UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

JAN 19 1994

MEMORANDUM

SUBJECT: Test Protocol for Wind Tunnel Modeling of Plume Impact Under Stable Stratification for the Cane Run Station (CRS) in Louisville, Kentucky

FROM: Joseph A. Tikvart, Chief
Source Receptor Analysis Branch, TSD (MD-14)

TO: Brenda Johnson, Regional Modeling Contact
Region IV

Douglas Neeley, Chief
Air Programs Branch, Region IV

In response to your request to Dean Wilson, the Model Clearinghouse has reviewed your draft comments to Louisville Gas and Electric Company (LGE) on the subject protocol. Also, as requested, we have reviewed the protocol itself, but a detailed technical review of the wind tunnel study protocol has not been done.

Based on discussions we had within the Office of Air Quality Planning and Standards, we agree with your draft comments on the test protocol. Below are a few additional comments based on our review of the test protocol. Also, because the modeled violations of the sulfur dioxide (SO2) national ambient air quality standards (NAAQS) occur on elevated terrain in Indiana, we recommend that your comments also be coordinated with Region V.

As noted in your comment number three, it is not clear how the wind tunnel results will be used in the compliance demonstrations of the SO2 NAAQS. There needs to be a clarification on whether the tunnel results will be used as part of a screening analysis or in a more refined modeling analysis. The protocol implies that the wind tunnel study will be done for the meteorological conditions that yield a potential violation of the SO2 NAAQS (i.e., stable stratification with possible plume impact on elevated terrain). The protocol implies 1 hour average SO2 concentration estimates will be derived from the wind tunnel results and the 3 and 24 hour average estimates will be derived from Environmental Protection Agency (EPA) scaling factors applied to the 1 hour estimates. However, if a refined modeling analysis is being proposed using hourly, sequential

meteorological data, the methodology is unclear concerning the use of wind tunnel results in deriving 3 and 24 hour average concentration estimates. There is no discussion on developing concentration estimates from the wind tunnel study for the other meteorological conditions represented in the hourly, sequential meteorological data. Also, as noted in your comment number two, if a refined modeling analysis is contemplated for this study, the availability and usage of on-site meteorological data needs to be addressed.

Another issue not addressed in the protocol is accommodation of intermediate terrain in any mathematical modeling of the stacks. For example, the protocol refers to a previous screening analysis using COMPLEX I (Valley equivalent) with violations of the SO2 NAAQS indicated on elevated terrain. The Guideline on Air Quality Models (Revised) specifies the use of COMPLEX I concentration estimates for receptors with elevations at or above plume height. For receptor elevations between stack top and plume height (intermediate terrain), a technique to determine concentration estimates should be developed in consultation with the Regional Modeling Contact. There is no mention of an intermediate terrain technique applied in the previous COMPLEX I modeling analysis. Also, intermediate terrain issues are not addressed in the test protocol for any mathematical modeling contemplated.

We have some concern on the plume representation in the wind tunnel under stable stratification and complex terrain. For example, in Appendix A of the test protocol, the preliminary wind tunnel study is described. This preliminary study compared ground level concentrations on elevated terrain under stable stratification derived from the wind tunnel results and modeled results. The conclusion was that the models overestimated the wind tunnel observations by at least a factor of 2 under these conditions. However, in describing the flow visualization for the wind tunnel, it was noted that "the plume traveled over the terrain and did not impact directly on Williams Peak under stable stratification." It is possible that the models could have predicted plume separation around the elevated terrain with some plume impaction. Thus the models would have predicted higher concentrations than were simulated in the wind tunnel. As plume impaction is a physical process that may occur, this raises a concern about the ability of the wind tunnel to fully simulate plume behavior in complex terrain under stable stratification.

The test protocol states that "..wind tunnel measurements will provide information to verify the performance of the guideline EPA models.." The protocol states that overall maximum concentrations from the tunnel studies and modeling will be compared. However, there is no discussion of performance measures or statistical measures to be used in the performance verification. The methodology to do the model performance verification should be made explicit. Also, there is no indication to compare wind tunnel or model results with measured

data to verify performance. The implication is that the wind tunnel replicates the stable atmosphere. As described above, we have some concern about the representation in the wind tunnel of neutrally buoyant plumes under stable stratification for complex terrain.

Appendix B of the protocol presents information regarding the validity of wind tunnel modeling. The comparisons described in Appendix B refer to wind tunnel modeling and field observations for neutrally buoyant plumes under neutral or unstable stratification and flat or complex terrain. It would be useful if comparisons were available of wind tunnel modeling results and field observations under stable stratification and plume impaction on elevated terrain (e.g., comparisons of wind tunnel data and observations from the Cinder Cone Butte study).

In summary, there are several procedural issues identified in your comments and ours that need to be addressed in the test protocol. However, in principle, the proposed techniques offer some potential and, provided the procedural issues can be resolved, it would be appropriate to further review the technical approach for using wind tunnel results in the regulatory compliance demonstration. As mentioned above, we have some concern about the representation in the wind tunnel of neutrally buoyant plumes under stable stratification for complex terrain. If appropriate, it may be useful to have direct discussions with LGE and their contractor on the technical approach for the wind tunnel study following resolution of the other procedural issues.

If you have any further questions, please contact Dean Wilson at (919) 541-5683.

Attachment

cc: G. Blais

FY-94 MODEL CLEARINGHOUSE MEMORANDA

Date	Region	Subject
11/18/93	X	Building Wake Effects on Volume Sources at FMC Corporation
11/22/93	IV	CP&L Stack Height Increase
12/07/93	VI	Revised Technical Comparison Document--Phelps Dodge
01/14/94	IV	Test Proposal for Wind Tunnel Modeling of Plume Impact Under Stable Stratification for the Cane Run Station (CRS) in Louisville, Kentucky

Draft Letter

4APT-APB

Mr. Richard M. Everhart, Chief
Air Pollution Control District of
Jefferson County
850 Barrett Avenue
Louisville, Kentucky 40204

Dear Mr. Everhart:

The following are comments on the "Test Protocol Wind Tunnel Modeling Of Plume Impact Under Stable Stratification for Cane Run Station (CRS)" as prepared for the Louisville Gas & Electric (LG&E) Company to help resolve modeled violations of the sulfur dioxide (SO_2) national ambient air quality standards (NAAQS).

1. The Introduction section states that screening modeling was done using the COMPLEX I model (VALLEY mode) and concentrations in excess of the NAAQS for SO_2 were predicted on the elevated terrain west-southwest of CRS. The modeling results were unacceptable to LG&E. A Black & Veatch modeling report is referenced on page 2 but is not included in the protocol. This report must be included in the protocol.

2. Page 2 states that the RTDM, VALLEY and CTDMPLUS models were run for conditions simulated in the wind tunnel. These models require specific meteorology input data and have different requirements for site specific data collection. What data was used as input for each model? This information should include the height and parameter requirements for each model.

3. The ultimate goal for this wind tunnel demonstration is unclear. It is unclear how modeling one stability category will be used to resolve the air dispersion modeling violations. The air dispersion modeling to resolve this must not only include the CRS sources, but the nearby sources (and address downwash for any applicable sources) as well. All stability categories and the required amount of meteorological data (at least one full year of on-site or five years of National Weather Service), and background concentrations for all averaging periods must also be used. The protocol should state how the wind tunnel study would achieve or allow the company to meet these requirements.

4. The third objective on page 3 states that the wind tunnel evaluation will provide a database to modify, improve and test the existing EPA dispersion models for future CRS applications. I assume that this is being proposed so that data will be available for calibrating or developing a model for CRS use. How will this objective be implemented after this study?

5. Section 2.3 states that the existing SO_2 emission rate for the Unit 4 flue will be used with the new 125m good engineering practice (GEP) stack height in the wind tunnel demonstration. Since the new source performance standard (NSPS) for this source category was used in the original fluid modeling to determine the GEP height, this NSPS emission rate should now be the emission rate for the unit and should be used in this proposed study.

6. Since multiflued stacks are still considered as prohibited dispersion techniques, each flue must be modeled as a separate source and the combined impact determined. Therefore, the same NSPS emission rate, and not the existing Unit 5 emission rate, should be used in the demonstration.

7. Page 16 states that wind tunnel measurements and EPA modeling results will be compared (1) for the same meteorological conditions at similar locations; (2) for overall maximum concentrations; and (3) against the NAAQS to determine compliance for the conditions modeled. Compliance with the NAAQS cannot be estimated only for the CSR sources. This compliance will have to address the items listed in comment 3 above.

8. A map indicating the location of proposed receptors on the terrain of concern near Williams Peak should be included in the protocol for use in the comparison for each dispersion model.

9. Specific documentation on how the inputs for the RTDM and CTDMPLUS models will be developed for use in this study must be included in the protocol. Tables indicating all options used in developing each CTDMPLUS input file (address each terrain preprocessor file) should be included. Only one input file is needed for the RTDM. A map indicating the specific terrain features that will be digitized for the CTDMPLUS model should be included.

The comments in this letter must be addressed and incorporated in a revised protocol prior to EPA approval. If further questions arise, please contact me or have your staff contact Brenda Johnson of my staff at (404) 347-2864.

Sincerely yours,

Douglas Neeley
Chief
Air Programs Branch
Air, Pesticides, and Toxics
Management Division