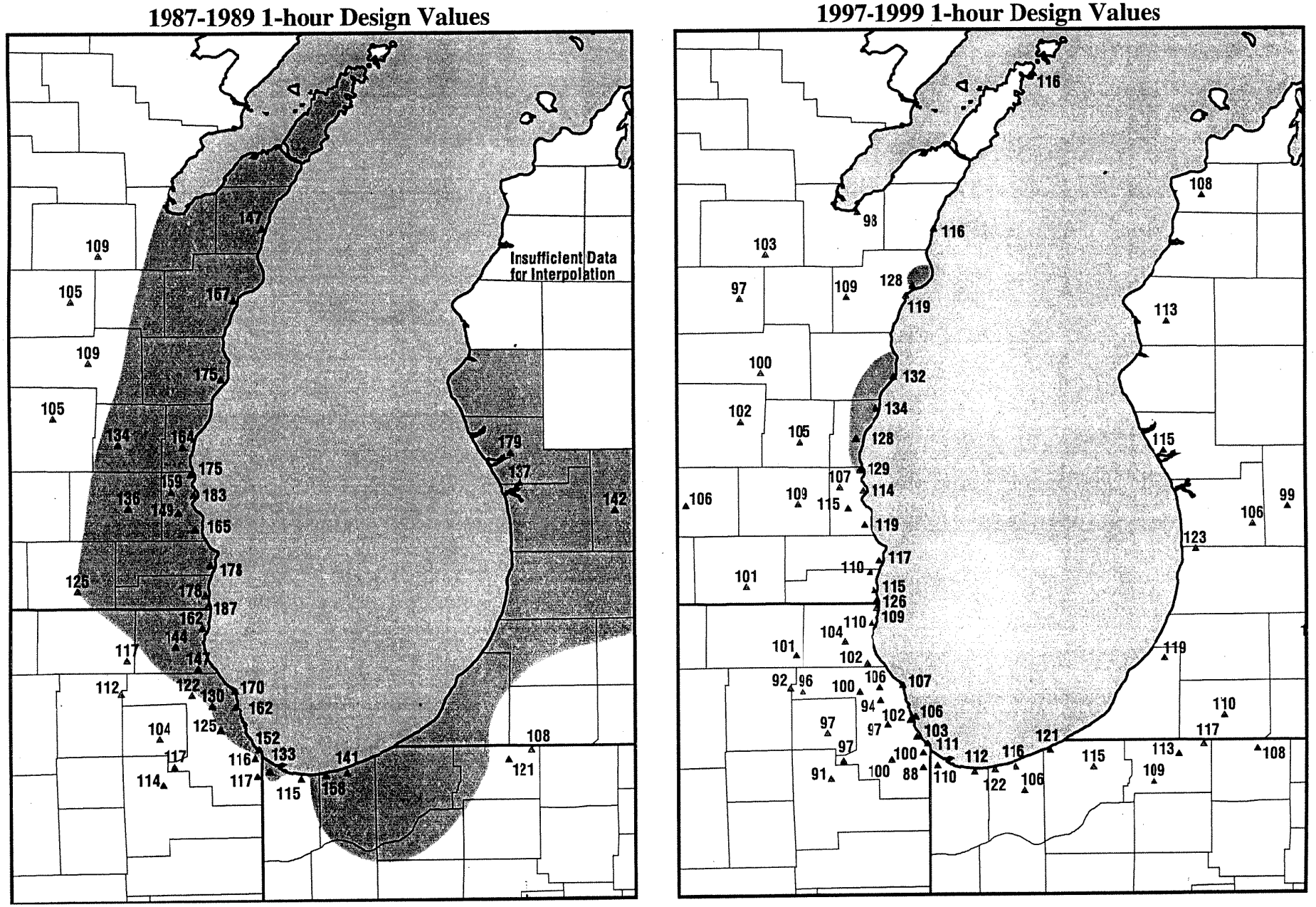


Figure 2
Comparison of 1987-1989 and 1997-1999 1-hour Ozone Design Values within the St. Louis NAA

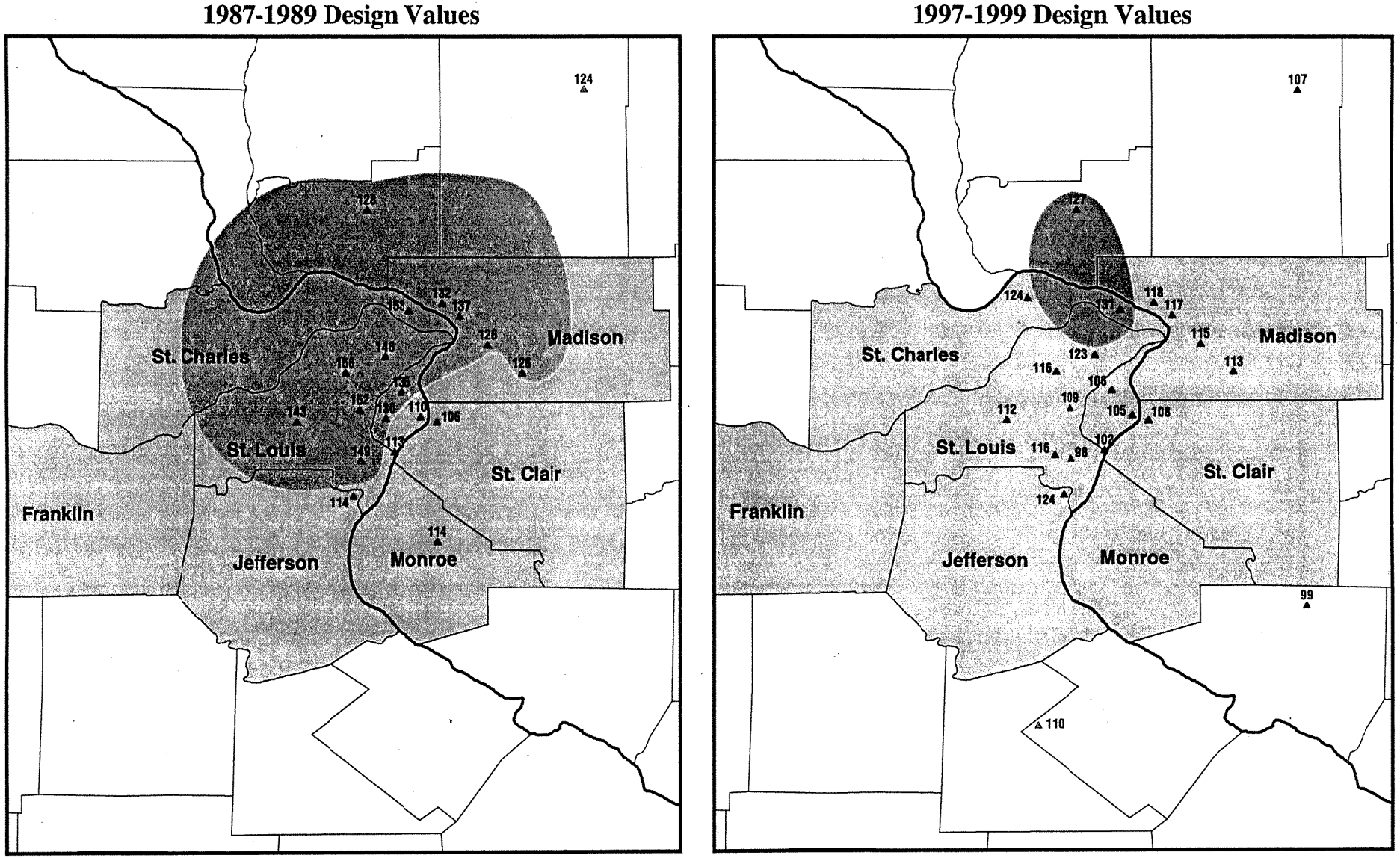


Figure 3
Midwest Modeling Domain
"Grid M"

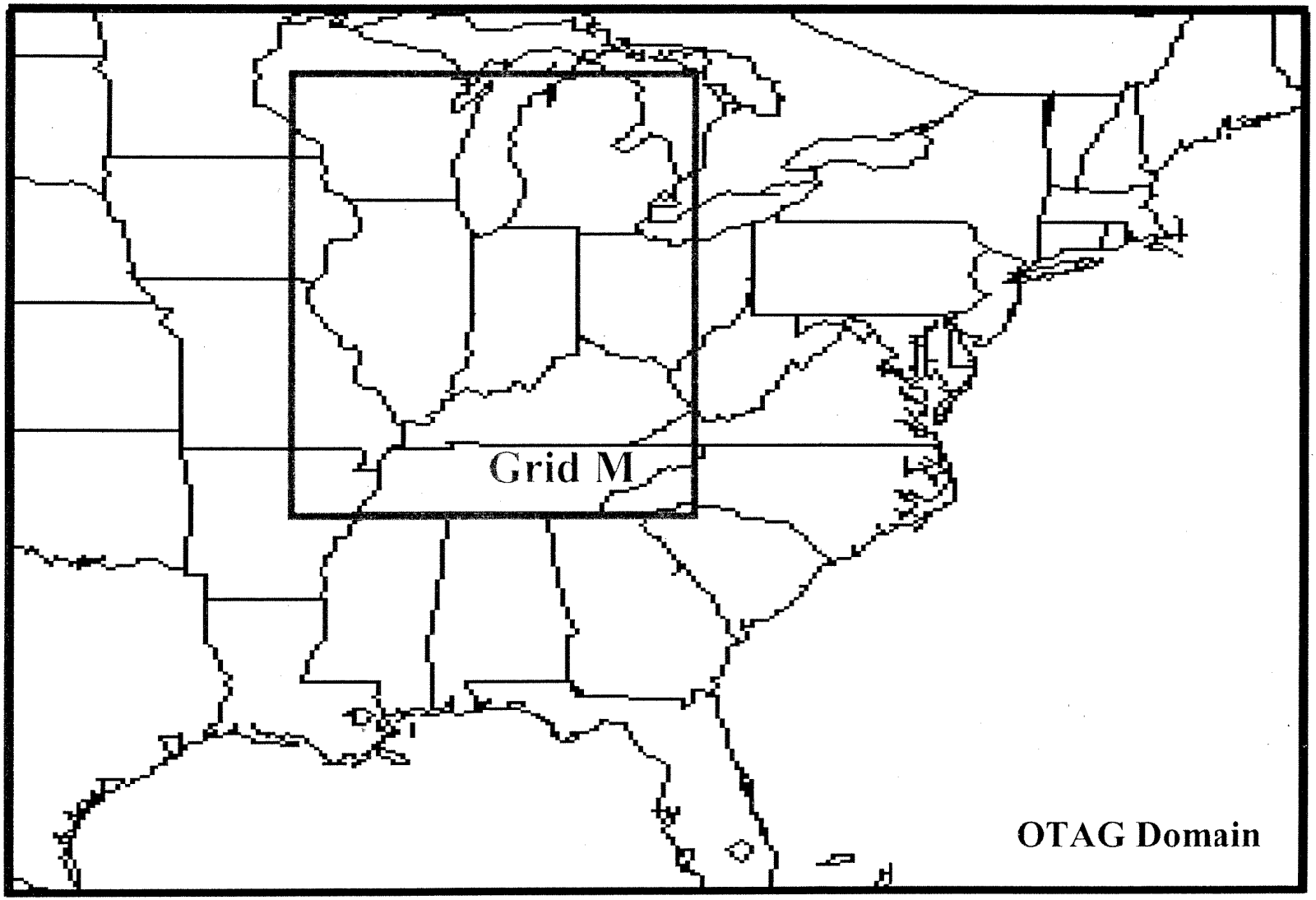


Figure 4
Domainwide Total Anthropogenic Emissions (tons per day)

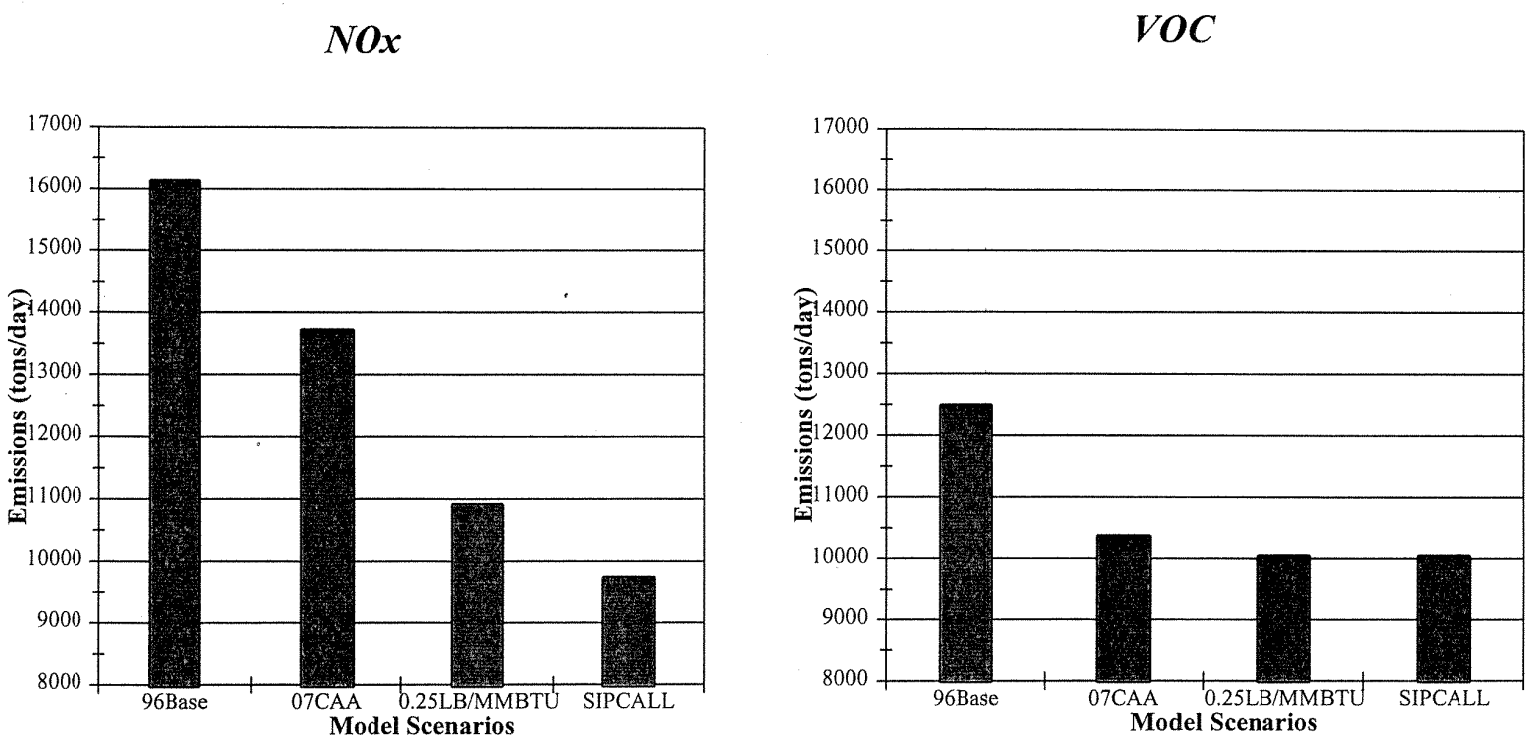


Figure 5
Peak 1-Hour Ozone Concentrations
July 13, 1995 – Lake Michigan Region

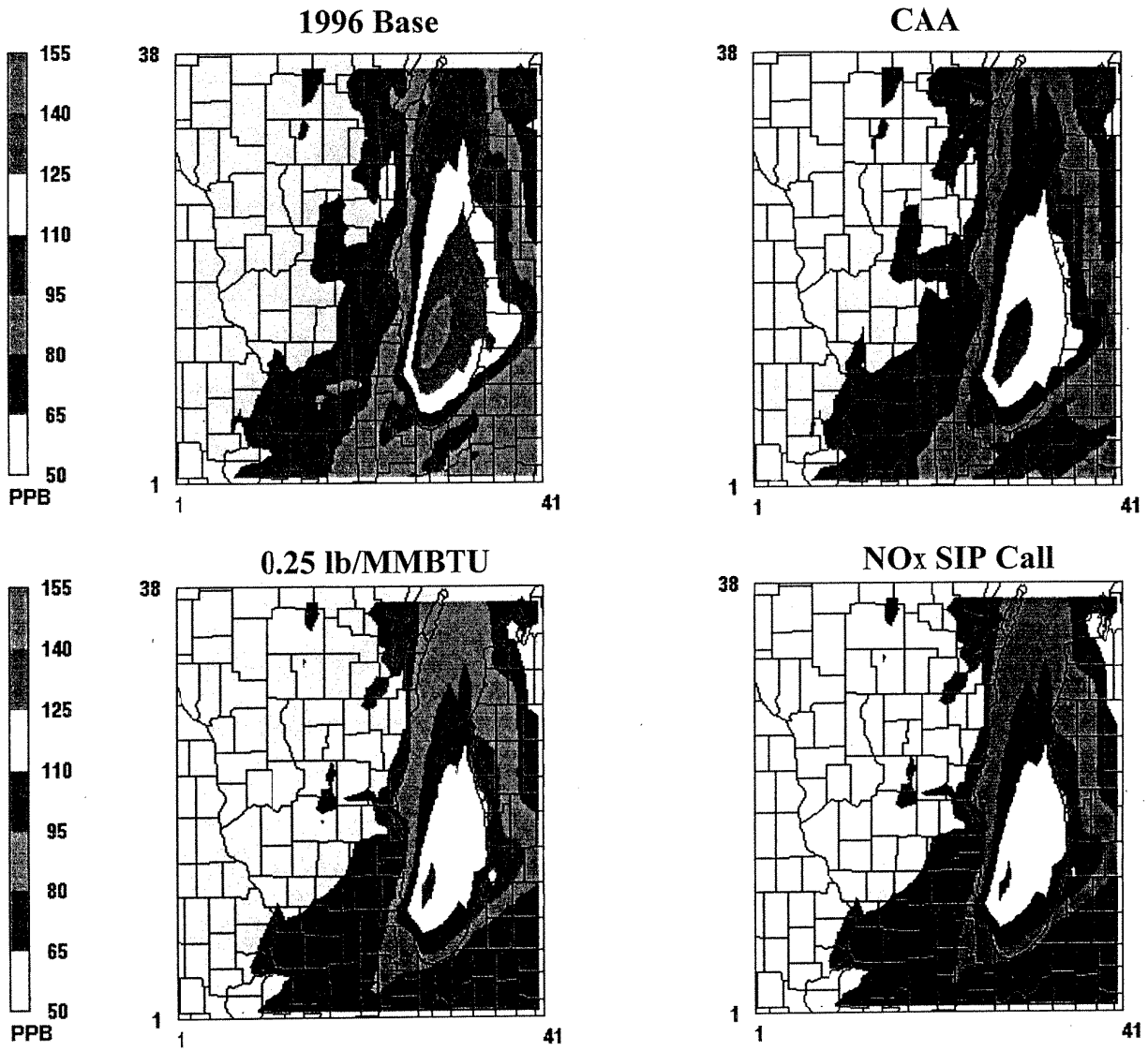


Figure 6
Peak 1-Hour Ozone Concentrations
July 18, 1991 - St. Louis Area

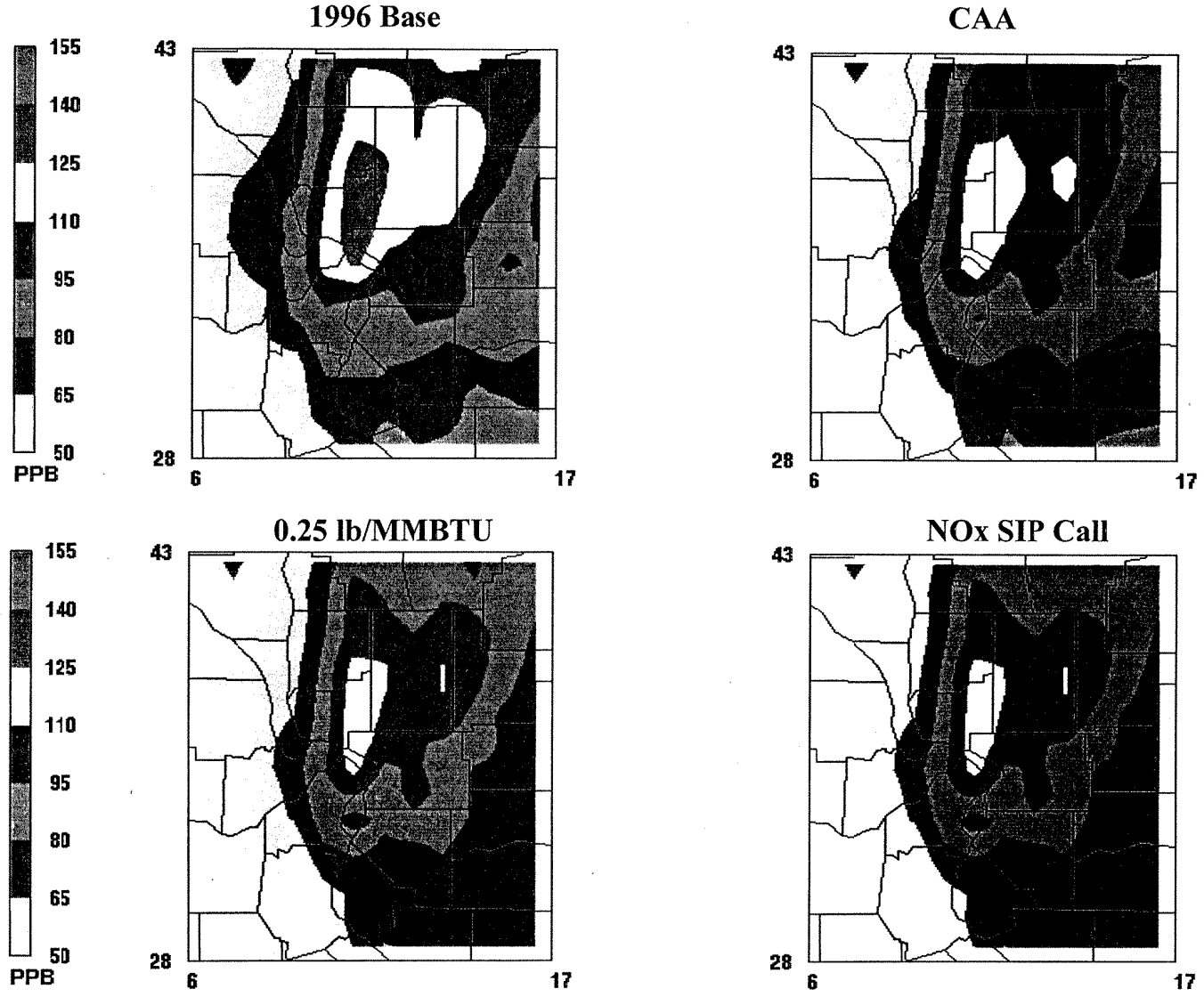


Figure 7
Attainment Strategy Modeling Results
Lake Michigan Region

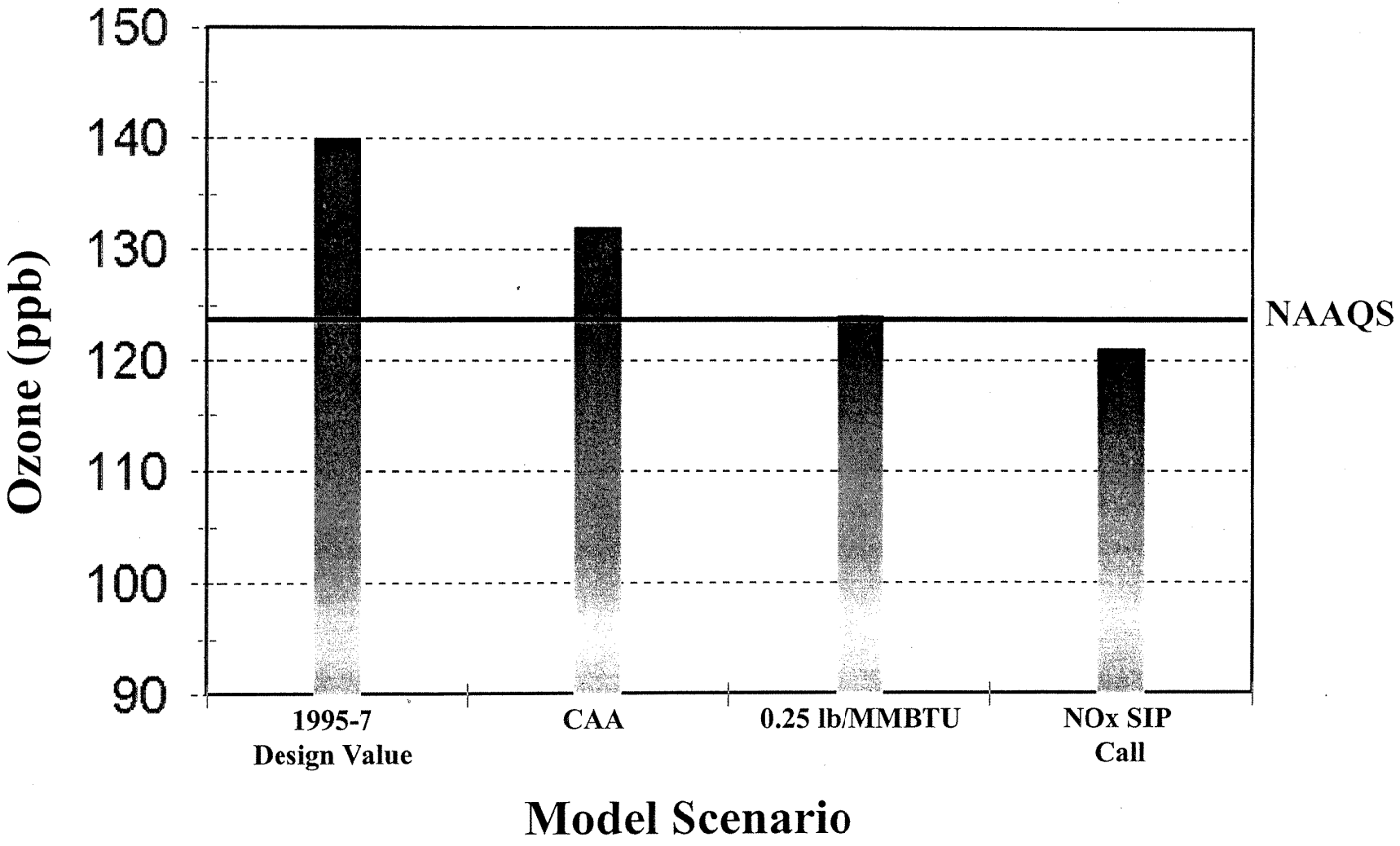
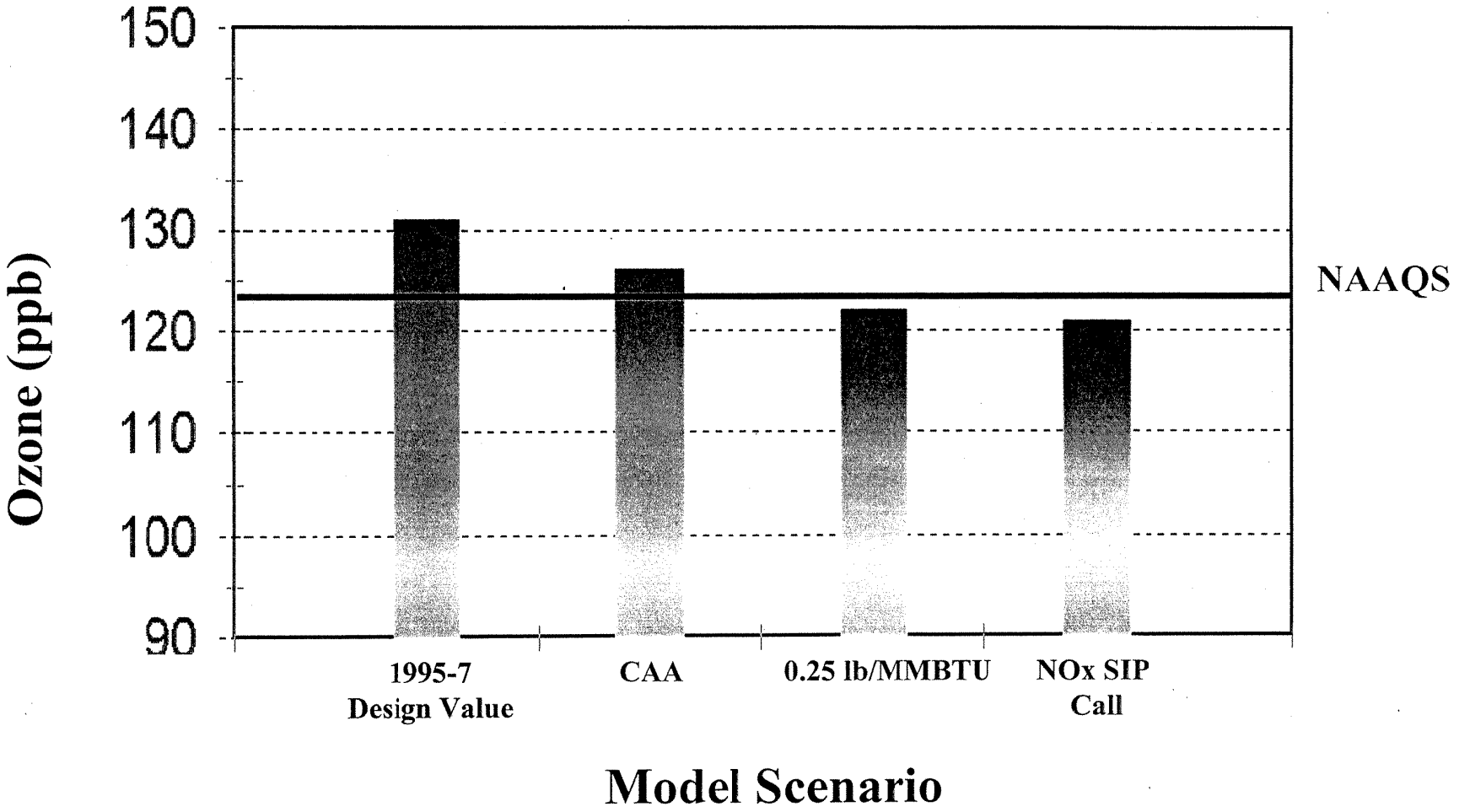


Figure 8
Attainment Strategy Modeling Results
St. Louis Area



STATE OF ILLINOIS)
) SS
COUNTY OF SANGAMON)

PROOF OF SERVICE

I, the undersigned, on oath state that I have served the attached TESTIMONY OF ROBERT KALEEL upon the person to whom it is directed, by sending a copy by facsimile to the (312) 814-3669 and by placing it with a courier for overnight delivery to the following:

TO: Dorothy Gunn, Clerk
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(Overnight Mail)

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Hearing Officer
Illinois Pollution Control Board
James R. Thompson Center
Suite 11-500
Chicago, Illinois 60601
(Overnight Mail)

SEE ATTACHED SERVICE LIST

from Springfield, Illinois on August 18, 2000.

Cynthia Sims

SUBSCRIBED AND SWORN TO BEFORE ME

This 18th day of August, 2000

Cynthia L. Wolfe
Notary Public

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NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES 3-30-2003

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