UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

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OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Model Clearinghouse Review of a BLP/AERMOD Hybrid Alternative Model Approach for Modeling Buoyant Roofline Sources at the FMMI Copper Smelter in Miami, AZ

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INTRODUCTION

The Model Clearinghouse has reviewed Region 9's March 12, 2018 memorandum and technical analysis seeking our concurrence with the Region's recommendation to approve an alternative modeling approach that uses a combination of the Buoyant Line and Point Source model (BLP) and the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) to represent buoyant roofline sources from the Freeport-McMoran Incorporated (FMMI) copper smelter located in Miami, Arizona. This alternative modeling technique is being proposed by the Arizona Department of Environmental Quality (ADEQ) as a part of its 2010 1-hr SO_2 National Ambient Air Quality Standard (NAAQS) State Implementation Plan (SIP) revision for the Miami, AZ Nonattainment Area (NAA).

The AQED contends that the use of BLP alone has several limitations that may affect the simulation of surface impacts from the FMMI copper smelter's roof vents:

- BLP treats complex terrain differently than AERMOD;
- Assumes all buildings are equally long and are equally separated;
- Assumes roof vents are aligned parallel to each other and have identical buoyancies;
- Uses Meteorological Processor for Regulatory Models (MPRM)/RAMMET meteorological files that use the Pasquill-Gifford (P-G) stability class procedure;
- Does not have a calms processing routine;
- Is limited to 100 receptors; and
- BLP-predicted concentrations overestimate when compared to higher elevation monitors in the Miami, AZ NAA, by a factor of 2-5.

To more appropriately represent emissions from FMMI's roofline, the ADEQ proposes to use a combination of AERMOD and BLP (BLP/AERMOD Hybrid Approach):

- Use the BLP model to estimate hourly line source final plume rise and sigma-z (σ_z) from the Smelter roof vents;
- Apply the BLP-predicted final plume heights and σ_z in AERMOD with hourly volume source approach; and
- Then run AERMOD to predict SO_2 concentrations for comparison with the NAAQS.

MODEL CLEARINGHOUSE REVIEW

The Model Clearinghouse provides three caveats in our review for context in this situation given several external factors that have transpired since the ADEQ began preparing the SIP revision for the Miami, AZ NAA. These caveats are important in our broader consideration of the Region's technical analysis and the additional supporting material that was included from the ADEQ.

1) The BLP model was the EPA's preferred dispersion model for buoyant line sources at the point that the ADEQ started developing this SIP revision. During ongoing development of the SIP revision, the EPA proposed and finalized a revision to the *Guideline on Air Quality Models*[1], that included incorporating the BLP dispersion formulation equations into the AERMOD Modeling System as a new source group, BUOYLINE, and the subsequent removal of BLP as a preferred model. Through this promulgation of a new version of AERMOD, the EPA did not make any substantive changes to the BLP formulation, such that most of the aforementioned limitations still exist in all releases of AERMOD since version 15181. Most notably, the BUOYLINE source group still considers a P-G stability approach in calculating the emission dispersion within AERMOD.

2) There is an increasing amount of evidence from previous PSD permit and SIP compliance demonstrations that buoyant line sources modeled with the BLP dispersion formulation approach in areas of complex terrain can result in overpredictions of modeled concentration estimates. While there is an extremely limited amount of adequately collected ambient SO_2 monitoring data to verify these model overpredictions in complex terrain situations, the model response for several smelter-like facilities in mountainous or river valley situations has seemed overly conservative or excessive. The EPA has indicated that scientific updates to buoyant line source modeling reflecting AERMOD's scientific model formulation is an area for needed future research and development.

3) The 2015 release of AERMOD, version 15181, with the proposed BUOYLINE source group contained a coding bug that could have resulted in excessively high concentrations from buoyant line sources in certain unique situations. Given uncertainty with the coding bug and the "beta" status of this source group at the time, the use of BUOYLINE was very limited in this version of AERMOD. This coding bug was corrected in the late-2016 release of AERMOD, version 16216r, which was the first version of AERMOD with the BUOYLINE source group considered as part of the "preferred" modeling system.

[1] Appendix W to 40 CFR Part 51 (82 **FR** 5182) – Revised January 17, 2017

Given no substantive changes in the dispersion formulation with the recent integration of BLP into AERMOD, a switch to using AERMOD over BLP by the ADEQ would not have significantly altered any aspect of the ongoing SIP revision development. With the state of the BUOYLINE source group in a state of flux and an identified coding bug between mid-2015 and late-2016, it is understandable and appropriate that the ADEQ continued to develop this SIP revision with BLP as a standalone preferred model and to consider alternative techniques that included use of AERMOD in a "hybrid" capacity given a case-specific model performance evaluation of the buoyant roofline sources at the FMMI copper smelter facility in Miami, AZ modeled with BLP yielded poor performance beyond a factor of 2 too high, especially considering the nearby complex terrain.

To this end, it is fortunate that there was an existing network of ambient SO_2 monitors in the Miami, AZ NAA surrounding the FMMI copper smelter. As noted in Region 9's technical analysis, the FMMI copper smelter accounts for over 99.9% of the SO_2 emissions in this NAA. Region 9 and the ADEQ provide a rational discussion of these SO_2 monitors and appropriate placement with respect to the FMMI copper smelter for comparative analysis. So, it is reasonable to assume that the SO_2 that these monitors are detecting are primarily emitted from the FMMI facility. Thus, the comparison of the ambient data against the modeling of the FMMI copper smelter could also reasonably demonstrate the degree of model performance. The network of SO_2 monitors then provided the needed case-specific basis for developing an alternative model technique that could reasonably satisfy the requirements of Section 3.2.2(b)(2) in the *Guideline on Air Quality Models* (40 FR Part 51, Appendix W), which states, "a statistical performance evaluation has been conducted using measured air quality data, and the results of that evaluation indicate the alternative model performs better for the given application than a comparable model in Appendix A."

Throughout the development of the Region's Model Clearinghouse Concurrence Request, Region 9 staff were very responsive and often proactive through their engagements with the ADEQ on additional needed information to adequately inform their alternative model analysis and justification. Initially, the ADEQ provided a statistical performance evaluation using measured air quality data at the SO_2 monitors in the Miami, AZ NAA comparing the 4^{th} highest daily 1-hour maximum SO_2 concentrations and Q-Q plots of hourly SO_2 concentrations. From this evaluation, the BLP/AERMOD Hybrid Approach was found to most closely predict concentrations at the monitor most indicative of buoyant roofline sources and was also within a factor of two at the second most important monitoring location. By comparison, the preferred model approach substantially over-predicted by more than a factor of 2 at both locations. With engagement by Region 9, the ADEQ also provided a statistical analysis following the EPA's Protocol for Determining the Best Performing Model, that compares the fractional bias and Composite Performance Measures (CPM), and equally found that the BLP/AERMOD Hybrid Approach performs better than the preferred model approach in this case.

MODEL CLEARINGHOUSE CONCURRENCE SUMMARY

After thorough review of the Region 9 technical analysis and the additional supporting material that was included from the ADEQ, the Model Clearinghouse concurs with Region 9 on the approval of the ADEQ's proposed BLP/AERMOD Hybrid Approach to represent buoyant roofline sources from the FMMI copper smelter located in Miami, Arizona. The analysis and justification provided with a basis secured by a case-specific model performance evaluation adequately satisfies the alternative model requirements of the *Guideline on Air Quality Models*, specifically Section 3.2.2(b)(2). It is noted that all aspects of this Regional Office alternative model approval and Model Clearinghouse concurrence should be included in the record and made available for comment during the normal SIP revision public comment period.

Through this concurrence with Region 9, the Model Clearinghouse is not broadly endorsing the BLP/AERMOD Hybrid Approach proposed by the ADEQ for application in additional PSD permit or SIP compliance demonstrations without adequate justification and appropriate alternative model approval by the respective EPA Regional Office with Model Clearinghouse concurrence. In this FMMI copper smelter situation, the case-specific model performance evaluation based on the SO_2 monitors located within the Miami, AZ NAA was fundamental in our concurrence of the alternative model approach. A similar case-specific model performance evaluation or a combination of strong scientific basis with comparative model performance will likely be necessary in other regulatory compliance circumstances. Should an applicant or state/local air agency desire to use the BLP/AERMOD Hybrid Approach in a regulatory PSD permit or SIP revision, early consultation with the respective EPA Regional Office is strongly encouraged.

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