UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

July 24, 2024

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Model Clearinghouse Review of an Alternative Model Approach, AERMOD-HBP, in Support of Clean Air Act (CAA) SO_2 Nonattainment SIP Attainment Demonstration Modeling – 1-Hour SO_2 Rusk-Panola Nonattainment Area

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TO: Erik Snyder, Lead Regional Air Quality Modeler
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THROUGH: Guy Donaldson, Branch Chief
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EPA Region 6, Dallas, TX

INTRODUCTION

The Texas Commission on Environmental Quality (TCEQ) has submitted a 1-Hour sulfur dioxide (SO_2) Attainment Demonstration State Implementation Plan (SIP) for the Rusk-Panola nonattainment area that includes modeling that uses an alternative model that TCEQ requested be approved instead of utilizing the regulatory version of the AERMOD Modeling System available at the time (v21112). The alternative model is a formulation of AERMOD v21112 with code changes to modify the way highly buoyant plumes that penetrate the boundary layer are treated within the model.

The major source of SO_2 in the Rusk-Panola 1-Hour SO_2 Nonattainment Area is the Martin Lake Electrical Generating Facility (Martin Lake EGU) that is owned by Luminant, which is a subsidiary of Vistra. Vistra and their contractor, AECOM, contacted TCEQ and U.S. Environmental Protection Agency (EPA) Region 6 in the fall of 2020 about the prospect of requesting an alternative model approval for the required model attainment demonstration. AECOM wanted to utilize modified code for how and when penetrated plumes are mixed back down into the atmosphere below the convective boundary layer. EPA Region 6, EPA OAQPS Air Quality Modeling Group Staff, TCEQ and their contractor Ramboll, and Vistra with their contractor AECOM had numerous phone call and email engagements in efforts to facilitate their

request and to identify the analyses and other information needed as a modeling protocol was being developed to support the alternative model request.

TCEQ submitted a letter dated May 24, 2021, from Ms. Tonya Baer (TCEQ Director of the Office of Air) to Mr. David Garcia (Air and Radiation Division Director) of EPA Region 6 requesting approval of an alternative model request for the use of AERMOD with Highly Buoyant Plume (AERMOD-HBP) code modifications in the Rusk-Panola 2010 1-Hour SO_2 Attainment Demonstration SIP.[1] The use of AERMOD-HBP is considered an alternative model application requiring EPA Regional Office approval with EPA's Model Clearinghouse concurrence per Section 3.2 of the *Guideline on Air Quality Models* (Appendix W to 40 CFR Part 51 or Appendix W). TCEQ sought approval to allow the use of the alternative model AERMOD-HBP for their air quality modeling analysis specifically under Section 3.2.2(b)(2) of Appendix W.

REGIONAL OFFICE REVIEW

EPA Region 6 and TCEQ continued to have discussions as TCEQ submitted the different informational components to support their alternative model request from May through early August 2021, with EPA Region 6 providing some clarifications on the different submittal components in support of the alternative model request. As noted above, TCEQ sought approval to allow the use of the alternative model AERMOD-HBP for their air quality modeling analysis under Appendix W, Section 3.2.2(b)(2). Under Condition (2) of that section, an alternative model may be used if the Regional Office finds the conditions specified in Appendix W, Section 3.2.2(d) are satisfied. While not specifically cross-referenced, Appendix W, Section 3.2.2(e) sets forth five conditions that should be considered as part of the modeling protocol for alternative model approvals by providing some of the framework for how to address the requirements of Appendix W, Section 3.2.2 and for how to perform an analysis from both a theoretical and performance perspective.

During EPA Region 6's and the Model Clearinghouse's ongoing review, there were some questions and a concern that some of the reference material was copyrighted and/or not released by the author for public circulation, and EPA Region 6 reached out to AECOM for further documentation. AECOM provided an updated document on May 1, 2024, to EPA Region 6 that included updated theory discussion, more details on the HBP formulation in AERMOD, and more details on the changes in the different AERMOD modules.

EPA Region 6 has conducted a thorough review of the request and has proposed to approve the use of AERMOD-HBP as an alternative model to conduct the air quality modeling analysis as part of TCEQ's attainment demonstration SIP for the 1-Hour SO_2 Rusk-Panola nonattainment area. In the concurrence request memo from EPA Region 6 to the Model Clearinghouse on July 11, 2024, EPA Region 6 proposed approval of an AERMOD-HBP alternative model for the 1-Hour SO_2 Attainment Demonstration SIP for the Rusk-Panola nonattainment area pursuant to

[1] https://gaftp.epa.gov/Air/aqmg/SCRAM/mchisrs/24-VI-01_Region6_MCHRequest_Rusk-Panola_NAA-TCEQ_Supporting_Materials.pdf.

Appendix W, Sections 3.2.2(b)(2), 3.2.2(d), and 3.2.2(e).[2] EPA Region 6 also provided modeling files and analysis files electronically and a technical support document (AERMOD-HBP TSD) summarizing their review.[3] EPA Region 6 included, the TCEQ's May 24, 2021, alternative model request and non-copywrited supporting documents submitted by TCEQ, and clarifying documentation provided by Vistra's contractor AECOM to EPA on May 1, 2024.[1] EPA Region 6's analysis concluded that AERMOD-HBP performs better than the regulatory version of AERMOD in this case-specific situation.

EPA Region 6's review and proposed approval recognizes that the analysis of the alternative model AERMOD-HBP had relatively limited ambient monitoring data to use in this review with only 3 years of SO_2 data from a nearby monitor that is 2 km from the Martin Lake EGU (main source of SO_2 in the Rusk-Panola nonattainment area) and one monitor with 5 years of data that is 19 km from the Martin Lake EGU. EPA Region 6 indicated that this approval for the use of the alternative model AERMOD-HBP is limited to this specific SIP action and a new alternative model request and approval would be needed to use AERMOD-HBP in future regulatory modeling and regulatory actions related to the Martin Lake facility. EPA Region 6 also indicated that this alternative model approval for AERMOD-HBP does not convey that this model could be used in another situation without an independent alternative model request with an appropriate monitor-to-model evaluation and subsequent Regional Office approval, per the requirements of Appendix W, Section 3.2.2.

MODEL CLEARINGHOUSE REVIEW

TCEQ with AECOM's supplement and EPA Region 6 provide a justification and review for the use of AERMOD-HBP as an alternative model to conduct the modeling demonstration for the analysis included in the TCEQ's 1-Hour SO_2 Attainment Demonstration SIP for the Rusk-Panola nonattainment area. In the alternative model justification, TCEQ provides technical reasons that the AERMOD-HBP model is more appropriate in this case-specific situation and supports that with preliminary modeling results of the Martin Lake facility comparing modeled values with nearby monitors and looking at specific hour comparisons. Based on this initial information TCEQ explored requesting a formal alternative model approval by EPA Region 6 and conducted technical analyses to identify the best performing model in this specific situation. Their analyses included a Cox-Tikvart analysis in accordance with EPA Model Evaluation guidance[4], Q-Q plots, time series plots, and percentile plots.

EPA Region 6 conducted additional modeling and performed a subsequent separate model performance analysis to assess the impact of a slight stack location difference for the three main boilers at the Martin Lake EGU in TCEQ's modeling files and analyses provided with their alternative model request. Both TCEQ's materials and EPA Region 6's model performance

[2] https://gaftp.epa.gov/Air/aqmg/SCRAM/mchisrs/24-VI-01_Region6_MCHRequest_Rusk-Panola_NAA.pdf.
[3] https://gaftp.epa.gov/Air/aqmg/SCRAM/mchisrs/24-VI-01_Region6_MCHRequest_Rusk-Panola_NAA-Region6_TSD.pdf.
[4] Environmental Protection Agency, 1992. Protocol for Determining the Best Performing Model (EPA-454/R-92-025). U.S. Environmental Protection Agency, Research Triangle Park, NC

related analyses are discussed and evaluated in EPA Region 6's AERMOD-HBP TSD that was attached to EPA Region 6's memorandum requesting concurrence on approval of AERMOD-HBP for this case-specific situation.

In convective conditions, the regulatory version of AERMOD has a 3-plume treatment for stack emissions: direct, indirect, and penetrated components. The direct and indirect plumes remain within the mixed/convective layer. The penetrated plume is the portion of the plume that is sufficiently buoyant to break through the elevated inversion into the stable layer aloft which has less vertical mixing than the mixed/convective layer. EPA's formulation in AERMOD does account for the penetrated plume, but the assertion by AECOM and TCEQ is EPA's formulation prematurely mixes the penetrated plume back into the convective layer resulting in penetrated plume impacts adding to the receptors on the ground in its predictions too early and repeats this behavior for hours leading up to the actual interception of the penetrated plume by the rising convective mixed layer. AECOM and TCEQ provided information indicating this behavior has been observed by investigators associated with field studies where the model is found to overpredict ground-level concentration events due to the penetrated plume component and make those predictions too early in the day.

The issues raised by AECOM and TCEQ, and the full model performance analysis conducted support that in this case-specific analysis of modeling for Rusk-Panola Attainment Demonstration SIP sometimes AERMOD's treatment of penetrated plume may be causing a premature mix down resulting in artificially elevated ground concentrations being modeled. The Model Clearinghouse has reviewed EPA Region 6's AERMOD-HBP TSD including TCEQ and EPA Region 6's Cox-Tikvart results, Q-Q plots, time series plots, percentile plots, and day specific analysis. The Model Clearinghouse also reviewed additional diagnostic and time of day modeling analyses that EPA Region 6 performed to assess how the HBP formulation in AERMOD results in modeled concentration changes.

TCEQ appropriately follows a Condition 2 pathway for alternative model justification per Appendix W, Section 3.2.2(b)(2), (d), and (e) in their alternative model justification package. EPA Region 6 performed a thorough review of each of the theoretical and statistical analysis evaluation of the Condition 2 alternative model justification. For brevity, the Model Clearinghouse will refrain from individually discussing these elements and the respective TCEQ and AECOM justifications and will direct the reader to the EPA Region 6 AERMOD-HBP TSD.

CONCURRENCE SUMMARY

In summary, the Model Clearinghouse fully concurs with EPA Region 6 proposed approval of a using AERMOD-HBP for the modeling to demonstrate attainment in the TCEQ's a 1-Hour SO_2 Attainment Demonstration SIP for the Rusk-Panola nonattainment area based on the alternative model justification package provided by TCEQ with supplemental material provided by AECOM and the technical review documentation provided by EPA Region 6. The Model Clearinghouse encourages EPA Region 6 to respond to TCEQ and to the docket of the proposed Limited Approval/Limited Disapproval of the State Implementation Plan with a letter of alternative model approval, as appropriate. The information associated with the EPA Region 6 alternative

model approval and the Model Clearinghouse concurrence should be available for comment during the appropriate public comment period for this SIP limited approval and limited disapproval action.[5]

Given the relatively limited data available for the analysis of AERMOD-HBP, the Model Clearinghouse recommends caution and careful review before additional alternative model considerations of AERMOD-HBP in other projects in this area or elsewhere. This case-specific Model Clearinghouse concurrence does not constitute a generic approval of AERMOD-HBP for any other applications. The Model Clearinghouse and the AERMOD Model Development Team will continue to evaluate potential model formulation concerns with AERMOD's treatment of penetrated plumes and may consider future regulatory updates as additional representative monitoring data is collected at a variety of facilities and subsequent model performance evaluations are conducted with appropriate scientific peer-review.

For any future projects considering the use of AERMOD-HBP, early consultation with the appropriate reviewing authority and EPA Regional Office is strongly recommended. Any alternative model application other than the preferred regulatory version of AERMOD model approach for a similar project requires Regional Office approval with Model Clearinghouse concurrence per Appendix W, Section 3.2.2.

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[5] All of the information associated with this alternative model request, concurrence, and approval is also available in the Model Clearinghouse Information Storage and Retrieval System (MCHISRS) record: https://cfpub.epa.gov/oarweb/MCHISRS/index.cfm?fuseaction=main.resultdetails&recnum=24-VI-01.