

REVISED

State of California AIR RESOURCES BOARD

Research Screening Committee Meeting

AGENDA

Cal/EPA Headquarters Building

1001 I Street

Conference Room 550

Sacramento, California 95814

(916) 445-0753

December 13, 2004

9:00 a.m.

ADVANCE AGENDA

Interagency Proposals

1. "Cardiovascular Health Effects of Fine and Ultrafine Particles during Freeway Travel," University of California, Los Angeles, \$502,050, Proposal No. 2574-246.

The purpose of this study is to investigate possible links between exposures to freeway-related ultrafine (< 0.1 μm) particles (UFP) and changes in measures of cardiovascular function. Ultrafine particles are suspected to play an important role in the link between particulate matter and cardiovascular mortality and morbidity effects because of their high deposition efficiency, high surface area, and ability to penetrate cell membranes. They have been shown in human subjects to translocate from the lung to the circulatory system and affect hemostasis. Decreases in heart rate variability (HRV) have also been observed to increase with exposures to UFP, but no studies have focused on traffic exposures, known to be a major source of UFP exposures. In this study, human subjects will be exposed to UFP in a van instrumented with particle and gaseous air pollutant measurement instruments, along with a filtration system capable of removing most particles when activated. Sixteen healthy, elderly subjects will be subjected to vehicle emissions on either gasoline-dominated or diesel-dominated freeways, with and without particles. Noninvasive measures of cardiovascular function such as heart rate variability (HRV) will be monitored to see if UFP exposures have immediate and/or short-term effects, and blood cytokines will be measured. Other studies have found effects for vehicle-related PM_{2.5} exposures, but vehicle-related UFP exposures have not been studied.

The results will aid the ARB in evaluating the importance of UFP and motor-vehicle-related UFP. It will also contribute to the evidence needed to evaluate

whether mass-based PM standards alone are adequate to protect public health, or if particle numbers also need to be regulated. Furthermore, this work will add to the ARB's ability to evaluate the contribution of freeway driving to overall air pollution exposures and health effects.

2. "Traffic-Related Air Pollution and Asthma in Economically Disadvantaged and High Traffic Density Neighborhoods in Los Angeles County, California," University of California, Los Angeles, \$422,089, Proposal No. 2561-246.

There is a growing body of literature that links outdoor air pollution exposure to asthma exacerbations in children. In California there is a need for further studies to investigate asthma exacerbations at the neighborhood and individual level in children that live in high traffic density areas and who may be more susceptible to adverse health impacts from air pollution exposure due to economic disadvantage. The objectives of this study are to conduct NO_x and NO₂ monitoring at 200 locations within the Los Angeles Family and Neighborhood Survey (L.A. FANS) study domain for the development of the land use-based regression (LUR) model for the Los Angeles (L.A.) county area. The LUR models will be used to predict traffic pollutants (NO_x, NO and NO₂) exposures for all of the LA FANS subjects, to evaluate associations between traffic pollutant exposure (NO_x, NO and NO₂) and lung function and asthma in children ages 0-17 years. This study will also use geostatistical models to estimate regional background concentrations of O₃ and PM_{2.5} to evaluate whether concentrations of these more regionally distributed background pollutants confound or modify the effects of exposure to the more heterogeneously distributed traffic-related pollutants (NO_x, NO and NO₂) on lung function and asthma. The findings from this study would help inform policy decisions on motor vehicle emissions control and asthma prevention/control in low socioeconomic status populations. They would also help in the development of air pollution exposure models that could be used in future epidemiological studies in L.A. County focused on different age groups and different adverse health outcomes.

3. "Monitoring and Modeling of Ultrafine Particulates and Black Carbon at the Los Angeles International Airport," University of California, Los Angeles, \$118,260, Proposal No. 2562-246.

Exposure to ambient particulate matter (PM) poses serious health concerns to Californians, with fine and ultra-fine (UF) PM exposure of special concern. Emissions from aircraft at major airports could have significant impacts on neighboring communities, but prior studies have not been able to quantify nearby PM exposures nor the extent of health concern. This is because the methods used could not distinguish aircraft emissions from other combustion sources such as traffic arteries and nearby industrial sources. They also could not assess UF PM. This study will use near-real-time monitoring equipment at the Los Angeles International Airport (LAX) and in the nearby community to determine levels of UF PM, black carbon, and PM_{2.5} emitted from aircraft. Statistical analysis and

modeling will be used to determine the contribution of aircraft emissions to fine and UF PM levels in residential areas downwind of LAX. If aircraft activities at LAX were found to contribute inordinate amounts of pollutants to the nearby neighborhoods, the ARB could work with stakeholders to mitigate the problem.

4. "Analysis of Activity Data Collected from Light Duty Vehicles Equipped with Global Positioning Systems Receivers," University of California, Riverside, \$25,000, Proposal No. 2564-246.

The ARB's emissions model EMFAC depends on accurate activity data (e.g., vehicle miles traveled, number of trip starts, etc.) to calculate emissions inventories. Data from three completed projects including activity data collected by equipping light-duty vehicles (LDVs) with on-board data loggers equipped with Global Positioning Systems (GPS) receivers will be used for this study. These data sets provide a rich source of data that can be processed and analyzed to directly determine or infer activity such as VMT, trip starts and trip ends, average speeds, etc. The objective of this project is to have a contractor perform data analysis to support the ARB's EMFAC model. These data are expected to improve the spatial and temporal resolution of the EMFAC model.

5. "Assessment of Out-of-State Heavy-Duty Truck Activity Trends in California," University of California, Davis, \$64,976, Proposal No. 2566-246.

The ARB's emissions model, EMFAC, depends on both accurate emissions as well as activity data (e.g., vehicle miles traveled (VMT), number of trip starts, etc.) to calculate emissions inventories. Heavy-duty truck (HDT) activity is less well characterized than light-duty vehicle activity because these classes of vehicles exhibit different travel patterns. In particular, many HDTs travel long distances, and a significant fraction of HDT vehicle VMT is accrued by out-of-state HDTs. The objective of this project is to collect data from out-of-state HDTs to better characterize their activity behavior in terms of vehicle miles traveled, activity by season, and age distribution. Two means will be employed to collect and analyze these data: review of existing literature and weigh station/truck stop surveys. The results from this project will improve the EMFAC model's estimate of the emissions contribution from out-of-state HDTs, and these improved estimates will assist policy makers in addressing emissions from these vehicles.

6. "Dairy Operations: An Evaluation and Comparison of Baseline and Potential Mitigation Practices for Emissions Reduction in the San Joaquin Valley," CSU, Fresno, \$250,000, Proposal No. 2567-246.

Dairies are a significant source of reactive organic gas (ROG) and ammonia emissions in the San Joaquin Valley. Due to the lack of experimental data, accurate quantification of these emissions has been, at best, difficult. Also, there is currently very little scientific information available to determine the most effective and feasible methods to reduce emissions from dairies. This project is

designed to improve the state of the knowledge. It will yield data needed to improve current estimates of baseline emission rates and to estimate the emission reductions that are achievable with available control technologies such as covered lagoons and digesters. The proposed approach includes conducting field monitoring at eight California dairies to measure atmospheric levels of the pollutants of interest. The data from the field monitoring will then be used with dispersion modeling to estimate emission rates. The eight test dairies will include five dairies using different types of emission mitigation strategies and three dairies using no emission mitigation strategies. The data collected at these dairies will allow the ARB staff to improve current emission estimates from dairies and the potential emission reductions that can be achieved by existing mitigation techniques. This information is needed to support the State Implementation Plan (SIP) and will be useful in assessing the need and feasibility of future regulatory strategies for dairies. Furthermore, the results of this project will add to the existing database from research sponsored by the dairy industry.

7. "Development of an Improved VOC Analysis Method for Architectural Coatings," California Polytechnic State University, \$249,991, Proposal No. 2568-246.

As volatile organic compound (VOC) limits in regulations for architectural coatings become more stringent, the accuracy of the existing test methods used to measure coating VOC levels in water-borne coatings has declined. This reduction in accuracy results, in part, from the fact the VOC content is not measured directly. The VOC content is calculated as the difference between total volatile matter content and water content. As the VOC content of water-borne paints is reduced, the total volatile matter content and the total water content approach the same value. Determining a small difference between two nearly equal numbers results in a large uncertainty. The objective of this project is to develop a new and improved test method for measuring (1) the VOC content of water-borne coatings and (2) the VOC content of solvent-borne coatings with a high content of exempt compounds. To remove the inherent uncertainty of the existing approach, the new test method will be based on direct measurements of the amount of actual VOC content in coatings. The new method for coatings will ensure that VOC emissions reductions achieved from paints regulations will continue to be realized as more stringent limits take effect.

8. "Development of In-field Diesel PM Compliance Method for Stationary and Portable CI Engines," University of California, Riverside, \$299,893, Proposal No. 2569-246.

The ARB recently adopted an Airborne Toxic Control Measure (ATCM) to control PM emissions from stationary and portable diesel engines. This ATCM requires the measurement of PM emissions from most of these engines. The test methods used to measure emissions from these engines are time consuming and costly, and hence the ARB would like to develop a simpler, less costly test

method. The objective of this project is to develop a "Simplified Field Test Method" (SFTM) that will be based on the existing PM measurement method for stationary sources (ARB Method 5). The development of a SFTM will allow local air districts and testing contractors to perform less expensive, in-the-field PM emissions compliance testing of in-use stationary and portable diesel engines to support implementation of the stationary diesel engine ATCM.

9. "Reducing Emissions of Volatile Organic Compounds(VOCs) from Agricultural Soil Fumigation," University of California, Riverside, \$200,000, Proposal No. 2570-246.

Fumigant pesticides are the largest contributors to the pesticide volatile organic compound (VOC) inventory in the San Joaquin Valley. To meet the requirements of the State Implementation Plan (SIP), improved emissions estimates and an assessment of potential VOC reductions are needed. Existing estimates are based on laboratory measurements and may not reflect real-world conditions. The objective of this project is to generate the field-based data to verify existing laboratory measurements.

The investigator will conduct a series of experiments designed to estimate the emissions and potential VOC reductions for up to three fumigant pesticides that are most commonly used in California: metam sodium, 1,3-dichloropropene (1,3-D), and/or chloropicrin. The experiments to be conducted are designed to provide emissions estimates based on different application techniques including (i) broadcast-shank fumigation comparing traditional sealing with the addition of intermittent water seals, (ii) metam sodium fumigation comparing traditional packing with an intermittent water seal and, (iii) shank fumigation comparing traditional sealing and the addition of a surface treatment.

It is expected that the results of this study will provide sufficient data to permit the Department of Pesticide Regulation (DPR) and ARB staff to include in the SIP improved emissions estimates and an assessment of potential emission reduction strategies from pesticide fumigants.

10. "Characterization of Versatile Aerosol Concentration Enrichment System," University of California, Davis, \$94,739, Proposal No. 2571-246.

The Versatile Aerosol Concentration Enrichment System (VACES) forms a critical component of current ARB-funded research on the adverse health effects caused by particulate matter. Studies have shown that elevation in PM10 and PM2.5 concentrations are correlated with increases in acute morbidity and mortality in the population. VACES allows researchers to study such effects on animal models by concentrating ambient particles. This technology is based on inducing particles to grow by water condensation, concentrating the droplets with a virtual impactor, and then drying the particles back to their original size. This method has been documented to preserve many particle properties, such as

size, bulk chemistry, indicators of single-particle composition, and particle morphology. Because of the use of water, however, there is a potential for the system to change the concentration of high volatility, water-soluble compounds, such as nitric acid and hydrogen peroxide, in particles. This project addresses the possibility and extent of such artifacts in the particle and gas phases of aerosols concentrated by VACES; in particular, the effects of nitric acid, ammonia, and hydrogen peroxide on concentrated aerosols. In addition, the temporal stability of VACES will be investigated. These results will provide further understanding and confirmation of VACES operation, and will help support the Air Resource Board's previous and ongoing health effects studies that utilize VACES.

11. "How New Chemistry Findings Affect Our Understanding of the Weekend Effect - A Modeling Study," University of California, Irvine, \$150,000, Proposal No. 2572-246.

Emissions caused by human activities show important changes during the week and thus affect the cycle of ambient pollutants during the week and on weekends. The observation that ozone concentrations are higher on weekends than on weekdays, despite lower atmospheric levels of ozone precursors on weekends, has been long recognized as the Weekend Effect. The proposed University of California, Irvine (UCI) air quality modeling project is an investigation of this phenomenon and will include recent atmospheric chemistry and emissions variation findings. The objectives include the study of impacts of renoxification processes, chlorine chemistry, pollutant dynamics aloft, and distributed generation (DG) on weekend ozone dynamics. This work will incorporate, for the first time, heterogeneous nitrogen and chlorine chemistry in an analysis of the weekend effect. The new chemistry (chlorine and renoxification) has proved recently to reduce deficiencies of air quality models and improve the accuracy of results. Recent studies of DG have shown significant impacts associated with the spatial and temporal variations in NO_x emissions. This project will provide the first conclusions on the influence that a transition from central to distributed power generation might have on the ozone cycle during weekends. Moreover, the quantitative analyses of other processes like NO_x emission variation and ozone recirculation aloft will fundamentally contribute to our understanding of weekend ambient pollutant dynamics.

12. "Investigation of Atmospheric Ozone Impacts of Selected Pesticides," University of California, Riverside, \$99,850, Proposal No. 2573-246.

VOCs, along with oxides of nitrogen, are known precursors to ozone formation and pesticides are a significant source of VOCs in many agricultural areas of California (e.g., San Joaquin Valley). However, the ozone impacts of most of the VOCs used in pesticides are unknown. To develop VOC control strategies for ozone attainment in these areas, improved understanding of the ozone impacts (i.e., reactivity) of pesticides is needed by the ARB and the California Department

of Pesticide Regulation (DPR). The objective of this project is to develop methods for estimating and quantifying ozone impacts for major pesticides. Environmental chamber experiments will be carried out for selected pesticides to obtain data needed to develop and test atmospheric chemical mechanism that can be used in airshed models to estimate ozone impacts associated with pesticide emissions in the atmosphere. Mechanisms and the reactivity for other major pesticides used in California will also be estimated where feasible. The outcome of this project can improve our understanding of pesticides' role in ozone formation in agricultural areas and then help ARB and DPR further improve control strategies for VOC emissions.

13. "Nighttime Chemistry: Observations of NO_3 and N_2O_5 ," University of California, Berkeley, \$ 120,000, Proposal No. 2560-246.

Nitrogen oxides play a key role in the formation of ozone and secondary aerosol. For example, ammonium nitrate is a key component of particulate matter with aerodynamic size of 2.5 micrometers and less ($\text{PM}_{2.5}$). While the daytime chemistry of NO and its subsequent products (i.e. NO_2 , peroxy nitrates, allyl nitrate and nitric acid) has been studied extensively, there has been relatively little study of the nighttime chemistry of nitrogen oxides. Nighttime chemical reactions between nitrates and nitrogen dioxide form N_2O_5 and further reactions produce nitric acid. Nitric acid combined with ammonia form ammonium nitrate that essentially removes emitted nitrogen oxides species from the troposphere. However, N_2O_5 may also dissociate to NO_2 , and NO_2 would continue to participate in nighttime aerosol reactions. There are no current field measurements for nighttime N_2O_5 and nitric acid that would reliably support California's $\text{PM}_{2.5}$ simulations. These simulations are the regulatory tools for compliance demonstration required by $\text{PM}_{2.5}$ and other PM California State Implementation Plans (SIP). In this proposal UC Berkeley researchers would upgrade the prototype laser induced fluorescence (LIF) instrument that has successfully measured ambient concentrations of nitric acid and N_2O_5 to reach 15 to 25 parts per trillion volume (pptV) sensitivity required for a robust simulation validation data set. UC Berkeley staff would conduct two month-long measurement campaigns at Blodgett Forest station and at the Fresno PM Supersite where substantial additional aerosol and gaseous chemical measurements are also available. These measurements would act both as inputs and as validation tools for PM simulations.

Final Reports

14. "Correlation Between Solids Content and Hiding as it relates to Calculation of VOC Content in Architectural Coatings," California Polytechnic State University, \$99,843, Contract No. 01-307.

Regulations for paints that have been adopted by ARB include a definition of the VOC content of the paint. This definition is based on the assumption that the

coverage (or hiding) of a paint is proportional to its solids content. It is also assumed that, for a given solids content, water borne paints and solvent borne paints have equal hiding capability. To better understand the relationship between hiding and solids content, an investigation was conducted based on experimental and theoretical considerations. In the experimental phase, the investigators formulated 30 paints of varying properties (including solids content) and measured the paint's hiding capacity. The investigators then related the measured hiding capacity to changes in solids contents using theoretical predictions. The results from the study demonstrate that, for a given paint, hiding is proportional to solids content, and that this relationship varies among both water-borne and solvent- borne paints. The study also shows that for a particular solids content, water-based paints have greater hiding capacity than solvent based paints. On the basis of these results, a new definition for the VOC content of a paint that better predicts the real-world emissions was developed.

15. "Initial Exploration of Advanced Data Analysis Methods to Assist Air Quality Management," Clarkson University, \$40,440, Contract No. 01-348

Conventional approaches to developing Particulate Matter (PM) control strategies use deterministic analyses such as modeling from an established emission inventory or "mass balance" analyses that statistically link pollutants to a "known" set of PM sources. Validation of these "bottom up" approaches requires "top down" source apportionment for PM, both as a quality check and a means to detect "missing" sources. This project demonstrated advanced multivariate statistical techniques that transform time series aerosol composition and concentration data into time series loading of chemical profiles linked to empirically defined "sources." First, the investigators applied Positive Matrix Factorization (PMF) to historical aerosol data from Crater Lake, OR and Mt. Lassen, CA, where hemispheric-scale transport is a significant aerosol source. Second, they performed PMF on IMPROVE data from San Geronio, CA to examine the urban plume of the South Coast Air Basin. Finally, they performed a matrix calibration on Aerosol Time of Flight Mass Spectrometry (ATOFMS) data, then applied PMF to develop source signatures for a site in Fresno, CA. The IMPROVE analyses were fully successful, showing PMF is suitable for the intended analyses. The ATOFMS results indicate that further work is needed to fully resolve sources in such data sets.