**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**
**REGION III**
**841 Chestnut Building**
**Philadelphia, Pennsylvania 19107**

**SUBJECT:** Fluid Modeling To Establish GEP
Kammer Power Plant, WV

**DATE:** 6/4/96

**FROM:** Denis M. Lohman
Meteorologist
Technical Assessment Section(3AT22)

**TO:** Dennis Doll
Model Clearinghouse

Region III is requesting assistance from the Model Clearinghouse in providing technically valid responses and recommendations in a long-standing issue. EPA management will be making a decision considering both technical and political aspects of the situation. We want to ensure that our technical recommendation is both sound and consistent with nation policy and precedent.

BACKGROUND:

Kammer is a 40-year-old, 630 MW, coal-fired power plant in Marshall County, West Virginia. Kammer is owned by Ohio Power Company, a subsidiary of American Electric Power (AEP). Kammer was built specifically to provide power for the Ormet Corporation aluminum production facility in Hannibal, Ohio. High sulfur coal is supplied to Kammer from a nearby mine of Consolidation Coal Co. The West Virginia SIP, approved in 1972, established a statewide emission limit of 2.7 lbs. per million Btu (lb/MM Btu) of design heat input. The actual emission rate at Kammer has always been greater than 6.0 lb/MM Btu.

In 1976, AEP began construction to replace the two 600-foot stacks at Kammer with a single 900-foot stack. The Clean Air Act Amendments of 1977 included Section 123 which limits credit for setting emission limits to good engineering practice (GEP) stack heights. Section 123 was applicable to all stacks constructed after 1970. AEP sought help from EPA Region III in conducting a fluid modeling demonstration, in accord with developing regulatory requirements, to justify the new stack height. The fluid modeling indicated a greater than 40 percent excessive concentration at all stack heights modeled (up to 900 feet). The three-hour NAAQS was exceeded at all stack heights up to and including 850 feet. The emissions modeled were 4,817.2 grams per second. Region III has calculated this to be equivalent to 5.91 lb/mm Btu.

In 1978 West Virginia revised its $SO_2$ regulations, setting source specific limits including a limit of 6.8 lb/MM Btu of design heat input for Kammer. EPA approved most of the revised limits but delayed acting on the Kammer limit because of the, then, ongoing fluid modeling demonstration. EPA informally approved the fluid modeling in 1982. West Virginia has never requested approval of the revised emission limit in the SIP. ?

In July 1985, the stack height regulations were revised in response to a remand by the U.S. Court of Appeals. The revised regulations invalidated the Kammer fluid modeling demonstration by including a presumption that all sources seeking credit by such a demonstration could meet the new source performance standard (NSPS) or show that it was not feasible to meet NSPS. Following many years of seeking relief or special exemption AEP, prompted by EPA action to enforce the 2.7 lb/MM Btu limit, is urgently pursuing an effort to rebut the NSPS presumptive limit, obtain credit for the 900-foot stack height, and obtain a revised emission limit for Kammer.

An infeasibility demonstration prepared by AEP has been approved by the state of West Virginia and forwarded to EPA Region III. The infeasibility demonstration, using the Best Available Retrofit Technology (BART) analysis, should establish the lowest feasible emission limit for Kammer. This limit would then be evaluated with the previously approved fluid modeling study to determine the GEP stack height which satisfies the final stack height regulations. In addition to economic and control technology concerns about the demonstration there are several questions about the interpretation of fluid modeling which need to be explored. Each of the questions, although specific to the Kammer situation, have general applicability.

## RELATING WIND TUNNEL RESULTS TO NAAQS

What is the appropriate factor to scale wind tunnel results to time periods of the NAAQS?

"Excessive concentration" for the purpose of determining good engineering practice stack height is defined at 40 CFR 51.100(kk)(1) as . . . "a maximum ground-level concentration due to emissions from a stack due in whole or part to downwash, wakes, and eddy effects produced by nearby structures or nearby terrain features which individually is at least 40 percent in excess of the maximum concentration experienced in the absence of such downwash, wakes, or eddy effects and which contributes to a total concentration due to emissions from all sources that is greater than an air quality standard."

In the case with the Kammer fluid modeling the 1.25 minute samples in the wind tunnel were initially assumed to represent ½-hour concentrations which were converted to three-hour concentrations as indicated in the table reconstructed below using a factor of 0.85.

# TABLE 1

| Stack Height (ft) | $\chi u/Q$ from tunnel ( $m^{-2}$ ) | Wind Speed (m/sec) | Three-Hour Concentration ($\mu g/m^3$) |
|---|---|---|---|
| 600 | 2.73 | 9.7 | 3,205 |
| 650 | 2.47 | 9.9 | 2,831 |
| 700 | 2.34 | 10.1 | 2,638 |
| 750 | 2.47[1] | 10.3 | 2,743 |
| 800 | 2.02 | 10.4 | 2,211 |
| 850 | 1.63 | 10.5 | 1,760 |
| 900 | 1.01 | 10.6 | 1,085 |

In a 4/23/80 memo to William Belanger of EPA Region III, providing comments on his review of the Kammer wind tunnel study, Alan Huber stated, "The measured concentrations in the wind tunnel could be used to represent concentrations for periods of an hour or more." Subsequently, AEP recalculated the 3-hour and 24-hour concentrations using the factors of 0.9 and 0.4, respectively, from the SCREEN Users Guide. These factors were characterized as "EPA factors." Region III has, for the purpose of illustration, converted the one-hour wind tunnel concentrations to 3-hour and 24-hour concentrations using the factors of 0.7 and 0.15, respectively, of CTSCREEN. These concentrations are compared in the following table.

# TABLE 2

| Stack Height (feet) | One-hour Wind Tunnel ($\mu g/m^3$) | Three-hour ($\mu g/m^3$) | | 24-hour ($\mu g/m^3$) | |
|---|---|---|---|---|---|
| | | SCREEN2 | CTSCREEN | SCREEN2 | CTSCREEN |
| 600 | 3770 | 3393 | 2639 | 1508 | 566 |
| 650 | 3331 | 2998 | 2332 | 1332 | 500 |
| 700 | 3104 | 2794 | 2173 | 1242 | 466 |
| 750 | 3227 | 2904 | 2259 | 1291 | 484 |
| 800 | 2601 | 2341 | 1821 | 1040 | 390 |
| 850 | 2070 | 1863 | 1449 | 828 | 311 |
| 900 | 1276 | 1148 | 893 | 510 | 191 |

For the specific example tabulated above, i.e., Kammer at a nominal emission rate of 5.91 lb/mm Btu, the GEP stack height determination from the three-hour factors is the same. The three-hour NAAQS (1300 $\mu g/m^3$) is exceeded at 850 feet and not exceeded at 900 feet. Therefore, the 900-foot stack would be GEP. The situation is much different in looking at the 24-hour concentrations. The 24-hour NAAQS (365 $\mu g/m^3$) is exceeded at the 900-foot level, suggesting that GEP height should be even greater than 900 feet, but not exceeded at the 850-foot level.

---

[1]We recognize the seemingly anomalous concentration associated with the 750-foot height. It further complicates subsequent analyses with respect to GEP. We would be interested in comment about the validity of fitting as curve of concentration as a function of stack height.

In a general sense it is obvious that the use of SCREEN2 factors, as opposed to CTSCREEN, factors will always produce a higher GEP stack height determination. The question is, which factors are most appropriate? Perhaps the question can be expanded to ask if there is one set of factors appropriate for terrain-induced downwash and a different set of factors appropriate for building-induced downwash?

## CONTROLLING AVERAGING PERIOD

Is GEP determined by the greatest height at which a NAAQS is not exceeded, or the lowest height at which a NAAQS is not exceeded?

For the specific example in Table 2 the question is essentially equivalent to asking for the appropriate scaling factor. In the circumstance contemplated by Region III the question can be looked at from a different perspective. If we assume that one of the two scaling factors is acceptable, the scaled concentration data can be replaced by an emission limit calculated proportionally to just equal the NAAQS. For the sake of simplicity in this illustration the background is assumed to be zero.

TABLE 3

| Stack Height (feet) | One-hour Wind Tunnel ($\mu g/m^3$) | Three-hour (lb/mm Btu) | | 24-hour (lb/mm Btu) | |
|---|---|---|---|---|---|
| | | SCREEN2 | CTSCREEN | SCREEN2 | CTSCREEN |
| 600 | 3770 | 2.26 | 2.91 | 1.43 | 3.81 |
| 650 | 3331 | 2.56 | 3.29 | 1.62 | 4.31 |
| 700 | 3104 | 2.75 | 3.54 | 1.74 | 4.63 |
| 750 | 3227 | 2.65 | 3.40 | 1.67 | 4.46 |
| 800 | 2601 | 3.28 | 4.22 | 2.07 | 5.53 |
| 850 | 2070 | 4.12 | 5.30 | 2.61 | 6.94 |
| 900 | 1276 | 6.69 | 8.60 | 4.32 | 11.29 |

If, for the purpose of illustration only, we assume that the BART emission limit is 4.0 lb/mm Btu the GEP stack height using the SCREEN2 factors would be 800 feet (the next height below the one at which a NAAQS exceedance would occur) for the three-hour NAAQS and 850 feet for the 24-hour NAAQS. If the CTSCREEN factors are considered appropriate, the GEP stack heights would be 850 feet for the 3-hour NAAQS and 600 feet for the 24-hour NAAQS. Since there can only be one GEP stack height we must choose one or the other. If the lower height is chosen the credit for a tall stack is minimized and we are confronted with the dilemma of having a demonstrated NAAQS exceedance at the other averaging time.

In summary, we have two questions to answer in evaluating the infeasibility analysis. (1)What is the appropriate way to convert wind tunnel measurements to concentrations at the time periods of the NAAQS? (2)Should the fluid modeling demonstration be analyzed to minimize stack height credit or to eliminate all NAAQS exceedances?

Region III would like to discuss these issues with you and any other individuals with insight into the problem. Please contact me at (215) 566-2192 to arrange a mutually convenient time.