UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
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MEMORANDUM

TO: Files

FROM: John Notar

SUBJECT: Review of the Four Modeling Proposals to Educate the Billings/Laurel SO_2 Issue

I have reviewed the four proposals to evaluate the Billings/Laurel SO_2 issue. The Billings/Laurel area has six SO_2 sources. None of these sources are PSD permitted and lack basic SO_2 controls. The Billings area where these sources are located, is in a narrow river valley with bluffs on both sides. The meteorology and wind flow can be complex.

Analyses performed by Montana Air Quality Bureau (MAQB) regarding the meteorological conditions which occur during high SO_2 concentrations indicates that 2 different meteorological conditions are observed. The two conditions are high wind speeds, and fumigation during the break-up of the nocturnal inversion in the Yellowstone River Valley. These conditions cause high SO_2 impacts in both the Yellowstone River Valley and the surrounding complex terrain.

None of the four proposals I have reviewed adequately address all of the above scenarios to the extent that EPA could approve of the methodology, for use in a regulatory action.

The Westinghouse proposal appears to address most of the issues (high wind speed, fumigation, and complex terrain) in an adequate manner except for the complex terrain analysis. The Westinghouse proposal does address the fumigation (inversion break-up) better than any of the other proposals. Westinghouse proposes to use 1982-83 on-site mixing height measurements to analyze the break-up of the valley nocturnal inversion and the following fumigation of the river valley. Westinghouse proposes to use a computerized version of Turner's technique to calculate the SO_2 concentration during fumigation. The short fall of this technique is that it fails to account for the build-up and storage of SO_2 in the inversion. This phenomena may have 12 hours or more of the area's SO_2 emissions that are rapidly impacted to the valley floor during fumigation. Westinghouse proposes to use ISCST and flagpole receptors to profile the SO_2 concentrations in the inversion. This is an interesting concept which has never been approved by EPA. It would require on-site demonstration with in-situ SO_2 inversion concentration data in

order to be entertained as a plausible technique. Despite these issues I feel this is the best offered approach to address the fumigation issue.

The other proposals for fumigation are as follows: Sigma proposes an EPA Volume 10 Guideline for Air Quality and Maintenance, approach or a box model. The GeoResearch proposes to use the EPA SCREEN model to evaluate the fumigation conditions. Note that SCREEN assume an atmospheric stability of "F" and 2.5 m/sec wind speed. Code changes to SCREEN would be needed and there is no accounting for the build-up of SO_2 within the inversion. The AV Projects approach is to use their AVACTA II segmented plume model. While this type of model with vertical and horizontal cells has theoretical possibility, there was no mention that this model has been successfully applied to a valley fumigation scenario. None of these techniques address the SO_2 concentration build-up in the inversion. To better evaluate the fumigation process, balloon measurements or SODAR measurements should be taken.

For the high wind scenario, Westinghouse, GeoResearch and Sigma all propose to use the EPA ISCST model and the building downwash option. All three of these proposals are technically correct. The AV Project proposal to use AVACTA II which does not have a building downwash algorithm is an unacceptable technique to address the high wind speed scenario.

For the complex terrain scenario, the three proposals by Westinghouse, GeoResearch and Sigma all mention EPA's two newest complex terrain models CTDM (Complex Terrain Dispersion Models) and RTDM (Rough Terrain Dispersion Model). The plume height winds and stack top winds necessary to drive these two models do not exist and therefore these two models cannot be applied. These three proposals all discuss the use of EPA's COMPLEX I model. The best approach for complex terrain was the GeoResearch plan to use 5 different meteorological stations. Each station would be equivalent to "on-site" data for the sources nearest or not represented by them. Westinghouse's proposal to use a modified version of COMPLEX I which would include adjusting wind flow to valley orientation has theoretical merit but is nonguideline application of the model and would require extensive and expensive evaluation before EPA could accept it. Sigma proposed CTDM or RTDM both cannot be used due to the lack of proper meteorological data. AV Projects proposed to use AVACTA II. Briefly address in some of the proposals is the urban/rural question. If the area to be evaluated is rural, then COMPLEX I is acceptable. If the Auer classification determines that the area is urban than SHORTZ would be the acceptable model.

Besides meteorological conditions the other very important issue is the emission inventory. None of the proposals seem to grasp the fact, that the SO_2 emission inventory is very poor. No matter how good a dispersion model is, or if there is excellent meteorological data, the lack of a correct emission inventory

will undermine all other efforts. None of the major SO_2 sources in Billings or Laurel have PSD permits and their exact SO_2 emissions are only vaguely known at best. AV Projects feels that they have an adequate inventory from December 1987 through November 1988, which was developed by BLAQTC. GeoResearch and Sigma also both propose to use these inventories. Westinghouse proposal to use fuel logs and emission data bases such as AIRS and NEDS. It has been my experience the some actual stack testing or in stack measurement is needed in Billings. Also the issue of sulfur trading between the refineries and Montana Sulfur needs to be understood. My conclusion is that all four proposals lack the means to develop an adequate SO_2 emission inventory and a better effort needs to be proposed.

In conclusion, the Region VIII meteorologist at this time cannot recommend any of the 4 proposals as meeting EPA modeling requirements if this were to evolve into a Federally approved SIP action. The Westinghouse and GeoResearch proposals have the best starting points. The Westinghouse complex terrain method needs to be reworked. But it does appear to have the best approach for fumigation. The GeoResearch proposal for complex terrain is a satisfactory approach but needs work in the fumigation analysis. I suggest to the City of Billings that they approach these 2 firms and require the following additional information.

(1) An emission inventory based on measured SO_2 emissions.
(2) An analysis of the build-up of SO_2 concentration embedded within the inversion prior to fumigation, with possible in-situ measurements.
(3) Accounting for the fact that during high wind speeds the area of impact may be quite narrow. When evaluating the ISCST model performance against monitored data, a slight error in wind direction can lead to erroneous results as to the models performance in their scenario.
(4) None of the proposals have adequately addressed the impact from the Laurel CENEX facility. Although high SO_2 concentration from CENEX is confined to the immediate Laurel area. Some amount of SO_2 is probably imbedded within the nocturnal inversion and is transported into the Billings airshed. SO_2 measurements made within the inversion could quantify this phenomena.

(5) To better define the strength of the inversion and the inversion breakup/fumigation process, either the balloon measurements or SODAR measurements need to be taken.

Technical notes from the Region VIII meteorological staff are attached.

Attachments

Enclosure

Comments and recommendations regarding the proposals

AV Projects, Inc.

1. The AeroVironment Air Pollution Model for Complex Terrain Applications (AVACTA) has been recommended for use in the Billings SO_2 study. Although the model has been approved by the EPA in a past study, it is not considered an Appendix A model. Therefore the model would undergo a review by EPA for its application in the Billings area.

2. Assuming the model is approved for use, it appears that it can effectively address the atmospheric conditions suspected to occur in the Billings area.

3. The proposal suggests that the SO_2 emission inventory for the period December 1987 thru November 1988 will be used. EPA is in the process of having the inventory updated and will strongly suggest to the contractor chosen that the revised emission inventory be used.

4. Additional details are needed on the optional Source-Receptor Validation Procedure outlined on page 3-13 of the proposal. It is the intention of the contractor to use this procedure as a possible method to validate the model? EPA recommends that the only the EPA guidance on statistical evaluation of model performance be used.

5. The AVACCTA model is a four dimensional model. How will validation of the modeling results be compared to air quality data typically collected in Billings and considered to be a three dimensional representation?

6. The proposal presents several figures depicting the grid system to be used in the model. What is the size of the individual grids cells? EPA recommends a 0.5 square kilometer size for most dispersion modeling applications.

7. Modeling scenarios for 1, 3, and 24 hour SO_2 average concentrations have been proposed. The modeling scenario should also address the annual average.

Westinghouse E & G Services

1. In general the proposal contains many modifications of standard EPA guideline modeling approaches. Each modification will require approval by EPA before being accepted.

2. Page ten of the proposal indicates that final plume rise wind speeds in concentration calculations will be used, surface wind directions will be adjusted to valley orientation during stable conditions, and surface wind direction will be adjusted to reflect the turning of winds with height for neutral and unstable conditions. These options are modifications of guidelines requiring approval before they could be incorporated.

3. Additional information is requested regarding Tier II of their modeling approach. Why does contractor feel that the additional correlations it has performed indicate that Complex I is valid for the area? The point regarding inversion breakup at the top of page 7 requires further explanation.

4. Contractor has proposed to use 1982-1983 meteorological data will an emission inventory prepared for the same year for calibration. Although this will be acceptable, it is unclear from the proposal whether the contractor intends to use the 1982-1983 meteorological data for the emission inventory it intends to develop to represent present conditions. If this is true it will be unacceptable. As an alternative, use of meteorological data collected at the same time that a new emission inventory for the Billings area is developed for later this year will be required.

Sigma Research Co.

1. On page 2-14 of their proposal, the contractor indicates that the models usually specified for complex terrain are deficient in several areas. On page 2-15, the Complex Terrain Dispersion Model (CTDM) with several additional algorithms is suggested for use in Billings as a model that can overcome these deficiencies. However, the proposal goes on to say that the models usually specified for complex terrain may also be tested. The Industrial Source Model (ISC), MESOPUFF-II model, and a box model are also suggested for use to address specific dispersion scenarios. If the contractor's proposal is chosen, a specific modeling protocol outlining exactly the modeling steps that will be used must be submitted to EPA for review. Use of the CTDM model for fumigation will require review by EPA's regional office for its appropriate application.

2. Glasgow, MT upper air data is suggested for use with Billings surface meteorological data as input into the models. EPA will require that surface temperature for Glasgow be used in conjunction with its upper air data for any modeling scenario.

3. Additional information is requested on the method that will be employed to convert available emission data to the hourly emission data that the contractor indicates should be used (page 2-18). EPA is in the process of having the inventory updated and will strongly suggest to the contractor chosen that the revised emission inventory be used.

4. Proposal lists six sources of SO_2 which emit more than 100 tons per year (tpy) of SO_2. Although these are significant sources, the Billings emission inventory should not be limited to these sources. The updated emission inventory for Billings mentioned in item #3 will list all significant sources in the area.

GeoResearch, Inc.

1. The proposal provides a general overview of EPA guidelines regarding dispersion modeling in complex terrain. It is not specific in its approach to steps that will be performed to conduct a dispersion modeling analysis in Billings. In addition, one model suggested for use the Rough Terrain Dispersion Model (RTDM) is currently being reevaluated by EPA because it has underpredicted concentrations in tests of the model.

2. Insufficient detail is provided on the development of the emission inventory. Contractor commits to obtaining inventory from Montana Air Quality Bureau and updating to best support the modeling effort. However, no information is provided on how this will be performed or to what level of detail.

3. Page 22 of the proposal indicates that the contractor intends to use a number of meteorological data sets to model different portions of the Billings-Laurel area. A composite meteorological data set would then be developed for use in the modeling. Use of composite meteorological data sets have not been approved by the EPA in previous studies where such data sets were proposed.