

**State of California
AIR RESOURCES BOARD**

**Research Screening Committee Meeting
Cal/EPA Headquarters Building
1001 I Street
Conference Room 550
Sacramento, California 95814
(916) 445-0753**

**October 28, 2005
8:30 a.m.**

ADVANCE AGENDA

Sole Source Proposals

1. "Fine-Scale Spatial and Temporal Variability of Particle Number Concentrations within Communities and in the Vicinity of Freeway Sound Walls", University of Southern California, \$461,334, Proposal No. 2600-250

The purpose of this study is to investigate variations in ultrafine (UF) particle number concentrations at a fine spatial and temporal scale (i.e., at the community and local level, over distances in the hundreds to thousands of meters), in real-time. A second part of this study will examine the effects of freeway sound walls on UF particle concentrations, along with other combustion-related pollutants, to see if wall effects on air flow and dispersion have an important influence. In this study, ten to twelve condensation particle counters already owned by the ARB will be located for alternating three-month periods in the Wilmington/Long Beach and Riverside areas of Los Angeles. Results will be analyzed to determine the relative importance of specific UF particle sources, and the impacts those sources have at the community level relative to urban background concentrations.

2. "Physicochemical and Toxicological Assessment of the Semi-Volatile and Non-Volatile Fractions of PM from Heavy- and Light-Duty Vehicles Operating with and without Emissions Control Technologies", University of Southern California, \$677,950, Proposal No. 2592-250

Recent emissions testing in either dynamometer or on-road testing facilities have shown that particles emitted from vehicles are externally mixed, i.e. different particles of the same size can have different chemical compositions. Depending on vehicle type, age and ambient conditions, between 70-90% of the particles by number (10-30% of the mass) may consist of more volatile material (known as semi-volatile) than the other particles, and upon heating, will partially or completely evaporate. Considering that people's exposures during commute are dominated by volatile particles, based on

particle number, it would be useful to know whether the non-volatile or semi-volatile material is more toxic than the rest of the particles.

The objective of this 4-year project is to distinguish the physicochemical and toxicological properties of the semi-volatile and non-volatile fractions of PM from heavy- and light-duty vehicles operating with and without emissions control technologies. This will be accomplished by collecting these particles separately using thermal denuder technologies, which evaporate and remove semi-volatile PM material, along with the USC particle concentrators (VACES¹). The collected PM will be used to compare to what extent particles of different volatility from different experimental configurations induce chemical toxicity as measured by a range of chemical assays that measure reactive organic species (ROS) formation and electrophilic chemistry. Select samples will be also collected and analyzed without the VACES.

Contract Augmentation

3. "Augmentation to Ventilation and Indoor Air Quality in New Homes", Indoor Environmental Engineering, \$93,519, Contract No. 04-310.

Concerns have been raised regarding whether households in new California homes use windows, doors, exhaust fans, and other mechanical ventilation devices enough to remove indoor air pollutants and excess moisture. There is also a need for indoor air pollutant measurements in homes to determine whether current levels of indoor pollutants in homes pose a serious health risk. ARB has approved a study to obtain information on ventilation characteristics and indoor air quality (IAQ) in new, single-family, detached homes across two seasons and in two regions of California. The California Energy Commission (Commission) has funded this study, and will use this information to revise their energy efficiency design standards for new single-family homes. ARB will use the information to update and improve its indoor exposure estimates for toxic air contaminants and other indoor air pollutants, and to develop recommendations for improving IAQ in new homes. The objectives of this proposed augmentation to the field study are: 1) to increase the number of study homes with whole house mechanical ventilation systems; 2) to use an improved method for measuring home air exchange rates (AERs); 3) to provide lock boxes on homes to allow researcher access while maintaining the security of the study homes; and 4) to deploy canisters to be provided by ARB to obtain data on acrylonitrile concentrations in new homes.

¹ The performance of the VACES has been widely published. In addition, ARB is now sponsoring an independent evaluation of the device at UC Davis.

Interagency Proposals

4. "Ultrafine Particle Concentrations in Schoolrooms and Homes", University of California, Berkeley, \$300,000, Proposal No. 2597-250

The objectives of this research are to measure concentrations of ultrafine particles (UFP) in California schoolrooms and residences, and to advance our understanding of the factors that influence UFP levels in indoor environments. Several studies have implicated UFP (those with diameters below about 100 nm) with adverse health effects. Yet, knowledge of the concentrations of UFP in indoor environments is limited, especially for schools and homes. Development of a smaller water-based condensation particle counter (WB-CPC) now allows investigators to more readily measure real-time UFP levels in indoor environments. The investigators will measure indoor UFP concentrations, determine the impact of indoor sources on indoor concentration, measure building ventilation rates in order to determine penetration of outdoor ultrafines to indoors, and calculate deposition rates. Information will be gained on indoor UFP concentrations near heavily traveled roadways, the influence of indoor combustion sources on indoor concentrations, and the influence of using cleaning products that contain terpenes, which can react with oxidant to produce UFP indoors. The baseline information gained in this study will help lead to a better understanding of indoor UFP concentrations and the factors that determine them, and Californians' exposures to both indoor and outdoor generated UFP.

5. "Effects of Inhaled Fine and Ultrafine Particles on Lung Growth and Lung Disease", University of California, Irvine, \$450,446, Proposal No. 2605-250

One of the most provocative and potentially important findings from the Children's Health Study (CHS) conducted by the University of Southern California for the ARB was the significant association between reduced lung function growth and exposure to NO₂, acid vapor, fine ambient particles and elemental carbon. The cohort of children was followed to 18 years of age, by which age most lung growth is complete. This raised the question of whether or not deficits are permanent, or whether they can be repaired after that time. Because the pollutants in ambient air that were associated with the development of lung function deficits were highly inter-correlated, it was not possible to definitively attribute the health effects to one or more specific pollutants. These findings also raise concern as to whether these deficits will manifest as chronic health effects in adult life.

The primary objective of this proposed study is to test the hypothesis that chronic PM exposures will cause pulmonary function deficits in rodents exposed from birth to adulthood that is not reversible with subsequent filtered air exposure. The secondary objective will be to examine potential molecular mechanisms that could explain the biological basis for the phenomenon. These objectives will be addressed using controlled animal exposures (mice) and a mobile exposure system using the VACES particle concentrator that was developed and tested with ARB support.

The results of the study will provide critical data on possible developmental effects of PM exposure during childhood and adolescence, and the potential for PM exposure during childhood to influence development of lung disease later in life. The project addresses a significant research gap that was identified during the recent review of the State ambient air quality standards for PM, and will support the next review of the State PM standards.

6. "Differences in Inflammatory Response to Exposure Concentrated Ambient Particles in Susceptible Volunteers", University of California, Los Angeles, \$599,776, Proposal No. 2601-250

Currently the ARB collects 24-hour average particulate matter concentrations for determination with ambient air quality standards. However, short-term ambient particulate matter concentrations may vary by large factors, often by an order of magnitude or more over an hour-to-hour time frame. Knowledge of the respiratory health impacts of short-term exposures is important to consideration of short-term particulate matter ambient air quality standards. However, the health impacts of exposures to the short-term concentrations are poorly understood. This study will add to our understanding of the mechanisms by which PM causes its health effects. One of the principle mechanisms postulated is through inflammation.

The overall objective of this project is to determine how short-term exposure to ambient particulate matter alters inflammation and airway function in humans. It is particularly important to study these effects in populations that may be more vulnerable than the general public. This study will test the hypothesis that individuals with certain susceptibility factors may have heightened inflammatory and airway responses to exposure to particulate matter.

Through controlled two-hour exposures to concentrated ambient particulate matter at two concentration levels plus filtered, particle free air the study will examine lung function changes and indicators of respiratory inflammation. The study will compare the responses of healthy and asthmatic volunteers.

7. "Impact of Reactive Halogen Species on the Air Quality in California Coastal Areas", University of California, Los Angeles, \$299,998, Proposal No. 2602-250

Air pollution continues to be a significant environmental challenge in most urban areas of California. Of special concern in this respect are coastal areas, including the South Coast Air Air pollution continues to be a significant environmental challenge in most urban areas of California. Of special concern in this respect are coastal areas, including the South Coast Air Basin, the San Francisco Bay Basin, and the San Diego Basin, because of their large and increasing populations and unique atmospheric chemistry. While most chemical species of marine and coastal origins are not present in high enough concentrations to impact the chemistry of pollutant formation, reactive halogen species (RHS) have been shown to have a significant influence on ozone and NOx chemistry, even at low concentrations. Despite this potential impact, the chemistry of

RHS is not currently included in airshed models. The primary cause of this absence is the lack of atmospheric observations of RHS in polluted coastal environments that would allow assessment of the influence of RHS on air quality.

The proposed project will address this gap in knowledge by conducting field observations of RHS, their precursors, and their reaction products along the coast in southern California. Four groups, each with a unique expertise in RHS measurement, will deploy a comprehensive set of instruments to investigate this problem. The expected results from this work are a greatly improved understanding of coastal RHS chemistry that can be used by the Air Resources Board to assess the impact of RHS on urban coastal air quality and to help determine whether RHS chemistry should be included in airshed models.

8. "CO₂ Emission Quantification from Vehicle Air Conditioning Operation in California-Specific Conditions", California State University, Northridge, \$400,000, Proposal No. 2606-250

In order to satisfactorily quantify the impact of A/C operation on California's GHG inventory and ensure that certified vehicles meet regulatory requirements, the ARB needs a whole-vehicle test that will provide a realistic estimate of CO₂ emissions due to A/C system operation under typical California conditions. The project methodology consists of two major parts: (1) acquisition of data on operator behavior and a/c system performance from vehicles operating in California; and (2) developing, analyzing and testing options for a vehicle testing protocol, including an add-on test procedure to the existing FTP, based on these data. Staff expects that the project will develop a viable test procedure that will enable ARB to realistically replicate "California average" conditions during emissions testing of vehicles with mobile air conditioning systems (MACS). Such an improved test procedure would provide increased accuracy in making estimates of the MACS contribution to California's GHG inventory, and could also be used to enhance the current estimates vehicle manufacturers now use to generate credits from MACS emissions improvements under current and future regulations.

9. "Improved Estimates of Greenhouse Gas Emissions and Mitigation Options for the California Petroleum Sector", University of California, Berkeley, \$129,561.50, Proposal No. 2604-250

Existing methods for estimating GHG emissions from the petroleum sector in California do not cover all aspects (for example petrochemicals), are not specific to California, and do not include some potentially important mitigation strategies. The overall objective of this study is to improve our understanding of greenhouse gas (GHG) emissions associated with the petroleum industry and potential mitigation strategies. The project is expected to result in a better understanding of the individual sources and effects of GHG emissions from California's petroleum industry, and potential mitigation measures.

10. "On-Road Measurement of Light-Duty Gasoline and Heavy-Duty Diesel Vehicle Emission Trends", University of California, Berkeley, \$ 288,463, Proposal No. 2598-250

Emissions of PM and ozone precursors are regulated to protect public health. Emissions of nitrogen species are also of concern because they can cause over-nutrication of watersheds and landscapes. In support of sound planning and regulatory decisions, trends in emission rates must be characterized. Changes in rates of emissions from motor vehicles stem from the combination of changes in fuel specifications, vehicle technology, emission controls, and fleet characteristics (e.g., distributions of vehicle age, model type, or fuel type).

The overall goal of this proposal is to characterize fleet averaged rates of pollutant emissions from light- and heavy-duty vehicle (LDV, HDV) fleets as operated in the Caldecott tunnel during summer 2006. Ancillary observations will characterize the distributions of vehicle ages, types, and operating conditions during the hours of monitoring. Past studies at the Caldecott tunnel demonstrate the feasibility of the proposed observations and provide prior year emission rates for trend information. The method of calculating emissions utilizes observed differences between concentrations at the tunnel entrance and exit. The emission rates are estimated based on a carbon balance approach that is independent of the rate of ventilation of the tunnel, removing a source of uncertainty present in some other studies. The emission rate units are mass of pollutant emitted per mass of fuel consumed. The proposed study is expected to provide fleet averaged emission rates of non-methane hydrocarbons for the LDV fleet only and PM_{2.5} species, and gaseous nitrogen species (for both the LDV and HDV fleets).

11. "Evaluation of the Proposed New European Methodology for Determination of Particle Number Emissions and its Potential in California for In-use Screening", University of California, Riverside, \$250,000, Proposal No. 2595-250

This project will study the utility of a proposed method for measuring the particle number concentration in exhausts from diesel engines with very low PM mass emissions, such as those that will meet the 2007 limits in California and the US. Particle number may prove to be a more precisely measurable metric than is mass determined by the standard gravimetric method. The European ECE-GRPE program has determined that solid particle number measurements on diesel exhaust are 20 times more sensitive than gravimetric mass measurements. That program has put forth the methodology for solid particle number measurements ("PMP" method), including instrument specifications and sampling protocols, that will be studied in this project. The general objective of this proposed project is to provide data needed by ARB for a critical evaluation of the PMP method as it could be used in California to characterize PM emissions in the laboratory and to "screen" PM emissions during over-the-road driving. The primary specific objective is to determine the precision of the PMP measurement, in comparison to the standard gravimetric method. Secondary objectives are to investigate the correlation of PMP results to gravimetric results and to investigate the importance of certain

limitations of the PMP method as it is currently specified. The project will include collaboration among UCR, ARB staff, and European partners who have been key participants in the technical developments of the existing PMP-related programs.

12. "Economic Value of Reducing Cardiovascular Disease Associated with Air Pollution", \$349,692, California State University, San Diego, Proposal No. 2599-250

Recent health effects research points toward air pollutants as risk factors for the onset of several chronic respiratory and cardiovascular illnesses. These include cardiovascular disease, asthma onset, and permanent lung function decrements. Willingness-to-pay (WTP) estimates are available in the economics literature only for reducing risks of onset of chronic bronchitis. This project will make an important contribution to better quantifying the health benefits of air pollution control in California, because there are no WTP estimates, or even very good COI (cost-of-illness) estimates, for lifetime cardiovascular disease (CVD) morbidity. The study team will design, implement and analyze a WTP survey that develops a monetary estimate of individual WTP to reduce the risk of developing cardiovascular disease. To gauge the economic benefit of regulating air pollutants that impact the incidence of CVD, WTP estimates must be combined with dose-response and exposure data. The proposed study does not develop dose-response functions or gather exposure data. Therefore, ARB staff work will be required to apply the study's findings.

13. "Process-Based Farm Emission Model for Estimating Volatile Organic Compound Emissions from California Dairies", University of California, Davis, \$274,851 Proposal No. 2596-250

Dairies in the San Joaquin Valley are a significant source of emissions of volatile organic compounds (VOC) and other pollutants. However, there is considerable uncertainty over which specific sources within dairies contribute most to total dairy emissions. Given this uncertainty, it is difficult to determine which sources within dairies should be the target of emission control strategies, and to quantify the emissions reductions that can be expected from these strategies. The objective of this project is to develop mathematical models, which can be used to better understand the emissions from individual processes within dairies and from dairies as a whole. The mathematical models would be developed using the data from experiments that would be conducted to simulate some of the various processes occurring at dairies which generate emissions. The experiments would simulate emissions from the fermentation of animal feed (silage) and from the collection, storage, and decomposition of the animals' manure. The models will be used to predict emissions from individual processes within dairies as a function of the parameters found to have the greatest influence on emissions.

14. "Light-duty Gasoline PM: Characterization of High Emitters and Valuation of Repairs for Emission Reduction", University of California, Riverside, \$249,827, Proposal No. 2603-250

Light-duty gasoline vehicles (LDGV) are currently estimated to emit a large portion of the total particulate matter (PM) emissions attributable to mobile sources and compared to diesel vehicles. More stringent diesel vehicle PM regulations will take effect in 2007 and, along with existing diesel retrofit strategies, will result in significantly lower PM emissions from diesel engines. With this reduction in the diesel PM emission burden, it is anticipated that PM emissions from LDGVs, particularly high PM emitters, may contribute disproportionately to the total on-road PM inventory.

The work proposed in this study will evaluate new means to identify high PM emitters on the highway and at inspection/maintenance (I/M) locations, evaluate the potential costs and benefits of repair and other emission reduction strategies, and try to characterize the extent of the high PM emitter problem.

15. "Improving the Carbon Dioxide Emission Estimates from the Combustion of Fossil Fuels in California", University of California, Berkeley, \$77,100, Proposal No. 2594-250

Central to any study of climate change is the development of an emission inventory that identifies and quantifies the primary anthropogenic sources and sinks of greenhouse gas (GHG) emissions. Fossil fuel combustion accounted for 98 percent of gross California carbon dioxide (CO₂) emissions. The transportation sector accounted for the largest portion of emissions, averaging 59 percent of the total CO₂ emissions from fossil fuel combustion in California for the period 1990-1999. Carbon dioxide emissions are one of the best-characterized emissions in the existing state inventory, but there still exist significant sources of uncertainties. This project will focus on 1) estimating the level of uncertainty related to emissions from fuel consumption in the existing inventory, 2) investigating the development of new or improved methodologies for estimating the consumption of specific fuels for which data are scarce or unreliable, and 3) providing recommendations regarding initiation of new data collection activities to improve the accuracy of the California CO₂ emissions inventory. Clearly understanding these uncertainties and developing new methodologies or data collection activities to reduce these uncertainties can significantly improve the characterization of California's CO₂ emissions.

Final Reports

16. "Spatial and Temporal Characterization of Fine Particulate Matter Mass Concentrations in California, 1980-2002", \$34,915, Envair, Contract No. 03-350

Two ongoing epidemiological studies require historical fine particulate matter (PM_{2.5}) databases. "Air Pollution and Cardiovascular Disease in the California Teachers Study Cohort (CTS)" is using an existing health data set, the California Teachers' cohort, established by the Northern California Cancer Center and the California Department of Health Services, to study whether long-term exposure to PM (PM₁₀ and PM_{2.5}) air pollution or to any of several gaseous pollutants is associated with cardiovascular and cardiopulmonary disease incidence or mortality. "A Pilot Study to Quantify Health Benefits of Incremental Improvements in Air Quality" is intended to determine if it is possible to quantify measurable improvements in health that are related to declining air pollutant levels in the SoCAB. Investigators in both studies need a reliable long-term record of ambient fine PM mass concentrations, to be used along with data on other air pollutants and contributing factors. In this project the ENVAIR investigators developed an historical record of fine PM mass concentrations by combining data from different monitoring programs, accounting for differences in measurement methods and accuracy. The product of this work is a database consisting of estimates of monthly-average fine PM mass concentrations and their uncertainties at monitoring sites in California for the period from 1980 through 2002. This project has resulted in a very valuable comparison of fine PM measurements and several possible surrogates for PM_{2.5} measurements. The final product of this study will be of use to all future health studies, which need to estimate exposure to fine PM from available historical data and will improve ARB's analysis of long-term PM_{2.5} concentration trends.

17. "Gas-Phase Formation Rates of Nitric Acid and its Isomers under Urban Conditions", \$180,000, California Institute of Technology, Contract No. 03-333

This project provided the most comprehensive experimental analysis to date of the kinetics and mechanism of the reaction of the hydroxyl radical (OH) with nitrogen dioxide (NO₂) under conditions relevant to the urban atmosphere. Specifically, the overall rate constant and branching ratio for the two primary reaction channels were measured with high accuracy. The reaction removes two highly reactive intermediates, OH and NO₂, and produces a relatively long-lived product, predominantly nitric acid (HNO₃), and thus highly influences the chain reactions that produce ozone and other pollutants. The importance of this termination step to urban airshed models is reflected in the high sensitivities of the spatial and temporal distributions of ozone to the value of the rate constant for this reaction in model calculations. In addition, the primary reaction channel is an important source of nitric acid, which plays a key role in secondary aerosol formation. The improved accuracy of the kinetic parameters obtained from this project will significantly improve the predictive capabilities of airshed models and help in the development of effective air pollution control strategies.

Other Business

18. Executive Office Meeting

19. Action Update