UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

JUL 16 2015

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Model Clearinghouse Review of the Use of the Beta ARM2 Technique for the Corning Diesel Manufacturing Facility in Steuben County, New York.

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INTRODUCTION

In response to your Model Clearinghouse request memorandum of June 18, 2015, the Model Clearinghouse has reviewed Region 2's position on the proposed use of the ARM2 technique for the Corning Diesel Manufacturing Facility in Steuben Count, NY. The ARM2 technique would be used as a Tier 2 approach to determine NO/NO_2 speciation in lieu the default Tier 2 approach, ARM, which assumes a fixed amount of conversion. As noted in your memo, this request is largely driven by the variable emission rates and NO_2/NO_x in-stack emission ratios of four "periodic" kilns. These kilns have an operating cycle that has a somewhat predictable operation pattern but is difficult to model. Specifically, these kilns operate in such a way that the peak emissions from any two kilns do not occur at the same time as the peak emission rates as the other two kilns. Additionally, peak emissions are anticorrelated with peak emission ratios. When modeled as allowable emission rates and in-stack ratios rather than with emission rates and in-stack ratios that represent the operating cycle, the impacts from the kilns are overestimated. Therefore, the use of ARM2 may be used to account for the variable emissions rates and in-stack ratios that occur from these sources without explicitly modeling the variable emissions rates and in-stack ratios, which is not possible in the current formulation of AERMOD.

MODEL CLEARINGHOUSE RESPONSE

We concur with Region 2's position that ARM2 is an appropriate technique for modeling NO_2 impacts from the Corning Diesel Manufacturing Facility in Steuben Count, NY. We agree that the ARM2 technique can be used to address changes in stack parameters along with changes in operating conditions that can otherwise be difficult or impossible to account for in a standard AERMOD model run. We also agree that this particular case requires substantial consideration when selecting the minimum ambient ratio to apply in ARM2. Based on the information provided to date, we believe the minimum ambient NO_2/NO_x ratio of 0.54 will be appropriately conservative. However, given that the overall modeling analysis is still under review, such that proposed emissions and ratios may change, we urge the reviewing authority to closely review this minimum ambient ratio once the final modeling analysis has been completed and the permitted emissions limits have been determined.

As noted in your memo, the September 20, 2014 EPA clarification memorandum (U. S. EPA, 2014) that provides guidance on the application of the ARM2 technique outlined several considerations that are important to its approval in this case:

1. If the total NO_x impacts are low enough (*i.e.*, threshold of 150-200 ppb of NO_x), then the default formulation of ARM2 is likely to be appropriately conservative.
    a. If background NO_2 contributions are significant, then an alternative, higher threshold can be considered.
2. If NO_x impacts are above the threshold determined in (1), then an alternative minimum ambient ratio may be used that is representative of the source.
    a. For this approach, source-specific data is preferred, though non-site specific data may be sufficient for determining alternative minimum ratios.
    b. Since the ambient NO_2/NO_x ratio is largely controlled by the NO_2/NO_x in-stack ratio, nominally, the alternative minimum ratio should be set to equal the largest NO_2/NO_x in-stack ratio at a facility. However, it was acknowledged that when plumes with varying in-stack ratios merge, there may be a justifiable alternative minimum ratio that is lower than the highest NO_2/NO_x in-stack ratio at the facility.
3. Since ozone is the primary mechanism for converting emissions of NO to NO_2, ambient levels of ozone should also be considered. Areas with higher ozone will see more conversion of NO to NO_2 and higher potential ambient NO_2/NO_x ratios from plume impacts. Conversely, areas with lower ozone will have lower potential ambient NO_2/NO_x ratios from plume impacts.

None of these factors constitute a single deciding factor for the approval of ARM2, but represent elements of a weight-of-evidence approach in considering its appropriate application.

We acknowledge Region 2's statement that Corning Diesel Manufacturing Facility does not clearly meet each of the individual elements above. For example, there are a small number total NO_x concentrations above the 200 ppb threshold, site-specific data indicates that some of the in-stack ratios are actually quite high (greater than 0.8), and ozone concentrations can exceed 80 ppb. For these reasons, the facility has conducted sensitivity testing using the Ozone Limiting Method (OLM) and a number of combinations of emission rates and in-stack ratios for the periodic operation of these kilns to determine an alternative minimum ambient ratio of 0.54. The data we have reviewed are generally supportive of an alternative ambient ratio in this range when considered with additional details about the background NO_2, the trends in maximum NO_x impacts and background ozone, and the relative contributions from the periodic operation of these kilns to the areas of maximum impact.

We agree that use of the ARM2 technique meets the 5 criteria for accepting an alternative model as outlined in section 3.2.2 of Appendix W. Specifically:

1. ARM2 has been peer reviewed (Podrez, 2015).
2. ARM2 is applicable to the problem on a theoretical basis when an appropriate minimum ambient ratio is considered.
3. The databases necessary to perform an analysis with ARM2 are identical to those that are required for those that are required to run AERMOD in general and are thus available and adequate.
4. Appropriate model performance evaluations have been performed (Podrez, 2015; U. S. EPA, 2014).
5. A protocol for application of ARM2 was submitted to the appropriate reviewing authorities.

DISCUSSION OF TECHNICAL ISSUES

This section provides a more detailed discussion of some of the technical issues associated with the Region 2 Model Clearinghouse request. We hope that this discussion will provide better clarity to some of the key technical issues on which this Model Clearinghouse response was based and also provides some insight that may assist in determining appropriate application of ARM2 in future situations. In particular, we would like to address the ARM2 approval guidelines that were provided in the September 20, 2014 EPA clarification memorandum (U. S. EPA, 2014) and how they fit together to meet approval of ARM2.

The context of the recommendations in the 2014 memorandum was the comparison of source impacts as determined by ARM2 (using a minimum ambient ratio of 0.2) against the impacts determined by the Plume Volume Molar Ratio Method (PVMRM) using the regulatory default in-stack ratio of 0.5. This comparison showed that ARM2 would predict lower concentrations than PVMRM at concentrations above the NO_x threshold (150-200 ppb of NO_x), *i.e.*, ARM2 was no longer appropriately conservative as a Tier 2 method and in fact, may have underestimated impacts from sources with in-stack ratios of 0.5. It is important to note that the default in-stack ratio is provided when no reliable information is available for a source. If a source is known to have in-stack ratios greater than this regulatory default, than this higher ratio should be considered in any analysis. If the OLM and PVMRM approaches were to be used for such a source, the stacks with the higher ratios should not get to model at the lower in-stack ratio. Nor should an ARM2 approval ignore the implications of having sources with in-stack ratios greater than 0.5.

The implications of sources with in-stack ratios greater than 0.5 can be accounted for in several ways. The recommendation that the minimum ambient ratio be set to the maximum in-stack ratio for the source is the easiest way to address in-stack ratios higher than 0.5. This assumption, however, effectively makes all the stacks at a facility adopt this higher ratio and could easily result in overly conservative results. In reality, most facilities will have multiple stacks, each with their own in-stack ratio that may vary according to the stack's emission rate. The ambient NO_2/NO_x ratio at any receptor will be a function of contributions from all sources, weighted according to the incremental contributions from each source. Thus, if a receptor has 90% of its NO_x from a source with an in-stack ratio of 0.2 and 10% of its NO_x from a source with an in-stack ratio of 0.8, the composite ambient ratio (ignoring chemistry) would be 0.26 (*i.e.*, 0.2*0.9 + 0.8*0.1). Considerations of chemistry and NO to NO_2 conversion will have additional effects, but the starting percentage of NO_2 will still be driven by the incremental impacts from each source. Thus, alternative ambient ratios can be determined by modeling a facility with a Tier 3 method and using the in-stack ratio from each stacks as well as background ozone. This approach takes into account the specific configuration of the facility, including the emission rates and ratios, stack heights and locations, receptor heights and locations, and meteorology. If this analysis has been conducted appropriately, and includes representative background NO_2 and ozone data, then the need for any consideration of the other limitations of approving ARM2 (*i.e.*, NO_x thresholds and background NO_2 and ozone) is largely eliminated.

The modeling files provided for the Corning Diesel Manufacturing Facility indicate six OLM sensitivity tests were conducted to determine this alternative minimum ambient ratio. The OLM tests varied the emission rates and ratios for the periodic kilns while all other emission sources were kept constant, at the rates proposed in the permit application. For each test, the modeled design value from OLM (*i.e.*, average of the 8^{th} highest 1-hour daily maximums) was found and compared to the full conversion results. A minimum ambient ratio was then developed such that the design values using ARM2 (with the alternative minimum ratio) produced concentrations approximating those found with OLM. When these sensitivity runs are completed without background ozone, the resulting OLM concentrations are much lower. Thus, the ratios from the sensitivity test accounts for both the in-stack ratios of the contributing sources and the increase in the ambient NO_2/NO_x ratios due to conversion of NO to NO_2. Given that the highest impacts tend to be at night, when ozone is quite low, the ambient ratio derived from this sensitivity test should be conservative during those low ozone periods and reasonably accurate during higher ozone periods.

REFERENCES

U. S. EPA, 2014, "Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 National Ambient Air Quality Standard", U.S. EPA, Research Triangle Park, NC.

Podrez, M., 2015, An update to the ambient ratio method for 1-h NO_2 air quality standards dispersion modeling. Atm. Env., 103, 163-170.

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