UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

OCT 2 6 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 AK Steel – Mountain State Carbon facility located in Follansbee, Brooke County, West Virginia

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INTRODUCTION

The AK Steel – Mountain State Carbon, LLC Follansbee Plant (Mountain State Carbon) located in Follansbee, West Virginia is a by-product coke plant that produces metallurgical-grade coke along with foundry coke from coal for use at off-site steel and foundry facilities and for commercial sales. Coke is produced from coal at the facility's four coke oven batteries. EPA Region III is seeking concurrence from the Model Clearinghouse on an alternative modeling approach using a combination of the Buoyant Line and Point Source model (BLP) and the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) to represent fugitive emissions from these four coke oven batteries at Mountain State Carbon. The proposed alternative modeling approach was applied in West Virginia's 2010 1-hour SO_2 National Ambient Air Quality Standard (NAAQS) Nonattainment Area State Implementation Plan (SIP) for the Steubenville, Ohio-West Virginia multi-state nonattainment area.

BACKGROUND

Mountain State Carbon is located along the Ohio River in the northern panhandle of West Virginia. This area resides in the Allegheny Plateau physiographic province of the Appalachian Mountain system and is marked by dendritic rivers systems imbedded within steep valleys. The terrain surrounding Mountain State Carbon rises approximately 120 meters above the river valley

floors and contributes to terrain induced atmospheric temperature inversions. These temperature inversions are periods of diminished air dispersion out of the river valley and often result in episodes of poor air quality for the nearby region.

While many of the emissions sources at Mountain State Carbon can be appropriately characterized by point, area, and/or volume source types for compliance demonstrations and SIP purposes, the coke oven batteries also produce a significant amount of fugitive emissions distributed along the length of the coke oven batteries and are much more difficult to accurately characterize given a variety of factors, including accurately estimating fugitive emissions across each battery, the sporadic nature of these emissions, extremely hot temperatures associated with some of these emissions releases, etc. Historically, coke oven fugitive emissions have been modeled as a type of buoyant line source using the BLP model. The BLP model was created for modeling aluminum reduction facilities with much more uniform heat release profiles and 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/or 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, 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 as part of the 2017 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 with the incorporation in AERMOD.

MODEL CLEARINGHOUSE REVIEW

In the West Virginia 2010 1-hour SO_2 NAAQS Nonattainment Area SIP for the Steubenville, Ohio-West Virginia multi-state nonattainment area, West Virginia used AERMOD for all sources except the fugitive emissions emanating from the coke oven batteries. To characterize these fugitive emissions, West Virginia generated hourly varying release heights using BLP and then calculated initial dispersion coefficients based on the release heights. Fugitive emissions were then included in AERMOD, using multiple hourly varying volume sources based on these parameters. This "BLP/AERMOD Hybrid Approach" is similar to the August 2018 Model Clearinghouse concurred and EPA Region 3 approved alternative model approach for the U.S. Steel Mon Valley Works – Clairton Plant (Clairton Plant) located in Allegheny County, Pennsylvania[1]

In this Model Clearinghouse review, it should be noted that the Model Clearinghouse did not reconsider the justification or basis for the application of the BLP/AERMOD Hybrid Approach

[1] https://cfpub.epa.gov/oarweb/MCHISRS/index.cfm?fuseaction=main.resultdetails&recnum=18-III-01

for fugitive emissions from coke oven batteries. Rather, the Model Clearinghouse focused its attention on the portability and applicability of the case-specific Model Clearinghouse concurrence and EPA Regional Office approval of this alternative model approach from the aforementioned Clairton Plant to the Mountain State Carbon facility. As stated in the EPA Region 3's technical assessment of the West Virginia 1-hour SO_2 SIP,

> "monitoring data necessary to complete [case-specific] statistical analysis is unavailable for the areas in which the regulatory version of AERMOD and the BLP/AERMOD Hybrid approach predict maximum impacts. EPA Region 3 is proposing to approve the use of the BLP/AERMOD Hybrid method based on a recently approved application of this methodology for the U. S. Steel Clairton Plant in Allegheny County, PA. We believe this approval is appropriate in this instance since both facilities are using a similar BLP/AERMOD Hybrid approach to simulate their buoyant fugitive coke oven emissions, both facilities are by-product coking plants with nearly identical coke production/handling methods, both facilities are located in similar terrain and both facilities appear to experience terrain-induced complex vertical wind patterns."

The previous justification for the application of the BLP/AERMOD Hybrid Approach at the Clairton Plant met the requirements of Section 3.2.2(b)(2) of the *Guideline on Air Quality Models* (Appendix W to 40 CFR Part 51, *Guideline*) for that particular situation based on a case-specific statistical analysis that was provided in the Allegheny County technical support document, "Alternative Modeling Technical Support Document: BLP/AERMOD Hybrid Approach for Buoyant Fugitives in Complex Terrain."[2]

From a facility perspective, the fugitive coke oven emissions from both Mountain State Carbon and Clairton Plant are essentially the same in that they are initially very buoyant due to the substantial heating involved in the coke making process. There are differences in the number of batteries and the overall size of the entire Clairton Plant facility as compared to that of Mountain State Carbon, but the near-field dispersion characteristics of the fugitive emissions from the coke oven batteries from both facilities are expected to be equivalent.

Further from EPA Region 3's technical assessment,

> "Mountain State Carbon and U.S. Steel's Clairton Plant are both located in similar terrain settings since they reside in the same physiographic province; the Allegheny Plateau province of the Appalachian Mountain system. Both plants lie in river valleys, the Monongahela and Ohio rivers, that make up a larger regional pattern of incised dendritic valleys within an overall elevated plateau. Elevation differences between the valley floor and surrounding elevated terrain for both facilities are approximately 120 meters (m). Actual distances between the two (2) facilities are modest. Mountain State Carbon is located approximately 60 km west of the Clairton Plant. Given the similarities in terrain between the coke plants we would expect each facility's buoyant fugitive emissions to

[2] http://www.epa.gov/ttn/scram/guidance/mch/new_mch/ACHD_Alternative_Demo_Buoyant_Fugitives_Final.pdf

behave similarly and therefore be better simulated using the alternative BLP/AERMOD Hybrid approach."

The Model Clearinghouse finds this geographical and proximity intercomparison especially important in determining the portability of the Clairton Plant case-specific alternative model approval to Mountain State Carbon. Although the two facilities are approximately 60 kilometers apart, their locations within the Allegheny Plateau are such that the meso- and synoptic-scale meteorological influences can easily be considered equivalent. While the surface height wind roses provided for both facilities were different, it was noted that the orientation of the river valleys in both cases was also different. EPA Region 3 demonstrated an equivalent and appropriately similar shifting of winds with height throughout the two valleys, which would result in similar dispersion patterns with respect to the nearby complex terrain of the river valley.

There are numerous aspects of complex terrain that could have significant influences on the downwind dispersion of pollutants from these two facilities. In both cases, the aspects of complex terrain are very similar; narrow river valley settings with elevated terrain at approximately 120 meters just beyond the property boundaries of both facilities. Had the facility settings been uniquely different, *e.g.*, one facility in a river valley and the other on a flat plateau with adjacent mountains, it would have been inappropriate for the Model Clearinghouse to consider the case-specific alternative model performance evaluation at one to be representative of the other. The Model Clearinghouse finds that the similarities of the topographical settings around both the Mountain State Carbon and Clairton Plant to be equivalent and that EPA Region 3 has provided a rational justification for the applicability of the Clairton Plant case-specific alternative model performance evaluation.

MODEL CLEARINGHOUSE CONCURRENCE SUMMARY

Per the request of EPA Region 3, the Model Clearinghouse has reviewed the model attainment demonstration included in the West Virginia 2010 1-hour SO_2 NAAQS Nonattainment Area SIP for the Steubenville, Ohio-West Virginia multi-state nonattainment area and associated EPA Region 3 technical assessment for the use of the alternative BLP/AERMOD Hybrid Approach for the assessment of the fugitive coke oven battery emissions at the Mountain State Carbon facility in Follansbee, West Virginia. The Model Clearinghouse finds that the requirements and recommendations of Section 3.2 of the *Guideline* were previously met for the BLP/AERMOD Hybrid method in the case of the U.S. Steel Mon Valley Works - Clairton Plant situation. Furthermore, a justifiable basis has been provided by EPA Region 3 for the application of this previously case-specific approved alternative model at the AK Steel – Mountain State Carbon, LLC Follansbee Plant given the unique similarities between the emissions sources at these two facilities, the similarities in complex topographical and meteorological settings surrounding these two facilities, and the similarities in alternative modeling approach for assessing the fugitive emissions from the coke oven batteries at these two facilities. The Model Clearinghouse hereby concurs with EPA Region 3 on the alternative model approval for the West Virginia SIP. It is noted that all aspects of this Regional Office alternative model approval and Model Clearinghouse concurrence should be included in the record for the SIP approval 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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[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