State of California
AIR RESOURCES BOARD

Research Screening Committee

Cal/EPA Headquarters Building
1001 I Street
Conference Room 620
Sacramento, California 95814
(916) 445-0753

October 6, 2006
9:00 a.m.

ADVANCE AGENDA

Interagency Proposals

1. "Toxicity of Source-Oriented Ambient Aerosol," University of California, Davis, $838,934, Proposal No. 2617-253

Ambient particulate matter (PM) has been linked with death and disease, but it is unknown which components are the most responsible. Ambient PM derives from a wide range of sources and experiences a range of atmospheric processes that may alter its toxicity. Direct exposures of animals to PM emissions neglects at the source atmospheric photochemistry that may enhance toxicity, while exposure to total ambient PM combines the effect of many sources so does not elucidate which source contributes to the toxicity. This study will use a single-particle mass spectrometer to selectively collect and separate ambient particles with a series of biosamplers attached to a particle concentrator. The biosampler contents will then be instilled into rats that will be studied for several possible toxic endpoints. The result will be relative toxicity indices for particles derived from each source category. This would help the ARB to develop a PM control strategy that focuses on sources based on the relative toxicities of their PM emissions.

2. "Analysis of Satellite Measurements to Improve California's Models for O_3 and PM," University of California, Berkeley, $350,724, Proposal No. 2618-253

Highly spatially or temporally resolved emission inventories are very labor intensive, so they exist only for limited times and places in California. Satellite-based methods could be powerful tools for building or validating such inventories. The objective of this project is to test the utility of satellite measurements of total column nitrogen dioxide (NO_2), carbon dioxide (CO), formaldehyde (H_2CO), glyoxal (CHOCHO), and aerosols to map emissions at scales useful for regional and urban air quality modeling. Although the "raw" satellite data have poor spatial resolution (tens of km per pixel), statistical treatment of satellite drift, cloud cover, and other sources of variation allows higher

resolution in composite mapping than is inherent in individual measurements. The contractor will develop satellite data analysis techniques and compare satellite data with ground measurements and models to develop prototype spatially resolved mean daily (weekday and weekend, by month) emission inventories for NO_2 at air basin and larger scales.

3. "Flux Measurements of Biogenic Precursors to Ozone and Particulate Matter in the Central Valley," University of California, Berkeley, $400,003, Proposal No. 2612-253

Biogenic volatile organic carbon (BVOC) inventories are critical for ozone and Particulate matter (PM) projections and thus they are critical instruments for promulgating federal EPA required state implementation plans for ozone and particulate matter. ARB's BVOC simulation platform requires plant species composition and dominance, canopy area, leaf area index, leaf mass density, and taxonomic emission factors to produce BVOC emission inventories. Much of the input leaf mass, leaf area index, vegetation maps, and emission factor data have been developed and tested either in southern California or at the Blodget Forest Research Station (BFR) in the Sierra mountain range. The proposed work would provide input data to the BVOC simulation platform from selected Central Valley agricultural operations. It would begin with a screening phase where many key agricultural plant species would be investigated for their BVOC emissions potential followed by a micro-meteorological to landscape level emission flux measurement program for certain selected crops identified during the screening phase. The proposed work could lead to new understanding of ozone and aerosol chemistry likely requiring new modules and important modifications to elements of the existing BVOC simulation platform. The project will improve ARB's BVOC emissions inventory.

4. "Development of the UCB-L Particle Monitor for California Applications in Environmental Justice," University of California, Berkeley, $213,088, Proposal No. 2613-253

There is a need for a PM2.5 measurement technology that is portable, inexpensive, and accurate at low concentrations. The adverse health effects of exposure to PM2.5 can be serious, but the current means of measuring exposure are inadequate except for persons who live near the fixed ambient monitoring sites or where expensive special studies may be conducted. The objective of this work is to develop an affordable, accurate, and portable PM2.5 monitor using available smoke-alarm technology and components. This would take advantage of the economies of scale of mass-produced components, so to keep the price very low. Professor Smith and his group have already adapted off-the-shelf smoke-alarm technology to measure high PM concentrations (40 to 50 $\mu g/m^3$). This proposed work will attempt to use more sensitive smoke detection methods in a similar monitor to achieve better sensitivity and accuracy at PM2.5 concentrations below 5 $\mu g/m^3$. Inexpensive and sensitive PM2.5 monitors may enable better spatial resolution of exposure to PM2.5 through greater numbers of measurements taken at more sites. One application could be air monitoring at the community level, especially in neighborhoods with environmental justice concerns.

5. “Development of Updated ARB Solvent Cleaning Emissions Inventory,” University of California, Riverside, $199,342, Proposal No. 2619-253

Solvent cleaning is one of the top five non-mobile sources of volatile organic compound (VOC) emissions in California. The ARB’s inventory of VOC emissions from the use of solvent cleaning is based on data that is more than 10 years old and does not reflect current technology or the types of solvents that are now being used. The ARB cannot consider the cost effectiveness and feasibility of additional control measures for this source until improved emission estimates are available. The objective of this project would be to update the ARB’s VOC emission inventory for solvent cleaning operations. The needed data will be obtained by conducting surveys of businesses that conduct solvent cleaning operations. The survey will include information on the types, quantities, and applications for the solvents that are used. The up-to-date emission inventory for solvent cleaning operations will permit the ARB staff and the local air pollution control districts to accurately assess the benefits and feasibility of new regulations to reduce VOC emissions from solvent cleaning operations. It will also help staff to examine the potential for reactivity-based measures for this category, as well as assess the impact of solvent cleaning on local communities.

6. “Lifecycle Analysis of the Climate-Change Reduction Strategies of the California Air Resources Board,” University of California, Davis, $199,561, Proposal No. 2614-253

The Climate Action Team has proposed many strategies to reduce greenhouse gases, however their full lifecycle emissions have yet to be analyzed. The Institute of Transportation Studies at University of California, Davis will enhance their Lifecycle Emissions Model (LEM) to quantify the lifecycle emissions of measures that ARB staff may propose to meet California greenhouse gas reduction targets. This contract will produce a user-friendly model that will allow staff to calculate the aggregate lifecycle greenhouse gas and criteria pollutant emissions of climate change mitigation strategies. Results from this model will facilitate decision-making as to which proposed strategies should be implemented.

7. “Impact of Climate Change on the Frequency and Intensity of Low-level Temperature Inversions in California,” University of California, San Diego, $249,989, Proposal No. 2615-253

Meteorology plays a dominant role in the determination of air pollution concentrations in California. Low-level atmospheric temperature inversions (where temperature increases with height) inhibit vertical movement of air and can thereby increase the concentrations of pollutants near the ground. As the climate and regional circulation patterns change, the frequency and intensity of low-level temperature inversions will be impacted in an unknown manner. A variation in the frequency or intensity of these low-level inversions would likely have a significant impact on air quality in California. This work is designed to better understand how the frequency and intensity of low-level temperature inversions has varied historically, and how these characteristics might vary or change in

California in a changing climate. Particular emphasis will be placed upon the San Joaquin and Los Angeles air basins, which are prone to episodes of poor air quality. This knowledge could then be used to produce a more accurate estimate of climate-induced changes in air quality in California during the next few decades. The results of this research project would answer questions on climate variability and which areas will experience the largest deterioration in air quality and subsequent failure to attain air quality standards. A better understanding of future changes in the temperature structure and other meteorological parameters is crucial to preparing for regional air quality plans in California over the next several decades.

Sole Source Proposal

8. "Deployment of a Novel Aerosol Mobility/Mass Spectrometer for Quantitative Chemical Analysis of Organic Aerosols from Mobile Sources," University of Southern California, $238,383, Proposal No. 2620-253

Currently *in-situ* quantitative measurements of organic compounds in aerosols is not possible, despite tremendous progress in the area of aerosol mass spectrometry. The proposed research addresses this need with a newly developed instrument that promises real time chemical speciation of fine and ultrafine aerosols. The novel instrument combines particle size classification with compound specific measurements - chemical ionization mobility/mass spectrometry (CIMMS). Because of uncertainties associated with the characterization and operation of CIMMS, the project is divided into two phases. The first phase consists of a demonstration and calibration of CIMMS, and an associated interim report. Confirmation of this report is required to start phase 2. Four field studies are planned during 2007-2009: characterization of Port of L.A. emissions, evolution of particles near the I-110 freeway, formation of secondary aerosol in Riverside, and characterization of LAX emissions. This work should make significant contributions to the understanding of the chemical composition and evolution of aerosols in the South Coast Air Basin, and to existing health, air pollutant formation, and climate change studies.

Solicited Proposals

9. "Investigation of the Role of Lubricating Oil on Particulate Matter Emissions from Vehicles," Southwest Research Institute, $832,000, ARB co-funding will be $100,000, Proposal No. 2616-253

Engine lubricating oil has been implicated as a significant parent material in the formation of mobile source particulate matter (PM) emissions, including nanoparticle emissions. As fuels become cleaner (especially with lower sulfur content) and emission control systems become more effective and durable, the contribution of the lubricant becomes increasingly significant. However, to date, much of the present understanding regarding the impact of lubricating oil on PM emissions has been anecdotal and not the subject of a focused and carefully conducted research study. The National Renewable Energy Laboratory (NREL), the South Coast Air Quality Management District

(SCAQMD), and the California Air Resources Board (CARB) are putting a concerted effort to characterize the potential for reformulated lubricants to reduce PM emissions from mobile sources, both from new vehicles and from the much larger in-use vehicle fleet (by using reformulated lubricants in old vehicles). This proposed study would help the CARB explore some currently unclear, but highly relevant issues regarding PM emissions from lubricating oil. The SCAQMD has agreed to supervise and coordinate the project on behalf of all three sponsors (NREL, SCAQMD, and CARB). The Department of Engine and Emissions Research (DEER) of Southwest Research Institute (SwRI), in conjunction with the Desert Research Institute (DRI), will conduct the research.

Request for Proposals

10. "Refrigerant Emissions Inventory for California Non-Light-Duty Vehicles," RFP No. 06-300

The final objective of this project is to develop an inventory of refrigerant emissions from the air-conditioning (AC) systems of on-and off-road motor vehicles of all classes other than light-duty vehicles (LDVs), in California. The subject air conditioning systems are those used for cooling and dehumidifying the passenger and operator space of the vehicles. An interim objective is to characterize the AC technologies used in the various vehicle classes, with emphasis on the technologies now, or about to be, used in new vehicles. The characterization should be in terms of variables that are known to affect leak rates.

Unless another construction is shown to be superior, the emission inventory should be constructed from emission factors (e.g., grams of HFC-134a per hour of operational mode of the AC) and activity factors (e.g., hours in an operational mode). Unless no distinction in the per-vehicle emission rate among vehicle classes is apparent or distinctions are infeasible to estimate, there should be separate emission factors for different vehicle classes (e.g., medium-duty vehicles, light heavy-duty vehicles, heavy heavy-duty vehicles, transit buses, and various off-road equipment classes).

Estimates are being sought only for emissions during the working lives of vehicles, not for losses that occur when vehicles are dismantled or their AC systems are breached during repair. "Emissions during the working lives" can be classified as (1) long-term leakage (such as permeation losses) and (2) rapid losses due to accidents or mechanical failures. The bidder should discuss if and how its proposed approach or combination of approaches would address the two types of loss.

Interim Reports

11. "Climate Change – Characterization of Black Carbon and Organic Carbon Air Pollution Emissions and Evaluation of Measurement Methods: Phase I: Method Comparisons," Desert Research Institute, $449,997, Contract No. 04-307

For the purposes of climate change emissions inventories, black carbon is defined as the carbon component of particulate matter that absorbs light. However, this specific component of particulate matter is difficult to measure. Most measurements of light-absorbing carbon are not well related, and consensus on interpretation has not yet been reached for the current suite of available measurement techniques. This research project is intended to examine the fundamental reasons underlying differences of optical and thermo-optical methods. The interim report covers work completed in Phase I: Method Intercomparison of the study, which compared different black carbon (BC)/elemental carbon (EC) and light absorption measurements. The reproducibility of aerosol generation was investigated for each source category using replicate runs conducted for each experimental set up. With a few exceptions, diesel, acetylene, and electric arc soot experiments were highly reproducible. The wood smoke samples showed the largest variability among sources tested, reflecting the natural variability in wood smoke emissions. A field evaluation of in-situ and integrated measurements was conducted at the Fresno Supersite during summer 2005, and the results were compared with measurements acquired during winter 2003. The field evaluation provide useful information to generalize laboratory test results and provide empirical formulae applicable to other California monitors that do not have collocated measurements. The Phase I research study has provided useful information of immediate value for BC emission inventories by better characterizing BC and EC measurement methods

12. "Characterization of the Off-Road Equipment Population- Phase 1" Eastern Research Group, $299,985, Contract No. 04-315

The contractor, Eastern Research Group (ERG), is reporting the results of Phase 1 of this project. Phase 1 is a pilot study of a project to develop, by surveys and datalogging, detailed information on the characteristics and activity of off-road equipment. The new information is needed for improving the emission inventory. Splitting the data collection work into a pilot run (Phase 1) and a severable complete analysis (Phase 2) was done to meet concerns of the RSC during consideration of the RFP.

The results of the Phase I study indicate that the data collection methods developed are likely to produce a representative profile of off-road engine characteristics and activity. Recommendations regarding potential improvements to collection methods are presented, along with options for addressing possible resource constraints during a full-scale Phase II study.

Draft Final Reports

13. "Identification and Atmospheric Reactions of Polar Products of Selected Aromatic Hydrocarbons", University of California, Riverside, $49,999, Contract No. 03-319

Aromatic hydrocarbons are important precursors to secondary organic aerosols and play a significant role in the formation of photooxidants in the lower atmosphere. Yet chemical reaction paths, reaction rates, and products for most aromatic hydrocarbons are poorly understood. This lack of knowledge translates into a corresponding weakness in aromatic mechanisms in models, e.g. SAPRC-99, which are used in MIR (maximum incremental reactivity) estimates and airshed model applications. This project investigated the atmospheric chemistry of the some of the most prevalent aromatic species - toluene, xylenes, trimethylbenzenes, and naphthalene – through chamber studies. In the first major task, reaction products formed from the reaction of OH-monocyclic aromatic adducts with O_2 were collected on Solid-Phase MicroExtraction fibers coated with derivatizing agent and identified/measured with gas chromatography/mass spectrometry. In the second major task, formation yields of selected products of OH radial initiated reactions of toluene and naphthalene were measured as a function of NOx concentration. The results from the project provide accurate mechanistic data for atmospheric reactions of selected aromatic hydrocarbons, which will assist in the formulation of more accurate atmospheric chemistry models of air pollution. Such models will also help in the development of effective air pollution control strategies and in assessments of the human health risks associated with aromatic hydrocarbons.

14. "The Use of Multi-Isotope Ration Measurements as a New and Unique Technique to Resolve NO_X Transformation, Transport and Nitrate Deposition in the Lake Tahoe Basin," University of California, San Diego, $75,000, Contract No. 03-317

The world-famous clarity of Lake Tahoe has declined significantly since the mid-1960s due to increased inputs to the Lake of particulate matter, phosphorus and nitrate. To develop improved estimates of the annual and seasonal loading of phosphorus, nitrogen, and particulate matter from atmospheric deposition to Lake Tahoe and improved attribution of the in-basin and out-of-basin sources of these materials, the ARB recently conducted the Lake Tahoe Atmospheric Deposition Study (LTADS).

As part of the effort, this project was intended to identify and quantify the sources and variability of nitrate in the region and to the Lake by performing oxygen isotope measurements on both aerosol and water nitrate. The study result indicates that measurement of ^{17}O isotopes in nitrate aerosols collected in the Tahoe Basin showed similar enrichments as those observed from southern California with an average $\Delta^{17}O$ of 23‰. This atmospheric isotopic signal was transferred to Lake Tahoe of water column nitrate $\Delta^{17}O$ average of 3‰. The difference indicates that ~13% of water column nitrate has retained its photochemical isotopic character and has not been recycled by biota. A

lake-wide average nitrification rate is estimated to be 1 mg/m^2/yr, which is in agreement with that of previous studies. Unfortunately, a significant number of atmospheric and lake nitrate samples were lost due to unexpected analytical limitations. Once the analytical issues are solved, improved seasonal and spatial isotopic variability interpretation may be possible.