UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Emissions, Monitoring, and Analysis Division
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November 20, 2000

TECHNICAL MEMORANDUM

TO: EPA Air Docket A-99-06

FROM: Eric O. Ginsburg, Senior Program Advisor
Emissions Monitoring and Analysis Division, OAQPS

SUBJECT: Summary of Modeled Estimates of 1-hour Concentrations of Ozone for Selected Years

This memorandum summarizes the results of analyses of model-predicted air quality estimates of 1-hour ozone concentrations and the anticipated air quality impact of reductions in emissions expected to result from implementation of the heavy duty engine and vehicle standards and highway diesel fuel sulfur control requirements.

We performed regional modeling for 6 different scenarios (1996 base, 2007 base, 2020 base and control, 2030 base and control) separately for the eastern and western regions of the United States, using the variable-grid Urban Airshed Model (UAM-V) and the meteorological inputs simulated for the Tier 2 rulemaking. UAM-V is a photochemical grid model that numerically simulates the effects of emissions, advection, diffusion, chemistry, and surface removal processes on pollutant concentrations within a three-dimensional grid. Emissions inputs to the model are described in Procedures for Developing Base Year and Future Year Mass and Modeling Inventories for the Heavy-Duty Diesel (HDD) Rulemaking, October, 2000, which was placed in the docket for this rulemaking. Other than the emissions inventory inputs, this ozone modeling followed the same protocol as was used for the final RIA for the Tier 2 Gasoline Sulfur rulemaking applications in 1999. Using this modeling, we estimated the absolute concentrations of ozone in the modeling domain to identify those areas in which the model predicts one or more exceedances of the 1-hour ozone NAAQS for each of the relevant scenarios.

In our assessment of model performance, comparisons of base year model output data against ambient observations in the western U.S. indicated that the model was significantly underestimating (by 30-50 percent) the observed amounts of ozone. Given that model performance was degraded relative to both the performance of the model in the eastern U.S. (where biases were found to be within plus or minus 10 percent) and what is typically expected from such regional modeling applications, we determined that this application of the model should not be used in assessing future air quality or the impacts of the emissions control strategy in the west.

Table A provides a summary of absolute predicted results, based on U.S. Bureau of

Census county-based estimated population in 1999 (http://www.census.gov/population/estimates/metro-city/ma99-02.txt) and model-predicted 1-hour ozone concentrations for the 2007 base case (i.e., before the application of emission reductions to be achieved by the rule). Based on this table, a total of 22 areas which recorded violations of the standard in 1997-99 were predicted to have at least one exceedance of the standard in the 2007 base case. In addition, 15 areas which had 1997-99 air quality concentrations below the level of the standard, but within 10% of that level, were predicted to have at least one exceedance of the standard in the 2007 base case.

Table B provides a summary of absolute predicted results, based on U.S. Bureau of Census county-based estimated population in 1999 and model-predicted 1-hour ozone concentrations for the 2020 base case (i.e., before the application of emission reductions to be achieved by the rule). Based on this table, a total of 22 areas which recorded violations of the standard in 1997-99 were predicted to have at least one exceedance of the standard in the 2020 base case. In addition, 14 areas which had 1997-99 air quality concentrations below the level of the standard, but within 10% of that level, were predicted to have at least one exceedance of the standard in the 2020 base case.

Table C provides a summary of absolute predicted results, based on U.S. Bureau of Census county-based estimated population in 1999 and model-predicted 1-hour ozone concentrations for the 2020 control case (i.e., after the application of emission reductions to be achieved by the rule). Based on this table, a total of 21 areas which recorded violations of the standard in 1997-99 were predicted to have at least one exceedance of the standard in the 2020 control case. In addition, 11 areas which had 1997-99 air quality concentrations below the level of the standard, but within 10% of that level, were predicted to have at least one exceedance of the standard in the 2020 control case.

Table D provides a summary of absolute predicted results, based on U.S. Bureau of Census county-based estimated population in 1999 and model-predicted 1-hour ozone concentrations for the 2030 base case (i.e., before the application of emission reductions to be achieved by the rule). Based on this table, a total of 22 areas which recorded violations of the standard in 1997-99 were predicted to have at least one exceedance of the standard in the 2030 base case. In addition, 14 areas which had 1997-99 air quality concentrations below the level of the standard, but within 10% of that level, were predicted to have at least one exceedance of the standard in the 2030 base case.

Table E provides a summary of absolute predicted results, based on U.S. Bureau of Census county-based estimated population in 1999 and model-predicted 1-hour ozone concentrations for the 2030 control case (i.e., after the application of emission reductions to be achieved by the rule). Based on this table, a total of 21 areas which recorded violations of the standard in 1997-99 were predicted to have at least one exceedance of the standard in the 2030 control case. In addition, 12 areas which had 1997-99 air quality concentrations below the level of the standard, but within 10% of that level, were predicted to have at least one exceedance of the standard in the 2030 control case.

These analyses of future air quality are based on projected population growth and projected increases in emissions over time, taking into account federal controls currently in place or scheduled for implementation, such as Tier 2 standards on light-duty vehicles and 2004 standards on heavy duty vehicle. Additional reductions may be achieved by further actions taken at the Federal, State, or local level.

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Attachments

Table A
1-Hour O3 Current Air Quality and 2007 Base Modeled Exceedance Comparison

Table 1a: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data violating (i.e., average expected exceedances greater than or equal to 1.1) the 1-hour NAAQS AND which are predicted to have 'exceedances' in the 2007 Base Case on days which meet certain model performance criteria[1].

CMSAs/MSAs	2007 BaseCase	1999 Population (millions)
Birmingham, AL MSA	X	0.9
Boston, MA CMSA	X	5.9
Chicago, IL CMSA	X	8.9
Detroit, MI CMSA	X	5.5
Houston, TX CMSA	X	4.5
New York, NY CMSA	X	20.2
Philadelphia, PA CMSA	X	6.0
Atlanta, GA MSA	X	3.9
Washington-Baltimore, DC-MD-VA-WV CMSA	X	7.4
Baton Rouge, LA MSA	X	0.6
Beaumont, TX MSA	X	0.4
Hartford, CT MSA	X	1.1
Louisville, KY MSA	X	1.0
Memphis, TN MSA	X	1.1
New London, CT MSA	X	0.3
St. Louis, MO MSA	X	2.6

Table 1b: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data within 10% of the 1-hour NAAQS (0.113 ppm) AND which are predicted to have 'exceedances' in the 2007 Base Case on days which meet certain model performance criteria[1].

CMSAs/MSAs	2007 BaseCase	1999 Population (millions)
Barnstable, MA MSA[2]	X	0.2
Benton Harbor, MI MSA	X	0.2
Biloxi, MS MSA	X	0.4
Grand Rapids, MI MSA	X	1.1
Houma, LA MSA[2]	X	0.2
Lake Charles, LA MSA	X	0.2
New Orleans, LA MSA	X	1.3
Providence, RI MSA	X	1.1

Table 2a: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data violating (i.e., average expected exceedances greater than or equal to 1.1) the 1-hour NAAQS AND which are predicted to have 'exceedances' in the 2007 Base Case on days which do not meet certain model criteria[1].

CMSAs/MSAs	2007 Base Case	1999 Population (millions)
Charlotte, NC MSA	U	1.4
Huntington, WV MSA	U	0.3
Macon, GA MSA	U	0.3
Milwaukee, WI	U	1.6
Nashville, TN MSA	U	1.2
Richmond, VA MSA	U	1.0

Table 2b: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data within 10% of the 1-hour NAAQS (0.113 ppm) AND which are predicted to have 'exceedances' in the 2007 Base Case on days which do not meet certain model performance criteria[1].

CMSAs/MSAs	2007 Base Case	1999 Population (millions)
Cincinnati, OH CMSA	U	2.0
Cleveland, OH CMSA	U	2.9
Charleston, WV MSA	U	0.3
Norfolk, VA MSA	U	1.6
Pensacola, FL MSA	U	0.4
Orlando, FL MSA	U	1.5
Tampa-St. Petersburg, FL MSA	U	2.3

Notes:

1 Tables 1a and 1b include those areas with predicted exceedances on days which the accuracy of peak predictions is within 20 percent which is the range recommended in EPA's modeling guidance for urban scale ozone attainment demonstration. Model performance for areas in Tables 2a and 2b are outside of this range.

2 Only 2 of the years used in estimating the design value for this location are complete (>75% complete).

Table B

1-Hour O3 Current Air Quality and 2020 Base Modeled Exceedance Comparison

Table B1a: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data violating (i.e., average expected exceedances greater than or equal to 1.1) the 1-hour NAAQS AND which are predicted to have 'exceedances' in the 2020 Base Case on days which meet certain model performance criteria[1].

CMSAs/MSAs	2020 BaseCase	1999 Population (millions)
Boston, MA CMSA	X	5.9
Chicago, IL CMSA	X	8.9
Detroit, MI CMSA	X	5.5
Houston, TX CMSA	X	4.5
New York, NY CMSA	X	20.2
Philadelphia, PA CMSA	X	6.0
Atlanta, GA MSA	X	3.9
Washington-Baltimore, DC-MD-VA-WV CMSA	X	7.4
Baton Rouge, LA MSA	X	0.6
Beaumont, TX MSA	X	0.4
Milwaukee, WI	X	1.6
Hartford, CT MSA	X	1.1
Memphis, TN MSA	X	1.1
New London, CT MSA	X	0.3
St. Louis, MO MSA	X	2.6

Table B1b: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data within 10% of the 1-hour NAAQS (0.113 ppm) AND which are predicted to have 'exceedances' in the 2020 Base Case on days which meet certain model performance criteria[1].

CMSAs/MSAs	2020 BaseCase	1999 Population (millions)
Benton Harbor, MI MSA	X	0.2
Biloxi, MS MSA	X	0.4
Grand Rapids, MI MSA	X	1.1
Houma, LA MSA[2]	X	0.2
New Orleans, LA MSA	X	1.3
Providence, RI MSA	X	1.1

Table B2a: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data violating (i.e., average expected exceedances greater than or equal to 1.1) the 1-hour NAAQS AND which are predicted to have 'exceedances' in the 2020 Base Case on days which do not meet certain model criteria[1].

CMSAs/MSAs	2020 Base Case	1999 Population (millions)
Birmingham, AL MSA	U	0.9
Charlotte, NC MSA	U	1.4
Huntington, WV MSA	U	0.3
Louisville, KY MSA	U	1.0
Macon, GA MSA	U	0.3
Nashville, TN MSA	U	1.2
Richmond, VA MSA	U	1.0

Table B2b: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data within 10% of the 1-hour NAAQS (0.113 ppm) AND which are predicted to have 'exceedances' in the 2020 Base Case on days which do not meet certain model performance criteria[1].

CMSAs/MSAs	2020 Base Case	1999 Population (millions)
Cincinnati, OH CMSA	U	2.0
Cleveland, OH CMSA	U	2.9
Charleston, WV MSA	U	0.3
Lake Charles, LA MSA	U	0.2
Norfolk, VA MSA	U	1.6
Orlando, FL MSA	U	1.5
Tampa-St. Petersburg, FL MSA	U	2.3

Notes:

1 Tables 1a and 1b include those areas with predicted exceedances on days which the accuracy of peak predictions is within 20 percent which is the range recommended in EPA's modeling guidance for urban scale ozone attainment demonstration. Model performance for areas in Tables 2a and 2b are outside of this range.

2 Only 2 of the years used in estimating the design value for this location are complete (>75% complete).

Table C

1-Hour O3 Current Air Quality and 2020 Control Case Modeled Exceedance Comparison

Table C1a: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data violating (i.e., average expected exceedances greater than or equal to 1.1) the 1-hour NAAQS AND which are predicted to have 'exceedances' in the 2020 Control Case on days which meet certain model performance criteria[1].

CMSAs/MSAs	2020 Control Case	1999 Population (millions)
Boston, MA CMSA	X	5.9
Chicago, IL CMSA	X	8.9
Detroit, MI CMSA	X	5.5
Houston, TX CMSA	X	4.5
New York, NY CMSA	X	20.2
Philadelphia, PA CMSA	X	6.0
Atlanta, GA MSA	X	3.9
Washington-Baltimore, DC-MD-VA-WV CMSA	X	7.4
Baton Rouge, LA MSA	X	0.6
Beaumont, TX MSA	X	0.4
Hartford, CT MSA	X	1.1
Milwaukee, WI CMSA	X	1.6
Memphis, TN MSA	X	1.1
New London, CT MSA	X	0.3
St. Louis, MO MSA	X	2.6

Table C1b: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data within 10% of the 1-hour NAAQS (0.113 ppm) AND which are predicted to have 'exceedances' in the 2020 Control Case on days which meet certain model performance criteria[1].

CMSAs/MSAs	2020 Control Case	1999 Population (millions)
Grand Rapids, MI MSA	X	1.1
Houma, LA MSA[2]	X	0.2

Table C2a: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data violating (i.e., average expected exceedances greater than or equal to 1.1) the 1-hour NAAQS AND which are predicted to have 'exceedances' in the 2020 Control Case on days which do not meet certain model criteria[1].

CMSAs/MSAs	2020 Control Case	1999 Population (millions)
Birmingham, AL MSA	U	0.9
Charlotte, NC MSA	U	1.4
Huntington, WV MSA	U	0.3
Louisville, KY MSA	U	1.0
Nashville, TN MSA	U	1.2
Richmond, VA MSA	U	1.0

Table C2b: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data within 10% of the 1-hour NAAQS (0.113 ppm) AND which are predicted to have 'exceedances' in the 2020 Control Case on days which do not meet certain model performance criteria[1].

CMSAs/MSAs	2020 Control Case	1999 Population (millions)
Benton Harbor, MI MSA	U	0.2
Biloxi, MS MSA	U	0.4
Cincinnati, OH CMSA	U	2.0
Charleston, WV MSA	U	0.3
Cleveland, OH CMSA	U	2.9
New Orleans, LA MSA	U	1.3
Orlando, FL MSA	U	1.5
Providence, RI MSA	U	1.1
Tampa-St. Petersburg, FL MSA	U	2.3

Notes:

1 Tables 1a and 1b include those areas with predicted exceedances on days which the accuracy of peak predictions is within 20 percent which is the range recommended in EPA's modeling guidance for urban scale ozone attainment demonstration. Model performance for areas in Tables 2a and 2b are outside of this range.

2 Only 2 of the years used in estimating the design value for this location are complete (>75% complete).

Table D
1-Hour Ozone Current Air Quality and Modeled Exceedance Comparison

Table D1a: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data violating (i.e., average expected exceedances greater than or equal to 1.1) the 1-hour NAAQS AND which are predicted to have 'exceedances' in the 2030 Base Case on days which meet certain model performance criteria[1].

CMSAs/MSAs	2030 BaseCase	1999 Population (millions)
Boston, MA CMSA	X	5.9
Chicago, IL CMSA	X	8.9
Detroit, MI CMSA	X	5.5
Houston, TX CMSA	X	4.5
New York, NY CMSA	X	20.2
Philadelphia, PA CMSA	X	6.0
Atlanta, GA MSA	X	3.9
Washington, D.C.-Baltimore, MD MSA	X	7.4
Baton Rouge, LA MSA	X	0.6
Beaumont, TX MSA	X	0.4
Milwaukee, WI	X	1.6
Hartford, CT MSA	X	1.1
Louisville, KY MSA	X	1.0
Memphis, TN MSA	X	1.1
New London, CT MSA	X	0.3
St. Louis, MO MSA	X	2.6

Table D1b: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data within 10% of the 1-hour NAAQS (0.113 ppm) AND which are predicted to have 'exceedances' in the 2030 Base Case on days which meet certain model performance criteria[1].

CMSAs/MSAs	2030 BaseCase	1999 Population (millions)
Benton Harbor, MI MSA	X	0.2
Barnstable, MA MSA[2]	X	0.2
Biloxi, MS MSA	X	0.4
Grand Rapids, MI MSA	X	1.1
Houma, LA MSA[2]	X	0.2
Lake Charles, LA MSA	X	0.2
New Orleans, LA MSA	X	1.3
Providence, RI MSA	X	1.1

Table D2a: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data violating (i.e., average expected exceedances greater than or equal to 1.1) the 1-hour NAAQS AND which are predicted to have 'exceedances' in the 2030 Base Case on days which do not meet certain model criteria[1].

CMSAs/MSAs	2030 Base Case	1999 Population (millions)
Birmingham, AL MSA	U	0.9
Charlotte, NC MSA	U	1.4
Huntington, WV MSA	U	0.3
Macon, GA MSA	U	0.3
Nashville, TN MSA	U	1.2
Richmond, VA MSA	U	1.0

Table D2b: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data within 10% of the 1-hour NAAQS (0.113 ppm) AND which are predicted to have 'exceedances' in the 2030 Base Case on days which do not meet certain model performance criteria[1].

CMSAs/MSAs	2030 Base Case	1999 Population (millions)
Cincinnati, OH CMSA	U	2.0
Cleveland, OH CMSA	U	2.9
Charleston, WV MSA	U	0.3
Norfolk, VA MSA	U	1.6
Orlando, FL MSA	U	1.5
Tampa-St. Petersburg, FL MSA	U	2.3

Notes:

1 Tables 1a and 1b include those areas with predicted exceedances on days which the accuracy of peak predictions is within 20 percent which is the range recommended in EPA's modeling guidance for urban scale ozone attainment demonstration. Model performance for areas in Tables 2a and 2b are outside of this range.

2 Only 2 of the years used in estimating the design value for this location are complete (>75% complete).

Table E
1-Hour Ozone Current Air Quality and 2030 Control Case Modeled Exceedance Comparison

Table E1a: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data violating (i.e., average expected exceedances greater than or equal to 1.1) the 1-hour NAAQS AND which are predicted to have 'exceedances' in the 2030 Control Case on days which meet certain model performance criteria[1].

CMSAs/MSAs	2030 Control Case	1999 Population (millions)
Boston, MA CMSA	X	5.9
Chicago, IL CMSA	X	8.9
Detroit, MI CMSA	X	5.5
Houston, TX CMSA	X	4.5
New York, NY CMSA	X	20.2
Philadelphia, PA CMSA	X	6.0
Atlanta, GA MSA	X	3.9
Washington, D.C.-Baltimore, MD MSA	X	7.4
Baton Rouge, LA MSA	X	0.6
Beaumont, TX MSA	X	0.4
Hartford, CT MSA	X	1.1
Milwaukee, WI CMSA	X	1.6
Memphis, TN MSA	X	1.1
New London, CT MSA	X	0.3
St. Louis, MO MSA	X	2.6

Table E1b: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data within 10% of the 1-hour NAAQS (0.113 ppm) AND which are predicted to have 'exceedances' in the 2030 Control Case on days which meet certain model performance criteria[1].

CMSAs/MSAs	2030 Control Case	1999 Population (millions)
Biloxi, MS MSA	X	0.4
Grand Rapids, MI MSA	X	1.1
Houma, LA MSA[2]	X	0.2
New Orleans, LA MSA	X	1.3

Table E2a: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data violating (i.e., average expected exceedances greater than or equal to 1.1) the 1-hour NAAQS AND which are predicted to have 'exceedances' in the 2030 Control Case on days which do not meet certain model criteria[1].

CMSAs/MSAs	**2030 Control Case**	**1999 Population (millions)**
Birmingham, AL MSA	U	0.9
Charlotte, NC MSA	U	1.4
Huntington, WV MSA	U	0.3
Louisville, KY MSA	U	1.0
Nashville, TN MSA	U	1.2
Richmond, VA MSA	U	1.0

Table E2b: CMSAs/MSAs associated with areas (ozone nonattainment areas designated in 1991 and additional counties) which have 1997-1999 air quality data within 10% of the 1-hour NAAQS (0.113 ppm) AND which are predicted to have 'exceedances' in the 2030 Control Case on days which do not meet certain model performance criteria[1].

CMSAs/MSAs	**2030 Control Case**	**1999 Population (millions)**
Benton Harbor, MI MSA	U	0.2
Cincinnati, OH CMSA	U	2.0
Cleveland, OH CMSA	U	2.9
Lake Charles, LA MSA	U	0.2
Norfolk, VA MSA	U	1.6
Orlando, FL MSA	U	1.5
Providence, RI MSA	U	1.1

Notes:

1 Tables 1a and 1b include those areas with predicted exceedances on days which the accuracy of peak predictions is within 20 percent which is the range recommended in EPA's modeling guidance for urban scale ozone attainment demonstration. Model performance for areas in Tables 2a and 2b are outside of this range.

2 Only 2 of the years used in estimating the design value for this location are complete (>75% complete).