



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

JUN 20 2016

MEMORANDUM

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

SUBJECT: Model Clearinghouse Review of the Use of the ADJ_U* Beta Option in the AERMET Meteorological Processor (Version 15181) for the Herbert A. Wagner Generating Station Modeling Demonstration

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INTRODUCTION

In response to your May 13, 2016 concurrence request memorandum, the Model Clearinghouse has reviewed Region 3's position on the proposed use of the ADJ_U* Beta option in the AERMET meteorological processor (version 15181) for the Herbert A. Wagner Generating Station (Wagner) facility located near the City of Baltimore, Maryland. As noted in our February 10, 2016 response memorandum to Region 10 regarding the Donlin Mine Compliance Demonstration¹ and in our April 29, 2015 response memorandum to Region 1 regarding the Schiller Station Modeling Demonstration², the ADJ_U* Beta option was incorporated in AERMET to address concerns regarding potential underprediction of the surface friction velocity (u^*) during low-wind/stable conditions that could contribute to overprediction of ambient air impacts by the AERMOD dispersion model (version 15181) for some applications. In the case of the Wagner facility, excessive 1-hour SO_2 concentrations on terrain at elevations above the lowest effective stack height at distances of 20 km to 34-37 km from the source were predicted by the regulatory default version of the AERMOD Modeling System, specifically during low-wind/stable conditions when u^* values were relatively small. This parallels similar excessive 1-hour SO_2 concentrations predicted on distant terrain during similar low wind/stable conditions for the Region 1 Schiller Station situation. Given this model response and our similar concurrence of ADJ_U* for a nearly identical circumstance, we agree that it was appropriate for the ADJ_U* Beta option in AERMET to be considered for this regulatory modeling application at the Wagner facility.

¹ <http://cfpub.epa.gov/oarweb/MCHISRS/index.cfm?fuseaction=main.resultdetails&recnum=16-X-01>

² <https://cfpub.epa.gov/oarweb/MCHISRS/index.cfm?fuseaction=main.resultdetails&recnum=16-I-01>

MODEL CLEARINGHOUSE RESPONSE

Application of ADJ_U* Beta Option in AERMET

Appendix W, Section 3.2.2 provides three different conditions for which an alternative model is approvable. These three conditions are briefly summarized as:

- 1) The alternative and preferred model provide equivalent estimates;
- 2) The alternative model outperforms the preferred model when comparing the results to actual air quality data; or
- 3) The preferred model is less appropriate or there is no preferred model for the given scenario.

In reviewing the May 13, 2016 concurrence request memorandum from Region 3 and the attached material from the Maryland Department of the Environment (MDE), it is noted that MDE chose to follow the third condition³ of Appendix W, Section 3.2.2 for the basis of this alternative model justification. Additionally, Region 3 summarized this approach and provided additional context for a third condition approval in concurrence request memorandum. The third condition includes five criteria that must be addressed in the development of a comprehensive alternative model justification package. These criteria are as follows:

- i) The model has received a scientific peer review;
- ii) The model can be demonstrated to be applicable to the problem on a theoretical basis;
- iii) The data bases which are necessary to perform the analysis are available and adequate;
- iv) Appropriate performance evaluation of the model have shown that the model is not biased toward underestimates; and
- v) A protocol on methods and procedures to be followed has been established.

While the Model Clearinghouse concurs that a well-reasoned justification following this third condition was thoroughly documented by MDE and subsequently Region 3, we feel that our concurrence with Region 3's approval for the use of the ADJ_U* Beta option in AERMET in the Wagner facility modeling demonstration is also appropriately aligned with the second condition⁴ of Section 3.2.2 mentioned above. In the MDE alternative model justification package, there is a reasonable demonstration that the ADJ_U* Beta option performs better than the default regulatory version of AERMET for the given application where high modeled concentrations are likely to occur under low wind, stable conditions. In this case, distant terrain features are located at around 20 km and between 34 and 37 km northwest of the Wagner facility with a peak elevation approximately 200m above the stack base, with relatively flat or gradually sloping terrain between the source and these terrain features.

This said, there is substantial and important information contained in the MDE discussion of each of the five criteria of the third condition that is germane to our concurrence of the Region 3

³ Appendix W to 40 CFR, Part 51, Section 3.2.2.b(3).

⁴ Appendix W to 40 CFR, Part 51, Section 3.2.2.b(2).

request. In particular, we appreciate the specific reference of the foundational peer reviewed scientific work of Qian and Venkatram⁵ and highlight of additional evaluation databases, namely the Lovett⁶ and Mercer County, ND⁷, that more directly represent the Wagner facility and surrounding terrain circumstances. MDE appropriately established that the Lovett evaluation demonstrates an improvement of the modeled concentrations with the use of the ADJ_U* Beta option for a facility with tall stacks located near complex terrain, particularly during low wind, stable conditions. While the Wagner facility is located at further distances from the higher terrain features than in the Lovett evaluation, we feel that the comparisons with respect to the application of the ADJ_U* Beta option are adequate for this circumstance. Combined with additional journal article references in the MDE alternative model submittal that support the scientific basis for the adjustment to u*, there is sufficient justification for the application of the ADJ_U* Beta option in the Wagner facility modeling demonstration.

The MDE alternative model submittal package included a source specific model sensitivity and monitor evaluation that is worth noting in our concurrence memorandum. As with the previously referenced Region 1 Schiller Station alternative model concurrence, a model sensitivity analysis was performed by MDE to demonstrate the appropriateness and applicability of the ADJ_U* Beta option in this modeling demonstration for the Wagner facility. The sensitivity analysis indicated that the most critical impacts at receptors on the distant terrain were only occurring at hours when the u* values were substantially low, which is indicative of low wind, stable conditions. These receptors were all at or above the lowest effective emissions release height at the Wagner facility. The application of the ADJ_U* Beta option resulted in comparable increases in the u* values and reductions to the concentrations at these receptors as demonstrated in the representative Lovett evaluation. For these nearby controlling receptors not associated with the distant terrain features, the critical impacts were occurring at times of much higher u* values, and these u* values were relatively unchanged with the application of the ADJ_U* Beta option. Therefore, we support that the model sensitivity analysis is providing further evidence of the relevance and appropriateness of the ADJ_U* Beta option for the Wagner facility modeling demonstration.

Lastly, there was indication in our aforementioned February 10, 2016 and April 29, 2016 response memorandums to Region 10 and Region 1, respectively, that EPA has concerns that the use of the ADJ_U* Beta option in combination with site-specific meteorological data that includes the sigma-theta and/or sigma-w turbulence parameters may introduce a bias toward concentration underprediction. We continue to evaluate the potential for this concentration underprediction bias and caution anyone considering the use of both the ADJ_U* Beta option and meteorological data that includes the derived sigma-theta and/or sigma-w turbulence parameters in regulatory applications without consultation and approval from the appropriate

⁵ Qian, W. and A. Venkatram. 2010. "Performance of Steady-State Dispersion Models Under Low Wind-Speed Conditions." *Boundary-Layer Meteorology* (2011) 138:475–491 DOI 10.1007/s10546-010-9565-1. Published online December 3, 2010. Accessed August 24, 2015.

⁶ EPA's Addendum: User's Guide for the AMS/EPA Regulatory Model – AERMOD. September 2004, updated June 2015. EPA-454/B-03-001. Appendix F. Evaluation of Low Wind Beta Options.

⁷ Paine, R., O. Samani, M. Kaplan, E. Knipping and N. Kumar. 2015. Evaluation of low wind modeling approaches for two tall-stack databases", *Journal of the Air & Waste Management Association*, 65:11, 1341-1353, DOI: 10.1080/10962247.2015.1085924.

permitting authority and the respective EPA Regional Office. However, it is noted that the meteorological data used in the Wagner facility modeling application were not site-specific and did not include any derived sigma-theta or sigma-w turbulence information. So, the underprediction bias concern is not a factor in this case.

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