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Arthur N. Marin, Executive Director

May 30, 2013

George Bridgers
Air Quality Modeling Group
U.S. Environmental Protection Agency
Mailcode: C439-01
109 T.W. Alexander Drive
Research Triangle Park, NC 27709

Re: *Draft Guidance for $PM_{2.5}$ Permit Modeling*

Dear Mr. Bridgers:

The Northeast States for Coordinated Air Use Management (NESCAUM) offers the following comments on the *Draft Guidance for $PM_{2.5}$ Permit Modeling* ("Draft Guidance") that was released by the U.S. Environmental Protection Agency (EPA) for public review on March 4, 2013. NESCAUM is the regional association of air pollution control agencies representing Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.

NESCAUM thanks the EPA for its efforts in developing this Draft Guidance and encourages the EPA to release its Final Guidance at the earliest practicable date after incorporating stakeholder comments. NESCAUM also encourages the EPA to propose an amendment to the Guideline on Air Quality Modeling (40 CFR Part 51 Appendix W) referencing the Final Guidance to provide clear and consistent requirements for permitting authorities and applicants.

Introduction

Stationary sources that seek a Prevention of Significant Deterioration (PSD) permit must submit an application to the appropriate permitting authority. The application must demonstrate that violations of the national ambient air quality standards (NAAQS) for particulate matter with aerodynamic diameter less than 2.5 micrometers ($PM_{2.5}$) will not occur as a result of the construction and operation of the source. As such, state permitting authorities and permit modelers must have clarity about what is required to successfully demonstrate that $PM_{2.5}$ emissions for new projects will not pose health risks to surrounding areas.

The release of the Draft Guidance is a step toward fulfilling the EPA's pledge to supply states with additional recommendations for modeling analysis of $PM_{2.5}$ compliance demonstrations, especially with regard to secondary formation of $PM_{2.5}$, as described in the memorandum by Stephen Page dated March 23, 2010. The Draft Guidance also conforms with the EPA's commitment to evaluate updates to the EPA's *Guideline on Air Quality Models*, Appendix W of 40 CFR 51 to incorporate new analytical techniques or models for ozone and secondary $PM_{2.5}$ as

appropriate, consistent with the EPA's January 4, 2012 grant of a petition for rulemaking on behalf of the Sierra Club. The EPA solicited feedback on its development of the Draft Guidance at multiple public forums, including the EPA's 10th Modeling Conference in March 2012.

NESCAUM offers eight comments in response to the assessment methods described in the Draft Guidance, the process for selecting the assessment method, and the thresholds at which the methods are applicable. Our comments also address the modeling for $PM_{2.5}$ increments, as described in Section V of the Draft Guidance.

1. Revising Precursor Emission Thresholds in the Assessment Cases

Background: In its Draft Guidance, the EPA describes four "assessment cases" that define what air quality analyses (if any) an applicant would need to conduct to demonstrate compliance with the $PM_{2.5}$ NAAQS. These are outlined in Table II-1 on page 18 of the Draft Guidance, and describe the four scenarios in which direct emissions of $PM_{2.5}$ are above or below a Significant Emission Rate (SER) of 10 tons per year (tpy) and emissions of nitrogen oxides (NOx) or sulfur dioxide (SO_2) (which are precursors to secondary $PM_{2.5}$ formation) are above the SER of 40 tpy. Cases 3 and 4 describe the situation in which emissions of either NOx or SO_2 precursor species are above the SER of 40 tpy.

Comment: Based on photochemical modeling experience within the NESCAUM states, the near-source secondary $PM_{2.5}$ impacts from sources with limited $PM_{2.5}$ precursor emissions (e.g., 100 tpy or less) is very low. NESCAUM recommends that the EPA perform photochemical modeling to develop emissions thresholds that more accurately reflect the emission levels at which precursor emissions may be important for near-source impacts. NESCAUM further encourages the EPA to work with the states to develop state-specific or region-specific analyses that will indicate the importance of local conditions to the formation of secondary $PM_{2.5}$ and possibly set state- or region-specific thresholds based on these analyses.

2. Section III.2.1 Qualitative Assessment

Background: The first approach for assessing the impacts of precursor emissions on secondary $PM_{2.5}$ formation that the EPA suggests in its Draft Guidance is a qualitative analysis. Section III.2.1 of the Draft Guidance provides information about the qualitative assessment process, both when it is to be selected and how it is to be performed.

In introducing the qualitative assessment, the EPA states the following:

> In a number of NAAQS compliance demonstrations requiring an assessment of the impact from secondary $PM_{2.5}$ formation, it is anticipated that a holistic qualitative analysis of the new or modifying emissions source and the atmospheric environment in which the emissions source is to be located will suffice for determining that secondary $PM_{2.5}$ impacts associated with the source's precursor emissions will not cause or contribute to a violation of the 24-hour or annual $PM_{2.5}$ NAAQS (p.25, lines 13-18).

The EPA indicates that a modeling protocol should include a detailed conceptual description of the background air pollution concentrations and of the nature of the emissions sources surrounding the new or modifying emissions source. The conceptual description is to be comprised of the following types of information:

- current $PM_{2.5}$ concentrations in the surrounding region;
- current NAAQS-form relevant design values for $PM_{2.5}$;
- seasonality in $PM_{2.5}$ concentrations;
- speciated composition of current $PM_{2.5}$ levels;
- long term trends;
- background concentrations of precursor species, including ammonia, volatile organic compounds (VOCs), and ozone;
- mitigating factors such as low ammonia levels that could limit secondary formation;
- regionally representative meteorological conditions associated with time periods of higher and lower ambient 24-hour average $PM_{2.5}$ concentrations, including temperature inversions, stagnant high pressure systems, etc.;
- a description of how any meteorological factors could limit or enhance the formation of secondary $PM_{2.5}$ from precursor emissions; and
- an analysis of existing photochemical grid modeling in the context of understanding the general response of secondary $PM_{2.5}$ formation to significant changes in regional precursor emissions.

Finally, the qualitative assessment described in the Draft Guidance also includes a narrative description of how the secondary $PM_{2.5}$ formation resulting from precursor emissions could contribute to existing regional $PM_{2.5}$ levels.

Comment: Based on the range of scenarios in which this guidance will be applied, NESCAUM requests that the EPA consider the qualitative assessment as one option that may be applied in a weight-of-evidence type of analysis. For areas in which a qualitative analysis will suffice, results from the assessment technique presented in the EPA's Draft Guidance may offer meaningful insight about the proposed source.

If finalized, this qualitative approach would become an initial approach selected for demonstration that significant precursor emissions would not lead to violations of the $PM_{2.5}$ NAAQS. While NESCAUM supports having a qualitative assessment as one option for a weight-of-evidence type of analysis, NESCAUM raises the following two concerns about the EPA's proposal:

(1) **There is no clear threshold for passing the qualitative analysis.** Rather, the approval or denial of the permit application hinges on the professional judgment of its reviewer. While we have great confidence in the competence of permit review officials, relying on

their professional judgment does not lead to a clear, reliably reproducible outcome for the permit review process, and may lead to significant differences in permit application processes in different regions.

(2) **The process is open to potential for abuse.** Because the qualitative assessment is open to interpretation, it provides an opportunity for unintentional or intentional misinterpretation of the facts.

As such, NESCAUM requests that the EPA develop clear guidelines describing when the qualitative assessment is appropriate, or when other, numerical approaches may be warranted to support a weight-of-evidence approach. NESCAUM requests that the EPA develop an optional numerical approach to be used in place of or in addition to the described qualitative approach when necessary to complete a weight-of-evidence approach. Comment 3 of this document describes NESCAUM's suggestion for such a conservative, numerical, screening assessment for use in a weight-of-evidence approach.

By proposing this qualitative assessment approach and indicating that the EPA expects that this approach will suffice for most sources, the EPA appears to be indicating that near-source secondary formation is not important. If it is the opinion of the EPA that near-source secondary $PM_{2.5}$ formation is not important, the EPA should state that.

3. Optional Numerical Screening Approach

Comment: Based on the discussion in Comment 2 above, NESCAUM is suggesting a numerical approach as an option for supporting a weight-of-evidence analysis.

The weight-of-evidence approach for the evaluation of secondary formation of $PM_{2.5}$ should include the option of using worst-case SO_2 to sulfate and nitrogen dioxide (NO_2) to nitrate conversion rates. One set of worst-case conversion values could be designated for modeling 24-hour $PM_{2.5}$ impacts and another for annual $PM_{2.5}$ modeling. Use of these worst-case conversion factors would be limited to all receptors in the near-field for determination of significant impact levels (SILs) and PSD increment/NAAQS compliance, but not long-range transport modeling (greater than 50 km).

Based on our initial review of available literature, a 9 percent per hour conversion rate represents a typical worst-case short-term conversion rate of SO_2 to sulfate (summertime mid- to late afternoon); and 8 percent represents a typical worst-case short-term conversion rate of NO_2 to nitrate (daytime winter).[1]

[1] *See* Luria M, Imhoff RE, Valente RJ, Parkhurst WJ, Tanner RL, "Rates of Conversion of Sulfur Dioxide to Sulfate in a Scrubbed Power Plant Plume," *Journal of the Air & Waste Management Association*, 51 (2001), 1408-1413; Conners J, Heinold D, Paine R, Moore G, "Screening Approach to Account for Secondary $PM_{2.5}$ in Stationary Source Modeling," (paper presented at the Guideline on Air Quality Models: The Path Forward, Air & Waste Management Association meeting, Raleigh, North Carolina, March 2013); Eatough DJ, Caka FM, Farber RJ, "The

Because the $PM_{2.5}$ impact will be modeled for a 24-hour period rather than a one-hour period, the one-hour worst-case conversion rates listed above can be reduced to reflect the lower conversion rates that occur the remainder of the 24-hour period. Use of a 7 percent per hour SO_2 to sulfate conversion rate and a 5 percent per hour NO_2 to nitrate conversion rate would still represent very conservative assumptions when modeling the contribution of secondary particulates to the 24-hour $PM_{2.5}$ concentration.

From these short-term conversion rates, annual average worst-case per-hour conversion rates can be derived. Three percent per hour represents a reasonable worst-case **annual** conversion rate of SO_2 to sulfate, and 2.5 percent per hour represents a reasonable worst-case **annual** conversion rate of NO_2 to nitrate.

The simplest method of incorporating these conversion rates into the modeling would be to multiply the designated worst-case conversion rates by the hourly and annual emission rates of SO_2 and NOx in units of pounds per hour or tons per year, respectively.

These worst case secondary $PM_{2.5}$ formation values must be adjusted further before combining with the direct $PM_{2.5}$ emission rate.

- Apply the ambient ratio method (ARM) Tier 2 nitric oxide (NO) to NO_2 conversion rate to the NOx emission rate. For the 24-hour $PM_{2.5}$ modeling, the NOx hourly emission rate (pounds per hour) should be multiplied by 0.8. For the annual $PM_{2.5}$ modeling, the NOx annual emission rate (tons per year) should be multiplied by 0.75.

- Because SO_2 and NO_2 will be transformed in the atmosphere to heavier molecules, the SO_2 and NO_2 mass emission rate must be adjusted to reflect the molecular weight (MW) of ammonium sulfate $(NH_4)_2SO_4$ and ammonium nitrate NH_4NO_3. The calculation of the adjustment factors are presented below.

$$(NH_4)_2SO_4 \text{ (lb/hr)} = SO_2 \text{ (lb/hr)} \cdot (MW_{(NH_4)_2SO_4}/MW_{SO_2})$$

$$(NH_4)_2SO_4 \text{ (lb/hr)} = SO_2 \text{ (lb/hr)} \cdot (132/64)$$

$$(NH_4)_2SO_4 \text{ (lb/hr)} = SO_2 \text{ (lb/hr)} \cdot 2.06$$

$$NH_4NO_3 \text{ (lb/hr)} = NO_2 \text{ (lb/hr)} \cdot (MW_{NH_4NO_3}/MW_{NO_2})$$

$$NH_4NO_3 \text{ (lb/hr)} = NO_2 \text{ (lb/hr)} \cdot (80/46)$$

$$NH_4NO_3 \text{ (lb/hr)} = NO_2 \text{ (lb/hr)} \cdot 1.74$$

Conversion of SO_2 to Sulfate in the Atmosphere," *Israel Journal of Chemistry*, 34 (1994), 301-314; Zak BD, "Lagrangian Measurements of Sulfur Dioxide to Sulfate Conversion Rates," *Atmospheric Environment*, 15 (1981), No. 12, 2583-2591.

For example, if a source had 100 tpy (22.8 lb/hr) of both SO_2 and NOx, the calculation would be as follows:

$$\text{Secondary } PM_{2.5} \text{ from } SO_2 = 22.8 \text{ lb } PM_{2.5}/\text{hr} \cdot 0.07 \cdot 2.06 = 3.3 \text{ lb/hr}$$

$$\text{Secondary } PM_{2.5} \text{ from } SO_2 = 100 \text{ tons } PM_{2.5}/\text{yr} \cdot 0.03 \cdot 2.06 = 6.2 \text{ tons/yr}$$

$$\text{Secondary } PM_{2.5} \text{ from } NO_X = 22.8 \text{ lb } PM_{2.5}/\text{hr} \cdot 0.05 \cdot 0.8 \cdot 1.74 = 1.6 \text{ lb/hr}$$

$$\text{Secondary } PM_{2.5} \text{ from } NO_X = 100 \text{ tons } PM_{2.5}/\text{yr} \cdot 0.025 \cdot 0.75 \cdot 1.74 = 3.3 \text{ tons/yr}$$

Therefore, the direct $PM_{2.5}$ emission rate would be increased by 4.9 lb/hr (3.3 lb/hr + 1.6 lb/hr) when modeling 24-hour $PM_{2.5}$ impacts. The direct $PM_{2.5}$ emission rate would be increased by 9.5 tpy (2.2 lb/hr) when modeling annual $PM_{2.5}$ impacts.

Possible refinements to this screening assessment would be to designate SO_2 and NO_2 conversion rates by region of the country (Northeast, South, Midwest, and West) and/or by season, and/or by daytime and night.

We believe adding this method as an option in support of a top-level weight-of-evidence assessment would provide a conservative, definitive, and defensible value of the estimated contribution of secondary particulates. Many sources, especially the smaller sources of SO_2 and NOx, would be able to apply this method and show no adverse $PM_{2.5}$ impact.

4. Appendix C: Example of a Qualitative Assessment of the Potential for Secondary $PM_{2.5}$ Formation

Background: In Appendix C of the Draft Guidance, the EPA provides an example of a qualitative assessment of the potential for secondary $PM_{2.5}$ formation. Unfortunately, this example is for an oil and gas exploration drill ship and support fleet over open water on the Chukchi Sea in the Arctic Ocean, a source type and a location environment having little in common with the continental United States.

Comment: NESCAUM requests additional examples of the qualitative assessment for urban and rural areas in the eastern and western continental United States.

5. Clarity Needed in Selecting the Required Assessment Type

Background: The hybrid qualitative/quantitative assessment (described in section III.2.2 of the Draft Guidance) is intended by the EPA to provide further information when the proposed qualitative assessment will not suffice. When introducing the topic, the EPA states that "it may not always be possible to provide such a justification [based on the proposed qualitative assessment] without some quantification of the potential secondary $PM_{2.5}$ impacts from the proposed new or modifying source's precursor emissions" (page 29, lines 16-18). However, there is no discussion indicating when such a situation would occur.

Comment: NESCAUM requests that the Final Guidance clearly indicate what the thresholds for passing the top-tier and mid-tier analyses are. Without a clear, reproducible methodology for decisions regarding permit modeling demonstrations for secondary $PM_{2.5}$, the states may be vulnerable to lawsuit by permit applicants and third-parties.

6. Section III.2.3 Full Quantitative Photochemical Grid Modeling

Comment: There will be significant logistical and technical difficulties in any attempts to adapt the regional photochemical grid models to individual source permit applications. The use of such models for performing regional ozone and $PM_{2.5}$ state implementation plan (SIP) modeling is not readily transferable to PSD permit scale modeling without a significant set of revisions to the process and platforms used for the SIP-level modeling. Based on the NESCAUM states' expertise in performing such assessments using CMAQ and CAMx, there are several technical issues that make the application of these modeling systems to PSD permitting challenging.

- Sub-models within photochemical grid, meteorological, and emissions modeling systems require very intensive data processing. For example, in simulating the chemical interactions and transformations of precursors to secondary $PM_{2.5}$, it is essential to include an inventory of significant sources, not just the source under scrutiny. Further, most models included in the regional modeling platforms require significant computer and operating system resources that states typically reserve for SIP attainment modeling but more intensive than what most state permitting staff typically use for assessment of individual sources.
- Inventories currently in use for SIP level modeling may not be appropriate for permit modeling due to the inventory "age"—the 2007 inventory is currently the generally accepted base year for analysis—and the fact that these inventories have not been fully scrutinized or evaluated for use in $PM_{2.5}$ evaluations—they were developed primarily for ozone planning. Evidence from some evaluations that have been performed[2] indicates that CMAQ generally overpredicts $PM_{2.5}$ concentrations. Additional work is necessary to fully diagnose and resolve these issues. One such evaluation by New York indicates that CMAQ overestimates $PM_{2.5}$ concentrations and certain species. Further work is necessary to understand the reasons. Thus, more detailed, longer-term evaluations must be carried out, and not just "sample period" evaluations.
- Meteorological data for input into the CMAQ and CAMx systems require detailed processing and may not accurately reflect the small scale weather conditions in the near-field of the emissions source. Such processing has been confined in the past to a sample period or at most a season (e.g., ozone season). Any extension of the modeling to a set of years of meteorological data will involve a large effort not only in the processing, but in revisiting the scale of the grids used. Most of the SIP modeling for the NESCAUM region to date has relied upon, at best, a 12 km scale grid, which is occasionally overlaid with a nested 4 km grid in the areas of interest. In some instances, such as complex

[2] *See* NYSDEC 2012. Preliminary Evaluation of the 2007 CMAQ Level 3 12 km base case: $PM_{2.5}$ Mass and Speciation. NYSDEC document prepared for OTC discussions, dated December, 2012.

> terrain setting, this latter grid might not be adequate either and a further refinement would be necessary. This added effort points to the need to start with a revised modeling platform, which will be resource-intensive. To run the WRF meteorological processing for one year's worth of data at the more refined grid scale would take about two months of runtime alone and will demand the same level of computational resources for generating the concentration fields.

All this work assumes that permitting staff at the state agencies and the EPA regional offices have the expertise and resources to review and/or perform independent verification of the photochemical model applications. Such expertise and the large computer resources (e.g., server clusters) at the states and regional offices are usually reserved for SIP level ozone modeling. The development of a comprehensive platform for $PM_{2.5}$ CMAQ modeling purposes has been estimated to exceed a million dollars in resources.

NESCAUM is concerned that state staff charged with evaluating permit applications may not have the capacity to review in detail the permit applications that contain results from photochemical grid models such as CMAQ and CAMx. Most permit modeling staff are very familiar with the dispersion modeling systems AERMOD and CALPUFF, and are very comfortable with reviewing permit modeling exercises that involve the use of those models. Expanding the use of CMAQ and/or CAMx to permit modeling will place a heavy burden on permit modeling staff, and may potentially result in inadequate review of permit applications that include results derived from photochemical modeling. Furthermore, photochemical grid modeling would require heavy financial investments from permit applicants and regulated sources.

Recommendations in the EPA's Guidance for performing photochemical grid modeling using CMAQ and CAMx must take these technical, logistical, and resource constraints into account.

NESCAUM suggests that the EPA support regional efforts to develop region-specific base inventories to serve as a basis for source-specific photochemical modeling analyses. This approach is a practical one for incorporating the contribution of secondary $PM_{2.5}$ from individual point sources in the permitting process when such detailed assessment is warranted. This approach will also allow the determination of the emission rates of the precursors that could trigger impacts over levels of significance as well as the downwind distances from a proposed source at which secondary formation becomes important enough for consideration of permitting conditions. Pending the availability of the results from this modeling platform, the agencies should be allowed to rely on less complex numerical approaches for the assessment of the secondary $PM_{2.5}$ contributions to total $PM_{2.5}$ impacts in permit application reviews, as described in Comments 3 and 7 in this document.

In summary, NESCAUM requests that the EPA limit the use of photochemical modeling to only the most in-depth analyses, exclude it from the hybrid modeling approach entirely, and encourage and facilitate the development of regional-level modeling efforts to serve as a basis for source-specific evaluations.

7. Use of the CALPUFF Model

Background: In the past, the EPA has approved of state personnel using the CALPUFF system at greater distances at which secondary pollutant formation becomes significant. In comparison to CMAQ, CALPUFF is designed for runtime efficiency in single source modeling. In addition, it will properly simulate interactive source modeling for PSD analysis. In modeling secondary $PM_{2.5}$ formation at greater distances, multiple years of analysis will be essential because inter-annual variability is more significant at these distances. It will be much more time and resource-effective to rely on CALPUFF than CMAQ for this purpose.

Comment: The Hybrid Qualitative/Quantitative Assessment should include a less subjective option than the proposed mix of the simplistic qualitative assessment and the use of the results from the highly complex regional photochemical SIP models. Somewhere within the final tiered modeling options that the EPA recommends in the Final Guidance should be a method of quantifying impacts of secondary $PM_{2.5}$ that is short of reliance on a photochemical model, but properly simulates the transport scenario and chemistry for PSD/interactive source modeling. This method should be valid beyond 50 km since secondary $PM_{2.5}$ formation can become significant at greater distances. A viable objective assessment of less complexity than using a photochemical grid model (e.g., CMAQ) would be the CALPUFF model, version 6.42, with the new ISORROPIA (version 2.1) chemistry algorithm for the source in question. The chemistry algorithm in CALPUFF version 6.42 has been found to be both more accurate and superior to that in the EPA's currently approved version of CALPUFF version 5.8.[3]

Another advantage of adopting CALPUFF version 6.42 as an option for estimating secondary $PM_{2.5}$ is that it would also improve model estimates of Class I Air Quality Related Values impacts and Class I increment consumption.

NESCAUM suggests that the EPA investigate the possible use of CALPUFF in single source mode (i.e., modeling the proposed source only) versus multiple source mode to determine the simplest creditable methods for evaluation of secondary particulate formation at greater distances when necessary. In addition, NESCAUM recommends that the EPA compare the results from CALPUFF and CMAQ analyses for the development of a hierarchy of viable modeling methods when screening methods fail.

8. Clarification of PSD Baseline Dates for Areas Redesignated to Attainment

Background: This section discusses the modeling of the $PM_{2.5}$ increments and the three important dates for setting the baseline: major source baseline date, trigger date, and the minor source baseline date. The 2010 PSD $PM_{2.5}$ Final Rule specified that the major source baseline date will be October 20, 2010 and the trigger date will be October 20, 2011.

[3] *See* Scire JS, Strimaitis DG, Wu Z-X, "New Developments and Evaluations of the CALPUFF Model," presented at the 10th Conference of Air Quality Models, RTP, North Carolina, March 2012; Karamchandani P, Chen S-Y, Balmori R, "Evaluation of Original and Improved Versions of CALPUFF Using the 1995 SWWYTAF Data Base, AER Technical Report," prepared for API, Washington, DC, October 2009.

Comment: Some areas in the NESCAUM region were designated nonattainment for $PM_{2.5}$ when the major source baseline date (October 20, 2010) and the trigger date (October 20, 2011) occurred, but have since been redesignated to attainment for $PM_{2.5}$ after these dates. The Final Guidance should address the timeline for areas that were redesignated to nonattainment for $PM_{2.5}$ after the baseline and trigger dates discussed above.

Summary

The NESCAUM states will be implementing their programs with input from the EPA Guidance, and therefore we have a significant stake in ensuring that the Final Guidance reflects the best practices for permit modeling for $PM_{2.5}$. We look forward to working with the EPA so that the Final Guidance incorporates these practical ideas to streamline and improve the process of modeling in support of the permitting process to address secondary $PM_{2.5}$.

If you or your staff have any questions regarding the issues raised in these comments, please contact Leiran Biton of NESCAUM at 617-259-2027.

Sincerely,

Arthur N. Marin
Executive Director

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