west virginia department of environmental protection

Appendix H:
Alternative Model Approval BLP/AERMOD Hybrid Approach

West Virginia Division of Air Quality
601 57th Street, SE
Charleston, WV 25304

Promoting a healthy environment.

[This page intentionally left blank.]

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

OCT 18 2018

MEMORANDUM

SUBJECT: Concurrence Request for Approval of Alternative Model: BLP/AERMOD Hybrid Approach for Modeling Fugitive Emissions from Coke Oven Batteries at the AK Steel – Mountain State Carbon facility located in Follansbee, Brooke County, West Virginia

FROM: Timothy A. Leon Guerrero, Meteorologist TALG
Office of Air Monitoring and Analysis, Air Protection Division, EPA Region 3

Todd Ellsworth for

THRU: Alice Chow, Associate Director
Office of Air Monitoring and Analysis, Air Protection Division, EPA Region 3

TO: George Bridgers, Director of Model Clearinghouse
Air Quality Modeling Group, Office of Air Quality Planning and Standards

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 four (4) coke oven batteries at the AK Steel - Mountain State Carbon facility located along the Ohio River in Brooke County, Follansbee, West Virginia (WV). EPA Region 3 is seeking concurrence under 40 CFR Part 51, Appendix W- Guideline on Air Quality Models, paragraph 3.2.2(b)(2), to use this alternative model. The modeling demonstration using this alternative model approach was included in West Virginia's 1-hour SO_2 State Implementation Plan or SIP that was submitted to EPA on April 25, 2016 and deemed administratively complete on October 2, 2016.

EPA Region III is seeking Model Clearinghouse concurrence with this alternative model approval based on the Model Clearinghouse's recent action for using the BLP/AERMOD Hybrid technique for U. S. Steel Corporation's Clairton Plant located in the City of Clairton, Allegheny County, Pennsylvania (PA). Both facilities utilized similar alternative model approaches to simulate their coke oven fugitive emissions. Additionally, coking operations at both facilities are nearly identical, both facilities are located in similar terrain settings and both facilities are subject to complex terrain-induced wind patterns. These similarities are the basis for this concurrence request. A short technical analysis is included for your consideration. Please feel free to contact Alice Chow at (215) 814-2144 or myself at (215) 814-2192 if you have questions regarding our concurrence request.

Attachment.

EPA Region III Technical Review of the BLP/AERMOD Hybrid Approach Used in the West Virginia Attainment Demonstration

1. Regulatory Background

On June 22, 2010, the Environmental Protection Agency (EPA) promulgated a new 1-hour primary SO_2 National Ambient Air Quality Standard (NAAQS) of 75 parts per billion (ppb), which is met at an ambient air quality monitoring site when the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations does not exceed 75 ppb, as determined in accordance with appendix T of 40 CFR part 50. (2010 SO_2 NAAQS). *See* 75 FR 35520. On August 5, 2013, EPA designated a first set of 29 areas of the country as nonattainment for the 2010 SO_2 NAAQS, including the Steubenville, Ohio-West Virginia (Steubenville, OH-WV) multi-state area, based on measured violations of the standard (*See* 78 FR 47191). The designations were effective on October 4, 2013. As a result of this designation, Ohio and West Virginia were required to develop State Implementation Plan (SIP) revisions to demonstrate attainment of the NAAQS within 18 months of the effective date of designation. The SIP revisions were due on April 4, 2015. On March 18, 2016, EPA found that West Virginia had failed to make this submittal *See* 81 FR 14736, effective April 18, 2016.

During the development of its attainment plan, West Virginia used the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD), the preferred model for most near-field regulatory applications, for all sources except the fugitive emissions emanating from the coke oven batteries. West Virginia used the Buoyant Line and Point Source Model (BLP) to characterize these fugitive emissions. In its approach, West Virginia generated hourly varying release heights using BLP and then calculated initial dispersion coefficients. Fugitive emissions were then included in EPA's preferred dispersion model, AERMOD, using multiple hourly varying volume sources with the hourly varying release heights determined from the BLP and these calculated initial dispersion coefficients.

Appendix W of 40 CFR Part 51 identifies models which are preferred for regulatory application and which have undergone evaluation exercises including statistical measures of model performance (appendix A of Appendix W). Under 40 CFR 51.11 2(a)(2) and 40 CFR 51 Appendix W, section 3.2, if the preferred model is inappropriate for a particular application in a SIP, the model may be modified or another model substituted, provided that EPA approves the modification or substitution. Appendix W, section 3.2.2 (b) requires that an alternative model be "evaluated from both a theoretical and a performance perspective before it is selected for use," and outlines several conditions under which an alternative model can be approved. EPA Region 3 is seeking concurrence for the alternative BLP/AERMOD Hybrid approach under Appendix W, section 3.2.2 (b), condition (2), where "*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.*" Unfortunately, monitoring data necessary to complete this 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 justification and concurrence for use of the BLP/AERMOD Hybrid alternative model approach is outlined in a recent EPA Model Clearinghouse action (18-III-01). Allegheny County prepared a detailed analysis supporting its methodology entitled "*Alternative Modeling Technical Support Document: Buoyant Fugitives in Complex Terrain with a BLP/AERMOD Hybrid Approach*" dated July 27, 2018, which is available via the Model Clearinghouse Information Storage and Retrieval System[1].

2. Facility Location and Description

The AK Steel - Mountain State Carbon, LLC Follansbee Plant (Mountain State Carbon) 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 (4) coke oven batteries. These batteries consist of one (1) 6-meter battery and three (3) 3-meter batteries; the battery dimensions are a reference to the coke oven battery heights. Coke oven battery heights are generally well correlated with a battery's age with taller ovens being more recently constructed than shorter ovens. Mountain State Carbon can produce in excess of one million tons of coke products per year (using slightly over 2,000,000 tons of coal). In addition, the facility operates a by-product plant that recovers usable products from the coking process and prepares coke oven gas (COG) for use as fuel for Mountain State Carbon's battery operations and on-site boilers. Other products produced at the by-product plant include light oil, ammonium sulfate, fuel gas, coal tar and sulfuric acid.

In 2017, Mountain State Carbon marked 100 years of coking operations at its Follansbee Plant. According to information in Mountain State Carbon's Title V permit[2], Batteries 1-3 were constructed in 1917 with major modifications occurring in 1953. Battery 8 is the most recently constructed battery and appears to have been brought online in 1976. At one time, coking operations were affiliated with a large steel mill complex located slightly down river near Mingo Junction in Jefferson County, OH. Operations at the former Wheeling-Pittsburgh Steel Electric Arc Furnace and Rolling Mill in Mingo Junction were suspended in 2009.

Mountain State Carbon resides in the Allegheny Plateau province of the Appalachian Mountain system. This area is made up of complex river valley terrain and includes rural land, densely populated neighborhoods and some industrial facilities. Besides the coke plant and shuttered steel mill, the nonattainment area also includes the Cardinal Power Plant, a coal-fired electric generating plant located approximately ten (10) km south of Mountain State Carbon near Brilliant, OH. Another large steel manufacturing complex, Weirton Steel, is located approximately ten (10) km north of Mountain State Carbon in neighboring Hancock County, WV, just outside the nonattainment area. This facility's SO_2 emissions, however, are less than two (2) tons per year (tpy) due to production changes that occurred a decade ago.

Coke products at Mountain State Carbon are made by heating coal to extremely high temperatures (over 1,800° F) in an oxygen deficient atmosphere. This concentrates the carbon and removes any impurities. The coke produced is subsequently used as fuel in iron and steel production and foundry operations because it generates very high heat with less smoke than coal. The production of the coke itself, however, produces significant amounts of reduced sulfur compounds due to sulfur in the raw coal being liberated in the coke oven batteries. Sulfur dioxide is produced when COG is burned in the ovens,

[1] https://cfpub.epa.gov/oarweb/MCHISRS/index.cfm?fuseaction=main.search
[2] See Section 1.1 of Mountain State Carbon's Title V permit documentation: https://dep.wv.gov/daq/permitting/titlevpermits/Documents/August%202015/Mt.%20State%20Carbon%20Final.pdf

boilers and flares. In 2013, Mountain State Carbon emitted 467.94 tons of SO_2[3]. Total combined SO_2 SIP modeled emissions for Mountain State Carbon were 2,229.7 tpy.

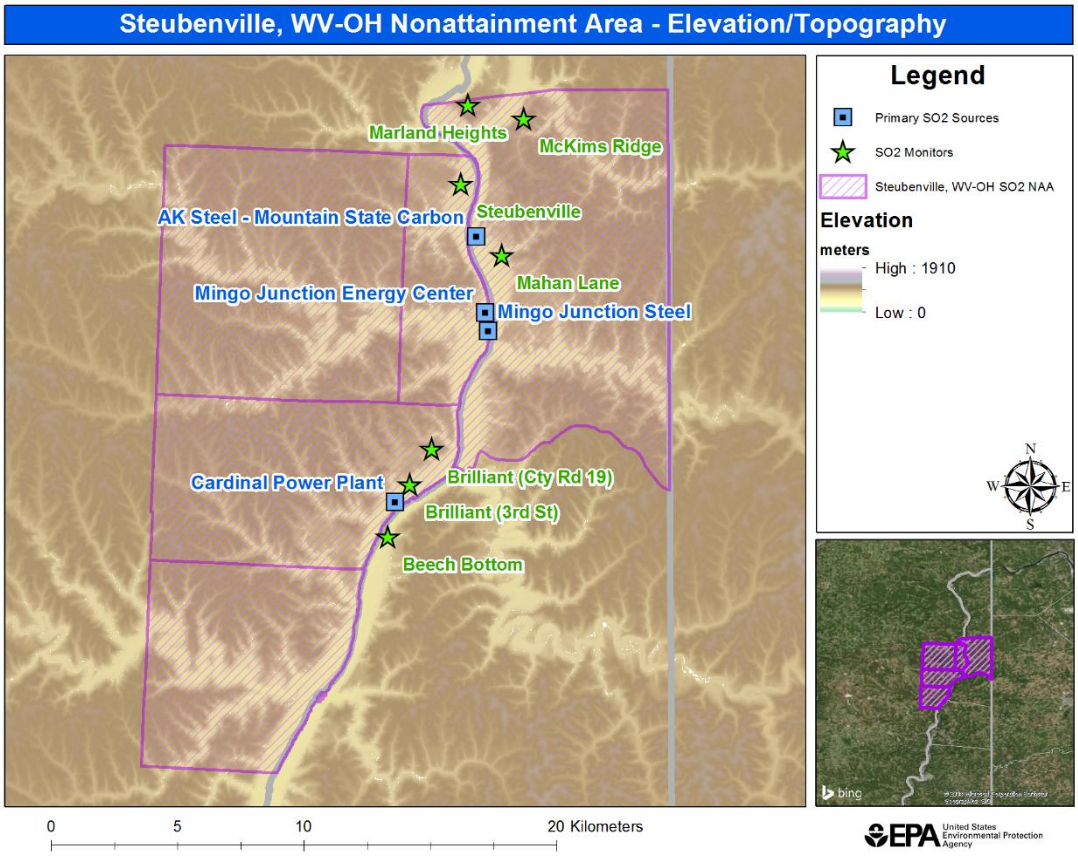
Coking facilities are complex emission sources with multiple emission points and include numerous structures where building downwash can impact pollutant dispersion. As noted previously, sulfur is driven off during the coking process producing reduced sulfur compounds, primarily hydrogen sulfide (H_2S). SO_2 is produced when reduced sulfur compounds are oxidized (or burned). Material/product handling processes generate numerous individual particulate emission sources while the coke production processing itself generates combustible COG that contributes to particulates and SO_2 emissions when burned. COG derived from the Mountain State Carbon's coking process is collected from the ovens and sent via pipeline to the facility's by-product (acid) plant to recover usable products including COG. Operations at Mountain Stare Carbon's acid plant effectively reduce the COG's sulfur content prior to combustion. Treated COG is then sent back to the coke ovens for combustion to heat the ovens, is used in on-site boilers for steam generation or is flared. Off-site transport of COG is no longer permitted in accordance with a Consent Order in the West Virginia portion of the Steubenville, OH-WV 1-hour SO_2 SIP.

Mountain State Carbon periodically shuts down its acid (by-product) plant for regularly scheduled maintenance; two ten-day periods, one ten-day period in the spring and one ten-day period in the fall. During these "outage" periods there is no means to reduce the COG's sulfur content and plantwide SO_2 emissions increase substantially. This practice is common for other by-product coking operations in Region 3 that do not have redundant COG treatment systems. Non-recovery type coke plants, by design, have no means of removing reduced sulfur compounds prior to COG combustion and therefore have much higher SO_2 emissions.

As noted previously, Mountain State Carbon is located along the Ohio River. This part of the northern panhandle of West Virginia resides in the Allegheny Plateau physiographic province of the Appalachian Mountain system. This area is marked by dendritic rivers systems imbedded within steep valleys were terrain rises approximately 120 meters above the (river) valley floors (Figure 1).

[3] See WV DEP Title V documents available at: https://dep.wv.gov/daq/permitting/titlevpermits/Pages/default.aspx

Figure 1. Steubenville, WV-OH 1-Hour SO_2 Nonattainment Area



3. BLP/AERMOD Hybrid Approach-Technical Basis

Generating metallurgical and foundry coke from coal involves prodigious amounts of heat. Coke ovens themselves operate at temperatures that can exceed 1,800° F. While emissions from coking operations can be well controlled at times, the nature of the production process generates opportunities for fugitive emissions that must be accounted for in any modeling demonstration. Fugitive SO_2 emissions are generated from leaks in the COG collection system (from stand pipes, manhole covers or flue ducts that can be caused by system upsets that generate brief episodes of positive pressure in the collection system that damage air-flow seals), from coke oven charging events, from leaks from malfunctioning and/or imperfect coke oven door seals, from coke oven door opening events, from coke oven pushing events, from hot-car transportation, from coke handling operations and from coke quenching activities**.** Fugitive emissions are reported as part of EPA's National Emission Inventory (NEI). According to the 2014 NEI, Mountain State Carbon's fugitive SO_2 emissions accounted for approximately 1% of the total plant-wide SO_2 emissions. This fraction represents a small percentage of the annual emissions from Mountain State Carbon. Fugitive SO_2 emissions represent a much smaller fraction of Mountain State Carbon's total hourly emissions during periods when the acid plant is offline (outage periods) when plant-wide hourly emissions increase substantially. These outages, according to West Virginia's SIP modeling demonstration, are generally the controlling periods and are the largest contributors to the SIP simulation's final modeled design value.

Fugitive coke oven emissions are not easily characterized using the standard emission characterizations available in current air-dispersion models, such as the POINT, VOLUME and AREA source characterizations used in AERMOD, because coke ovens involve super-heated materials that generate emissions that are very buoyant with respect to normal ambient temperatures. Historically in Region 3, coke oven fugitive emissions have been modeled using a technique that accounts for these emissions' initial buoyancy. Previous PM_{10} SIPs for Allegheny County and Steubenville-Weirton, OH-WV have used a technique that used EPA's Buoyant Line and Point Source (BLP) model. More specifically, the modeling used emission source estimates of temperature and vertical velocity as input into BLP to yield estimated plume rise and the calculated initial dispersion coefficients, then treating emissions as (hourly varying) VOLUME sources within the air-dispersion model. Memos discussing this characterization are referenced as 91-III-12, 93-III-06, and 94-III-02 in the Model Clearinghouse Information Storage and Retrieval System[4]. A similar approach was used in EPA's *Risk Assessment Document for Coke Oven MACT Residual Risk*[5]. More recently, this approach was used to model buoyant fugitive coke oven emissions from the U. S. Steel Corporation's Clairton Plant in Allegheny County, Pennsylvania, by the Allegheny County Health Department for its current $PM_{2.5}$ SIP modeling platform and previously in its 1-hour SO_2 SIP modeling demonstration[6]. A comprehensive analysis by the Allegheny County Health Department[7] using several source characterization methods and AERMOD's regulatory BUOYLINE source characterization determined that the BLP/AERMOD Hybrid approach "…*is currently the best available method for modeling buoyant line sources in the complex terrain*…". Given the similarities in terrain and source type, EPA Region 3 believes it is appropriate to use this approach for Mountain State Carbon's buoyant coke oven fugitive emissions.

4. Approval Basis for the Alternative BLP/AERMOD Hybrid Approach for Mountain State Carbon

The basis for approval of West Virginia's use of the alternative BLP/AERMOD Hybrid approach is predicated on the Allegheny County Health Department's alternative model demonstration, which recently received alternative model approval and concurrence. A full statistical analysis for Mountain State Carbon's coke oven fugitive emissions was unable to be performed due to the lack of monitoring data near the area of the modeled predicted peak concentrations. Coke oven fugitive emissions from Mountain State Carbon and U. S. Steel's Clairton Plant are both simulated using a similar approach. An extensive analysis by Allegheny County fully demonstrates that the alternative BLP/AERMOD Hybrid approach provides better model performance over the current regulatory (BUOYLINE source characterization) version of AERMOD. Similarities in buoyant fugitive emission sources, terrain and complex wind flows between these two (2) facilities, in EPA Region 3's opinion, are sufficient for an alternative model concurrence from the Model Clearinghouse.

While there are some differences in feed coal, coke oven age and COG by-product plant operations, the fugitive coke oven emissions from both Mountain State Carbon and U. S. Steel's Clairton Plant are essentially the same in that they are initially very buoyant due to the substantial heating involved in the coke making process. Based on Allegheny County's recent alternative model analysis, utilizing the

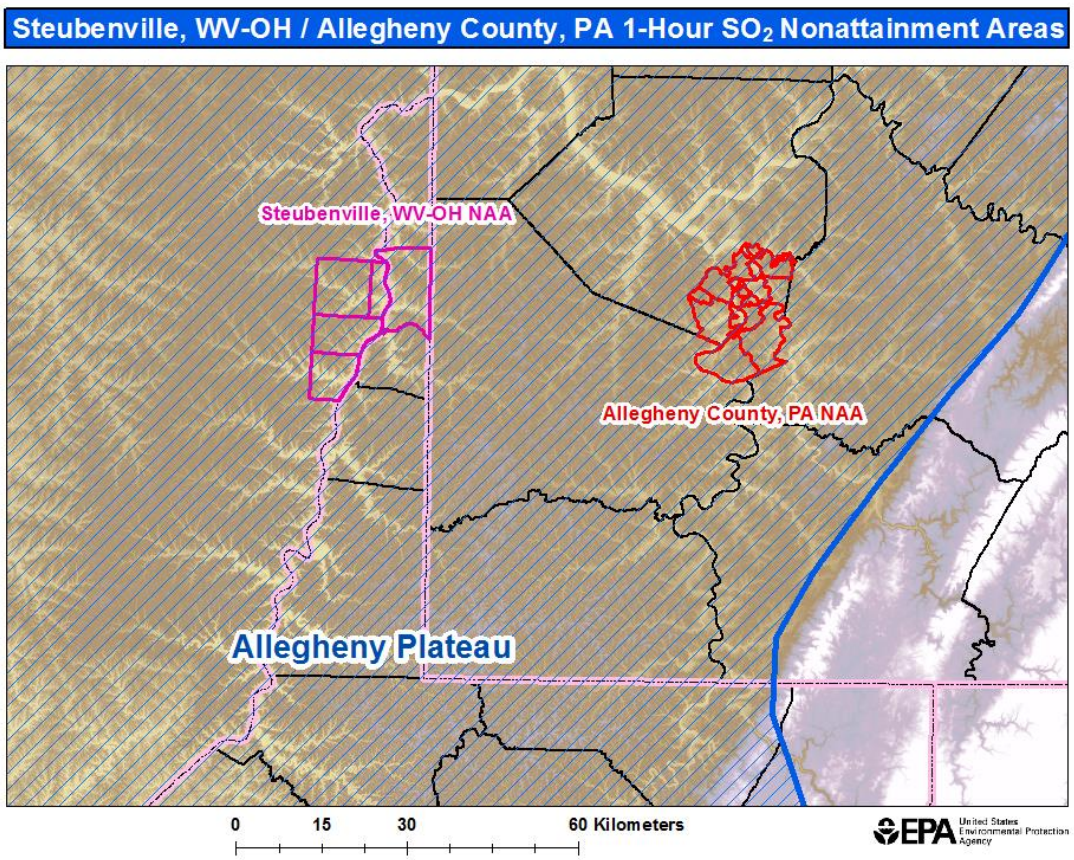
---

[4] https://cfpub.epa.gov/oarweb/MCHISRS/index.cfm?fuseaction=main.search
[5] Report dated December 22, 2003, and available at: https://www.epa.gov/sites/production/files/2016-01/documents/coke_rra.pdf
[6] https://www.alleghenycounty.us/Health-Department/Programs/Air-Quality/Regulations-and-SIPs.aspx
[7] https://www3.epa.gov/ttn/scram/guidance/mch/new_mch/ACHD_Alternative_Demo_Buoyant_Fugitives_Final.pdf

BLP/AERMOD Hybrid approach provides better model performance for these very hot (buoyant) fugitive emission sources than the regulatory version of AERMOD.

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 (see Figure 2). 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 U. S. Steel's Clairton Plant. Given the similarities in terrain between the coke plants we would expect each facility's buoyant fugitive emissions to behave similarly and therefore be better simulated using the alternative BLP/AERMOD Hybrid approach.

Figure 2. Steubenville, WV-OH and Allegheny County Nonattainment Areas

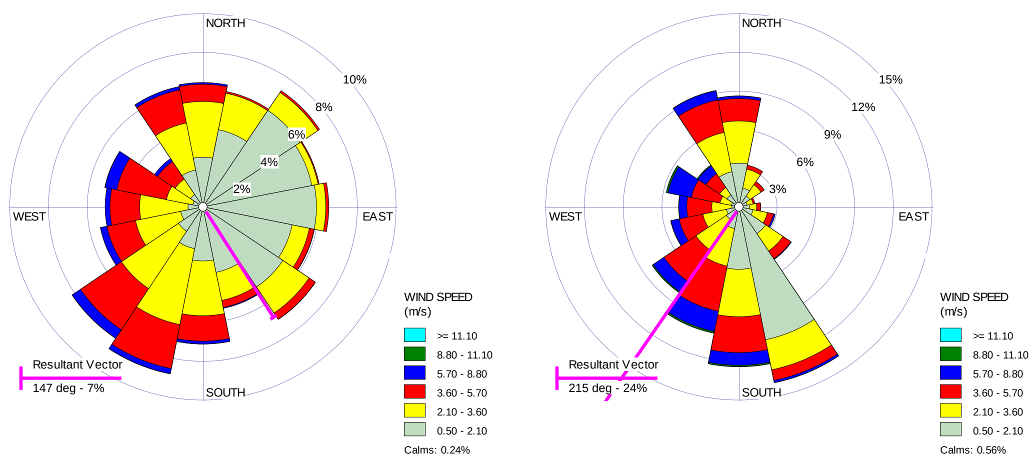


Another common feature shared between Mountain State Carbon and U. S. Steel's Clairton Plant is the presence of complex wind fields created by the surrounding terrain. Both areas experience nocturnal inversions that impact overnight wind field patterns. Allegheny County conducted a thorough analysis of the impacts of local terrain induced meteorological patterns using a prognostic meteorological model to more accurately reproduce the wind flows that impact local air dispersion. Given the similar terrain setting surrounding Mountain State Carbon, it should similarly be subject to complex wind flow patterns, especially during the overnight hours. West Virginia used meteorological data from a 50-m tower (Follansbee Met Tower) located just south of Mountain State Carbon in its 1-hour SO_2 SIP modeling analysis. Winds were collected at 10-m and 50-m for three years (2007-09). Figure 3 shows wind roses for the Follansbee Met Tower and the prognostic Weather Research Forecast or WRF model used to simulate winds near U. S. Steel's Clairton Coke Plant. Wind roses and predominant wind field vectors represent the 10-m and 50-m levels at both facilities and show that wind fields vary with height at both locations. Wind directions differ between the two (2) sites due to differences in valley orientations between Mountain State Carbon and U. S. Steel Clairton. While there are differences in each area's wind fields, both areas experience similar complex (vertical) wind patterns that impact dispersion.

Figure 3. Follansbee Met Tower and U. S. Steel's Clairton Plant Prognostic Wind Roses

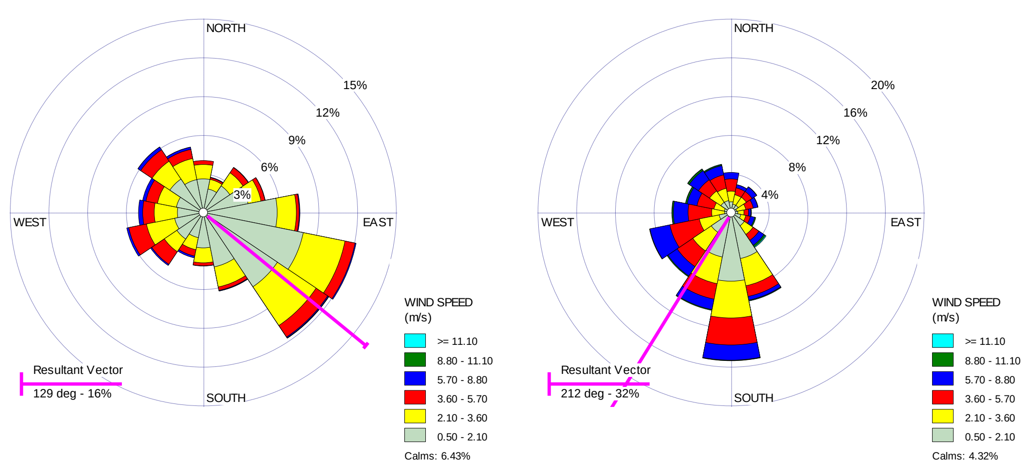
Follansbee, WV Met Tower

10-m Tower Wind Rose **50-m Tower Wind Rose**



US Steel – Clairton Plant 440-m Grid MMIF Data

10-m MMIF Wind Rose **50-m MMIF Wind Rose**



5. Conclusion

EPA Region 3 is seeking Model Clearinghouse concurrence of the alternative model approval for West Virginia's use of the BLP/AERMOD Hybrid approach to model Mountain State Carbon's buoyant fugitive coke oven emissions. A similar alternative model approach received Model Clearinghouse concurrence for a similar by-product coking plant in Allegheny County, Pennsylvania, as described in the previous sections.

While a complete statistical analysis under Appendix W section 3.2.2 (b)(2) was not possible for Mountain State Carbon due to the lack of monitoring data in the area of maximum model impact, EPA Region 3 proposes that an alternative model approval and Model Clearinghouse concurrence can still be granted based on the recent statistical analysis completed by the Allegheny County Department of Health and the similarities between Mountain State Carbon and U.S. Steel Clairton. This statistical analysis showed the BLP/AERMOD Hybrid approach provided better model performance than the regulatory version of AERMOD for these source types. These similarities between the two facilities include:

- Both coke plants used a similar approach, the BLP/AERMOD Hybrid approach, to model buoyant fugitive emissions from their coke oven operations
- Both coke plants have similar (fugitive) emission sources. Mountain State Carbon (Steubenville, OH-WV nonattainment area) and U. S. Steel's Clairton Plant are by-product coke plants with nearly identical coke-production processes, which release similar types of very hot (buoyant) fugitive SO_2 emissions.
- Both coke plants have similar topographic settings. Each plant is located in a major river valley with steep valley slopes that give way to higher plateau elevations. Elevation differences between the river valley floor and higher plateau areas at both plants are approximately 120 m. Similar topographic settings are due to the plants residing within the Allegheny Plateau physiographic province of the Appalachian Mountain system. Mountain State Carbon is roughly 60 km west of U. S. Steel's Clairton Plant.
- Both coke plants show evidence of complex (vertical) wind structures, which ultimately impact emission dispersion though differences in valley orientation yield different wind patterns between the two (2) sites.

Analysis recently submitted by the Allegheny County Health Department and reviewed by EPA indicates that the BLP/AERMOD Hybrid approach, also utilized by West Virginia for Mountain State Carbon, provides better model performance when simulating the impacts from the very hot (buoyant) coke oven fugitive emissions in complex terrain settings. This approach for modeling buoyant coke oven fugitive emissions has a long history of use in EPA Region 3 and ultimately received Model Clearinghouse concurrence (18-III-01) for use at the U. S. Clairton Plant on August 10, 2018. Due to similarities between Mountain State Carbon and U. S. Steel's Clairton Plant, we formally request Model Clearinghouse concurrence with our request to approve the BLP/AERMOD Hybrid approach, an alternative model under section 3.0 of Appendix W – Guideline on Air Quality Models, in West Virginia's 1-hour SO_2 SIP modeling demonstration.

[This page intentionally left blank.]

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

FROM: George Bridgers, Model Clearinghouse Director
Air Quality Modeling Group, Air Quality Assessment Division, Office of Air Quality Planning and Standards

TO: Timothy A. Leon Guerrero, Meteorologist
Office of Air Monitoring and Analysis, Air Protection Division, EPA Region 3

Alice Chow, Associate Director
Office of Air Monitoring and Analysis, Air Protection Division, EPA Region 3

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.

cc: Richard Wayland, C304-02
Anna Wood, C504-01
Tyler Fox, C439-01
Raj Rao, C504-01
EPA Air Program Managers
EPA Regional Modeling Contacts

[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