UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

MAR 1 3 2018

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Model Clearinghouse Review of Alternative Model Techniques to Address Two Issues with Modeling Buoyant Line Sources in AERMOD for the PSD Compliance Demonstration of the Nucor Steel Facility in Darlington, South Carolina

FROM: George Bridgers, Model Clearinghouse Director
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TO: Christopher M. Howard, Physical Scientist
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INTRODUCTION

In response to your February 27, 2018 concurrence request memorandum, the Model Clearinghouse has reviewed Region 4's technical summary and recommendations for approving the use of an alternative model technique proposed by the State of South Carolina Department of Health and Environmental Control (SCDHEC) to address two identified issues with modeling buoyant line sources using the preferred near-field model, AERMOD for the PSD compliance demonstration of the Nucor Steel facility in Darlington, South Carolina. First, the current version of AERMOD, version 16216r, is limited to a single group of buoyant line sources that are described with identical characteristics (*e.g.*, requires an average building width, line length, and buoyancy parameter and assumes all lines are parallel to each other with an average separation distance), which creates a limitation in modeling a facility with multiple buoyant line sources with dissimilar characteristics in one model run. Second, the modeling consultant for the Nucor Steel facility identified a coding issue or bug within AERMOD that adds the modeled NO_2 impacts from buoyant lines sources to other modeled NO_2 impacts after the Tier 2 and 3 NO_2 methodologies are applied to the modeled NO_x concentrations from other source types. This results in an inappropriate NO_x to NO_2 conversion calculations for the modeling simulation. Both of these modeling issues are subsequently addressed through a multi-step alternative modeling technique using the AERPOST program as summarized by Region 4 in your concurrence memorandum and more fully described in the documentation and equivalency demonstration provided by the SCDHEC.

MODEL CLEARINGHOUSE REVIEW

The Model Clearinghouse appreciates the degree to which Region 4 has reviewed the alternative modeling technique proposed by the SCDHEC and verified the model equivalency demonstration provided by the modeling consultant. During the preliminary discussions between the SCDHEC, Region 4, and the Model Clearinghouse concerning the Nucor Steel Darlington facility's PSD compliance demonstration, both modeling issues described above were confirmed to be valid issues in the current version of the AERMOD, version 16216r. With respect to the limitations of modeling numerous dissimilar buoyant line sources, this is a known limitation that was brought forward into AERMOD at the point that the previous preferred model for buoyant line sources, BLP, was fully integrated with AERMOD. It has been understood that modeling numerous dissimilar buoyant line sources would require multiple AERMOD simulations and some post-processing technique to combine the results. The second modeling issue regarding the order in which Tier 2 and 3 NO_2 methodologies are calculated within AERMOD with respect to buoyant line sources was a new issue to the Model Clearinghouse that required the AERMOD Model Development Team to review the model code. It was determined by this internal team that there was, in fact, an AERMOD coding bug with buoyant line sources and appropriate Tier 2 and 3 NO_2 processing. This coding bug effects all versions of AERMOD since the buoyant line source option in v15181.

As noted above, the modeling of dissimilar buoyant line sources has been a known limitation with the current implementation of the buoyant line source option in AERMOD. In order to simulate multiple dissimilar buoyant line sources, multiple runs of AERMOD are required with some type of post processing step to appropriately combine the concentration outputs for consideration in the compliance demonstration. Similar to Region 4, the Model Clearinghouse followed the first 4 steps of the proposed multi-step alternative modeling technique, including the use of the BINSUM and AERPOST utilities developed by ERM, to compare those results against other internal methodologies for combining concentration outputs from multiple AERMOD modeling runs with appropriate considerations of the ranked statistical averaging necessary for NAAQS comparison. Our review of the proposed alternative technique to address the issue of modeling multiple dissimilar buoyant line sources resulted in equivalence in all of the cases tested. Thus, we have established that the BINSUM and AERPOST utilities in this case specific situation meets one of the three criteria for which for which an alternative model may be approved as described in Section 3.2.2(b)(1) of the *Guideline on Air Quality Models* (40 FR Part 51, Appendix W) "If a demonstration can be made that the model produces concentration estimates equivalent to the estimates obtained using a preferred model."

With respect to the identified coding bug within AERMOD v16216r that adds the modeled NO_2 impacts from buoyant lines sources to other modeled NO_2 impacts after the Tier 2 and 3 NO_2 methodologies are applied to the modeled NO_x concentrations from other source types, the Model Development Team has implemented a series of amendments to AERMOD v16216r that correct the coding bug for Tier 2 NO_2 processing. With this corrected version of AERMOD, the ARM2, Tier 2 NO_2 modeling option is correctly applied to buoyant line sources along with all other sources groups. The Model Clearinghouse used this corrected version of AERMOD to evaluate the proposed 5th step of the multi-step alternative modeling technique. We found that

this last optional step for ARM2 processing also resulted in equivalent model concentrations to our corrected version of AERMOD.

MODEL CLEARINGHOUSE CONCURRENCE SUMMARY

Considering that both Region 4 and the Model Clearinghouse found equivalency consistent with Appendix W, Section 3.2.2(b)(1) for the alternative modeling technique proposed by the SCDHEC in the PSD compliance demonstration of the Nucor Steel Facility in Darlington, South Carolina, we concur with Region 4 on the alternative model approval. It is noted that all aspects of this Regional Office alternative model approval and Model Clearinghouse concurrence should be included in the permit record and made available for comment during the normal permit public comment period.

While the alternative modeling technique proposed by SCDHEC includes the application of ERM's BINSUM and AERPOST utilities, the next release of AERMOD will include updates to apply the ARM2, Tier 2 NO_2 modeling option for buoyant line sources. AERPOST is currently limited in that it is only applicable to the 1-hour averaging period and the source group "ALL." The next release of AERMOD will enable the user to take full advantage of the post-processing and output options in AERMOD when buoyant line sources are modeled with the ARM2, Tier 2 NO_2 modeling option. However, the next release of AERMOD will not include coding updates to appropriately apply either of the Tier 3 NO_2 modeling options (OLM or PVMRM) for buoyant line sources. Should an applicant desire to use a Tier 3 NO_2 modeling option with a buoyant line source(s), consultation with the appropriate reviewing authority and EPA Regional Office will be required. Additionally, a case specific approach will still be necessary for modeling dissimilar buoyant line sources. While the combination of multiple AERMOD modeling runs in such situations may be considered only a post processing technique, consultation with the appropriate reviewing authority and EPA Regional Office is strongly encouraged.

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