NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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Mr. Richard Ruvo
U.S. EPA Region II
290 Broadway, 25th Floor
New York, N.Y. 10007-1866

Dear Mr. Ruvo:

The New York State Department of Environmental Conservation (NYSDEC) is seeking concurrence with EPA Region 2 on approval of the use of two site-specific modeling approaches for sulfur dioxide (SO_2) emissions at Alcoa, an aluminum smelter located in Massena, NY. As part of EPA's Round 4 SO_2 NAAQS designation process, a portion of St. Lawrence County surrounding the Alcoa Massena facility was designated as a non-attainment area. The two non-guideline modeling methods will be used as part of an attainment demonstration showing how the Alcoa Massena facility plans to achieve attainment with the 2010 SO_2 National Ambient Air Quality Standard (NAAQS).

The two site-specific modeling approaches include the use of a neutral lapse rate to simulate the fugitive heat loss continuously emanating from Alcoa Massena's potline buildings, as well as incorporating the 2019 draft version of BPIPPRM_19191. Section 3.2.2 of Appendix W to 40 CFR Part 51 defines three conditions under which an alternative model may be considered for use. One of these conditions, found in Section 3.2.2(b)(2) states that an alternative model may be considered "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". A detailed case-specific monitor to model comparison was performed by AECOM, and details regarding this analysis can be found in Section 4.2 of "SO2 Modeling Protocol for Alcoa Massena Operations - West Plant" submitted to DEC on June 13, 2022, by AECOM. This statistical evaluation demonstrated improved model performance using the two non-guideline methods relative to the regulatory default modeling methods.

The 1-hour SO_2 impacts from this facility were originally modeled in 2016 as part of Round 3 of the 2010 SO_2 NAAQS designations. This modeling analysis was used to inform the siting of two ambient SO_2 monitors adjacent to the Alcoa Massena fence line, Alcoa East (Site 1) and Alcoa West (Site 2). The modeling approach used to site these two monitors was approved by EPA and incorporated the regulatory guideline methods found in Appendix W. The Buoyant Line and Point (BLP) source option was used to model the two roof vents. The 36 potline stacks and the anode bake furnace were modeled as point sources.

After three years (2017-2019) of hourly SO_2 measurements from the two monitors, it was apparent that the regulatory guideline modeling methods used in the 2016 modeling analysis had greatly overpredicted the 1-hour SO_2 impacts from the Alcoa Massena facility. By evaluating output from the DEBUG option in AERMOD, it appeared that these overpredictions were due in part to an underestimation of the plume rise from the long buildings with fugitive heat release located at the Alcoa Massena facility. AERMOD's plume rise calculations do not account for the additional buoyancy due to the fugitive heat released from the top of the long potline buildings at this location. To account for this additional buoyancy, DEC is seeking concurrence from EPA Region 2 regarding the use of a manually generated neutral lapse rate in the proposed modeling analysis.

The Alcoa Massena facility is located in the continental climate zone of northern New York near the Canadian border. The average low temperatures in Massena range from 4°F (-15°C) in January to 59°F (15°C) in July. Aluminum smelters are known to have substantial fugitive heat loss from the potline buildings, which create a localized heat island surrounding the facility. It was estimated that the fugitive heat loss at the Alcoa Massena facility was around 50 MW per year. The fugitive heat released by the facility to the atmosphere during the nighttime hours was estimated to be on the same order of magnitude as the daytime sensible heat flux due to incoming solar radiation. Based on the year-round steady-state operation of the aluminum smelter, both the daytime and the nighttime stability of the atmosphere above the Alcoa Massena facility would best be categorized as neutral or unstable. Therefore, DEC requests that the stability of the boundary layer in the lowest 100 meters above the ground be classified as neutral. The vertical temperature profile in the lowest 100 meters of the atmosphere would be manually generated using the dry adiabatic lapse rate of -9.8°C per kilometer.

The potline buildings at Alcoa Massena are long, narrow and rectangular. It is a widely known issue that the Building Profile Input Program (BPIP) has a tendency to overpredict impacts in the wake of long, narrow buildings. To account for this issue at the Alcoa Massena facility, DEC is seeking concurrence from EPA Region 2 to use the 2019 draft version (19191_DRFT) of the Building Profile Input Program for PRIME. This draft version of BPIP is designed to reduce AERMOD's overprediction of impacts due to downwash in the wake of the long, rectangular buildings found at the Alcoa Massena facility.

The results from the statistical model performance tests conducted by AECOM are found in the attached modeling protocol. The default AERMOD analysis incorporated the original BPIPPRM and the original AERMET Profile file with a single observation level at the Massena Airport (KMSS). The non-guideline AERMOD analysis (Massena MOD) included the draft version of BPIPPRM_19191 and an AERMET Profile file for the Massena Airport, which included a manually generated second observation level at 100 meters to simulate a neutral lapse rate throughout the lowest 100 meters of the atmosphere.

These performance evaluations include quantile-quantile (Q-Q) plots for each of the two monitors, design value comparisons between the modeled and observed 1-hour SO_2 impacts and utilizing the Model Evaluation Methodology outlined in EPA's 1992 Protocol for Determining the Best Performing Model.

The results from the Q-Q plots showed that the default model grossly overpredicted the SO_2 impacts at both monitors by at least a factor of 5. The Massena MOD approach also overpredicted the impacts, however the overprediction was generally between 2 and 3 times the observed concentrations which indicates better performance than the default model.

The design value comparison between the default model and Massena MOD approach showed that both models overpredicted the SO_2 impacts. The modeled-to-observed design value ratios for the default model were between 5.69 and 6.81. The Massena MOD approach showed better performance with modeled-to-observed design value ratios between 2.23 and 2.80.

EPA's Model Evaluation Methodology was used to analyze the Robust High Concentrations (RHC) for both monitors. Ideally, the ratio of model-predicted RHC to observed RHC should be around 1.0. The default model run showed ratios for the two monitors between 5.45 and 7.11. The Massena MOD approach showed ratios between 1.99 and 2.79. When using a 90% confidence interval for the Composite Performance Measure, the analysis also indicated that there was a statistically significant difference in the performance between the two models. Finally, the Model Comparison Measure results for both monitors were evaluated and determined to all be positive, indicating that the Massena MOD modeling approach performs better than the default modeling approach.

Based on the long, narrow building configuration found at the Alcoa Massena facility, along with the continuous fugitive heat release from the hot buildings to the surrounding airshed, DEC seeks concurrence on the use of BPIPPRM_19191_DRFT and a neutral lapse rate. The modeling files and statistical evaluation results are available for download on the DEC File Transfer Service website (https://fts.dec.state.ny.us/fts/). A link and password to access these files will be sent to you separately via email. If you would also like to receive a USB drive containing the modeling files, please let me know.

Sincerely,

Margaret LaFarr

Margaret LaFarr
Assistant Director
Division of Air Resources

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