UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Model Clearinghouse review of a Stack-Specific Alternative Modeling Approach for Applying Downwash in AERMOD for Ahlstrom-Munksjö in Rhinelander, Wisconsin

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INTRODUCTION

The Wisconsin Department of Natural Resources (WI DNR) is seeking approval of a stack-specific alternative modeling approach for modeling building downwash of sulfur dioxide (SO_2) at the Ahlstrom-Munksjö pulp and paper mill located in Rhinelander, Wisconsin (Rhinelander facility) emissions. This alternative modeling approach will be included as part of the WI DNR's "State Implementation Plan Attainment Demonstration for the Oneida County 2010 1-hour Sulfur Dioxide National Ambient Air Quality Standard Nonattainment Area" (SO_2 NAAQS SIP). The stack-specific approach is only applied to stack S09 at the Rhinelander facility. In this approach, the impact of downwash is reproduced by applying a relationship derived from wind tunnel modeling in which the effect of downwash increases with increasing wind speed and decreases with declining wind speeds until the effect becomes negligible, at wind speeds below 2 m/s. This is implemented in AERMOD by increasing hourly emissions based on ambient wind speed to account for the increasing influence of downwash on surface concentrations.

EPA Region 5 reviewed the alternative model justification and submission from the WI DNR and considers the use of the proposed stack-specific alternative modeling approach to applying downwash in AERMOD to be acceptable based upon improved model performance as demonstrated through a case-specific model-to-monitor comparison as required by the EPA's *Guideline on Air Quality Models* (40 CFR Part 51, Appendix W or *Guideline*), Section 3.2.2(b)(2). Subsequently, EPA Region 5 submitted a formal alternative model concurrence request to the Model Clearinghouse on April 29, 2021.

BACKGROUND

As more thoroughly described in the EPA Region 5 alternative model concurrence request memorandum, the Oneida County, Wisconsin area was designated nonattainment for the 2010 SO_2 National Ambient Air Quality Standard (NAAQS) in August 2013. The nonattainment designation was based on ambient SO_2 concentrations from a monitoring site (AQS site ID 55-085-0996) that was located immediately downwind from the Rhinelander facility. This monitoring site has further been demonstrated by a wind tunnel study to be located in the area of expected peak concentrations from the Rhinelander facility. The WI DNR has also determined that the Rhinelander facility stack, S09, is the primary source contributing to the current SO_2 nonattainment in the Oneida County area.

There have been previous regulatory compliance efforts with the Rhinelander facility for earlier SO_2 NAAQS and permitting requirements. In each of these previous efforts, the use of modeling, both ISCST and AERMOD, has resulted in significantly underpredicted SO_2 impacts at the monitoring location. These model biases towards underestimates have partially been attributed to a building downwash phenomenon, referred to as a corner vortex or corner vortices, that are not fully captured by AERMOD in certain situations.

To further evaluate the corner vortex phenomenon and to adequately justify an alternative modeling approach to applying downwash in AERMOD for stack S09, a scientific wind tunnel study was conducted to evaluate dispersion conditions in and around the Rhinelander facility. The wind tunnel study was conducted using appropriate EPA technical guidance in consultation with EPA Region 5, EPA's Office of Air Quality Planning and Standards, and EPA's Office of Research and Development. There were two resulting wind tunnel study reports that are cited in the EPA Region 5 alternative model concurrence request memorandum. The WI DNR used the wind tunnel study to evaluate the impact of building downwash and to justify a stack-specific approach for representing building downwash associated with emissions from stack S09 into its air quality modeling demonstration in the SO_2 NAAQS SIP to show modeled attainment for the Oneida County area.

MODEL CLEARINGHOUSE REVIEW

The EPA's *Guideline*, Section 3 provides for the promulgation of EPA preferred air quality models and allows for the acceptance and approval of alternative models and modeling techniques. The *Guideline*, Section 3.2.2(a) requires that all alternative models are determined to be acceptable by the appropriate EPA Regional Office in consultation with the Model Clearinghouse. Further, the *Guideline* outlines three separate conditions in Section 3.2.2(b) to which an alternative model can be determined to be acceptable for use in regulator applications.

Given the previously identified underestimate biases specific to downwind SO_2 impacts attributed to stack S09 with the EPA preferred models and the statistical model evaluation presented in the accompanying WI DNR Technical Support Document (TSD), Section 3.2.2(b)(2) is the most appropriate of these three conditions for this specific Rhinelander facility alternative modeling application. This condition requires that a statical performance evaluation

be conducted using measured air quality data and that the results of that evaluation indicate that the alternative model performs better for the given application than the comparable preferred model as listed in Appendix A to the *Guideline*.

The Model Clearinghouse finds that EPA Region 5 performed a reasonable and thorough review of the CPP Inc. wind tunnel evaluation of the corner vortex downwash phenomenon and the subsequent case-specific model-to-monitor comparison of the stack-specific alternative modeling approach for representing downwash at stack S09. An adequate basis was provided in the EPA Region 5 alternative model concurrence request and the WI DNR TSD for the alternative downwash approach using a site-specific relationship between wind speed and the degree of concentration enhancement due to building downwash from the wind tunnel results.

Regarding the case-specific model-to-monitor comparison presented in the WI DNR TSD, the previous model underestimate biases were abated with resulting alternative modeling results predicting SO_2 concentrations significantly higher than the regulatory default version of AERMOD at the monitoring site. Across the three years of air quality monitor data used in the model-to-monitor comparison, there was not a demonstrated systematic model underestimate bias.

The Model Clearinghouse also appreciates the degree to which EPA Region 5 considered and additionally evaluated the various equations and coefficients brought forward by the WI DNR from the CPP Inc. October 2020 report, "SO2 NAAQS Compliance Modeling Report for the Rhinelander Mill." Due to the many complicating facets of the situation with stack S09 at the Rhinelander facility over the past few years, the EPA Region 5 concise summary of this CPP Inc wind study through our internal coordination engagements and the alternative model concurrence documented were especially helpful to the Model Clearinghouse's concurrence with the Region's determination of alternative model acceptability. This report will be attached to this Model Clearinghouse action for future reference by interested parties.

The Model Clearinghouse fully concurs with the following 3 paragraphs pulled directly from the EPA Region 5 April 29, 2021 alternative model concurrence request,

> "Region 5 is recommending approval of Wisconsin's stack-specific approach for representing downwash of SO_2 emissions from the Mill's stack S09 with the Equation 1 multiplier, R, and is requesting concurrence for this recommendation from the MCH. Section 3.2.2.b.2 states that an alternative model may be approved, on a theoretical and performance basis, if a statistical evaluation shows the model to perform better than the comparable model in Appendix A. The accompanying Technical Support Document (TSD) details a case-specific statistical model-to-monitor analysis conducted for this alternative model application. It clearly shows improved model performance compared to the recommended Appendix A model, AERMOD, and further demonstrates that the alternative model approach does not have a general bias toward model underprediction. The alternative approach is based on data acquired from wind tunnel studies for this specific site, conducted in accordance with EPA guidance. The approach is also consistent with downwash principles regarding increased downwash impacts with increasing wind speeds.

AERMOD has historically underestimated the significance of downwash from this source. The wind tunnel study demonstrated in fact that more downwash was occurring, and so the comparison described in the TSD gave the expected result that an approach that reflects the greater impact of downwash demonstrated in the wind tunnel study yields a better assessment of ambient concentrations than the standard application of AERMOD. Given the theoretical basis and the improved model performance, the alternative approach is recommended as acceptable for this specific application.

Note that approval of this approach only applies to the Mill's stack S09 for this specific State Implementation Plan attainment demonstration. Emissions from stack S09 represent over 95% of the SO_2 emissions from the Mill. Also, in the event downwash algorithms are enhanced in future AERMOD regulatory versions to appropriately consider the corner vortices issue, subsequent attainment demonstrations at this facility will need to utilize the current version of AERMOD rather than rely on the above approach. Lastly, and importantly, the air quality monitor that has been instrumental in identifying this corner vortex downwash issue, will continue to operate and thus provide a means for measuring real time impacts from emissions, including the actual concentration reductions achieved by the taller stack and lower SO_2 emission limit at the Mill as required by Wisconsin in its Oneida County area SO_2 attainment plan."

MODEL CLEARINGHOUSE CONCURRENCE SUMMARY

In summary, the Model Clearinghouse concurs with EPA Region 5 that the proposed stack-specific alternative modeling approach to applying downwash in AERMOD is acceptable for stack S09 at the Rhinelander facility in the context of the WI DNR's SO_2 NAAQS SIP. The documentation and technical support information provided in the EPA Region 5's April 29, 2021 alternative model concurrence request supports improved model performance as demonstrated through a case-specific model-to-monitor comparison. Additionally, the alternative modeling approach has been demonstrated to not be biased toward underestimates. Therefore, the Model Clearinghouse finds the alternative model justification is consistent with the requirements of the *Guideline*, Section 3.2.2(b)(2) and is approvable by the Region per the provisions of the *Guideline*, Section 3.2.2(a).

The Model Clearinghouse encourages EPA Region 5 to respond to the WI DNR with a letter of alternative model approval for inclusion in their SO_2 NAAQ SIP record. The WI DNR should include the information associated with the EPA Region 5 alternative model approval and this Model Clearinghouse concurrence in the SIP record and make it available for comment during the appropriate public comment period. For future reference, the memoranda associated with this Model Clearinghouse action will be included in the Model Clearinghouse Information Storage and Retrieval System (MCHISRS) on the EPA's SCRAM website under the record number 20-V-01[1].

[1] https://cfpub.epa.gov/oarweb/MCHISRS/index.cfm?fuseaction=main.resultdetails&recnum=21-V-01

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