October 18, 1989

MEMORANDUM

SUBJECT: Comments on TACB Area Source Discussion Which Was Dated 4/20/89, and its attached report, "Modeling Techniques for Municipal Solid Waste Landfills."

FROM: Russell F. Lee
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TO: Dean Wilson
TES

The Texas Air Control Board (TACB) has conducted some experiments using the ISCST area source algorithm with other approaches to modeling area sources. As a result of these experiments, TACB has concluded that the ISCST "area source algorithm, as currently programmed, should not be used for modeling landfills or any other area sources where two or more sources share a common boundary." Although their study raises some questions concerning the behavior of the ISCST area source algorithm, their conclusion is not justified by the results provided in their report. I believe that the ISCST area source algorithm is appropriate for modeling landfills, if it is used properly and judiciously. However, the TACB report does provide evidence of some anomalous results that should be investigated.

The area source algorithm in ISCST is an algorithm that functions best for area sources that are small (relative to the source to receptor distance). This is consistent with its purpose of estimating air quality impact from area sources (e.g., gravel piles, tailings ponds, etc.) that are a part of an industrial source complex. Because of this characteristic of the algorithm, a relatively large area source must be represented as a group of small area sources to give appropriate results. Mr. Durrenberger's statement that "For an area source algorithm to appropriately function, it must be possible to take a given square and subdivide it into smaller squares and with each approach obtain the same results" is not correct in general, and is particularly incorrect in the case of the area source algorithm in ISCST. For a large area source, or a receptor very close to the area source, this algorithm will give more and more accurate results as the area source is subdivided into more and smaller sources.

The results obtained by TACB in the area source scenarios show three notable characteristics. When the area source is represented as a single 50 x 50 meter source, the concentration profile is flat-topped. This is what one would expect intuitively. When the area source is represented by four 25 x 25 meter sources, a different peak concentration is found, which was expected, with a spike in the center, which was not expected. When the area source was represented as sixteen 12.5 x 12.5 meter sources, a similar result was found for the nearest receptor distance. Again, this was not surprising. At other distances, the concentration profile is much more realistic, being nearly flat-topped, with concentrations tapering off near the edges of the area source, as one would expect. The best test to determine how realistic the representation of the area source is, is to compare these results to an

area source represented as a very large number of ground level point sources. As the area source emissions are divided among a larger and larger number of point sources, the concentration calculations approach a "true" area source representation. This was not done. (As noted in the TACB report, the point source experiment was done with a different data set.)

TACB recommends modeling landfills either 1) using an array of pseudo-point sources, 2) an arrangement of volume sources, or 3) an arrangement of area sources.

In method 1, the array of point sources is designed for virtually no plume rise, and a height of release of 1 meter. This is reasonable, although a height of zero meters would probably be more appropriate.

The TACB report described the volume source in ISCST as "a box with uniform emissions through the rectangular 'window' defined by the initial coefficients." This is incorrect. The emissions profile through the "window" is bivariate gaussian, not uniform. As a result, a single volume source is not an appropriate representation of an area source. As with point sources, an area source can be represented by a sufficiently large number of volume sources. Differences between the concentration estimates obtained from using volume sources versus using area sources in the model are more likely to be due to inappropriate use of the volume sources than a flaw in the area source algorithm.

I recommend that we resolve concerns about possible inaccuracies of any of the area source methodologies. To do this, comparisons should be made between each methodology and a "correct" representation of an area source, namely, a sufficiently large number of point sources to define the limit of using an infinite number of point sources to represent the area source. The point sources should be at ground level, with no plume rise. I strongly suggest that we identify the cause of the spike in the concentration profile, to determine if this is normal for the algorithm or an error in the code. I also suggest that we derive a simple scheme to determine how much an area source should be subdivided to give acceptable results at receptor at a given distance.

Attachment

cc: Jerry Mersch
Joe Tikvart

FY 90 MODEL CLEARINGHOUSE MEMORANDA

Date	Region	Subject
10/17/89	VI	Ambient Air
11/7/89	II	Interpretation of On-site Meteorological Data Requirements and the Use of RTDM for a PSD Source
11/28/89	VIII	Utah PM-10 Secondary Sulfate and Nitrate Calculations
01/02/90	IV	Effect of Changing Stack Heights on Prevention of Significant Deterioration (PSD) Modeling and Monitoring
01/10/90	VIII	Utah PM-10, Secondary Sulfate and Projections
01/10/90	VIII	Review of The Utah County PM-10 Draft SIP
01/11/90	VI	Alternative Emission Reduction (Bubble) SIP Revision Authorizing Operation of a New Sulfur Recovery Plant at the Conoco Inc. Ponca City Refinery
01/16/90	VI	Recent Texas Air Control Board (TACB) Evaluation of the ISC Area Source Algorithm
01/16/90	V	Refined Metals Lead Modeling Analysis