Comments on

Revised Guidance for Ozone and Fine Particulate Matter Permit Modeling

(Issued by EPA on September 20, 2021)

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1.0 Introduction.

The authors provide the following comments regarding the United States Environmental Protection Agency's (EPA's) revised Guidance for Ozone and Fine Particulate Matter Permit Modeling ("Revised Guidance" or "Guidance"), issued on September 20, 2021. This guidance was referenced in the latest revisions to the Guideline on Air Quality Models (40 CFR Part 51 Appendix W) promulgated on January 17, 2017 (82 FR 5182) as Reference 59. The Revised Guidance relies upon and references various EPA guidance documents that have been issued since January 2017, but for which EPA did not solicit comments. Due to the reliance of the Revised Guidance on these previously issued documents, our comments address these referenced guidance documents as well.

2.0 EPA has changed its approach yet again regarding the modeling requirements involving emission increases of applicable pollutants.

The revised policy indicates that if any of the precursor pollutants (or the primary pollutant in the case of fine particulate matter, or PM2.5) is emitted in amounts greater than the Significant Emission Rate (SER), then all precursor pollutants (plus the direct pollutant in the case of PM2.5) must be included in the modeling. This is the case even if some of the remaining precursor or direct pollutants are emitted in insignificant amounts.

2.1 EPA has been inconsistent in this approach, especially for PM2.5.

In the original 2014 Draft Guidance, EPA's policy was to not require modeling of direct PM2.5 emissions if they were not emitted in significant amounts by the project, whether or not the precursor emissions of SO_2 or NOx were more than their SER of 40 tons per year (tpy). Then, at the 2018 Regional/State/Local Workshop in Boston, EPA presented[1] a major update without any formal guidance document to this policy consistent with the current Revised Guidance. Although this update was only a

[1] Presentation available at ftp://newftp.epa.gov/Air/aqmg/SCRAM/workshops/2018_RSL_Modelers_Workshop/Presentations/1-20_2018_RSL-O3_PM25_Modeling_Guidance.pdf.

presentation and not official guidance, many regulatory reviews of permit applications submitted afterward relied upon the 2018 workshop presentation. Then, in February 2020, EPA changed its mind again and in its Draft Guidance, it decided that only those pollutants emitted in significant amounts would need to be modeled. Now, EPA has revised the policy once again. This inconsistency conveys doubt and uncertainty in the durability of EPA's guidance. There are also several technical issues that complicate this revised policy, as noted in comment areas below.

The increased likelihood of cumulative modeling analyses brings additional focus upon current conservative features of Appendix W procedures as well as AERMOD features (more details provided below) that EPA needs to address in the next Appendix W update. These conservative features will become even more critical to establishing compliance if the PM2.5 NAAQS is further tightened in the current NAAQS review. EPA needs to review and work to correct several overly conservative features of cumulative modeling analyses based on current guidance. These features tend to overestimate impacts of the source seeking a permit and also tend to double-count impacts of all other sources. The result of these approaches is an overstatement of net air quality impacts that could severely constrain the permitting process, in some instances blocking environmentally beneficial projects. In this context, we provide several comments below that address areas that EPA should address in the next Appendix W revision, especially in light of possible tightening of the PM2.5 NAAQS.

2.2 A review of the MERPs indicates that the SER levels for precursor pollutants would always result in insignificant impacts.

For precursor pollutant emissions just at the SER levels (40 tons per year for SO_2, NOx, and VOCs), it is evident that the combined precursor pollutants Tier 1 Modeled Emission Rates for Precursors (MERP) concentration would be well under the SIL for both ozone and $PM_{2.5}$. For ozone, the lowest MERPs anywhere in the country are 125 TPY for NOx and 1,049 TPY for VOCs. For $PM_{2.5}$, the lowest MERPs between the daily and annual averaging times are 188 TPY for SO_2 and 1,073 TPY for NOx. It is apparent that the SER value of 40 TPY is a small fraction of the MERPs, and therefore the policy of not requiring modeling for proposed emissions below the SERs is on sound technical ground. The exclusion of the contributions in a Tier 1 analysis for small emission increases of a precursor pollutant for a proposed source in the 2020 Draft Guidance was appropriate because 1) the concentration impact is a low fraction of the SIL, and 2) the MERP procedures are inherently conservative. Combined, these factors add a further safety buffer that makes the 2020 Draft Guidance approach suitably protective of air quality.

2.3 The guidance does not provide credit for decreases in precursor pollutant emission rates, which should be applied to offset increases in other precursor emission rates.

If one of the precursor pollutants for a proposed project will have an emissions decrease, then the resulting decrease in PM2.5 production should be considered as offsetting the effects of an increase in the other precursor pollutant. An example of how this offset could be considered is provided below.

The offsets to be provided by the emissions decrease for one precursor pollutant to the emissions decrease for the other precursor pollutant can be computed using the MERP relationships. For a PM2.5 example, suppose that the applicable MERP for SO_2 is 200 tons per year and it is 400 tons per year for NOx. In this hypothetical case, assume an increase in SO_2 emissions of 50 tons per year and a decrease in NOx emissions of 50 tons per year. Since in this case NOx emissions are only 50% as effective in producing secondary PM2.5, a reduction in NOx emissions would offset the SO_2 production of PM2.5 at a 1:2 ratio. Therefore, a reduction in NOx emissions of 50 tons per year would be equivalent to an offset of 25 tons of SO_2. This would lead to an effective increase in SO_2 emissions (for the purpose of secondary formation of PM2.5) of 25 tons per year. This results in a net insignificant increase in SO_2 and no increase in NOx. Therefore, the net increase in precursor emissions is insignificant in this case.

2.4 The Tier 1 modeling approach is conservative and leads to overestimates in the modeled concentration for any given emission rate.

The MERPs are based upon a peak concentration over the entire modeling domain due to a single precursor pollutant, unpaired in time and space with impacts from other precursor pollutants and (in the case of PM2.5) with direct emissions of the pollutant. If these peak impacts from multiple precursors are added, they are implicitly assumed to occur simultaneously and at the same geographical location. This scenario is so unlikely that it probably never occurs, especially considering that maximum impacts from directly emitted pollutants occur close to a source and secondary pollutants resulting from precursor emissions necessarily occur downwind after sufficient transport time. Adding maximum modeled impacts from multiple precursor and direct pollutants is inherently conservative. Therefore, the 2020 Draft Guidance was sufficiently conservative in focusing upon the impact of individual large emission components that may not coincide with the impacts of other minor emission components. The Revised Guidance increases even more the conservatism of the Tier 1 approach. We recommend that EPA return to the 2020 guidance for a Tier 1 analysis because it was sufficiently conservative.

If EPA decides not to return to the 2020 guidance approach, then we provide recommendations to reduce the conservatism of the Tier 1 analyses. Although EPA has provided Tier 1 MERP results as a function of distance (with 10-km distance intervals), there is no information at distances under 10 km because many of the photochemical grid modeling runs were conducted with a resolution of 12 km. This is not a serious issue for ozone modeling, but it is for PM2.5 modeling because peak impacts for primary PM2.5 could be very close to the facility fenceline, well within 10 km. Due to the conversion of gas to secondary particle formation is a function of travel time and there is zero conversion at the stack, it is very likely that for small travel times, the 10-km estimate for the secondary formation is far too high. EPA should create a distance relationship formula between 0 and 10 km to fill in this gap that produces realistic results between <u>zero secondary conversion</u> at the stack location and the stated secondary production at 10 km.

3.0 Tier 2 modeling procedures are likely to be required more frequently if the Revised Guidance is not changed to reduce over-conservatism, and pre-approved modeling platforms should be readily accessible to permit applicants.

If the Revised Guidance procedures are retained and the recommended enhancement in the Tier 1 approach noted above is not provided, then permit applicants may need to apply Tier 2 approaches. The current guidance on the more realistic and refined Tier 2 approaches raises a very high bar and attendant permitting delays for protocol approval. We encourage EPA to prepare to provide pre-approved approaches and modeling platforms for Tier 2 photochemical modeling exercises to mitigate potential delays and protocol complications. The Windows-based CAMx approach noted by Tim Allen[2] (of the Fish and Wildlife Service) as presented at the 2021 Air & Waste Management Association is an example of an emerging method to make such modeling easier for permit applicants as well as agency reviewers.

4.0 Several aspects of the current AERMOD modeling system need to be refined to avoid excessively conservative concentration estimates for the proposed new project emissions of direct PM2.5.

It is our understanding that EPA is considering or presently working on several areas for improving AERMOD performance designated as "white paper" issues. We encourage EPA to implement those features in a future regulatory version of AERMOD that implements such features as noted below.

<u>Low wind speed improvements.</u> EPA started this process with the ADJ_U* option, but the work has not been completed. EPA needs to seriously consider adding minimum sigma-v, sigma-w, and/or other features to the guideline version of AERMOD. The American Iron & Steel Institute provided comments on this issue in their written submittal to the docket of the 12th EPA Modeling Conference (EPA-HQ-OAR-2019-0454), and these comments are incorporated here by reference.

<u>Building downwash improvements.</u> EPA is familiar with ongoing developments by the "PRIME2" workgroup and EPA's Office of Research and Development. Cases of overpredictions in low wind, stable conditions have been documented, and we are hopeful that updates to AERMOD's treatment of downwash will improve model performance in these conditions.

<u>Source-caused effects on plume rise.</u> We have documented conditions where the source itself enhances plume rise: large industrial areas with large fugitive heat releases, heat releases from individual buildings, stacks in a line for which plumes partially merge, and stacks with moist plumes. With appropriate documentation, modeling applicants should be permitted to apply these advanced approaches to obtain improved model performance.

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[2] Allen, Tim, 2021. Panelist for session # 983742 entitled, "AERMOD Modeling System Updates with U.S. EPA and Federal Land Manager Initiatives". Air & Waste Management Association's 114th Annual Conference and Exhibition (Virtual).

Partial plume penetration modeling. We have documented conditions where AERMOD mixes the penetrated plume to the ground too early in the day, well before the convective mixing layer rises to intercept it. The "Highly-Buoyant Plume" (HBP) enhancement to AERMOD should be incorporated into the model to address this deficiency in AERMOD.

Particulate emissions from facility roadways (including "haul roads"). EPA has not adequately resolved overpredictions from mobile source emissions, especially on facility roadways for which barriers act to reduce the effective emission rate. Comments by the American Iron & Steel Institute submitted in association with EPA's 12th modeling conference have more details about model improvements to consider.

Further progress on BUOYLINE implementation. EPA's implementation of the BLP modeling into AERMOD starting with version 16216 was a first step in an incomplete integration of buoyant line sources into AERMOD. Remaining steps should include: a) enabling AERMOD's complex terrain treatment (using the dividing streamline concept) to be applicable to buoyant line sources, b) consideration of plume dispersion using AERMOD's formulation rather than the Pasquill-Gifford stability class-based approach that AERMOD replaced upon promulgation. These advancements could be accomplished by using BLP's plume rise approach and then utilizing an hourly volume source approach to have AERMOD implement the advancements noted above.

Updated AERSURFACE roughness lengths need to be reviewed. Another white paper issue involves the manner in which AERSURFACE is computing surface roughness lengths. These values are lower than expected due to the geometric mean computational approach. A better approach would focus upon determining the effects of different surfaces or surface cover types to obtain the effective roughness height (z0ef) for a heterogeneous surface. In this approach, the "tiling method" for determining the relevant surface energy flux of a surface grid in a numerical weather prediction model can be used (e.g., see Manrique-Sunen et al., 2013)[3].

5.0 Appendix W should allow modeling approaches that account for emissions variability and intermittent utilization of a source.

Permit applicants are challenged with representing variable emissions with a modeling system that is not designed to accommodate the random nature of some source emissions. Although AERMOD can accommodate planned emission changes by time of day, day of the week, monthly, etc., it currently does not have the capability to handle the more commonplace random high emission periods. AECOM has developed an approach[4] that can handle this issue with the use of a large number (e.g., 100) sets of

[3] Manrique-Sunen, A., A. Nordbo, G. Balsamo, A. Beljaars, and I. Mammarella, 2013: Representing land-surface heterogeneity: Offline analysis of the tiling method. *J. Hydrometeor.,* 14, 850–867.

[4] Warren, C. and R. Paine, 2017. Modeling of Infrequent and Random Peak Emission Events for Permit Applications. Paper MO07, presented at the Air & Waste Management Association's Specialty Conference, Guideline on Air Quality Models: the Changes, Chapel Hill, NC. November 2017.

“Randomly Reassigned Emission” input streams that rely upon a defined emissions distribution. The placement of the high emission hours for this approach is tailored to the individual situation. The result is a rigorous modeling test governed by a defined emissions distribution and rules for sequences of high emission periods.

6.0 EPA’s treatment of nearby source emissions in Appendix W Table 8-1 needs to be updated.
For a cumulative modeling exercise, EPA requires the characterization of concentration impacts from both nearby sources and distant sources. The difference between these two categories is that distant sources have less spatially-varying impact and can thus be represented by monitoring data. The values used from the monitoring data are conservatively high, representing a high percentile statistic comparable to the form of the standard (e.g., 99^{th} percentile value for SO_2). A refined tier for this approach is to use a 99th percentile value as a function of hour and season.

Modeling is required for nearby sources (e.g., those sources whose emissions are not affected by the activity represented by the permit application) because the resulting concentrations can vary in space as well as in time. In its Appendix W changes, EPA attempted to create more realism for this characterization by changing one of the factors (temporally representative level) used in the emission rate calculation.

The only factor that was changed for short-term emission rates for nearby sources was the operating level (MMBtu/hr), rather than also including the two other factors (emissions limit in lb/MMBtu and operating factor (hr/year). This change was a step toward more realism, but additional changes are needed to make this adequately realistic and workable, for the reasons provided below. In general, the three factors should be combined into a short-term emission rate that might vary by hour and season, much like the regional background monitoring data used for the distant sources.

The three factors do not make sense for emissions from processes that do not burn fossil fuels. Examples of this are SO_2 emissions from smelting activities; the emissions come from a process that liberates SO_2 via a chemical or thermodynamic reaction, rather than fuel consumption. Even for fuel consumption, there are many cases in which the highest operating levels (e.g., full load) does not correspond to the periods of the highest emission rate in lb/MMBtu. Therefore, the product of these parameters is more relevant than treating them separately. In other cases, sources in a group do not act independently in that when one unit is down, the one next to it is operated at a very high level. Therefore, assuming that all units are operated simultaneously at peak levels is unrealistic.

The definition of “nearby sources” should be clarified as including any source, even at the same facility as that involved in the proposed change, whose emissions are not affected by the proposed activity.

The use of Continuous Emissions Monitoring System data can inform the process for determining the temporal nature of emission changes, as noted in the current Table 8-1. However, the temporal changes need to be applied to the product of the three factors (e.g., emission rate in lb/hr) rather than just one factor because these factors are not independent of each other. The result of the analysis could be a varying emission rate for a nearby source by hour and month/season.

7.0 EPA's approach for estimating a conservatively high regional background to add to the nearby background source impacts can significantly overstate the total concentration.

It is important for EPA to provide a more realistic estimate of background concentrations for a cumulative analysis. The background concentration has two components: the regional background representing distant sources and minor local sources not being modeled, and the concentrations due to local sources that could have a varying impact across the modeling domain (mentioned above in Section 6).

The modeling procedures should be designed such that as the emissions from the proposed project approach zero, the total modeled concentration should approach the current design concentration without the contribution from the proposed project emissions. The combination of modeling conservatively high emission rates for nearby sources plus adding a background design concentration that may include impacts from sources being modeled will clearly overstate current design concentrations unless there are no nearby sources to model. Therefore, the selection of the background monitor should be tailored such that if there are nearby sources being modeled, the background monitor should be selected from a "clean" area which is not influenced by any modeled sources or sources local to the selected monitor.