

ENVIRON

MEMORANDUM

To: Bay Area 2004 SIP Modeling Advisory Committee (MAC) Participants

From: Chris Emery,
BAAQMD Staff and Management

Date: October 15, 2002

Subject: Response to comments received on the Bay Area SIP Modeling Protocol.

As of September 30, 2002 the Bay Area Air Quality Management District (BAAQMD or District) and ENVIRON had received additional comments on the subject protocol from the following MAC members:

- Julia May, Communities for a Better Environment (CBE);
- Bob Nunes, Monterey Bay Unified Air Pollution Control District (MBUAPCD);
- John DaMassa, California Air Resources Board (CARB);

We have placed these comments on the project web site (www.viron.org/basip2004). ENVIRON and the BAAQMD management and staff appreciate the MAC members' time and effort to review the Modeling Protocol and to forward their thoughtful comments, questions, and issues to our attention. This memorandum attempts to address the concerns raised from this latest review in a succinct manner, and will be reflected in the revised project protocol document to be made available via the project web site prior to the forthcoming MAC meeting on October 30, 2002.

CBE

1) Flaring emissions underestimated: For example, up until just last year, refinery flares were in the inventory at only 0.1 ton per day (tpd). It appears that this only included flare pilots and purge gases, but didn't include the huge flow of hydrocarbons to the flare from process vessels. As a result of our inquiries, the District added 13 tons per day of emissions from just this one source to the inventory. There is evidence that these emissions may be much larger than 13 tpd (up to ten times higher or more).

Response: Flare emissions are highly variable. For this modeling, we expect to develop a day-specific emissions inventory of flaring emissions from refineries. The result of this day-specific emissions inventory effort would be hourly emissions estimates of NOX, CO and TOG for flares at each refinery in the domain. We will determine hourly fuel throughputs

based on records, and apply appropriate emissions and control factors. The District staff has obtained day specific throughput for each of the refineries for the CCOS modeling days. It is important to complete the selection of additional modeling days in order for the District staff to calculate flare emissions for each day.

2) Ongoing investigations of other refinery source emissions show underestimation: There are ongoing investigations as part of the Clean Air Plan proceedings to evaluate emissions from flares and other refinery sources including vessel depressurization, wastewater ponds, marine loading, and tanks. For example, results of source testing of marine loading of products currently exempt from District regulations showed much higher emissions than the emissions factors used by the refineries to characterize this source. In the case of certain exempt products for which there is a very large amount of marine loading, the source tests showed emissions up to thousands of times higher than the extremely low emissions factors used. I'm not sure exactly how these sources are reflected in the inventory at this time, but I know that the exempt products are not present at the levels shown by the recent source tests.

Response: As we discussed with the flaring emissions, the District staff is preparing a day-specific inventory for additional, refinery related sources.

3) Refinery "incidents" underestimated: Another source which seems clearly drastically underestimated is the category of refinery "incidents." The huge incident at the Phillips Rodeo refinery this summer was estimated on the District website to dump from 480 to 720 tons of emissions in a few hours, since the entire refinery shut down, and since all of the gases dumped through the flare in short order. These huge emissions can overwhelm the District inventory. Many other major refinery "incidents" occur regularly, about every 2 months. They appear not to be reflected in the inventory.

Response: By their very nature, upset events are unpredictable. However, events that occurred during the CCOS modeling days and other days modeled as the base case will be part of the emission scenario. District staff will estimate the future case emission scenario and control effectiveness based upon the future study measure Technical Assessment Documents.

4) Pressure Relief Valve emissions underestimated: Yet another refinery source has been known by the District for quite a while to be likely underestimated: Pressure Relief Valves. These sources have no monitoring. When they open to vent and then close, it is very difficult to determine whether they have vented or not. District inspectors cannot determine this unless rupture disks are installed on the PRV. PRVs are safety devices to ensure that vessels don't explode when the pressure gets too high. Approximately half of the refinery-wide population of PRVs vent to the atmosphere, and the other half go to refinery gas recovery systems. A District staff report found that it was likely that the number of ventings go underreported. The average from one PRV lifting was calculated by the District at 9 tons, and the worst known release was 150 tons (in less than one day).

Response: Please see response (2).



5) NOx source controls underestimated: There are many other examples of source underestimation, and the list above only touches on VOC emissions. I am certain from recent review of Title V permit documents that NOx sources are poorly characterized as well. We are especially concerned that weekend-effect studies are being used by the refineries to avoid regulation of NOx sources. Clearly NOx emissions not only cause ozone, but deadly particulate emissions as well. A combined strategy of VOC and NOx control should be the District's mission for a number of health reasons, and the modeling protocol needs accurate data on both VOC and NOx emissions.

Response: Following guidance from the District, we are using TOG, NOX, and CO emissions estimates from the CARB in the air quality modeling study. Since this is an ozone SIP driven by the regulatory process, we will not be collecting, nor examining the impacts of, particulate emissions on air quality. We will supplement the CARB emissions estimates with day-specific emissions estimates from fuel combustion processes from commercial marine and possibly military vessels, which the project team will develop. We will also supplement the CARB emissions estimates with emissions estimates for the portion of Nevada in the air quality modeling domain. These will be the best available emissions data for use in the study (in general, NOx emission rates are better and more reliably documented than VOC). Also following guidance from the District, we will be examining episodic events that occur during the weekend as well as during Monday through Friday.

6) Houston study found industrial emissions are highly reactive: We would also ask if the MAC is reviewing the recent Houston studies which show that industrial VOCs are much more reactive than mobile source hydrocarbons. We request that the committee include these effects in the modeling protocol.

Response: The project team, as well as members of the MAC, are intimately aware of the issues that face the participants in the Houston-Galveston SIP study. We will bring the collective knowledge that we have accumulated based on our experiences with the Houston-Galveston study, as well as many other SIP-related studies, to bear on the BAAQMD SIP revision study.

7) Advisory Council Meeting presentation on inventory should be provided to the Modeling Committee. I understand from the minutes of the Advisory Council that a presentation was provided by Jim Karas of the District, on refinery further study measures and how they relate to the inventory. I suggest that this presentation would be highly relevant to the MAC as well and should be scheduled.

Response: The District staff is well aware of this presentation and will distribute it to the MAC members via the project web page.

MBUAPCD

Bob Nunes provided (via e-mail) his input into recommended procedures for addressing long range transport issues as part of the episode selection process (see compiled comments available on the project web site).

Response: At this point, three modeling episodes have been selected from an extensive analysis and review. The meteorological conditions and transport paths will be described in the third Draft Modeling Protocol. The modeling domain includes Sacramento, the San Joaquin Valley, and Monterey, so that base case and control scenario impacts will be shown. The District will consider the MBUAPCD's concerns, as well as those of the other downwind Districts, in any future evaluations they undertake.

CARB

General Comments

1) The episode characterization is based on ozone air quality only. While useful, it does not consider meteorological factors affecting air quality. We would strongly recommend that meteorology be integrated into the episode characterization to make it more robust.

Response: The episode selection section of the third draft of the Modeling Protocol will include a much broader analysis of the recent historical ozone episodes in the Bay Area, including the integration of meteorological factors. Early results of the new analyses were discussed on a MAC conference call on October 7, and more complete results will be available for the October 30 MAC meeting.

2) Design value scaling is proposed for use, yet the exact methodology for implementation is not clear. For example, how will peak model predictions away from monitoring sites be addressed in the scaling? What if the design and observed values at a monitoring site are significantly different? If model performance is poor at some monitoring sites, how will this affect the design value scaling? Our experience is that there are a number of issues that need to be considered for design value scaling. We would suggest that these issues be carefully considered and addressed early on in the process.

Response: We agree that the identified issues should be carefully considered and addressed early on in the process to the extent possible. Whether design value scaling is used or not will depend on all of these issues. One-hour ozone design value scaling has been used in many recent ozone SIPs approved by the U.S. EPA as part of their Weight of Evidence (WOE) attainment demonstration (e.g., Dallas-Fort Worth, St. Louis, Houston/Galveston). This is an evolving area of technical dialog, including guidance at the national level from U.S EPA for attainment demonstrations throughout the U.S. Further, the CARB is certainly facing similar issues in their ozone SIP attainment and maintenance demonstrations for the San Joaquin Valley, South Coast Air Basin, and the Sacramento regional area. We welcome CARB



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technical input into this complex topic area. As further technical information and guidance becomes available by way of the U.S. EPA, CARB, and the insight of the MAC, we will certainly reflect that combined wisdom in this study. In the interim, the third draft of the Modeling Protocol will attempt to address design value scaling more completely.

Specific Comments

3) It is proposed to match the vertical resolution of the air quality model to that of RAMS up to about 1 km. Above that level the resolution of the air quality model decreases fairly rapidly with height. Is there a concern that the afternoon mixing depths during the episode may not be properly resolved with the current vertical structure? Should a decision on the vertical structure be delayed pending analysis of mixing depths during the episode?

Response: The vertical layer structure described in the second draft of the Modeling Protocol presents a suggested configuration, based on the need to resolve the depth of the typical boundary layer depths throughout central California during ozone episodes. Under such circumstances, the depth of the mixing depth is usually lower than 1000 m, particularly over the Bay Area. Certainly, the analysis of mixing depths from observations will be analyzed before a final layer structure is defined, and we will conduct sensitivity tests with different vertical structures to understand their effects on photochemical modeling results. We have also held discussions with CARB staff on their proposed vertical grid structure for CCOS meteorological modeling, and have agreed to match their RAMS definition identically through 1500 m. The third draft of the Modeling Protocol will reflect all of this.

4) The protocol recommends the use of the PPM scheme for calculating horizontal advection. Even though the Bott and PPM advection schemes are comparable in certain aspects, such as accuracy and mass conservation, the PPM scheme may reduce predicted peaks significantly in some cases. The Bott scheme may not have this undesirable feature. Alternatively, while the formulation of the Bott scheme appears to be sound, we are unable to rule out numerical problems with the computer code implementation. We are aware of one attempt to evaluate the computer code by scientists at the University of California at Davis, and the findings from that work would be relevant to this modeling effort. In short, we strongly recommend sensitivity testing and evaluation of both schemes before selecting one.

Response: We agree with the recommendations for sensitivity testing of both advection schemes, and will carry out such tests. Our experience with these schemes suggests that PPM is a better overall approach given that Bott tends to generate some small but definite numerical artifacts. On the other hand, the CAMx Decoupled Direct Method (DDM) probing tool is coded to only utilize the Bott approach. Therefore, if DDM is to be extensively used in this project, we may need to establish Bott as the default standard in these applications. On balance, we need to use an overall technical approach that best serves the needs of the study to accurately and efficiently develop a technically defensible ozone attainment plan within the regulatory time table for the SIP development. These issues will be raised in the third draft of the Modeling Protocol.



5) The proposed meteorological model (RAMS) uses a different map projection than the emission inventory and air quality models. Although touched upon in the protocol document, we would like to reiterate that care must be exercised in dealing with the different map projections.

Response: We fully agree with the comment. The RAMS projection will be defined to match the CCOS Lambert projection as closely as possible in the focus area. The software to be used in translating RAMS data to CAMx has been written to be as mass-consistent as possible. It is emphasized that simply assigning a cell-by-cell correspondence of meteorological variables to a slightly different air quality grid and/or projection is not an appropriate approach. We realize that the CARB, as well as others, are facing similar issues in defining different projections between emissions and meteorological grids in both their CCOS and SCOS modeling. We welcome MAC review and input on the specific methods to be used in the BA2004 SIP effort as well as those to be explored for use by the CARB in the CCOS and SCOS modeling to be carried out by CARB and contractor support. Ideally, we would want full consistency between the emissions, meteorological, and air quality models. However, like CARB, we also believe it is important to be flexible in selecting various model components, and to consider alternative models (e.g., RAMS vs. MM5) that may represent the ambient conditions in the best possible manner.