PM$_{2.5}$ Modeling – What can I do to get a permit?

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Modeling Projects – the good, old days

• Perform project-specific Significant Impact Level (SIL) analyses
  – If modeled concentrations less than the SIL at all receptors, modeling complete (1st SIL test)

• If more than the SIL, perform cumulative analyses using monitored background and nearby sources
  – If modeled concentrations less than the NAAQS/increment at all receptors, modeling complete
Modeling Projects (cont.)

- If modeled concentrations more than the NAAQS/increment, use “cause or contribute” test at each “problem” location / time (2nd SIL test)

- If less than the SIL, then modeling complete
  - Otherwise, iterations begin to reduce project or external predicted impacts
New PM$_{2.5}$ SIL Treatment

- Difference Between NAAQS and Measured Background Greater Than SIL?
  - Y: Significant Impact Analysis
    - Source Impact Above SIL?
      - N: Satisfies AQ Impact Analysis
      - Y: Cumulative Impact Analysis
        - Projected NAAQS Violations?
          - N: Satisfies AQ Impact Analysis
          - Y: Contributions Above SIL at Projected Violations?
            - N: Satisfies AQ Impact Analysis
Difference between the old and the new

- The new test does not allow the use of the EPA SIL when the background concentration is “too close” to the NAAQS
  - For example, the annual PM$_{2.5}$ SIL is 0.3 $\mu$g/m$^3$
  - If the background concentration is 11.7 $\mu$g/m$^3$ or greater, then you can’t use the 1$^{st}$ SIL test and must go straight to the cumulative impact analyses
- More effort and delays for your project
Regulatory / Legal Background

- **July 18, 1997** – PM$_{2.5}$ 24-hour and Annual National Ambient Air Quality Standards Issued

- **January 22, 2013** – US District of Columbia Court of Appeals vacated EPA’s PM$_{2.5}$ SIL and SMC rulemaking

- **March 4, 2013** – EPA issues draft guidance for PM$_{2.5}$ Permit Modeling
Questions to be answered (1 of 3)

• Will my facility be required to conduct a year of PM$_{2.5}$ air quality monitoring before I can get a permit?

• Is modeling required for both primary and secondary PM$_{2.5}$ emissions?

• What are the possible alternatives for consideration of secondary PM$_{2.5}$ formation?
• Can I still model only the project emissions after the January 22, 2013, U.S. Court of Appeals decision that vacated portions of the Significant Impact Level language for PM$_{2.5}$?

• How do I incorporate background concentrations as part of the mix of modeling and other analyses?
Questions to be answered (3 of 3)

• Is there ANY way out of this modeling maze that will allow me to get an air permit when my project triggers modeling for PM$_{2.5}$?
Will my facility have to conduct pre-construction PM$_{2.5}$ monitoring?

• **Maybe**, but it is more likely now to perform a full year of pre-construction monitoring for Prevention of Significant Deterioration (PSD) projects

• EPA’s current response to the Court vacatur of the SMC is to encourage use of existing monitoring data by state agencies to fulfill the requirement for pre-construction monitoring
  – This has drawbacks due to the potential inclusion of high background concentrations from NAAQS compliance monitors (see next presentation)
### Table ES-1. EPA Recommended Approaches for Assessing Primary and Secondary PM2.5 Impacts by Assessment Case

<table>
<thead>
<tr>
<th>Assessment Case</th>
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<th>Primary Impacts Approach</th>
<th>Secondary Impacts Approach</th>
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| Case 3: Primary and Secondary Air Quality Impacts | Direct PM2.5 emissions ≥ 10 tpy SER NOx and/or SO2 emissions ≥ 40 tpy SER                  | AERMOD                   | • Qualitative  
• Hybrid qualitative / quantitative  
• Full quantitative photochemical grid modeling |
| Case 4: Secondary Air Quality Impacts Only | Direct PM2.5 emissions < 10 tpy SER NOx and/or SO2 emissions ≥ 40 tpy SER                        | N/A                      | • Qualitative  
• Hybrid qualitative / quantitative  
• Full quantitative photochemical grid modeling |
So, is modeling required for both primary and secondary PM$_{2.5}$ emissions?

- Depending on the case, the answer is either maybe or no
  - Case 1 – no modeling required
  - Case 2 – AERMOD modeling for primary emissions only (no secondary)
  - Cases 3 and 4 – maybe, the EPA guidance suggests an approach for secondary PM$_{2.5}$ using qualitative analysis that is labor intensive
  - Offset ratio in Minnesota
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What are the alternatives for secondary PM$_{2.5}$ analyses?

- **Qualitative**
  - Development of a nonattainment-style modeling protocol
    - Conceptual model including meteorological conditions, seasonality and speciation of concentration data
  - Positive result is a demonstration that increases in SO$_2$/NO$_x$ emissions will not cause increase in PM$_{2.5}$ concentrations
    - Drawback – no guarantee of successful demonstration
  - No formal analyses just review of existing data (if available) and write-up
    - Drawback – the write-up guidelines for each analysis appear to be directly analogous with the SIP guidelines; think months of effort
What are the alternatives for secondary PM$_{2.5}$ analyses?

- **Hybrid Qualitative / Quantitative**
  - The use of existing modeling photochemical modeling information to provide additional data that would support qualitative effort
  - Only acceptable in areas with current PM$_{2.5}$ modeling information
  - MPCA developed a shortcut modeling approach in 2011 called the offset ratio that “conservatively estimates the conversion of SO$_2$/NO$_x$ to PM$_{2.5}$”
    - Ratios are conservative
    - Mandate the use of the AERMOD modeling system for consideration of secondary pollutant impacts
    - Modeling still includes background
Offset Ratio

• Current MPCA practice is to require modeling of secondary PM$_{2.5}$ using the offset ratio
  - Total equivalent primary PM$_{2.5}$ emissions =
    - Direct PM$_{2.5}$ emissions + SO$_2$ emissions / 10 +
    - NO$_X$ emissions / 100

• Use this if your project can pass the modeling analysis, but will likely overestimate secondary impacts due to the conservative nature of the analysis used to develop the ratios
What are the alternatives for secondary PM\textsubscript{2.5} analyses?

- Full Quantitative Photochemical Grid Modeling
  - Requires the use of an existing state, regional, national modeling platform to begin (i.e. large domains)
  - Modeling is complex and requires a great deal of computing resource and experience to execute
  - Could be used to account for both primary and secondary emissions (full reaction chemistry)
  - More “flexibility” to determine impacts (SIL and NAAQS/increment)
Photochemical Grid Model Output (Ozone)

**Attainment Demonstration**

*July 1995 Meteorology*
*2003 Controlled Emissions*

**Ozone Difference**

*New NOx Sensitivity - Attainment Demonstration*
*July 1995 Episode (Post-Control)*
Am I able to model only project emissions after the vacatur?

• Depends on your specific project circumstances, but probably
  – However, be aware of:
    • responses to the vacatur from EPA as part of any revised modeling guidance
    • potential additional legal action on SIL / “cause or contribute”

• The tendency appears to be moving away from project only analysis, toward cumulative analysis
How do I incorporate background data as part of the modeling?

- EPA has stated that background monitoring be used to account for secondary PM$_{2.5}$ impacts from external sources and more distant primary PM$_{2.5}$ emission sources (i.e. not modeled sources).

- Also, EPA suggests using the variability of PM$_{2.5}$ concentrations (e.g. monthly/seasonal) for the 24-hour standard along with consideration of “double-counting of the impacts from modeled emission” sources.
Is there ANY way out of this modeling maze that will allow me to get a permit?

- **Yes**, there are many ways out of the maze:
  - Less than SIL modeling (remember the Court decision)
  - Cumulative NAAQS modeling less than the standard (elevated or non-existent background)
    - Remember to consider primary and secondary emissions, if applicable
  - Compliant increment modeling
    - EPA’s increment modeling paradigm is still “under development”
Future EPA Plans (hot off the press)

• July 31, 2013 was EPA’s planned date for “non-draft” PM$_{2.5}$ Permit Modeling guidance (now January 2014)
  – Government shutdown
  – Significant number of comments on the draft
  – Not many substantive changes from the draft guidance, more specific situations documented (except increment)

• Mid- to late 2014 – EPA plans to undertake rulemaking to complete update to 40 CFR Part 51 Appendix W (i.e. modeling requirements)
No, really how do I get a permit?

• Investigate all possible measures to stay below emission thresholds in the modeling guidance

• Some of the “old” modeled solutions can still help problems from primary sources:
  – No rain caps
  – Taller stacks, higher temps and flow rates
  – More distance to ambient air boundary from sources
  – More detailed external source inventories (i.e. lower)
  – Hour of day limitations (on both project and external sources)
No, really how do I get a permit?

• Some potential new solutions:
  – Update representative background data for nearby source exclusion and include month/seasonal and hour of day data
  – Different models available for difficult cases (i.e. photochemical)
  – Pre-construction monitoring data to get background specific to your site
What does the last 16 years tell us?

- EPA continues to struggle with the permitting, regulation, and modeling of ultra-fine particles due to:
  - the complex manner in which it is formed via primary AND secondary emissions
  - difficulties in measuring emissions including condensables
  - the often overlooked problems with attempting to model pollutants using tools that were not designed to handle complex atmospheric situations.
Questions

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