BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

# ADVISORY COUNCIL
# TECHNICAL COMMITTEE

# AGENDA

## COMMITTEE MEMBERS

**LOUISE BEDSWORTH, PH.D., CHAIRPERSON**
**ROBERT BORNSTEIN, PH.D.**
**STAN HAYES**
**NORMAN A. LAPERA**
**SAM ALTSHULER, P.E.**
**WILLIAM HANNA**
**JOHN HOLTZCLAW, PH.D.**

**WEDNESDAY**
**AUGUST 4, 2004**

**4TH FLOOR CONF. ROOM**
**1:30 P.M.**

## 1. Call to Order – Roll Call

## 2. Public Comment Period

***Public Comment on Non-Agenda Items, Pursuant to Government Code Section 54954.3.*** *The public has the opportunity to speak on any agenda item. All agendas for Committee meetings are posted at the District, 939 Ellis Street, San Francisco, at least 72 hours before a meeting. At the beginning of the meeting, an opportunity is also provided for the public to speak on any subject within the Committee's purview. Speakers are limited to five minutes each.*

## 3. Approval of Minutes of June 3, 2004

## 4. District's Ozone Control Strategy

*The Committee will discuss the development of the District's Ozone Control Strategy and consider adopting recommendations for submittal to the Advisory Council at its September 8, 2004 Regular Meeting.*

## 5. Committee Member Comments/Other Business

*Committee members, or staff, on their own initiative, or in response to questions posed by the public, may ask a question for clarification, make a brief announcement or report on his or her own activities, provide a reference to staff regarding factual information, request staff to report back at a subsequent meeting on any matter or take action to direct staff to place a matter of business on a future agenda.*

## 6. Time and Place of Next Meeting

*At the call of the Chair.*

## 7. Adjournment

**CONTACT CLERK OF THE BOARDS - 939 ELLIS STREET SF, CA 94109** **(415) 749-4965**
**FAX: (415) 928-8560**
**BAAQMD homepage:**
**www.baaqmd.gov**

- To submit written comments on an agenda item in advance of the meeting.
- To request, in advance of the meeting, to be placed on the list to testify on an agenda item.
- To request special accommodations for those persons with disabilities notification to the Clerk's Office should be given in a timely manner, so that arrangements can be made accordingly.

**LB:jc**

# BAY AREA AIR QUALITY MANAGEMENT DISTRICT
## 939 ELLIS STREET, SAN FRANCISCO, CALIFORNIA 94109
## (415) 771-6000

## CLERK OF THE BOARDS OFFICE:
## MONTHLY CALENDAR OF DISTRICT MEETINGS

## JULY 2004

| TYPE OF MEETING | DAY | DATE | TIME | ROOM |
|---|---|---|---|---|
| **Board of Directors Stationary Source Committee** *(Meets 4th Monday every other Month)* **- CANCELLED** | **Monday** | **26** | **9:30 a.m.** | **Board Room** |
| **Board of Directors Budget & Finance Committee** *(Meets 4th Wednesday each Month)* **- CANCELLED** | **Wednesday** | **28** | **9:45 a.m.** | **4th Floor Conf. Room** |

## AUGUST 2004

| TYPE OF MEETING | DAY | DATE | TIME | ROOM |
|---|---|---|---|---|
| **Advisory Council Air Quality Planning Committee** | **Tuesday** | **3** | **1:30 p.m.** | **Room 716** |
| **Board of Directors Regular Meeting** *(Meets 1st & 3rd Wednesday of each Month)* **- CANCELLED** | **Wednesday** | **4** | **9:45 a.m.** | **Board Room** |
| **Board of Directors Budget & Finance Committee** *(Meets 4th Wednesday each Month)* | **Wednesday** | **4** | **9:45 a.m.** | **4th Floor Conf. Room** |
| **Advisory Council Technical Committee** | **Wednesday** | **4** | **1:30 p.m.** | **4th Floor Conf. Room** |
| **Board of Directors Public Outreach Committee** *(Meets 2nd Monday every other Month)* **- CANCELLED** | **Monday** | **9** | **9:45 a.m.** | **4th Floor Conf. Room** |
| **Advisory Council Public Health Committee** | **Monday** | **9** | **1:30 p.m.** | **Room 716** |
| **Board of Directors Mobile Source Committee** *(Meets 2nd Thursday each Month* **- CANCELLED** | **Thursday** | **12** | **9:30 a.m.** | **4th Floor Conf. Room** |
| **Board of Directors Regular Meeting** *(Meets 1st & 3rd Wednesday of each Month)* **- CANCELLED** | **Wednesday** | **18** | **9:45 a.m.** | **Board Room** |
| **Board of Directors Budget & Finance Committee** *(Meets 4th Wednesday each Month)* | **Wednesday** | **25** | **9:45 a.m.** | **4th Floor Conf. Room** |

# SEPTEMBER 2004

| TYPE OF MEETING | DAY | DATE | TIME | ROOM |
|---|---|---|---|---|
| **Board of Directors Regular Meeting** *(Meets 1st & 3rd Wednesday of each Month)* **- CANCELLED** | **Wednesday** | **1** | **9:45 a.m.** | **Board Room** |
| **Advisory Council Executive Committee** | **Wednesday** | **8** | **9:00 a.m.** | **Room 716** |
| **Advisory Council Regular Meeting** | **Wednesday** | **8** | **10:00 a.m.** | **Board Room** |
| **Advisory Council Public Health Committee** | **Wednesday** | **8** | **12:30 p.m.** | **Room 716** |
| **Board of Directors Mobile Source Committee** *(Meets 2nd Thursday each Month)* | **Thursday** | **9** | **9:30 a.m.** | **4th Floor Conf. Room** |
| **Board of Directors Public Outreach Committee** *(Meets 2nd Monday every other Month)* | **Monday** | **13** | **9:45 a.m.** | **4th Floor Conf. Room** |
| **Board of Directors Regular Meeting** *(Meets 1st & 3rd Wednesday of each Month)* | **Wednesday** | **15** | **9:45 a.m.** | **Board Room** |
| **Regional Agency Coordinating Committee – (RACC)** | **Friday** | **17** | **1:30 p.m.** | **Location:** **MTC 101 – 8th St. Oakland, CA 94607** |
| **Board of Directors Budget & Finance Committee** *(Meets 4th Wednesday each Month)* | **Wednesday** | **22** | **9:45 a.m.** | **4th Floor Conf. Room** |
| **Board of Directors Stationary Source Committee** *(Meets 4th Monday every other Month)* | **Monday** | **27** | **9:30 a.m.** | **Board Room** |
| **Board of Directors Executive Committee** *(Meets 5th Wednesday of Months that have 5 Wednesdays)* | **Wednesday** | **29** | **9:30 a.m.** | **4th Floor Conf. Room** |

**MR:hl**
**7/22/04 (3:05 p.m.)**
**P/Library/Calendar/Moncal**

**AGENDA NO. 3**

Bay Area Air Quality Management District
939 Ellis Street
San Francisco, California 94109

DRAFT MINUTES

Advisory Council Technical Committee
9:30 a.m., Tuesday, June 3, 2004

1. **Call to Order – Roll Call.** 9:36 a.m. Quorum present: Louise Bedsworth, Ph.D., Chairperson, Sam Altshuler, P.E., Robert Bornstein, Ph.D., William Hanna (9:44 a.m.), Stan Hayes, John Holtzclaw, Ph.D., Norman A. Lapera, Jr.

   **Also Present:** Harold Brazil (9:40 a.m.).

2. **Public Comment Period.** There were no public comments.

3. **Approval of Joint Technical & Air Quality Planning Minutes of April 6, 2004.** Mr. Lapera requested the following correction on the bottom of page two under his comments, last sentence, 11,000 miles of trails should be 1,100 miles of trails. Mr. Lapera moved approval of the minutes; seconded by Dr. Holtzclaw; carried unanimously.

4. **Presentation on EMFAC 2002.** Amir Fanai, Senior Air Quality Engineer, Planning Division, presented "EMFAC and San Francisco Bay Area Ozone Planning. Mr. Fanai provided a brief history of EMFAC and noted the following:

   - In 1987 a Van Nuys Tunnel Study showed that EMFAC7D underestimated CO and Reactive Organic Gases (ROG) emissions for California On-Road Motor Vehicles by factors of 2-3.
   - For Photochemical Modeling in 1991, Bay Area ROG emissions for 1989 from EMFAC7EP were scaled up by 90% to improve the photochemical model performance
   - EMFAC7G (1995) underestimated 1990 emissions for the Bay Area by 40% for ROG relative to Fuel Based Inventory that came out at the time.
   - The current version, EMFAC2002 (April 2003), shows better agreement with Fuel Based Inventory for Year 2000 but discrepancies still exist.

   Mr. Fanai's presentation included the following topics:

   EMFAC2002 FEATURES:
   Inventories for 1970 to 2040 can be projected provided that travel emission inventory data are available. Weekend emissions are not estimated because of lack of data. The categories include:
   - 13 vehicle classes
   - 45 model years within a calendar year
   - 69 geograpahic areas
   - 24 hourly periods
   - 12 months
   - 3 seasons for planning

- 7 pollutants (HC/CO/NOx/PM/CO2/Lead/Sox)
- 7 processes that include running exhaust, start emissions, idle emissions, running losses, hot soak, diurnal emissions and resting losses.

CO2 and Methane have been added for Green House gases, and PM2.5 added for new ambient standards.

VEHICLE CLASSES:
With regard to vehicle classes in EMFAC, Heavy Duty trucks have been divided into light, medium and heavy-duty classifications to better track NOx emissions. Other classifications include Passenger Car, Line-Haul Vehicle, Urban Bus, Motorcycle, School Bus and Motor Home.

ON ROAD MOTOR VEHICLE EMISSIONS FOR SUMMER 2000:
ROG emissions total 207 tons per day, of which heavy duty diesel trucks contribute 3%. The Vehicle Mile Travel (VMT) from this class of vehicles is 3-4% of total Bay Area VMT. In the Bay Area 96-97% of VMT are attributable to gasoline vehicles, which produce 97% of ROG emissions. Diesel vehicles do not have a large impact on ROG emissions. ROG emissions are not weighted for reactivity.

NOx emissions are 351 tons per day, of which 41% are from heavy-duty diesel trucks (including buses and motor homes). Despite the low VMT by heavy-duty trucks, over 40% of NOx emissions are from heavy-duty trucks, most of which run on diesel.

BAY AREA SUMMER 2000 EMISSIONS (ROG: 505 TONS/DAY; NOx: 630 TONS/DAY):
On-road motor vehicles are responsible for 41% of the total ROG inventory. Traditionally biogenic emissions are not included. On-road motor vehicles are responsible for 56% of NOx in the Bay Area. Overall, 25% of NOx in the Bay Area are from heavy-duty diesel trucks. Three to four percent of VMT, produce 25% of NOx emissions. The fuel-based inventory provides an independent estimate of on-road motor-vehicle emissions.

EMFAC2002 VS. FUEL-BASED INVENTORY – ROG EMISSIONS (TONS/DAY) SUMMER 2000:
A fuel based inventory helps to assess accuracy of EMFAC projections. The Central California Ozone Study (CCOS) domain is in San Joaquin, San Francisco, and Sacramento, and the fuel based inventory (related to work of former Advisory Council Member Rob Harley of UC Berkeley) shows higher ROG emissions than what EMFAC projects.

EMFAC2002 VS. FUEL-BASED INVENTORY – NOx EMISSIONS SUMMER 2000:
The model does a good job for Sacramento and San Francisco, though emissions for the Bay Area appear to be slightly overestimated. The greatest discrepancy is in the San Joaquin Valley – approximately 35%. When the numbers came out, staff did a simple scaling and ran the photochemical model, and the model did not show changes in ozone. Staff was working on meteorological data at the time and will repeat this work again when finished with the met data. Fuel sales data suggest that diesel sales have increased since 1990, and the model is not capturing this for the San Joaquin Valley area. The California Air Resources Board (CARB) is looking into this as well.

The District has been very proactive in wanting to improve emissions inventory for on-road motor vehicles and it is apparent that for ROG there has been a change of nearly 100% from an old version of the model. Emissions have increased for every new version of the model and the District tries to obtain the best inventory possible at all times.

CHANGES IN BAY AREA ON-ROAD MOTOR VEHICLE EMISSIONS ESTIMATES FOR YEAR 2000:

Dr. Holtzclaw noted that there are two things at issue: (1) whether or not the District is properly estimating the emissions of the vehicles that are out there now, and (2) whether or not the projections are accurate regarding how rapidly the emissions will decrease in the future due to the assumptions of fleet turnover, cleanliness of cars and vehicle mix in the future.

Dr. Bornstein stated that the fuel emission surveys are based on how much fuel is sold. People drive differently on Super Highways. They may buy their gasoline in one place and travel out of that area; therefore, the emissions from that sale would not be reported in the location it was sold. He inquired if this issue was built into Dr. Rob Harley's study. He was of the opinion that urban counties versus Super Highway counties could, perhaps, be treated differently since the fuel-based approach is giving higher values of emissions and ignoring the drive-through, which may be one of the reasons for the problem. He suggested that, perhaps, staff could look into this.

BAY AREA ON-ROAD MOTOR VEHICLES 1990-2000 EMISSION REDUCTIONS: EMFAC2002 VS. FUEL-BASED INVENTORY - 1990 and 2000:

The EMFAC2002 emission reduction for the Bay Area is more optimistic than fuel based inventory. EMFAC 2002 tends to overestimate NOx. Mr. Fanai pointed out that when projections are made in 1990 for the year 2000, there are some assumptions being made about changes of VMT and speed, congestion and high speed travel, and vehicle deterioration. If a mistake is made in predicting the emissions for 1985 vehicles in the year 2000, then that will be reflected. The 2000 fleet has less of the older vehicles in it so that the margin of error becomes less; and then as one projects into the future for the year 2020, most of the vehicles are high tech and, therefore, there is a much better chance of predicting their emissions 20 years from now than when predictions were made in 1985 for the 1975 vehicles.

Dr. Holtzclaw expressed a concern that when he reviewed the Clean Air Plan for the past years and then looked at the projections for the future, they all showed a strong reduction in emissions for the future which have not yet materialized; but for the present year, the emissions were still high. He felt that it was important to address this issue. In response, Mr. Fanai pointed out that there is definitely a downward trend in emissions that can be quantified.

POSSIBLE SOURCES OF UNDERESTIMATION AND PLANNED IMPROVEMENTS:

Mr. Fanai pointed out that there would be extensive remote sensing within the next 12 months by CARB and the Bureau of Automotive Repair (BAR) to improve fleet characterization with regard to old vehicles and high emitting vehicles. The benefits of the Inspection and Maintenance Program (Smog Check) may be over estimated within the model, and that is why this program is being re-evaluated every two or three years. One of the evaluation reports has been released recently and is currently being reviewed. CARB continues to do In-Use Vehicle Testing and hopes that this will also improve the new version of EMFAC that is planned for Spring 2005.

Another possible source of underestimation could be the underestimation of congestion and high speed travel. EMFAC does not have emission rates for vehicles going over 65 miles per hour because the data for how much of the VMT is done at those speeds is unavailable. Also, there has not been extensive testing done at higher speeds. One can only make estimates of what that might be.

Regarding underestimation of heavy-duty truck travel that affects NOx emissions, ARB is looking into this for the San Joaquin Valley. They are also analyzing hourly variation of truck travel (peak vs. off-peak hours). Dr. Bornstein inquired if trucks coming in from Mexico, which are not under U.S. emission standards, are included; and how many of these trucks make it into the Bay Area. Mr. Fanai stated that the figures do include vehicles from out of state. Dr. Holtzclaw stated that he was under the impression that most trucking companies now use GIS equipment to determine truck location and wondered if ARB had access to such information. He suggested that staff look into this.

POSSIBLE SOURCES OF UNDERESTIMATION AND RELEVANT CONTROL PROGRAMS:
CARB's Smog Check program directs high emitters to Test-Only Stations and the Repair Assistance Program from BAR is also still in effect. The possible elimination of the 30-year Rolling Exemption is the subject of current legislation. The evaluation of the Smog Check Program will make sure that there is a good handle on emissions. Vehicle Buy-Back and Smoking Vehicle Programs are also still in effect.

For the Underestimation of Congestion and/or High Speed Travel, the Transportation Fund for Clean Air and Spare the Air Programs help towards this. Bay Area emissions will continue to decline according to the inventory and the prediction is that there will be fewer emissions in the year 2006 compared to 2000.

Mr. Hayes stated that not all ROG is equal. For example, formaldehyde accelerates the photochemical process. Recent toxicity data suggests a strong link between formaldehyde and certain types of cancers and leukemia. Therefore, it might be useful to look at some of these other species for more than just ozone planning.

Dr. Holtzclaw asked if any data is available on vehicles traveling at high speed. Mr. Fanai responded that ARB does not have test data for vehicles traveling at speeds over 65 mph.

Dr. Bornstein inquired if there are any economic data in the emission estimates and whether or not any attempt has been made to include economic factors in episode modeling to adjust the emissions. Harold Brazil, Advisory Council Member, and a staff member of Metropolitan Transportation Commission (MTC), stated that MTC, periodically, has to do a conforming analysis on its transportation improvement program and regional transportation plan. One of the regulations that they have to follow, when doing this analysis, is to use the latest planning assumptions. Therefore, a lot of the inventories that the Air District has and what has been submitted by MTC, in the past, for the State Implementation Plan (SIP) and for photochemical modeling work include the previous version of the socio-economic forecast, which are projections of the year 2000 that the Association of Bay Area Governments (ABAG) developed. However, to do the conforming analysis MTC had to use projections for the year 2003 and that data reflected the dot com bust. Therefore, one of the differences that will be seen when the speed distribution data is put into the EMFAC model, is a speed-up of the speeds, basically because congestion goes down when the number of jobs decline. Hence, there is a subtle reduction in the inventories and there is a slight increase in NOx emissions.

David Souten, ENVIRON, commented on some of the charts presented by Mr. Fanai. He stated that in the case of air pollution, the Bay Area is both politically and physically connected to the San Joaquin Valley and Sacramento areas. The charts presented were focused on the accuracy of the emissions in the entire Bay Area. However, the accuracy of the emission inventories is also important for San Joaquin Valley and Sacramento because there are air quality considerations that cross over the air pollution control district boundaries that may affect regulation development in the Bay Area.

Peter Hess, Deputy Air Pollution Control Officer, Gary Kendall, Director of Technical Services, and Fanai responded to Committee members' questions and comments, as follows:

a) ROG emissions are not weighted for reactivity. Based on a study that Alan Gertler of DRI did a few years ago regarding VOC emissions from diesel versus VOC emissions from gasoline-powered vehicles, while the emission rates are different for grams per gallon or grams per mile, when the speciation profiles for each of the two sets of emissions are analyzed and a reactivity weighted analysis is conducted, it turns out that they are very similar. They do not emit the same grams per mile or grams per gallon, but if a gram of VOC emission is analyzed and then one looks at all the different compounds that comprise those emissions and then apply the reactivity weighting factors, it turns out that they are very similar. (Altshuler)

b) The fuel-based inventory is related to the work conducted by Dr. Rob Harley. The latest work was done specifically for the CCOS study. (Altshuler)

c) Fuel-based inventory is not aggregated by vehicle type. Only gasoline and diesel are aggregated. It seems that diesel emissions may be underestimated. Fuel sales have been increasing much more rapidly than gasoline sales; therefore, it is possible that at least for the San Joaquin Valley the emissions are not captured due to the higher sales. (Altshuler)

d) Emissions for 2000 from the EMFAC7EP, 7F, 7G EMFAC2000 and EMFAC2002 were presented. These are the emission estimates that came out of the model at the time. The Bay Area Air District is one of the few districts that actually referred to the underestimation of the motor vehicle emissions in its plan, and the District was hoping that the emissions estimates would improve. (Holtzclaw)

e) The differences between EMFAC2002 and the fuel-based inventories, both for ROG and NOx, are within the margin of error. (Hayes)

f) Mr. Fanai stated that he was unaware of any recent work that addressed the issue of compiling a list of weak points or assumptions for each of the methodologies. (Bornstein)

g) Dr. Bornstein inquired if the District had developed any simulations using both emission inventories to see which one produces a better ozone field, and whether or not Dr. Harley's emission inventory had been checked for this. He also stated that Dr. Harley's emission inventory is being used in a study at Lawrence Berkeley Laboratory, and that the Livermore ozone peak was well simulated. He suggested that it would be good to know the results of Dr. Harley's simulations and to find out if they are pleased with the results. Mr. Fanai stated that he did not have a conclusive answer on this issue and that he would follow up with Dr. Harley regarding the results of his study.

h) The information about the number of vehicles on the road was obtained from the Department of Motor Vehicles (DMV). Dr. Bornstein indicated that there are a lot of unregistered vehicles in California, and probably many of them are old vehicles because there are many poor people who cannot afford insurance and registration. Therefore, it is possible that the number of high emission vehicles is underestimated because they may not include estimates of unregistered vehicles. Mr. Fanai clarified that EMFAC does allow for unregistered vehicles. The DMV registrations include some unregistered vehicles. The reasons for the change from

EMFAC2000 to EMFAC2002 were based on the fact that ARB was criticized because it was overestimating the number of unregistered vehicles. (Bornstein)

i) Mr. Altshuler stated that when an engine manufacturer certifies a diesel engine, it is done on a grams/brake/horsepower hour basis, and this is different from grams/mile. He wanted to know what the current ratio is assumed in this conversion. Mr. Fanai stated that he would obtain the conversion ratio numbers for Mr. Altshuler.

j) Mr. Fanai said that he was not aware of NO2 emission calculations being included in EMFAC for the future, but was of the opinion that ARB is open to suggestions like that, such as the addition of methane and CO2, and that he would recommend NO2 to them, if so desired. (Altshuler)

k) Mr. Hayes stated that each time one goes through the planning process, there are major changes in the inventory, and gradually over time, the changes get smaller. He wondered if staff had a sense of how close the District is with the estimates, and the actuality of numbers, as shown in the final chart of this presentation.

Mr. Fanai stated that he is optimistic that emission estimates are improving and will continue to improve. As the older vehicles decrease in the system, the estimates will improve, and it will be easier to know what the true emissions might be. Because of the Enhanced Smog Check Program, it is predicted that by the year 2006 there will be additional reductions – 14 tons of NOx and 10 tons of ROG. These numbers are currently built into the model, and into the emission projections for the year 2006.

l) Mr. Altshuler inquired from Mr. Hess whether he had read a report recently regarding a potential change in ozone formation as a result of dieselization of passenger vehicles. There is a potential that the Europeans are leading that charge and there has been some modeling done to assess what would happen if the U.S. had more diesel vehicles like Europeans. They looked at the increase in NOx and NO2 and thought that that would increase the ozone.

Mr. Hess stated that he had seen the report. This report describes the penetration of diesel vehicles into the passenger car fleet. To draw conclusions for the Bay Area based upon a national report is indicative and gives the District a heads-up. Large quantities of passenger vehicles are coming into the Bay Area from the Sacramento area, and especially the San Joaquin Valley, on a daily basis. Many of the automobiles that are being used in the choice of the commute are not the best-kept ones. They are the "commute" vehicles. The District needs to look at the emissions that are coming from these vehicles into the Bay Area from Tracy, Manteca and Stockton. He felt that in the future these might be diesel passenger vehicles. Staff is working closely with both the San Joaquin Valley and the Sacramento districts in regard to controlling the emissions from heavy-duty diesel trucks and actively looking at various different control strategies for the heavy-duty diesel truck fleets.

Mr. Hess reminded the Committee that the Technical Committee, as well as the full Advisory Council, provided the District with very good ideas regarding the Smog Check Program and they are before the Inspection & Maintenance Review Committee (I&M). Once the I&M Review Committee looks at the existing program, Dick Wiser, Chair of the I&M Review Committee, will unveil the Council's suggestions on I&M improvement.

m) Mr. Hanna noted that BAR had projected that it would cost $8 to $10 more per Enhanced Smog Check, but he is seeing $30 differences in the Napa area.

**5. NOx Controls and Ozone Formation.**

Dr. Saffet Tanrikulu, Research & Modeling Manager, presented the "NOx Control As They Relate to Ozone Formation in the Bay Area." Mr. Hess stated that the presentation had interesting insights, both for the Bay Area ozone and transport, and welcomed the Committee's input on this topic. Dr. Tanrikulu addressed the following topics:

- Ozone and PM2.5 chemistry
- NOx controls as they relate to ozone formation in the Bay Area
- NOx transport to neighboring districts
- NOx-PM2.5 relation in the Bay Area

OZONE CHEMISTRY (Page Nos. 3 & 4 of Presentation):

NO2 splits under the sunlight to produce NO + O. Then O reacts with O2 to produce O3. O3 reacts with NO to produce NO2 and O2. At the end of this reaction there is neither net gain nor loss for ozone. However, in the presence of hydrocarbons, HO2 and RO2 radicals are produced. These will convert NO to NO2, without losing ozone; thus, ozone concentrations will increase.

Dr. Tanrikulu pointed out the following:

a) The reaction rate for the last two equations, as shown on the chart on Page No. 4, is about 400 times faster than the reaction rate of the third reaction (ozone + NO). However, the conversion rate of NO to NO2 depends on the reaction rate as well as the concentration of the species. Since ozone concentration is much higher than HO2 and RO2 concentrations under normal conditions, NO is converted to NO2 about four times faster through the reaction of ozone + NO.

b) NO2 splits into NO + O to produce ozone, and NO is again converted to NO2; in the Central California Ozone Study Emissions Inventory, NO is converted to NO2 2.6 times before NO2 becomes something else, so this cycle goes around about 2.6 times. This is a lot lower compared to the cycle that is observed by Professor Harvey Jeffries over Houston, which is about 4 to 4.5 times, and over Atlanta, which is about 6 times. This implies that hydrocarbons in the Central California Ozone Study domain are less reactive compared to those in Texas and Georgia. One other possibility is that the reactivity of hydrocarbons may be underestimated in California because photochemical models underestimate ozone there.

c) Scientists have been looking at the conversion rate among the last three reactions and there are various methods to see which reaction is going to convert NO to NO2 faster. There are a number of research papers available on this issue and the most common way of looking at the comparison is the VOC/NOx ratio. If the VOC/NOx ratio is less than 6.5, the area is considered to be rich in NOx, and if the ratio is higher than 6.5 then the area is rich in hydrocarbons. This means that if one is in the region where the VOC/NOx ratio is less than 6.5, ozone + NO is going to be more effective, which will not increase ozone concentration; if, however, one is in an area rich with hydrocarbons, then HO2 + NO and RO2 + NO will be

important. If the VOC/NOx ratio is over 11 or 12 then that means that there is usually insufficient NOx in the environment to produce ozone.

d) During the daytime, NO2 combines with OH to produce nitric acid. This is a daytime reaction because OH is produced during the daytime. At night, NO2 combines with ozone to produce nitric acid as well. Nitric acid will react with ammonia, producing ammonium nitrate, which is PM2.5. About 30% to 40% of PM2.5 concentrations in the Bay Area are produced through this reaction. There are several main sources that produce ammonia such as feedlots, catalytic converters on cars, natural decay of vegetation and wildlife. NOx is the main source for nitric acid.

VOC/NOx 2000 (Page No. 6 of Presentation):
Dr. Tanrikulu showed VOC/NOx ratio from four stations: Bethel Island, Patterson Pass, Sunol and San Jose. The table shows measurements from midnight to 3 a.m., 5 a.m. to 8 a.m., Noon to 3 p.m., and 4 p.m. to 7 p.m. The morning hours from 5 a.m. to 8 a.m., indicates that the VOC/NOx ratio was less than 6.5, except for Bethel Island. During Noon to 3 p.m., the ratio increases, mostly due to additional biogenic VOC emissions, which are a function of temperature – as the temperature increases, there are more biogenic emissions.

EKMA DIAGRAM (Page No. 7 of Presentation):
This graphic is based upon modeling sensitivity simulations that were conducted in 1989 with 1989 emission inventory, and projected to the year 2000. Based upon the 2000 emissions inventory, there were 648 tons of NOx and 554 tons of VOC emissions. This produced about 139 ppb of ozone in Livermore. The federal standard is 124 ppb. If hydrocarbon emissions are reduced about 15%, they will reduce ozone to 124 ppb. Also, the diagram shows that when NOx is reduced by about 40%, it is likely that ozone concentrations will increase in Livermore. The diagram also points out that if NOx is reduced in the Bay Area by 2.6 tons per day, VOCs need to be reduced by about 1 ton per day in order to avoid ozone disbenefit. The Bay Area's emissions currently are a lot different than they were in 1989 because there were more reactive hydrocarbons in 1989. If the EKMA Diagram is created using today's emissions inventory, the disbenefit is expected to be smaller.

The model indicates that there may be a potential disbenefit if only NOx is reduced. Dr. Tanrikulu made some estimates to motor vehicle emissions, for example, if 2.6 tons of NOx are reduced from motor vehicle emissions, then VOCs are automatically reduced by about 2.1 tons. Therefore, reducing motor vehicle emissions will not lead to disbenefit in ozone concentrations. The natural hydrocarbons are not included in the EKMA Diagram because they are not considered controllable.

NUMBER OF OZONE EXCEEDANCES (1991-2003) (page No. 8 of Presentation):
This table shows ozone exceedances from 1991 to 2003 for days of the week, for the 1-hour and 8-hour standards. During Saturday, Sunday and Monday, the number of ozone exceedances is higher than weekdays. During the weekends, emissions are lower compared to weekdays because most of the heavy-duty utility trucks are not operating during the weekends and, probably, NOx is reduced more than VOC during the weekend. This is also supporting evidence for model results on the potential disbenefit of reducing NOx alone.

Dr. Bornstein pointed out that assuming that these differences are statistically significant, there are two things that stand out from this table: (1) that Monday is a continuation of the weekend, and so it is better to look at it from Tuesday to Monday. The fact that Monday is a continuation of

Saturday and Sunday, implies a time lag. If it were just proportional to the emissions, Monday would not be the same or a continuation of Saturday or Sunday. There is some sort of time lag in which the exceedances, on a given day, have something to do with the emissions on the previous days; (2) Friday also stands out. Therefore, Mondays and Fridays show how they are related to a time lag, which is connected to the weekend.

Mr. Hess pointed out that during the summer season, a lot of people travel on Fridays, which causes the traffic pattern to change considerably. Fridays, in the summer time, are almost a weekend. Additionally, on Sunday evenings, there is very heavy traffic returning to the Bay Area. Dr. Bornstein commented that the Sunday evening returning traffic would not affect the Sunday afternoon ozone, but if the precursors stay around, then Mondays might be affected.

MEAN NOx Or NOy IN TWO 5-DAY SUMMER PERIODS, 2000 (Page No. 9 of Presentation):
This graph shows the NOx and Ozone measurements made near the surface levels at the following stations: San Francisco (SFA), Livermore (LVR1), Concord (CCD), Pittsburg (PBG), Vallejo (VJO), Bethel Island (BTI), Lamby Road (LAMB), Patterson Pass (PATP), Davis (DVS), Sacramento, 13th Street (S13), Stockton (SOH), Tracy (TPP), Modesto (M14), Fresno Drummond Street (FSD) and Fresno First Street (FSF).

The model suggests that, for the Bay Area, it is going to be more beneficial if both VOCs and NOx are reduced for ozone. If NOx reductions are slow in the Bay Area, it will not impact ozone in the Sacramento and San Joaquin Valley. The chart shows two measurements taken during the summer periods, July 10-14 (low ozone concentration period) and July 28-August 1 (moderate ozone concentration period). The difference between NOx and NOy are displayed at Bethel Island – NOx is about 20% to 25% less than NOy. In order to compare LAMB and PATP where only NOy measurements were made, against other stations, it is assumed that the numbers will be 20% or 25%. These stations were selected along the transport corridors, from the Bay Area to Sacramento and San Joaquin Valley.

In the Livermore and Concord areas there are about 27 to 32 ppb NOx concentrations. If the rate of reduction in the NOx concentrations from Concord to LAMB and Livermore to PATP continues from LAMB to Sacramento and PATP to Fresno, transport from the Bay Area to Sacramento and San Joaquin Valley will be at a minimum level.

Another point that Dr. Tanrikulu made with this graph is that if NOx concentrations are compared between high or moderate ozone days, and low ozone days, the NOx concentrations are a lot higher because there was a lower inversion layer during the high ozone period. Mr. Hess stated that motor vehicle emissions are at a tail-pipe level, which is under the boundary level emitted at a very hot temperature. This results in a mixture of VOC and NOx.

Committee members opined that this graph addresses some of the issues that the Committee has been struggling with in the past, and felt that the information it relayed was very useful.

MEAN OF DAILY MAX OZONE IN TWO 5-DAY SUMMER PERIODS, 2000 (Page No. 10 of Presentation):
This graph shows the ozone concentrations from the two 5-day periods. However, it is incomplete and staff is still waiting for information from ARB for Lamby Road and Patterson Pass in order to complete it.

PM2.5 JULY-AUGUST, DEC-JAN AVERAGES FOR BAY AREA SITES, 1999-2003 (Page Nos. 11 and 12 of Presentation):
Staff studied the average PM2.5 concentrations over the Bay Area stations during the summer and winter periods. Measurements of PM2.5 concentrations started in 1999 in the Bay Area, and this graph shows the results from 1999-2003. In 2002, PM2.5 concentrations were the highest. Also, the average PM2.5 concentrations are very close to each other at these stations, even though the stations are widely distributed throughout the Bay Area. PM2.5 concentrations are low during the summer periods. During the winter periods the concentrations are significantly different among the stations – about 15 to 25 mg/m3.

NOx DECEMBER-JANUARY AVERAGE FOR BA PM SITES (Page No. 13 of Presentation):
NOx is one of the precursors of PM2.5 concentrations. San Jose, for example, has the highest NOx concentrations compared to the other stations, and Bethel Island has low NOx concentrations compared to the other stations. The issue of how NOx is impacting the formation of PM2.5 still requires a lot of research and staff is working to understand how NOx control may affect PM2.5 concentrations.

(PM10) NO3 DECEMBER-JANUARY AVERAGE FOR BA PM SITES, 1999-2004 (Page No. 14 of Presentation):
This graph shows the amount of NOx that is converted to nitrate. It does not necessarily show that there are high concentrations of PM2.5 where there are high concentrations of NOx. Therefore, it is unclear from the figures as to how much NOx reduction will benefit PM2.5 concentrations immediately. Dr. Tanrikulu explained that there is additional research to be done to better understand the relation between NOx and PM2.5.

Mr. Kendall explained that the chart shows only a component of PM10, whereas the previous one shows the total of PM2.5. Because the District has the attainment for the national standard in the Bay Area, samples are taken only once every six days, whereas for the PM2.5 there are much more frequent samplings taken every day during the winter at several of the sites, so there is a greater chance of capturing them.

CAMx LAYER 1, O3 DISTRIBUTION (Page No. 15 of Presentation):
This diagram is based on ongoing modeling work. Staff is working with ENVIRON to simulate two episodes – one of them is the July 11 and 12, 1999 episode, and the other one is the July 30-August 2, 2000 episode. This diagram shows the model results from the July 12, 1999 episode, at 4 p.m. There is a higher O3 concentration area at the east side of the 680 corridor, towards south of Mt. Diablo, which has about 150 ppb of ozone, and at the same time there were about 146 ppb and 156 ppb of ozone observed in Livermore and in Concord, respectively. This indicates that the model is doing a very reasonable job, except that it is missing the high concentration at Concord.

CAMx LAYER 1, EFFECT OF 15% NOx REDUCTION ON O3 (Page No. 16 of Presentation):
For purposes of this presentation, staff reduced only the NOx in the emissions inventory and conducted another simulation. When the difference between the two simulations, in terms of ozone, were analyzed to see whether there was any ozone disbenefit, it showed that the ozone disbenefit was about 4 ppb. The difference between the previous chart and this one, shows ozone disbenefit to the west side, the maximum produced by the model. Therefore, it is not necessarily true that there is ozone disbenefit where there is maximum ozone concentration. Another point is that if one looks at the downwind areas within the Bay Area, there are ozone benefit areas; one of

them is in Alameda County and south of Livermore, and the other location is south of San Jose. There is a benefit of about 6 ppb of ozone by only reducing NOx.

Mr. Hayes inquired as to how there could be a balance between reductions of 4 ppb against a 4 ppb increase some place else. He stated that this issue has been a problem for some time and that he has worked on it with the Environmental Protection Agency (EPA) earlier, when they tried to link together exposure and health risk models that looked at people's actual exposure to what they might be and what the health consequences of that would be. It is helpful to those who live in the vicinity of the peak where one can see a reduction, and the ozone levels are higher there than elsewhere; but if an increase occurs on a lower base elsewhere, that also has health consequences, and the way to trade this off is to look at a net change in aggregate health risk. The tools are around to do this and he suggested that staff consider some simple ways to aggregate each of these grid cells; otherwise there is no resolution as to what the net choice might be. Mr. Hess commented that staff is working on this issue continuously and that it is important to run various scenarios by looking into the future. By only looking at the 2006 runs there will be a different epicenter; or instead of having high ozone levels in Concord using 2006 numbers and this episode, there might be no exceedances in that one area. There will be a change in the hydrocarbons/NOx ratios and even further changes in the future.

Dr. Bornstein commented that the health standard is based on an assumption that there are no health impacts if they are below the bright line; therefore, it is true that some people will breathe slightly more polluted air. As long as that does not push them over the bright line, in theory, there are no health impacts. He also commented that there would still be a violation under these conditions. Dr. Tanrikulu explained that since the District is in attainment for the 1-hour standard, EPA is allowing the maximum of three exceedances in three consecutive years. On July 11 and 12, 1999 there were exceedances in both the Sacramento and San Joaquin Valley areas. Since this is the first simulation of this episode, staff is still researching and studying this issue.

Mr. Hess pointed out that since CARB will be transitioning to the 8-hour standard, he assumed that they will be doing away with the 1-hour ozone standard. He feels that the focus should be on the 8-hour standard in the future because the EPA will be transitioning from the 1-hour federal ozone standard in June 2005. Therefore, the Committee should be thinking into the 8-hour, with very different control strategies. There are many different meteorological scenarios that cause ozone exceedances and there will be a transitioning from an exceedance-based standard (namely, the 1-hour federal) to a value-based standard for the 8-hour federal ozone standard.

**6. Discussion of Possible Committee Input on Cumulative Risk Assessment.**

Chairperson Bedsworth reminded the Committee that this item was discussed last at the full Advisory Council meeting, and wanted to know if members had any additional comments to make on this item.

Mr. Hayes stated that he had requested this item be placed on the agenda. The Cumulative Risk issue is a very important one and he is aware that the Public Health Committee has been looking at the issue for the last few months. In addition to this, there is the Toxics New Source Review project that is moving forward and ready for adoption in the next few months. Mr. Hayes commented that it seems that there are similar issues in today's presentations, that have to do with emission inventory of air toxics, and it would make sense that those technical issues be explored. Cumulative Risk is a way of putting into perspective the various policy choices that the District has, and which sources might be viewed most effectively and quickly with regard to public health.

In order to come to a good decision about that, Mr. Hayes felt that it is important to understand what people's cumulative risk might be and to what one might attribute it to. The risk that an average Bay Area resident faces comes more from the time they spend in traffic at the Bay Bridge – an exposure to diesel particulate from trucks idling while they sit there. It is important to know if the risks are because of some industrial facility that is down the street, particularly if it's the result of a cumulative effect from multiple sources that individually are so small that they might not be linked to them. Therefore, there are a lot of reasons as to why the Committee might want to look at Cumulative Risk.

In summary, he stated that there are many technical issues that deal with the emission inventory, and the measurement of air toxics in the air. It would be worthwhile to know what the trends might be, what the design and configuration of the monitoring network ought to be and to start looking at what tools might be useful in performing Cumulative Risk assessments. This project is new for the Technical Committee to research and study, although emission inventories and monitoring data are items that this Committee has routinely looked at for ozone and PM10. It is a logical extension to also look at air toxics. Tools available for Cumulative Risk have certain inherent capabilities and limitations, and a discussion of those would be beneficial. Mr. Hayes recommended that this item, especially the scientific and technical issues associated with Cumulative Risk, be brought before this Committee in the near future for further discussions.

Dr. Holtsclaw suggested that the Committee might also want to consider all of the individual risks that currently have standards and establish a total Cumulative Risk that the Committee would not want to exceed. Mr. Althuler commented that the entire subject of Cumulative Risk is a very extensive one; it includes the individual pollutants, combination of pollutants, additive effects of exposure, acute versus chronic exposure problems, etc., and he was of the opinion that since this topic is so important it is something that the Technical Committee cannot avoid being involved in the discussions and adding some value to it.

Chairperson Bedsworth asked the members if they would like to wait and discuss this topic further when there is some additional information, specific to the Bay Area, received from the pilot study that the District is embarking on in the next fiscal year; or whether they would like to proceed sooner. Dr. Bornstein requested the District for its input as to what its plans and goals are, and how they are going to proceed so that the Committee might provide some input that could help guide the District in its planning stages.

Messrs. Hess and Kendall stated that the District staff is scheduled to make a presentation to the full Advisory Council at its meeting on July 15 on the Cumulative Risk Reduction Program. The Technical Committee members could, at that time, become aware of the District's plans. Mr. Hess stated that the District welcomed comments and input from any of the Council members to help guide them in this matter.

Mr. Hayes stated that there is a lot that the Committee can begin to do, such as, understanding the levels of toxics in the air, and the monitoring trends. He would be happy to wait and find out the outcome of the discussions from the July 15 meeting, and it would be helpful if staff can provide some input in this area.

**7. Committee Members' Comments:**

Dr. Holtsclaw suggested that since the Committee has not yet completed its work with EMFAC, that Mathew Barth from U.C. Riverside be invited back for another presentation to the Committee.

His laboratory is conducting research by subjecting off-road cars to different speeds and cold starts, taking them through the different cycles and calculating the emissions from them. When he made his presentation to the Committee five or six years ago, he had not come to any final conclusions. It might be useful to know the results of his recent research findings. He would be able to provide some insight and input into EMFAC. This will give the Committee a better understanding of motor vehicle emissions in the future, the influence of both newer cars and trucks and different speed and travel/speed profiles.

Chairperson Bedsworth asked the members whether they would like to have the presentation from Mr. Barth before the Committee tries to pull together all of its thoughts for the District on the ozone planning process, or whether the members would like to study EMFAC in more depth as a separate issue. Dr. Holtsclaw felt that it could probably be done afterwards. Dr. Bornstein commented that it is an on-going process, and that the Committee can summarize its current understanding and then after it receives more information, it can provide another summary some months down the road. Dr. Bornstein felt that its an important topic and that if the Committee has not done a summary recently, then this is a good opportunity to point out the progress that has been made and highlight some of the areas that can be worked on further.

Mr. Altshuler proposed that perhaps staff should contact Mr. Barth to find out the status of his research and then make a recommendation to the Committee as to whether it is appropriate to invite him to make another presentation. Parallel to this, Rob Harley is a lot closer in proximity, and he may have a little bit more to offer. Since the Committee has to stay in touch and follow up with Dr. Harley on other issues, staff could contact him for this also. Dr. Bornstein suggested Mark Jacobsen also as a possible name and, perhaps conducting some sort of a mini workshop by bringing together people who are on the cutting edge of dealing with the topic of emissions. By doing this, the Committee could come to a resolution so that it can state in the submission to EPA that the Committee is aware of all the differences, has made its selections based on the best that is available, and have references to people who can back that up. Mr. Altshuler agreed with Dr. Bornstein's comments.

8. **Time and Place of Next Meeting.** 1:30 p.m., Wednesday, August 4, 2004, 939 Ellis Street, San Francisco, California.

9. **Adjournment.** 12 Noon.

Neel Advani
Deputy Clerk of the Boards

**AGENDA NO. 4**

**To:** Technical Committee members
**From:** Louise Bedsworth
**Re:** Discussion of district ozone reduction strategies and planning

20 July, 2004

Since our last meeting of 2003, we have been discussing topics related to ozone attainment in the Bay Area. In our August, 2004 meeting, we would like to develop a set of findings and, if relevant, recommendations based on our committee's review to bring to the full Advisory Council in September. Below is a list of relevant meetings and topics and some points that were raised either by staff or committee members in meetings. In an effort to start the discussion in our August meeting, I have listed some key findings based on my review of notes, minutes, and presentations to start our discussion at the end of this document.

**Relevant meetings & topics:**

- December 9, 2003: Ozone, NOx, and HC ambient concentration trends in the Bay Area; Update on District modeling efforts
- February 24, 2004: Control Strategy Review
- April 6, 2004: Control Strategy Descriptions
- June 3, 2004: Review of EMFAC2002; NOx Controls and Ozone Formation

**Ambient trends** (12/9/2003)

- Since 1965, the number of days above the standard, ozone levels measured, and the number of stations per ozone episode have decreased
- Reaction times seem to be getting longer – slower reactivity could have impacts for downwind areas
- Temperature conditions for ozone exceedances
  - 95°F - necessary, but not significant condition for exceedance of federal standard
  - State standard tends to be exceeded when temperature is between 90° - 95°F
- Meteorological conditions for ozone exceedance
  - High pressure over the Bay Area
  - "Four Corners" high that impedes on-shore breeze flow
- Design values have leveled off in recent years and Livermore has been the design value site for most of the 1990's and seems to be resistant to efforts to reduce it
- Ozone levels in the Bay Area are very close to the federal standard. Attainment will be highly susceptible to meteorological conditions.

**District Modeling Efforts** (12/9/2003)

- Modeling is part of Central California Ozone Study (CCOS)
- The model is underestimating temperature, wind speed, and $O_3$
- There appear to be inventory disparities – ROG appears to be underestimated and NOx overestimated

**Control Measures** (2/24/2003 and 4/6/2003)

- All feasible measures must be adopted to be in compliance with the California Clean Air Act
- Some NOx measures if adopted in the Bay Area may not affect $O_3$ locally, but could reduce transport to the San Joaquin Valley air basin
- Most stationary source measures have been adopted to date. Need reductions from sources that are under the jurisdiction of CARB and EPA.

**EMFAC 2002** (6/3/2003)
- Fuel-based inventory indicates that emissions from diesel fuel combustion are underestimated
- Model does not account for increase in diesel fuel sales between 1990 and 2000 – could be an activity issue.
- ROG inventory is not weighted by reactivity
- Model does not include weekend travel patterns and weekend emissions

**NOx Control Measures** (6/3/2003)
- HC in the Bay Area appear to be less reactive than in other states
- For every 2.6 tons of NOx reduction, VOC has to be reduced by 1 ton to avoid an $O_3$ disbenefit
    - Because VOCs are less reactive than in 1989, $O_3$ disbenefit is likely to be smaller
    - Modeling shows that a NOx reduction results in an $O_3$ disbenefit to the west side of the ozone peak and an $O_3$ benefit in downwind areas
    - There is not likely to be an $O_3$ disbenefit from reducing NOx from mobile sources because of the tendency to simultaneously reduce NOx and VOC (2.6 tpd NOx: 2.1 tpd VOC)
- Based on surface measurements of NOx and NOy, NOx transport appears to be minimal by the time is reaches Sacramento or the San Joaquin Valley

**Key Findings** (for discussion)
1. Ozone exceedances and attainment are increasingly dependent on meteorological conditions
2. Evaluation of control measures accounts for local air quality impacts, but also for impact on air quality in downwind locations. Because of the high VOC to NOx ratio in the San Joaquin Valley, NOx controls adopted in the Bay Area could reduce the impact of NOx transport.
    a. NOx transport to San Joaquin Valley and Sacramento appears to minimal, particularly in the summer
    b. NOx controls should focus on mobile sources to avoid local $O_3$ disbenefit
    c. Role of NOx in PM-2.5 formation is not well understood
3. Need to consider reactivity in evaluating control strategies – focus on strategies that will reduce more photochemically reactive VOCs
4. Many of the "low hanging fruit" have been picked – District needs to place continuing pressure on CARB and EPA to pass stringent regulations. Increasing emphases on land use and social change are needed.
5. High numbers of ozone exceedances occur primarily Saturday through Monday, but it is not clear that emissions or activity patterns are well understood on these days