State of California
AIR RESOURCES BOARD

Research Screening Committee Meeting
Cal/EPA Headquarters Building
1001 I Street
Conference Room 510, 5th Floor
Sacramento, California 95814
(916) 445-0753

March 27, 2015

9:00 a.m.

ADVANCE AGENDA

I. Approval of Minutes of Previous Meeting:

    January 30, 2015 meeting

II. Discussion of New Research Projects:

1) "Women's Cardiovascular Risk from Particulate Matter Exposure," University of California, Irvine, $600,000, Proposal No. 2784-282

    Epidemiological studies suggest that women have a greater relative risk of cardiovascular mortality than men. Yet animal studies designed to shed light on the mechanism of toxicity of particulate matter (PM) are mostly conducted on male animals. This study will compare the response to particulate matter of female and male rodents and investigate possible mechanism of PM2.5 toxicity unique to females. Evidence from the scientific literature shows that: 1) PM2.5 exacerbates cardiovascular disease severity and progression; and 2) impaired ovarian function is associated with cardiovascular disease. Studies that focus on women's health have found an increased risk of mortality from exposure to air pollution compared to studies with both men and women. These studies include the California Teachers Cohort Study, Women's Health Initiative, Nurses' Health Study, and the Adventist Health Air Pollution Study. Statistically, heart attacks are more deadly and disabling for women than for men; 38 percent of women die within one year of their first heart attack, compared with 25 percent of men. This research project will investigate whether the increased cardiovascular effects of PM2.5 exposure can be observed in a rodent model and the possible role of the ovarian system for these effects. Animals exposed to concentrated PM2.5 will be evaluated for evidence of cardiovascular disease such as markers of oxidative stress, decreased heart rate variability, and atherosclerotic plaque development. This project is among the first to address how different hormonal conditions can influence the levels of various toxicological endpoints in animals subjected to the same exposure conditions to PM and would identify additional risk factors which may need to be taken into account when evaluating exposure

to PM. The results are expected to help us understand why epidemiological studies have found a greater risk of cardiovascular mortality for women than men, which would suggest that women's cardiovascular health be included as an important risk factor in the next national air quality standard review.

2) "Are Adverse Health Effects from Air Pollution Exposure Passed on from Mother to Child?," University of Davis, California, $330,483, Proposal No. 2785-282

In animal models, there is some experimental evidence that early life environmental exposures can persistently alter developmental programming through mechanisms that alter gene function such that adverse health effects can be manifested in two or more generations without additional exposure (epigenetic changes). A previous project funded by the Air Resources Board (ARB) studied of nonhuman primates exposed during infancy to high levels of particulate matter less than 2.5 microns in diameter (PM2.5) enriched with wildfire smoke from a series of wildfires during summer of 2008. When evaluated at three years of age, the 2008 animals had adverse changes in lung function and cytokine markers of immune function compared to animals of the same age that were born in 2009 and not exposed to elevated levels of air pollution. This suggests that epigenetic changes could have taken place in the 2008 animals. This project will extend the original investigation by evaluating immune and lung function parameters in the 2008 female animals and their offspring. The investigator hypothesizes that the immune and lung function profile changes imposed by the high PM2.5 plus wildfire smoke exposure during infancy can be transmitted into subsequent generations (epigenetic effect), and that the epigenetic effects may be detected in the form of histone modification profiles in both the mother and her offspring. The project has three specific aims: 1) determine if the peripheral blood immune function response previously observed in the 2008 animals remains modulated and whether the same response is evident in the animals' unexposed offspring; 2) determine if changes in parameters of lung health (volume, density, obstruction) that were observed in the 2008 animals remain compromised and whether the same response is evident in the animals' unexposed offspring; and 3) determine if the high PM2.5 plus wildfire smoke exposure elicited peripheral blood epigenetic changes in the form of histone modifications in the 2008 animals and whether the same changes are evident in the animals' unexposed offspring.

3) "Greenhouse Gas Measurements at Walnut Grove Tower," University of California, Davis, $200,000, Proposal No. 2786-282

The California Global Warming Solutions Act (Assembly Bill 32 or AB 32) requires ARB to monitor and regulate sources of emissions of greenhouse gases (GHG), and reduce GHG emissions to 1990 levels by 2020. Because inventory estimates of GHGs are uncertain, independent methods are valuable and necessary to evaluate the statewide emissions and ensure progress towards meeting the emission reductions goals. Atmospheric inverse modeling methods offer the potential to quantify and evaluate current GHG emissions using ambient measurements. The objective of this project is to provide a continuous long-term record of GHGs for Central Valley and the San Francisco Bay Area regions. This

objective will be accomplished by continuous time series measurements of methane (CH_4), nitrous oxide (N_2O), carbon dioxide (CO_2), and carbon monoxide (CO) with advanced research grade instrumentation, and every 2-3 day flask sampling for the above species, radiocarbon $^{14}CO_2$, and volatile organic compound (VOC) tracer measurements at the Walnut Grove tower. This project will deliver high-quality, post-processed data in support of the purpose of future inverse model analysis. In addition, the principal investigator will also provide a long term analysis of the GHG trends in the California Central Valley and San Francisco Bay Area regions over a 10-year period using the data from this project as well as two prior ARB contracts.

4) "Certification and In-Use Compliance Testing for Heavy-Duty Diesel Engines to Understand High In-Use NO_X Emissions," University of California, Riverside, $500,000, Proposal No. 2787-282

The State of California needs considerable reduction in oxides of nitrogen (NO_X) emissions to meet ambient air quality standards for ozone and particulate matter (PM). To achieve some of the reduction, the NO_X emission certification standards for heavy duty diesel engines (HDDE) were reduced by 90 percent in 2010, and the in-use heavy-duty diesel vehicle (HDDV) compliance program (known as the "Not-To-Exceed," or NTE, standard) was implemented to control NO_X and PM emissions over the full range of engine speed and load combinations commonly experienced in use. However, recent chassis dynamometer test studies of HDDVs show smaller reductions of in-use NO_X emissions than expected based on their certification standards. These results raise questions about the effectiveness of the in-use HDDV compliance program in reducing NO_X emissions. This proposed study will first review fundamental principles and purposes of current certification and in-use emission testing procedures, then conduct experiments featuring two selective catalytic reduction (SCR)-equipped HDDVs that involve collection of engine operation and emissions data from both chassis and engine dynamometers, as well as on-road portable emission measurement systems (PEMS). The collected data will be analyzed to understand the differences between NO_X emissions measured from model year 2010 or newer in-use HDDEs and the emissions obtained from the same engines during certification. The collected data will be also analyzed to evaluate the effectiveness of current and alternative in-use HDDV compliance requirements for control of NO_X emissions. The results from this proposed study will be used to evaluate the effectiveness of current HDDE certification and in-use HDDV compliance procedures for meeting the ambient air quality standards for ozone and PM in California.

5) "Investigative Modeling of PM2.5 Episodes in the San Joaquin Valley Air Basin during Recent Years," University of California, Davis, $199,928, Proposal No. 2788-282

The greatly decreased severity of air pollution events in California over the last 15 years has benefited human health, yet also presented new challenges for air quality modeling. Chemical transport models (CTM) that are used in State Implementation Plan development have not been able to completely adapt to the

changing emissions and meteorological conditions. One of the results from this is that compared with events 10 15 years ago, CTMs underpredict nitrate concentrations by a much larger amount. To address this and other model shortcomings, this project will systematically address all potential causes for underpredictions in nitrate concentrations and correct them where possible. To accomplish this, two phases of the project are planned. An initial phase will investigate possible modeling biases in both reactive nitrogen emissions and meteorological fields through various comparisons with measurements. Based on the results of this work, the principal investigator and ARB staff will select and prioritize the most promising tasks for phase 2 from four hypotheses. These consist of corrections to biases in emissions of nitrate precursors, corrections to biases in meteorological fields, optimization of nitrate production conditions, and refinements to the spatial resolution for nitrate formation. Using an updated CTM, the researchers will simulate historical and current air pollution episodes, which will then be used make final improvements to the model. Results from this work will include verified model inputs for CRPAQS, CalNex, and DISCOVER-AQ periods, a revised conceptual model for nitrate formation, and the incorporation and demonstration of a computationally efficient algorithm in a CTM. The techniques and model will be easily transferable to regulatory models such as CMAQ, which will improve ARB's modeling basis for SIP development.

III. Discussion of Draft Final Reports:

1) "Technical Analysis of Vehicle Load Reduction Potential for Advanced Clean Cars," Control-Tec, $162,120, Contract no. 13-313

Reducing vehicle road load through greater use of improved aerodynamic designs, low rolling resistance tires, and mass reduction can contribute to tailpipe greenhouse gas (GHG) emission reductions to varying degrees. This research analyzed vehicle attribute data to identify the configurations within the 2014 model year using best available or best-in-class load-reducing technologies and determined the impact on the overall vehicle fleet if all vehicles utilized such technologies. These findings were used to project potential tailpipe carbon dioxide (CO_2) emission reductions from the light-duty fleet. Assuming that all vehicles adopt load reduction technologies and strategies already demonstrated in today's better performing vehicles, it is estimated that a reduction in tailpipe CO_2 emissions of 10.4 percent is achievable. The results of this study will be useful for producing a technical assessment of the feasibility for producing vehicles complying with the Advanced Clean Cars program in future model years.

2) "Evaluating the Benefits of Light Rail Transit," University of California, Irvine, $200,000, Contract No. 12-313

Senate Bill 375 (SB 375) requires Metropolitan Planning Organizations (MPOs) in California to develop a Sustainable Communities Strategy that demonstrates how they will meet regional greenhouse gas reduction targets set by ARB. The introduction and expansion of light rail transit (LRT) systems and the densification of communities living around LRT stations are among the strategies

being considered and pursued by regions as they work toward SB 375 goals. However, the regional travel demand forecasting models used by MPOs in their planning process are limited in their ability to accurately evaluate the impact of transit investment and transit-oriented development projects on travel demand. This research project implemented the first ever longitudinal, experimental-control, before-after evaluation of the impact of a light rail transit investment in California on travel behavior and the active transportation co-benefits for nearby residents. This project built upon an existing study that collected baseline data on travel behavior for 248 households in and near the Expo Line corridor in south Los Angeles. Due to substantial co-funding to support the second phase of data collection, this project supported a third phase of data collection, which allowed for a rare longitudinal look at travel behavior. The results of this research provide insight into whether and to what extent light rail transit investments can support the goals of SB 375.