State of California
AIR RESOURCES BOARD

Research Screening Committee Meeting
Cal/EPA Headquarters Building
1001 I Street
Conference Room 510
Sacramento, California 95814
(916) 445-0753

December 16, 2010
9:00 a.m.

ADVANCE AGENDA

Contract Augmentation

1. "Are there any Counteracting Effects that Reduce the Global Warming Benefits Attributed to Diesel and other Black Carbon Controls," University of California, San Diego, $11,000, Augmentation to Contract No. 09-337, Proposal No. 2704-269

   Black carbon (BC) is a major component of aerosol particles that is generally emitted by combustion sources such as automobile exhaust and biomass burning. BC is the main light-absorbing component of atmospheric aerosols and has been tied to regional climate change by its contribution to global warming and the suppression of precipitation. Unlike other greenhouse gases (GHG), BC has a short atmospheric lifetime resulting in a strong correlation to regional emission sources. The mitigation of BC warming effects by emission controls has been proposed as a viable policy. The objective of the original research proposal, which was approved by the Research Screening Committee (RSC) on December 17, 2009, is to assess the relative importance of the indirect and direct aerosol forcing effects of BC on California's climate by employing an aerosol-cloud microphysical model constrained with chemically-resolved aerosol measurements. In this supplemental study, the investigators propose to perform additional global-through-local nested model simulations to study BC impacts on clouds and climate in California. The investigation will enhance informed policy making on the regulation of BC emissions.

Interagency Agreements

2. "Location Specific Systemic Health Effects of Ambient Particulate Matter," University of California, Davis, $285,866, Proposal No. 2706-269

   A growing body of epidemiologic literature has associated ambient particulate matter (PM) with cardiovascular morbidity and mortality. Although the observed association has been relatively consistent, biological mechanisms through which inhaled PM could influence systemic and cardiovascular health endpoints are

unclear. In addition, most studies focus on PM in urban areas, which have been shown to have a different mixture of constituents than PM from rural areas. Ongoing ARB-funded research demonstrates that platelets are activated in the circulation of mice that are exposed to concentrated ambient particles from the Central Valley, and that platelet activation in some exposures is associated with an increase in circulating pro-inflammatory mediators. In addition, there is evidence that platelet and pro-inflammatory mediator release varies between seasons and locations, suggesting differential contributions of endotoxin, polycyclic aromatic hydrocarbons (PAH) and reactive oxygen species generation related to metals in the particulate mixture.

The study will evaluate lung inflammation by histopathology and inflammatory mediator production by lung tissue, systemic markers of platelet activation and concentrations of several inflammatory mediators in the blood. The investigators expect to see different correlations between biological endpoints and summer/winter and urban/rural PM2.5. They also anticipate that pro-inflammatory and pro-coagulant responses to the particulate challenges will vary with the amount of PAH, soluble metal, and endotoxin in the particles to which the mice are exposed. The project addresses the topic of whether or not there are significant differences in responses to PM of differing chemical composition, and will support the question as to whether it would be more health protective to reduce one type of PM as opposed to the ambient mixture as a whole.

3. “Persistent Immune Effects of Wildfire PM Exposure During Childhood Development,” University of California, Davis, $268,029, Proposal No. 2715-269

Little is known about whether air pollution exposure during early life has life-long impacts. Some have speculated that air pollution exposure during the early childhood lung development period could alter lung and immune system development in ways that increase susceptibility to lung-related morbidity later in life. This project will investigate the impact of early childhood exposure to ozone and PM on lung function development, and development of immune system parameters that modulate responses to infectious disease and contribute to lung function decline with aging. The study will involve a cohort of rhesus monkeys that was born during the three month period prior to the wildfires that impacted the Sacramento Valley during June and July 2008. Half of the cohort has lived outdoors since birth, and was exposed to the elevated air pollution concentrations that occurred during the fires, while the other half of the cohort was born and raised indoors in highly filtered air so that they are specific pathogen free. The results will address a key data gap, namely, the influence of early childhood exposure to ambient air pollution during childhood, and whether air pollution-related alterations in lung function and immune parameters persist into adulthood. The results will contribute to development of ambient air quality standards that adequately protect the health of children, widely considered a particularly vulnerable sub-population.

4. “Air Movement as an Energy Efficient Means Toward Occupant Comfort,” University of California, Berkeley, $170,000, Proposal No. 2705-269

   Most California commercial buildings are not properly sealed and mechanical ventilation, if it is operational at all, is available for only a minority of these buildings. With central heating and cooling as their only lever of thermal comfort management, some commercial building owners and operators overcool and overheat. This results in poor thermal comfort and likely indoor air quality concerns, and consumes excess electrical and thermal energy. Personal environmental control (PEC) systems including micro fans and nozzles have been demonstrated to improve thermal comfort, reduce or eliminate potential overcooling, and potentially improve indoor air quality if handled properly. Numerous fan-and nozzle configurations can be attached to office furniture, partitions, and ceilings, but the market may best be characterized by lack of innovation. This project would optimize the design of air movement devices suitable for mounting in a range of positions within a room, and to quantify their ability to produce fast-acting personal environmental control for the occupants. Using manikins, measurement instruments, and constructing office type environments equipped with PEC, the PI would investigate the optimum PEC configurations and maximum energy savings. Using example buildings in northern and southern California, the PI would investigate the transition from current air conditioning systems to a PEC equipped systems. In collaboration with industrial partners, the PI would recommend optimal devices to act as stand alone devices or integrated into building systems. Success in this study can have significant impacts in terms of energy reductions and associated avoided anthropogenic emissions, thus supporting the Title 24 California Energy Efficiency standards and the 2006 Global Warming Solutions Act. Avoided anthropogenic emissions may reduce ambient ozone and aerosol concentrations (impact state implementation plans). PEC incorporation into buildings could improve indoor air quality (if handled properly) following guidelines the Board has established.

5. “Extended Analysis of the CARES Aerosol Chemistry Data to Characterize Sources and Processes of Organic Aerosol in the Sacramento Valley of California,” University of California, Davis, $155,000, Proposal No. 2712-269

   Particles less than one micron in diameter have serious adverse impacts on human health and play an important role in climate forcing, visibility degradation, and deposition to ecosystems and crops. Organic aerosols (OA) form a significant fraction of submicron aerosols and typically comprise between 30 - 80% of the mass fraction. Nevertheless, the sources and composition of submicron OA in California remain highly uncertain. The objective of the proposed research is to provide an improved characterization of the sources and atmospheric processing of OAs in the Sacramento and foothills region. Specifically, advanced analyses will be carried out on data collected with a high-resolution, time of flight, aerosol mass spectrometer (HR-ToF-AMS) and other instruments during the DOE-funded Carbonaceous Aerosols and Radiative Effects Study (CARES). The proposed research will provide information on source strengths of primary organic aerosols

(POA), mechanisms leading to secondary organic aerosol (SOA) formation, and photochemical processing of organic aerosols and gaseous organic precursors in Northern California. The resulting data will lead to improvements in regional air quality models used to predict the efficacy of various emissions control programs.

6. "Understanding Primary Organic Aerosol Volatility at Atmospherically Realistic Concentrations for SIP Analysis," University of California, Davis, $309,769, Proposal No. 2708-269

   Recent emissions tests have determined that primary organic aerosols (POA) generated from combustion sources behave like a series of semi-volatile compounds when the particulate phase concentrations range between 100–10,000 $\mu g/m^3$. The data available for atmospherically relevant concentrations below 30 $\mu g/m^3$ are sparse and the data below 10 $\mu g/m^3$ are missing entirely. The simple absorption theory that appears to explain the behavior of gas-particle distribution of condensable organics at high concentrations may not be accurate at atmospherically relevant concentrations. It is likely that other processes such as chemical and physical adsorption onto elemental carbon and partitioning into the aqueous phase play significant roles at lower concentrations. The objective of the proposed research is to identify the dominant partitioning mechanism for POA emitted from diesel- and gasoline-powered vehicles. The results of experiments conducted at atmospheric concentrations will determine if the simple absorption theory can be extrapolated to the real atmosphere. These findings will have broad application within regional air quality models and global climate models used to evaluate the efficiency of emissions control programs on PM.

7. "Probing the Intrinsic Ability of Particles to Generate Reactive Oxygen Species and the Effect of Physiologically Relevant Solutes," University of California, Los Angeles, $301,039, Proposal No. 2711-269

   Determining the 'causative agents' in PM that are responsible for damaging health is the subject of increasing research activity but many questions remain. A scientific consensus has emerged that oxidative stress mediated by reactive oxygen species (ROS) is a major mechanism by which PM contributes to illnesses and mortality. Freshly collected ambient particles are able to generate significant amounts of ROS. This work is aimed at understanding the components in PM responsible for ROS formation under physiological conditions and the role of two important ROS: hydrogen peroxide (H_2O_2) and hydroxyl radical (OH). Measurements of aerosols in the field will be complemented by laboratory studies of ROS generation by metals and organics in PM, as well as source aerosols such as diesel exhaust. The detailed analysis of organics and metals from field samples will allow for the attribution of those components most responsible for ROS activity to their sources. This will enable the development of PM controls that target the sources that are most responsible for the toxicity of PM.

8. “Development of a Portable In-Use Reference PM Measurement System,” University of California, Riverside, $300,000, Proposal No. 2709-269

   The problem addressed by this proposal is that as vehicular PM emissions continue to be reduced, it is increasingly difficult to reliably measure in-use PM emissions. Protocols based on particle number or portable emissions measurement systems (PEMS) have not been satisfactory for gauging PM mass emissions rates. Comparisons of PEMS-based PM measurements to gravimetric reference methods reveal significant disparities, with deviations on the order of 100%. This poor correlation does not indicate faulty real-time instruments, but is the result of different instruments using different measurement principles. The objective of this research is to develop and evaluate a new gravimetric-based system designed specifically for in-use conditions including on-highway, marine, and non-road applications. The system will satisfy ARB’s need for in-use PM measurements that are collected with PEMS and are comparable to the gravimetric federal reference methods. The system provides a tool to monitor in-use on-road vehicle emissions of PM which allows for compliance testing, general real-world emission monitoring, and collection of on-road emissions data to supplement emission inventory models. These capabilities are essential to evaluate the effectiveness of the Board’s diesel PM emission control policies, and to guide future policy decisions in this realm.

9. “Construction of a DOAS Instrument for Installation at ARB for the Low Level Measurement of SO_2 to Investigate the Relation between SO_2 and Sulfate,” University of California, Riverside, $90,004, Proposal No. 2710-269

   Sulfur is an important component of combustion and lubricant-derived particles. Sulfate levels in vehicle exhaust particulates can be readily measured, but it is important to understand the relative contribution between combustion and oil-derived particles and conversion rates of sulfur dioxide (SO_2) to sulfate. Current instruments are not capable of measuring the very low sulfur dioxide concentrations typical of new vehicles. The objective of this research is to construct, test, and provide to ARB laboratories a differential optical absorption spectrometer (DOAS) that can measure down to 10 ppbV in real time and determine a mass balance between SO_2 and sulfate. Training for ARB’s technical staff will also be provided as part of this program so they can run this state-of-the-art instrument independently. This instrument will open testing possibilities for ARB to understand the workings of advanced catalyzed aftertreatment systems and their interactions with the fuel/lube systems, and the potential of those systems to attenuate or produce sulfate PM. This understanding will help ARB understand the impacts of current emission control policies and guide the development of policies to obtain further reductions.

10. “Behavioral Responses to Real-time Individual Energy Usage Information: A Large Scale Experiment,” University of California, Los Angeles, $330,000, Proposal No. 2714-269

    Residential and commercial buildings collectively account for more than two-thirds of electricity usage. While current research indicates that behavioral changes induced by detailed feedback to consumers about their energy usage can greatly reduce residential energy consumption, more rigorous, long-term studies are required to determine how energy consumption feedback can be used as an effective tool for energy conservation. The proposed study will undertake an experimental implementation of electricity monitoring technologies, private real-time information displays, public information posting, and incentive programs in a large sample group of graduate student family apartments at the University of California, Los Angeles (UCLA). Study results will illuminate whether and to what extent, real-time, easily accessible energy usage information and financial or social (e.g., normative, social recognition) incentives result in significant reductions in energy consumption. Ultimately, findings of the proposed research will help ARB and its partners understand how to communicate real-time usage information to residential customers in a manner that leverages positive encouragement and/or social recognition, as well as financial motivations, to foster conservation and GHG emissions reductions.

11. “Using Feedback from Commercial Buildings to Support Energy Conserving Behavior at Work and Beyond,” University of California, Berkeley, $184,260, Proposal No. 2713-269

    Assembly Bill (AB) 32 Scoping Plan specifies 20 MMTCO2e GHG emissions reductions from retrofits in existing buildings as well as voluntary measures. Commercial buildings account for 33% of energy use in California’s buildings and are thus a critical target for emissions reductions. Proposed research will develop guidelines for and a prototype of a Building Information and Feedback System (BIFS) that fosters energy efficient operations and occupant behaviors. Based on five-month trials with BIFS in two commercial buildings in California, occupant behaviors, beliefs and attitudes regarding energy will be monitored, as will persistence of any effects measured after the trial is concluded. Results will shed light on how commercial building occupants respond to energy messaging designed to encourage energy conservation. Occupant response will be analyzed for a demographically diverse group with a variety of attitudes and beliefs toward energy conservation. Unlike many conservation programs, which require that participants “opt in” to a program, this study’s sample is not restricted to those who have demonstrated opt-in initiative. The development of a BIFS, systematic monitoring of occupants and operators’ interactions with energy conservation messaging, and persistence of changed attitudes and behaviors will support ARB’s efforts to encourage voluntary emissions reductions in the commercial building sector. In addition to supporting the AB 32 Scoping Plan, results of this work can help building managers earn LEED Innovative Design credits for occupant education.

Standard Agreements

12. "Calibrating, Validating, and Implementing Process Models for California's Agriculture Greenhouse Gas Emissions," University of New Hampshire, $249,688, Proposal No. 2707-269

    Agricultural soils are important sources of nitrous oxide (N_2O) and methane (CH_4), both of which are potent GHGs that cause global warming. Because formations of N_2O and CH_4 in soil are microbe driven processes, affected by numerous environmental factors, the emission fluxes of these gases are extremely variable both spatially and temporally. Therefore, the traditional approach of using emission factors for soil emission estimate is limited and suffers from great uncertainty. The Intergovernmental Panel for Climate Change has recommended alternative approaches such as process modeling as ways to improve the emission estimation. This project is intended to simulate N_2O and CH_4 emissions from agricultural soils using geochemical modeling based on California specific soil, crop, meteorological, and management conditions. The outcome of this project is expected to improve the understanding of GHG emissions in agricultural soils and transfer to ARB the modeling technology and databases for future use in emission assessment.

13. "Synthesis of Policy Relevant Findings from the CalNex 2010 Field Study," National Oceanic and Atmospheric Administration, $252,378, Proposal No. 2716-269

    The measurements phase of the CalNex field study, which was jointly sponsored by ARB and the National Oceanic and Atmospheric Administration (NOAA), was conducted during spring/summer of 2010. It is important to ensure that the data from the CalNex study are promptly and adequately analyzed and that the results and findings are made available to policy makers who must deal with the interrelated issues of air quality and climate change in California. The fieldwork was designed to address twelve Science Questions from the CalNex study plan. The questions address several specific and general scientific topics pertinent to the development of policies associated with the interrelated issues of air quality and climate change. Most of the publications coming out of the CalNex field study will primarily present scientific findings from each investigator's specific area of focus and will not comprehensively address the CalNex Science Questions. The full relevance and the best guidance for policy makers will come from analyses that integrate the data sets from the various CalNex researchers as well as other historical air quality studies in California. As fully as possible, the findings from the scientific publications and from the additional integrated analyses must be synthesized in a timely fashion and in a style useful for policy makers. This proposal will meet that need.

Other Business

14. Update to "Economic Value of Reducing Cardiovascular Disease Morbidity," San Diego State University, $392,036, Contract No. 07-301

    Project goals were to design and implement an economic valuation instrument to estimate the willingness-to-pay for reducing new cases of cardiovascular disease. ARB routinely estimates the costs and benefits of proposed regulations. Cardiovascular morbidity is an un-monetized health benefit of PM-reducing regulations.

    A survey instrument was designed and delivered to ARB August 23, 2010, along with the second of two technical memoranda.

    Project steps completed:
    - Literature Review,
    - Study Plan Development,
    - Survey Instrument Development.

    Steps remaining to project completion:
    - Survey instrument pretest, (200 respondents),
    - Survey instrument implementation (1000 respondents),
    - Survey Data Analysis,
    - Draft & Final Reports.

    This contract was permitted to expire August 30, 2010 because contract funds reverting back to the State on July 1, 2010 could not be spent, extended, or replaced. Non-reverting funds were inadequate to complete the project. Contract delays were caused by the State-mandated contract suspension and by unanticipated survey design issues. Of the $392,036 originally budgeted for the project, $134,511.55 was utilized by June 30, 2010. Of the remaining $257,524.45, $207,619.07 reverted back to the State.

15. Update to "Integrated Physical, Chemical, and Optical Measurements of Heavy-Duty Diesel Emissions at NASA AMES Full Scale Wind Tunnels," University of California, Davis, $419,917, Contract No. 08-322

    Originally the Team (Cornell University, National Aeronautics and Space Administration (NASA), and West Virginia University (WVU)) had proposed to characterize the physical and chemical evolution of the exhaust plume in the National Full-Scale Aerodynamics Complex (NFAC) at the NASA Ames Research Center. However, despite sustained efforts, the Team could not establish a firm test schedule with the NFAC staff, and finally an urgent military assignment resulted in last minute cancellation. Given the scheduling setbacks and the potential budgetary losses, the Team is now proposing to conduct this project by constructing and qualifying a wind tunnel at WVU. The new wind tunnel will provide controlled dilution conditions similar to the NFAC tunnel, hence, the Team can achieve the

majority of the original objectives. Unlike the old tunnel, the Team will have full access to the new tunnel, allowing extended sampling time for comprehensive measurements. Professor Mridul Gautam's research group from WVU will be in charge of constructing the new tunnel and developing a QA/QC program. A team with expertise in construction from Mechanical and Aerospace Engineering group from WVU will build the tunnel in three months to meet the deadline. The cost of constructing the wind tunnel will be the same as the savings from rental of the NFAC facility. Staff believes that this new proposal is feasible, and a cost effective path to achieve the original objectives of the study. The total budget remains the same.