UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

AUG 10 2018

MEMORANDUM

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

SUBJECT: Model Clearinghouse Review of the BLP/AERMOD Hybrid Alternative Model Approach for Modeling Fugitive Emissions from Coke Oven Batteries at the U.S. Steel Mon Valley Works – Clairton Plant in Allegheny County, PA

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INTRODUCTION

The U.S. Steel Mon Valley Works – Clairton Plant (Clairton Plant) in Allegheny County, PA is the country's largest coking facility with an annual capacity of 4.3 million tons. This plant is a tremendously complex coking facility with 708 ovens grouped into 10 operational batteries, comprised of 5 distinct battery lines, as a part of their coking operations. As noted by EPA Region 3 in its Concurrence Request Memorandum to the EPA's Model Clearinghouse,

> "coking facilities are complex emissions sources with multiple emission points and include numerous structures where building downwash can impact pollutant dispersion. Particulate and SO2 emissions are produced during the coke forming process, Material/product handling processes generate numerous individual particulate emission sources while the coke production processing itself generates combustible coke oven gas that contributes to particulates and SO2 emissions when burned."

Adding to the complexity, the Clairton Plant is located in the Monongahela River Valley. The terrain surrounding the facility rises approximately 120 meters above the valley floor and contributes to terrain induced atmospheric temperature inversions. These temperature inversions are periods of diminished air dispersion out of the river valley and often episodes of poor air quality.

While many of the emissions sources at the Clairton Plant can be appropriately characterized by point, area, and/or volume source types for compliance demonstrations and State Implementation Plan (SIP) purposes, the coke oven batteries also produce a significant amount of fugitive emissions distributed along the length of the battery and are much more difficult to accurately characterize given a variety of factors and challenges, including accurate estimating fugitive emissions across each battery, sporadic nature of these emissions, extremely hot temperatures associated with these emissions releases, etc. Historically, coke oven fugitive emissions have been modeled as a type of buoyant line source using the Buoyant Line and Point Source (BLP) model. Traditionally created for modeling aluminum reduction facilities with much more uniform heat release profiles, the BLP model was intended to handle the unique dispersion from these types of facilities where plume rise and downwash effects from stationary line sources are important in simple terrain environments.

For coke oven batteries in complex terrain environments, a variety of alternative model approaches have been used in compliance demonstrations and SIP submittals over the past 40-years. Most commonly, some "hybrid" combination of the BLP model estimates of plume rise and initial vertical and/or lateral dispersion characteristics have been used to characterize coke oven battery emissions as volume sources within the Industrial Source Complex (ISC) model. In 2005, the American Meteorological Society/Environmental Protection Agency Model (AERMOD) replaced the ISC model as EPA's preferred near-field dispersion model. The BLP model was also replaced as an EPA preferred model with the release of AERMOD version 16216 and the 2016 revisions to the *Guideline on Air Quality Models* (Appendix W to 40 CFR Part 51, *Guideline*). AERMOD now incorporates the BLP model formulation algorithms as a "BUOYLINE" source option. However, there have not been any scientific formulations updates to the original BLP model formulations algorithms.

MODEL CLEARINGHOUSE REVIEW

From the EPA Region 3 Concurrence Request Memorandum, per the requirements of Section 3.2.2(b)(2) of the *Guideline*, the Allegheny County Health Department (ACHD) is seeking EPA approval to use an alternative model approach for their 2012 Annual Fine Particulate Matter ($PM_{2.5}$) National Ambient Air Quality Standard (NAAQS) Nonattainment Area State Implementation Plan (SIP) and for their 2010 1-hr SO_2 NAAQS Nonattainment Area SIP for the respective Allegheny County, PA nonattainment area. Alternative models shall be evaluated from both a theoretical and a performance perspective before they are selected for regulatory use, specifically Section 3.2.2(b)(2) states,

> "2. If 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"

ACHD is seeking to use a combination of the BLP and AERMOD models to represent the fugitive emissions from coke oven batteries at the Clairton Plant as described in the ACHD technical support document, "BLP/AERMOD Hybrid Approach for Buoyant Fugitives in Complex Terrain." Specifically, estimates of emissions temperature and vertical velocity are

used to compute buoyancy for input into BLP's plume rise module to yield estimated plume rise and subsequently derive initial vertical dispersion characteristics on an hourly varying basis as function of the plume height. The plume rise is then used to determine volume source characteristics for the fugitive emissions with AERMOD. Henceforth, this alternative model approach will be referred to as the "BLP/AERMOD Hybrid Approach." It should be noted that similar plume rise and calculated initial dispersion characteristics could have been generated from the BUOYLINE source group within AERMOD rather than the stand-alone BLP model for determining the fugitive emissions volume source characteristics in the alternative application of AERMOD, but the Model Clearinghouse does not anticipate that there would have been any discernable differences in the resulting alternative model demonstration.

For situations where it has been determined that an EPA preferred model is either not appropriate for the particular application or a more appropriate model or technique is available and applicable, the EPA Regional Administrators have the delegated authority to issue an alternative model approval under Section 3.2 of the *Guideline*, provided that such an approval is issued after consultation with the Model Clearinghouse. In this determination, the *Guideline* provides guidance to an objective and consistent evaluation protocol for the basis of the associated alternative model demonstration. The "Protocol for Determining the Best Performing Model" (EPA-454/R-92-025, NTIS No. PB 93-226082), also known as the Cox-Tikvart Protocol, provides a general framework for objective decision-making on the acceptability of an alternative model for a given regulatory application.

The Model Clearinghouse appreciates the efforts by EPA Region 3 to thoroughly review the ACHD technical support document and summarize their results in its Concurrence Request Memorandum. We find and agree with the EPA Region 3 assessment that ACHD applied the Cox-Tikvart Protocol using a network of facility representative ambient monitors and sufficiently demonstrated, per Section 3.2.2(b)(2) of the *Guideline*, that the BLP/AERMOD Hybrid Approach performed better than the EPA's preferred model approach and other approaches tested for characterizing the fugitive emissions from the coke oven batteries at the Clairton Plant. We also note that ACHD included additional weight-of-evidence statistical measures, as highlighted in Table 3 and Figure 7 of the Concurrence Request Memorandum and the associated information from the ACHD technical support document. The culmination of the recommended Cox-Tikvart Protocol approach and the additional weight-of-evidence statistics uniformly support the results of the ACHD alternative model performance evaluation.

The Model Clearinghouse concurrence is based on the assessment that is included in the EPA Region 3 Concurrence Request Memorandum and specifically refer readers Figure 8 and Figure 9 in the EPA Region 3 assessment and subsequently to the ACHD technical support document. As of this Model Clearinghouse Concurrence Response Memorandum, there has been only one other case-specific regulatory approval of a hybrid combination of information from the BLP model or the BUOYLINE source group as parameters for a volume source group within AERMOD. In that 2018 EPA Region 9 alternative model approval for a copper smelter in complex terrain, a statistical analysis following the Cox-Tikvart Protocol using a network of facility representative ambient monitors equally found that the BLP/AERMOD Hybrid Approach

performed better than the preferred model approach in that specific case. For more information on this EPA Region 9 alternative model approval, please reference the record[1] in the Model Clearinghouse Information Storage and Retrieval System (MCHISRS) on the EPA's SCRAM website[2].

MODEL CLEARINGHOUSE CONCURRENCE SUMMARY

Per the request of EPA Region 3, the Model Clearinghouse has reviewed the ACHD alternative model demonstration and associated EPA Region 3 assessment for the use of the BLP/AERMOD Hybrid Approach for the assessment of the fugitive coke oven battery emissions at the Clairton Plant for the ACHD's 2012 Annual $PM_{2.5}$ NAAQS Nonattainment Area SIP and for the ACHD's 2010 1-hr SO_2 NAAQS Nonattainment Area SIP for the respective Allegheny County, PA nonattainment area. The Model Clearinghouse finds that the requirements and recommendations of Section 3.2 of the *Guideline* have been appropriately followed and hereby concur with EPA Region 3 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 SIP record and made available for comment during the appropriate public comment period.

The EPA has highlighted the need for further model development related to buoyancy in the AERMOD Development White Papers[3] initially released for the 2017 Regional, State, and Local Modelers' Workshop. More specifically, buoyancy related to elongated sources, such as coke oven batteries, was further discussed by the EPA at the 2018 Regional, State, and Local Modelers' Workshop[4]. The White Papers, which will be expanded in the EPA's forthcoming AERMOD Model Development and Update Plan, chart a pathway for further model development for addressing plume rise from many source types. It is expected that such development will better address model performance issues with sources like coke oven batteries. In the interim, the EPA has evaluated characterizing coke over batteries as a series of point sources in a manner that reasonably accounts for plume rise, downwash, and subsequent dispersion within the framework of the preferred model.

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[1] https://cfpub.epa.gov/oarweb/MCHISRS/index.cfm?fuseaction=main.resultdetails&recnum=18-IX-01
[2] https://www.epa.gov/scram/air-quality-model-clearinghouse
[3] https://www3.epa.gov/ttn/scram/models/aermod/20170919_AERMOD_Development_White_Papers.pdf
[4] http://www.cleanairinfo.com/regionalstatelocalmodelingworkshop/archive/2018/Presentations/1-9_2018_RSL-White_Paper_Summaries.pdf