

DIVISION OF AIR QUALITY
AIR PERMITS PROGRAM

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October 20, 2004

Mr. Herman Wong
U.S. EPA Region 10
1200 Sixth Avenue
Seattle, WA 98101

Subject: Request to Use PVMRM to Estimate Ambient NO₂ Concentrations

Dear Mr. Wong:

The Alaska Department of Environmental Conservation (ADEC) requests permission to use the Plume Volume Molar Ratio Method (PVMRM) to refine modeled nitrogen dioxide (NO₂) concentrations in ambient analysis conducted in support of our air quality permit programs. Initial use of PVMRM would be limited to assessments conducted using the U.S. Environmental Protection Agency's (EPA's) AERMOD modeling system. However, ADEC intends to expand usage to future regulatory models that contain the PVMRM algorithm (e.g., if EPA includes the PVMRM algorithm in CALPUFF).

ADEC originally made a similar request of EPA Region 10 (Region 10) on March 17, 2000.¹ Region 10 replied on February 8, 2001 that PVMRM had promise for regulatory use, but could not be approved without additional development and review.² Region 10 stated the following items need to be addressed before they could approve use of PVMRM.

1. "To be approved as an alternative model, it is critical that the method be publicly available in a commonly used computer code (e.g., Fortran) to allow the method to be consistently applied in regulatory applications, and to facilitate evaluation and testing of the method. It would be best if the PVMRM option was made available in the AERMOD modeling system and the Calpuff modeling system."
2. "Second, there is limited sensitivity testing of PVMRM.... PVMRM needs to be tested on a much wider variety of NO_x sources."

¹ John M. Stone (ADEC) to Bonnie Thie (Region 10), *Permission to use PVMRM to Estimate Ambient NO₂ Concentrations*, March 17, 2000.

² Robert B. Wilson (Region 10) to John Kuterbach (ADEC), *Permission to Use PVMRM to Estimate Ambient NO₂ Concentrations*, February 8, 2001.

Region 10 also recommended that PVMRM be made applicable to multiple receptors (the original algorithm was limited to a single receptor), and that “for each source analyzed, the percentage of NO_x emitted as NO₂ should be an input variable, rather than being ‘hard-wired’ as 10%.”

As you know, the above items and recommendations have been addressed through a cooperative effort between the Prudhoe Bay Unit Owners, Region 10 and ADEC. PVMRM has been incorporated into AERMOD and will be publicly available with the next AERMOD update on EPA’s *Support Center for Regulatory Air Models* (SCRAM) web-page. A sensitivity analysis was also conducted under this cooperative effort. The final sensitivity analysis report, model formulation document addendum, and AERMOD User’s Guide addendum are attached, along with a compact disk containing the AERMOD source code, executable and test case, as well as electronic copies of the reports.

ADEC notes that improved methods of estimating ambient NO₂ methods is allowed under Tier 3 of Section 6.2.4 “Models for Nitrogen Dioxide (Annual Average)” of EPA’s *Guideline on Air Quality Models*. ADEC expects that most applicants will continue to use the Tier 1 (full conversion) and Tier 2 (0.75 ambient ratio method) approaches for estimating ambient NO₂ concentrations. However, ADEC intends to allow applicants to use PVMRM as needed, per our approval. Applicants will also have the option of using the Ozone Limiting Method (OLM) under Tier 3. In both cases, applicants will need adequately representative ozone data, which will also be subject to our approval.

The NO₂ estimates generated by PVMRM (or OLM) may not be linearly proportional to the NO_x emission rates, due to the ozone-limiting effects of these algorithms. This affect has led to several recent discussions with Region 10 regarding when and how PVMRM should be applied.

ADEC intends to use PVMRM for both project impact assessments and for cumulative (full) impact assessments. In regards to project impact assessments of just *new* emissions, PVMRM should provide conservative NO₂-to-NO_x ratios (relative to the cumulative NO₂-to-NO_x ratios) since small emission inventories tend to be NO_x limited rather than ozone limited. Therefore, there is no reason why PVMRM should not be allowed to estimate the impact from just new NO_x emissions. The larger question regards the use of PVMRM to estimate credits (increment or project) from removed units.

The question regarding the use of PVMRM for credits is actually two-fold. The first question regards the potential for PVMRM to overstate the credit, and therefore, whether it should be allowed as a matter of policy. The second question regards the appropriate technical approach for using a non-linear method to estimate credits.

The first question should be easy to answer. ADEC agrees that PVMRM tends to provide conservative NO₂ estimates. However, PVMRM was developed as a refined method for estimating NO₂ concentrations since the Tier 1 and Tier 2 approaches are overly conservative. It is the most accurate, yet practical, method available for conducting an ambient NO₂ assessment in support of a permit application. *Therefore, it is very appropriate to use PVMRM to estimate*

NO₂ credits. This is especially true since EPA has not precluded the use of the more conservative Tier 1 and Tier 2 algorithms to estimate NO₂ credits.

The proper technical approach for using PVMRM to calculate credits is the bigger question. PVMRM combines plumes prior to comparing the NO_x concentration to the ambient ozone concentration. Therefore, plumes from different time periods (e.g., baseline versus future) should be separately compared to the ambient ozone concentrations. Credits could also be overstated if the modeling analysis only entails a portion of the actual emissions. This would occur in cases where there are sufficient emissions in reality for the plume to be ozone-limited (i.e., limited NO to NO₂ conversion), but the use of only some of these emissions leads to a NO_x-limited (i.e., maximum conversion) result. Therefore, full inventories for the given time-period should be required to calculate NO₂ credits.

ADEC plans to include increment credits in a full impact assessment using the approach developed by our contractor, Roger Brode of MACTEC Federal Programs, Inc. (MACTEC)³ This approach currently requires the modeler to combine the results from two separate runs on a receptor-by-receptor basis. Please note that the approach could be coded into AERMOD so that only a single run is needed. However, that step has not yet been accomplished. Roger's approach uses the following source group designations:

“A” = all increment consuming emission units (new units plus existing *post*-baseline units);

“B” = existing (non-retired) baseline units; and

“C” = increment-expanding (retired baseline) units

Increment consumption (without credits) would then be calculated as follows:

$$\text{Consumption} = (A + B) - B$$

where (A + B) refers to the PVMRM results from running groups A and B together, and B refers to the PVMRM impacts from group B alone.

Increment credits would be calculated as follows:

$$\text{Credit} = (B + C) - B$$

where (B + C) refers to the PVMRM results from running groups B and C together, and B refers to the PVMRM impacts from group B alone.

Combining these equations, the resulting *cumulative impact* (CHITOTAL) would be

$$\text{CHITOTAL} = [(A + B) - B] - [(B + C) - B]$$

or

³ Electronic-mail message from Roger Brode (MACTEC) to Alan Schuler (ADEC), with courtesy copy to Herman Wong (Region 10) and Rob Wilson (Region 10), *Re: PSD Credits with PVMRM and OLM*, May 21, 2004

$$\mathbf{CHITOTAL} = (\mathbf{A} + \mathbf{B}) - (\mathbf{B} + \mathbf{C})$$

In some cases, this equation could be reduced to:

$$\mathbf{CHITOTAL} = \mathbf{A} - \mathbf{C}$$

where PVMRM would be ran separately for group A and group C.

However, this simpler approach could only be used in situations where the plume from group B does not overlap with the plumes from group A or group C. Therefore, this simpler approach could only be used on a case-by-case basis.

ADEC is aware that AERMOD is still a non-guideline model, and therefore, still requires case-by-case approval from Region 10. Nevertheless, ADEC desires Region 10's approval of PVMRM in an effort to make it known to our applicants that PVMRM is available for use. ADEC also hopes that EPA will soon promulgate AERMOD as a guideline model, in which case PVMRM could be used as needed, without further Region 10 involvement.

Please contact me at (907) 465-5112 if you have any questions regarding our request.

Sincerely,

Alan E. Schuler, P.E.
Environmental Engineer

Enclosures:

Sensitivity Analysis of PVMRM and OLM in AERMOD (September 2004)
Addendum: User's Guide for the AMS/EPA Regulatory Model – AERMOD (September 2004)
Addendum – AERMOD: Model Formulation Document
CD of above documents, model codes and model test case

cc: Alison Cooke, BPXA (w/enclosures)