State of California

AIR RESOURCES BOARD

Research Resolutions

Research Division

September 20, 2001

INTRODUCTION

Contained herein for Board review are five resolutions and accompanying summaries from the Extramural Research Program recommended to the Board by the Research Screening Committee.

Item 1 is a research proposal from the University of California, Irvine entitled, "Impact of NO_X Surface Reactions on the Formation of Particles, Ozone and the Development of Control Strategy Options". The principal investigator will be Professor Barbara Finlayson-Pitts. Resolution No. 01-32

Item 2 is a research proposal from the University of California, Riverside entitled, "Development and Evaluation of a Gas-Phase Atmospheric Reaction Mechanism for Low NO_X Conditions". The principal investigator will be Dr. William Carter. Resolution No. 01-33

Item 3 is a research proposal from the University of California, Davis entitled, "Source Apportionment of Fine and Ultrafine Particles in California". The principal investigators will be Professors Michael Kleeman, Michael Hannigan and Jonathan Allen. Resolution No. 01-34

Item 4 is a research proposal from California Polytechnic State University, San Luis Obispo entitled, "Correlation between Solids Content and Hiding as it Relates to Calculation of VOC Content in Architectural Coatings". The principal investigator will be Professor Albert C. Censullo. Resolution No. 01-35

Item 5 is a research proposal from AC Propulsion, Inc. entitled "Vehicle-to-Grid Demonstration Project: Grid Regulation Ancillary Service with a Battery Electric Vehicle". The principal investigator will be Mr. Alec Brooks. Resolution No. 01-36

Item 6 is a research proposal entitled "Determination of the Contributions of Light-Duty and Heavy-Duty Vehicle Emissions to Ambient Particles in California" that had previously been awarded to the University of California, Riverside. The project will now be performed at the University of California, San Diego. The principal investigator, Dr. Kimberly Prather, will remain unchanged. Resolution No. 01-37

PROPOSED

State of California
AIR RESOURCES BOARD

Resolution 01-32

September 20, 2001

Agenda Item No.: 01-7-3

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2498-221, entitled "Impact of NO_X Surface Reactions on the Formation of Particles, Ozone, and the Development of Control Strategy Options," has been submitted by the University of California, Irvine;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2498-221 entitled "Impact of NO_X Surface Reactions on the Formation of Particles, Ozone, and the Development of Control Strategy Options," submitted by the University of California, Irvine, for a total amount not to exceed $400,003.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2498-221 entitled "Impact of NO_X Surface Reactions on the Formation of Particles, Ozone, and the Development of Control Strategy Options," submitted by the University of California, Irvine, for a total amount not to exceed $400,003.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and described in Attachment A, in an amount not to exceed $400,003.

ATTACHMENT A

"Impact of NO_X Surface Reactions on the Formation of Particles, Ozone, and the Development of Control Strategy Options"

Background

Nitrogen oxides (NO_x) play a fundamental role in the creation of ozone, particles, and other pollutants in the atmosphere through photochemical reactions with volatile organic compounds. In addition to these gas-phase processes, heterogeneous reactions of NO_x are also important in the creation of pollutants. Two such reactions that are likely to be important in urban areas, yet are poorly understood and are not included in current airshed models, are the hydrolysis of NO_2 to produce HONO and HNO_3, and the generation of NO_2 from NO and HNO_3. The first reaction creates HONO, which plays a pivotal role in the initiation of smog formation at dawn. The second reaction transforms deposited HNO_3 into photochemically active (gas-phase) NO_x. This latter reaction counters the widely accepted viewpoint that HNO_3 is an end product that takes NO_x out of the atmosphere. An understanding and accurate parameterization of these reactions is necessary to assess different pollution control strategies and air quality modeling studies. Preliminary modeling studies suggest that these heterogeneous reactions may have a significant effect on peak levels of ozone and particulates.

Objective

The objectives of this research are to determine, using a combination of laboratory and modeling studies, 1) the mechanism and rate of HONO formation from the hydrolysis of NO_2, 2) the mechanism and rate at which HNO_3 is converted back into photochemically active forms, 3) the possible photoenhancement of these reactions, and 4) the impact of these reactions on ozone and particulate formation in urban areas.

Methods

A newly constructed attenuated total reflectance-long path infrared apparatus (ATR-LPIR) will be used to simultaneously monitor the infrared spectrum of the gas phase and a liquid film in a reaction cell. Nitric acid, N_2O_4, nitric and nitrite ion will be measured in a thin water film on an ATR crystal (composed of Ge, KRS-5, ZnSe, or AMTIR). The thickness of the water layer will be varied by using air of various relative humidities. Photosensitivity of the reactions will be investigated using a Xe lamp, which simulates solar radiation with suitable filters. In addition to these measurements, a long-path gas cell with Fourier transform infrared spectrometry will be used as an independent method to investigate the possible photoenhancement of heterogeneous NO_X reactions.

Expected Results

A comprehensive chemical reaction model will be constructed from the experimentally determined mechanisms and rate constants. Airshed modeling studies will be carried out for different NO_X/VOC scenarios.

Significance to the Board
The information gained in this project will improve our understanding of the reactions critical to accurately predicting the effect of NO_X controls on PM and ozone levels. Thus, it will improve our understanding of the processes involved in the formation of secondary pollutants that pose health risks and degrade California's visibility. The information will also be used to improve the chemical mechanisms used in the ARB's attainment modeling for the State Implementation Plan.

Contractor:
University of California, Irvine

Contract Period:
27 months

Principal Investigator (PI):
Professor Barbara Finlayson-Pitts

Contract Amount:
$400,003

Cofunding:
none

Basis for Indirect Cost Rate:
The State and University of California System have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
Professor Finlayson-Pitts did an excellent job on a previous ARB contract and she was very cooperative in responding to requests from ARB staff. Her previous project produced a large amount of excellent quality science.

Prior Research Division Funding to the University of California, Irvine:

Year	2001	2000	1999
Funding	$ 0	$ 215,000	$ 501,999

BUDGET SUMMARY

University of California, Irvine

Impact of NO_X Surface Reactions on the Formation of Particles, Ozone, and the Development of Control Strategy Options

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 272,556	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 6,000	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 65,544[1]	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 21,000	
	Total Direct Costs		$365,100
INDIRECT COSTS			
1.	Overhead	$ 34,903	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$34,903
TOTAL PROJECT COSTS			**$400,003**

[1] Funds will be used for the purchase of disposable supplies such as optical components, gases, solvents, chemical, glassware, stockroom and office supplies to be used on this project.

PROPOSED

State of California
AIR RESOURCES BOARD

Resolution 01-33

September 20, 2001

Agenda Item No.: 01-7-3

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2497-221, entitled "Development and Evaluation of a Gas-Phase Atmospheric Reaction Mechanism for Low NO_X Conditions," has been submitted by the University of California, Riverside;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2497-221 entitled "Development and Evaluation of a Gas-Phase Atmospheric Reaction Mechanism for Low NO_X Conditions," submitted by the University of California, Riverside, for a total amount not to exceed $79,884.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2497-221 entitled "Development and Evaluation of a Gas-Phase Atmospheric Reaction Mechanism for Low NO_X Conditions," submitted by the University of California, Riverside, for a total amount not to exceed $79,884.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described and in Attachment A, in an amount not to exceed $79,884.

ATTACHMENT A

"Development and Evaluation of a Gas-Phase Atmospheric Reaction Mechanism for Low NO_X Conditions"

Background

Air quality simulation models are used to assess the effectiveness of the control strategies and to develop plans and regulations for achieving air quality standards by regulatory agencies. The gas-phase chemical mechanism that represents the gas-phase chemical reactions involved in the model is a critical component for predictions of concentrations of pollutants such as ozone, particulate matter, and other secondary pollutants.

Under the sponsorship of the ARB, a detailed version of the atmospheric chemical mechanism SAPRC-99 has recently been developed by Dr. William Carter at the University of California, Riverside. This mechanism has been peer-reviewed and is considered a state-of-the-science mechanism. It has been used extensively in many regulatory and research applications. For example, this mechanism was recently used in developing the reactivity scales for California's aerosol coatings regulations. However, this mechanism was developed and evaluated for high NO_X conditions typical of urban areas. Its applicability to low NO_X conditions has not been validated. Low NO_X conditions exist in many current ambient atmospheres and will become typical of future case scenarios as the urban air quality improves. Thus, the chemical mechanism must be evaluated for accuracy when modeling low NO_X conditions in regional model simulations.

Objective

The objective of this two-year project is to evaluate and improve the performance of the current version of the SAPRC-99 chemical mechanism for simulating chemical transformations under low and very low NO_X conditions.

Methods

Both experimental and model studies are proposed to accomplish the objectives of this project. The four tasks proposed are to develop a low NO_X version of SAPRC-99, to evaluate the mechanisms using available low NO_X environmental chamber data as well as for new low NO_X chamber experiments, and to update and modify the mechanism.

Expected Results

A version of the SAPRC-99 chemical mechanism for low NO_X conditions and other files and programs related to the implementation of this mechanism in airshed model simulations.

Significance to the Board

The results of this project will improve our understanding of atmospheric chemistry in rural and remote areas, allow more accurate air quality simulation when modeling low NO_X conditions, and lead to more scientifically sound control plans and strategies.

Contractor:
University of California, Riverside

Contract Period:
24 months

Principal Investigator (PI):
William P. L. Carter, Ph.D.

Contract Amount:
$79,884

Cofunding:
The U.S. EPA is funding a four-year project to develop the next-generation environmental chamber facility needed for evaluating gas-phase and gas-to-particle atmospheric reaction mechanism. Specifically, this facility is designed for mechanism evaluation under low NO_X conditions. The characterization runs will be carried out under the funding from the U.S. EPA, which are critical for the new chamber runs of low NO_X evaluation to be useful. Because the U.S. EPA is funding a significant amount of the chamber work, this project is a very cost-effective use of the ARB's research funds.

Basis for Indirect Cost Rate:
The State and the University of California System have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
The principal investigator, Dr. William Carter, is one of the pioneers in determining and quantifying VOC reactivity. He is the leader of the NARSTO's VOC reactivity assessment team. He has published approximately 75 journal articles and almost 70 technical reports in the areas of atmospheric chemistry, chemical mechanism development, and VOC reactivity assessment. He compiled the list of compound reactivities codified in California's Low Emission Vehicles/Clean Fuels and aerosol coatings regulations. He has completed several studies on VOC reactivity for the ARB and has always delivered a quality product at a very reasonable cost.

Prior Research Division Funding to the University of California, Riverside:

Year	2001	2000	1999
Funding	$0	$ 988,578	$ 484,943

BUDGET SUMMARY

University of California, Riverside

Evaluation of Atmospheric Impacts of Selected Coatings VOC Emissions

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 47,636	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 500	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 1,500	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 20,122[1]	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 3,150	
	Total Direct Costs		$ 72,908
INDIRECT COSTS			
1.	Overhead	$ 6,976	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 6,976
TOTAL PROJECT COSTS			**$ 79,884**

[1]

Phone, copying, office supplies	$ 500
Software upgrades and other computer supplies	$ 2,000
Miscellaneous laboratory supplies	$ 1,100
Power for chamber experiments	$ 2,200
CE-CERT Lab fees: 22 days @ $651/day	$14,322
	$20,122

PROPOSED

State of California
AIR RESOURCES BOARD

Resolution 01-34

September 20, 2001

Agenda Item No.: 01-7-3

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2500-221, entitled "Source Apportionment of Fine and Ultrafine Particles in California," has been submitted by the University of California, Davis;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2500-221 entitled "Source Apportionment of Fine and Ultrafine Particles in California," submitted by the University of California, Davis, for a total amount not to exceed $314,998.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2500-221 entitled "Source Apportionment of Fine and Ultrafine Particles in California," submitted by the University of California, Davis, for a total amount not to exceed $314,998.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $314,998.

ATTACHMENT A

"Source Apportionment of Fine and Ultrafine Particles in California"

Background

Airborne particulate matter (PM) has recently been implicated in increased mortality. Approximately 20,000 Californians die prematurely each year due to PM. Reducing fine particulate pollution is one of the most difficult environmental challenges facing California because of the great diversity of sources and chemical species involved. Developing a technically defensible PM control program requires identifying the contribution of each source type to the measured PM concentrations and then estimating the air quality benefits associated with implementing a suite of emission controls.

Linking sources to measured air quality uses empirical methods termed "source apportionment" and "receptor modeling." Source apportionment techniques for airborne PM determine how emissions released from different sources contribute to the observed concentrations of airborne particles. These models are popular because they can be applied to an air quality episode without detailed knowledge of meteorological conditions and emissions patterns within the geographical area of interest. Recent advances in traditional statistical source apportionment techniques combined with high-resolution source profiles have improved the power of this tool. Apportionment of the particulate matter would effectively reveal the contribution that different sources make to fine and ultrafine particle concentrations. Because fine particles have been implicated in serious health effects, a better understanding of source contributions to fine particle concentrations will enable decision makers to formulate effective control strategies to protect public health.

Objective

The objective of this research project is to perform a source apportionment of airborne fine and ultrafine particulate matter in California. Particle samples collected during several major ambient field monitoring and source sampling studies will be analyzed and a new ultrafine particle source library will be developed.

Methods

The investigators propose to carry out a statistical source apportionment study of airborne fine and ultrafine particles in California. Airborne particle samples collected with filter-based samplers and Micro Orifice Uniform Deposit Impactors (MOUDIs) will be analyzed for the quantity of unique chemical tracers that can be used in a source apportionment analysis. The final stage of the MOUDI collects particles exclusively in the ultrafine particle size range. Apportionment of the particulate matter collected on this stage will effectively reveal the contribution that different sources make to ultrafine particle concentrations. The standard chemical mass balance program will be used to calculate how the known sources of ultrafine and fine particles contribute to the concentrations of ambient air particles observed during CRPAQS and SCOS97 field monitoring programs.

Expected Results
This research project has been organized in three separate parts. These parts of research include characterizating ultrafine particles at the source, characteriing fine particles collected during SCOS97 and ultrafine particles collected during CRPAQS, and performing source apportionment analysis for collected fine and ultrafine particles. Source apportionment results will be compared with results from similar studies of fine PM in Southern California including the 1982 and 1993 studies that were also made by Prof. Cass' research group. Trends in fine PM sources among the 1982, 1993, and 1997 samples will provide a measure of the effectiveness of fine PM control strategies over this period. Finally, the results of all parts of the project will be documented as a technical report submitted to ARB and as technical papers submitted to peer-reviewed journals.

Significance to the Board
Currently, we know very little about the contribution that different urban sources make to airborne ultrafine particle concentrations. The statistical source apportionment techniques proposed in this study can provide valuable insight. Information of this type plays a vital role in the design of emissions control programs that reduce airborne particle concentrations. Having a better understanding of the sources of atmospheric ultrafine particles is also needed to design abatement strategies.

Contractor:
University of California, Davis

Contract Period:
36 months

Principal Investigator (PI):
Dr. Michael Kleeman

Contract Amount:
$314,998

Co-funding:
No co-funding but this project has cost savings through a cooperative effort with ongoing major diesel study, i.e., CRC Project E55/59.

Basis for Indirect Cost Rate:
The State and University of California System have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
Although staff has a limited direct experience with Dr. Kleeman, he has extensive previous experience in the construction of air quality models that describe aerosol

processes and in the measurement of airborne particulate matter in the ambient atmosphere and his work is well-published.

Prior Research Division Funding to the University of California, Davis:

Year	2001	2000	1999
Funding	$ 0	$ 215,000	$ 501,999

BUDGET SUMMARY

University of California, Davis

Source Apportionment of Fine and Ultrafine Particles in California

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 83,312	
2.	Subcontractors	$ 161,180[1]	
3.	Equipment	$ 2,500	
4.	Travel and Subsistence	$ 8,960	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 3,000	
7.	Mail and Phone	$ 2,000	
8.	Supplies	$ 20,906[2]	
9.	Analyses	$ 1,680	
10.	Miscellaneous	$ 14,474[3]	
	Total Direct Costs		$298,012
INDIRECT COSTS			
1.	Overhead	$ 16,986	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$16,986
TOTAL PROJECT COSTS			**$314,998**

[1] University of Colorado State ($111,176) and Arizona State University ($50,004)

[2] Supplies include items needed to collect source samples to characterize diesel vehicles (filter media, etc) in addition to items needed for trace organics analysis (solvents, standards, etc). Tape backup media are included to archive the databases produced during the research to insure against data loss. Glassware, plasticware, nitrogen blowdown and solvent are needed during sample extraction and analysis activities. Authentic standards are included in the budget so that trace organic compounds can be quantified with greater certainty, increasing the accuracy of the overall analysis.

[3] Student/University registration fee

PROPOSED

State of California
AIR RESOURCES BOARD

Resolution 01-35

September 20, 2001

Agenda Item No.: 01-7-3

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2499-221, entitled "Correlation between Solids Content and Hiding as it Relates to Calculation of VOC Content in Architectural Coatings," has been submitted by California Polytechnic State University, San Luis Obispo;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2499-221 entitled "Correlation between Solids Content and Hiding as it Relates to Calculation of VOC Content in Architectural Coatings," submitted by California Polytechnic State University, San Luis Obispo, for a total amount not to exceed $99,932.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2499-221 entitled "Correlation between Solids Content and Hiding as it Relates to Calculation of VOC Content in Architectural Coatings," submitted by California Polytechnic State University, San Luis Obispo, for a total amount not to exceed $99,932.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and agreements for the interagency research effort proposed herein, and as described in Attachment A, in an amount not to exceed $99,932.

ATTACHMENT A

"Correlation between Solids Content and Hiding as it Relates to Calculation of VOC Content in Architectural Coatings"

Background

Architectural coatings are a significant source of volatile organic compounds (VOC) emissions in California. In recent years, water-based coatings have been increasing their market share relative to solvent-based coatings. Paint can labels must state their VOC content, which facilitates both enforcement of rules and consumer comparison of the VOC content of different brands. U.S. EPA rules, which are adopted by local air districts, define "regulatory VOC" by computing the VOC of coatings on a "less water and exempt compounds basis". However, for coatings with a high percentage of water, the regulatory VOC can be much higher than the actual VOC.

The regulatory definition implies that the volume of solids is directly related to the ability of the applied coating to "hide" the underlying substrate. If a particular coating does not "hide" sufficiently, the consumer will repeat the application with additional paint. However, a low-solids water-based coating with a high "regulatory VOC" can provide the same hiding ability as a high-solids solvent-based coating with higher "actual VOC". In that case, a consumer looking for a low-VOC paint might buy a can that would emit more VOCs when applied.

Objective

The objective of this project is to investigate the relationship between the type and amount of solids, and coverage and hiding, for selected classes of water-based architectural coatings.

Methods

The first task will be to develop a plan for experimental design. The contractor, California Polytechnic State University (CalPoly), will use standard methods to determine film thickness and coverage, produce films of uniform thickness, and determine the hiding power of paints by reflectometry. The second task will be to formulate, apply, and evaluate coatings. CalPoly will prepare thirty formulations, apply them to suitable substrates, and test them. CalPoly will vary levels of pigment to adjust pigment volume concentration in the dry films.

Expected Results

Based on the expected results of this project, ARB staff may be able to justify an alternative VOC calculation procedure for labeling paint cans. Ultimately, this would provide a more accurate way to compare the emissions impacts of various coatings. Enforcement would be easier since the test method will be more straightforward.

Significance to the Board
The Board, during its approval of the 2000 Suggested Control Measure for Architectural Coatings, directed ARB staff to evaluate the issue of the "less water and exempts" calculation. Manufacturers indicate that the labeling requirement "penalizes" them for formulating coatings with water. The results of this project are expected to provide benefits to manufacturers of water-borne coatings, and to consumers who will be better able to compare labeled VOC contents on paint cans.

Contractor:
California Polytechnic State University, San Luis Obispo

Contract Period:
16 months

Principal Investigator (PI):
Professor Albert C. Censullo

Contract Amount:
$99,932

Cofunding:
None

Basis for Indirect Cost Rate:
The 35 percent indirect cost rate is a federally approved rate.

Past Experience with this Principal Investigator:
The PI has almost completed an ARB-funded project (98-310) titled, "Investigation of Low Reactivity Solvents for Use in Consumer Products." In earlier work for the ARB, the PI's team developed sampling methods and analyzed over 50 water-based and solvent-based coatings. In that work, the PI demonstrated excellent analytical abilities and showed a willingness to put extra effort into the project to ensure accurate and useful results.

Prior Research Division Funding to California Polytechnic State University, San Luis Obispo:

Year	2001	2000	1999
Funding	$ 0	$ 0	$ 0

BUDGET SUMMARY

California Polytechnic State University, San Luis Obispo

Correlation between Solids Content and Hiding as it Relates to Calculation of VOC Content in Architectural Coatings

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$66,917	
2.	Subcontractors	$ 0	
3.	Equipment	$ 1,000	
4.	Travel and Subsistence	$ 2,007	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 500	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 3,600	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 0	
	Total Direct Costs		$74,024
INDIRECT COSTS			
1.	Overhead	$25,908	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$25,908
TOTAL PROJECT COSTS			**$99,932**

PROPOSED

State of California
AIR RESOURCES BOARD

Resolution 01-36

September 20, 2001

Agenda Item No.: 01-7-3

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2501-221, entitled "Vehicle-to-Grid Demonstration Project: Grid Regulation Ancillary Service with a Battery Electric Vehicle", has been submitted by AC Propulsion, Inc.;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2501-221 entitled "Vehicle-to-Grid Demonstration Project: Grid Regulation Ancillary Service with a Battery Electric Vehicle", submitted by AC Propulsion, Inc., for a total amount not to exceed $164,676.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2501-221 entitled "Vehicle-to-Grid Demonstration Project: Grid Regulation Ancillary Service with a Battery Electric Vehicle", submitted by AC Propulsion, Inc., for a total amount not to exceed $164,676.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $164,676.

Significance to the Board
The proposed project aims to develop and demonstrate technology and systems that allow an electric vehicle to create value while the vehicle is stationary and plugged in to the power grid. By deploying the vehicle's power systems to perform ancillary services for the power grid operator, there is the potential for economic value to be created that will nullify the excessive cost-per-emissions-benefit argument. With the value created through vehicle-based grid services, there is the potential for electric vehicles to have a lower net cost than a conventional vehicle. This could invert the cost vs. emissions benefit tradeoff as there could be a cost benefit together with the emissions benefit. The significance to the Air Resources Board is that vehicle based grid services may prove to be instrumental in overcoming market and cost barriers in the adoption of electric and other advanced technology vehicles.

Contractor:
AC Propulsion, Inc.

Contract Period:
Seven (7) months

Principal Investigator (PI):
Alec N. Brooks

Contract Amount:
$164,676

Cofunding:
Volkswagen will contribute the use of a prototype "New Beetle" electric vehicle. CalISO will participate in the demonstration effort at no charge to the project.

Basis for Indirect Cost Rate:
The indirect cost consists solely of a profit of $12,198, an acceptable rate of eight percent of the Total Direct Cost. No charge will be made for overhead or general & administrative costs.

Past Experience with this Principal Investigator:
This Principal Investigator participated in a study entitled "Vehicle-to-Grid Power: Battery, Hybrid, and Fuel Cell Vehicles as Resources for Distributed Electric Power in California," supported by the ARB's Mobile Source Control Division. The study's results were well received.

Prior Research Division Funding to AC Propulsion:

Year	2001	2000	1999
Funding	$ 0	$ 0	$ 0

ATTACHMENT A

"Vehicle-to-Grid Demonstration Project: Grid Regulation Ancillary Service with a Battery Electric Vehicle"

Background

The Air Resources Board has determined that zero emission vehicles need to be an integral part of the efforts to reduce air pollution in California. The Low Emission Vehicle program, first adopted in 1990, contains a mandate for the production of a growing number of ZEVs. In the most recent biennial review, completed in September 2000, the ARB commissioned an independent technical expert to evaluate the state of the art of batteries and other ZEV technologies. The report determined that high costs of batteries would result in a cost premium of battery powered electric vehicles over conventional vehicles. The report cites a $20,000 per vehicle cost premium over a conventional vehicle was cited in the report. This cost premium has been widely used in attacks against the ZEV mandate.

Objective

The goal of this project is to integrate all of the essential elements needed to demonstrate the operation of a battery electric vehicle performing grid regulation while parked, and to demonstrate that capability in actual operation. The primary intent is to provide a way of adding value to the ownership of electric vehicles, whereby the reduced cost-of-ownership would ease an objection to their use and thus help reduce automotive air pollution.

Methods

This project will assemble available components into an existing battery electric vehicle, develop the controlling software, implement the control technology with the California Independent System Operator (CallSO), and demonstrate the vehicle in actual grid regulation usage for approximately 120 hours. During the demonstration periods, data will be collected on how well the vehicle responds to regulation commands, on power flow, on battery state of charge and other important parameters. These data will be analyzed to evaluate the feasibility of this technology for use of battery electric vehicles for grid power regulation.

Expected Results

It is anticipated that this project will successfully demonstrate the technology, hardware and software for using battery electric vehicles for grid power regulation, and to show the feasibility of this approach.

BUDGET SUMMARY

AC Propulsion, Inc.

Vehicle-to-Grid Demonstration Project:
Grid Regulation Ancillary Service with a Battery Electric Vehicle

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 106,061	
2.	Subcontractors	$ 600	
3.	Equipment	$ 30,487[1]	
4.	Travel and Subsistence	$ 4,851	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 100	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 1,100	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 9,280	
	Total Direct Costs		$152,478
INDIRECT COSTS			
1.	Overhead	$ 0	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 12,198	
	Total Indirect Costs		$ 12,198
TOTAL PROJECT COSTS			**$ 164,676**

[1] The majority of the equipment budget is for an electric motor drive system costing $22,500.

PROPOSED

State of California
AIR RESOURCES BOARD

Resolution 01-37

September 20, 2001

Agenda Item No.: 01-7-3

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2491-219, entitled "Determination of the Contributions of Light-Duty and Heavy-Duty Vehicle Emissions to Ambient Particles in California," was awarded to the University of California, Riverside under Resolution number 01-15 on April 26, 2001;

WHEREAS, Dr. Kimberely Prather, who is the principal investigator for research proposal number 2491-219, is changed employment within the University of California system;

WHEREAS, the same project will now be undertaken by Dr. Prather at the University of California, San Diego;

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the change in University campuses and approves the following:

> Proposal Number 2491-219 entitled "Determination of the Contributions of Light-Duty and Heavy-Duty Vehicle Emissions to Ambient Particles in California," awarded to the University of California, San Diego, for a total amount not to exceed $333,790.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $333,790.

Attachment A

"Determination of the Contributions of Light-Duty and Heavy-Duty Vehicle Emissions to Ambient Particles in California"

Background

Source apportionment experiments indicate that motor vehicle exhaust is a major component of PM10, especially in urban areas. To date, source apportionment within the motor vehicle fleet has relied on inferred fractionation based on "broad brush" approaches such as elemental carbon (EC) ratios or modeling from dynamometer test data. Since they are based on generalized and/or assumed fleet emission characteristics, these approaches are inappropriate for several types of analyses, especially examining "hot spots" and comparing in-use emissions with inventory estimates and modeled air quality ("top down" validation). Resolving these issues depends on developing methods to directly detect diesel and gasoline vehicles' emissions in ambient air, a capability that appears beyond the reach of conventional sampling and analytical techniques.

Although many particle sources produce distinct "diagnostic" particles, the bulk collection of particles on filters or impaction plates masks individual particles, and precludes their recognition in ambient samples. Bulk sampling methods generally cannot gather samples over the short time periods needed for direct observation of the formation and transformation of secondary aerosols. Finally, bulk methods cannot distinguish between aerosols composed of identical particles with complex composition and those composed of mixtures of different kinds of particles. Without these kinds of data, source apportionment for primary aerosols relies on statistical inferences that often lack sound observational and theoretical bases, and interpretation of secondary particles relies on assumed gas-aerosol interactions not verified by observations in ambient air. The aerosol time-of-flight mass spectrometry (ATOFMS) technology, combines single-particle analyses, real-time data stream, and continuous operation. Therefore, it can potentially answer many questions about aerosols that cannot be practically addressed by other means, and can provide detailed information necessary to refine and extend the interpretation of data gathered by conventional bulk sampling and analysis methods. Previous work with ATOFMS indicates that this technology can distinguish gasoline and diesel emissions as well as sample aerosols with temporal resolution down to a few seconds. These are the exact capabilities needed to resolve the diesel-gasoline emission problem.

Objective

The objective of this project is to demonstrate source-specific (diesel versus gasoline) detection of ambient particles emitted by motor vehicles. The approach involves limited new source sampling to better characterize "fresh" diesel exhaust particles, reanalysis of existing ambient monitoring data, and new field sampling along roadways, in a tunnel, and in a complex urban setting.

Expected Results
The expected results are techniques to perform time-resolved (possibly real-time) source apportionment for motor vehicle particulate emissions. This project consists of multiple components. It will develop an ATOFMS data management system and sample diesel exhaust to identify "marker" compounds and particles. It will also characterize aerosol signatures of unburned fuel and lubricants as well as compare diesel and gasoline vehicle exhaust in a traffic segregated tunnel by assessing particle transformation by upwind-downwind sampling of roadway emissions. Finally, it will demonstrate the detection schemes in a complex urban setting.

Significance to the Board
Motor vehicles are major contributors to ambient concentrations of particulate matter (PM10 & PM2.5). Diesel exhaust particles, a significant fraction of total motor vehicle PM emissions, are classified as a Toxic Air Contaminant. Developing plans to reduce human exposure to these air pollutants requires data on the origins of ambient aerosols, both to identify source-specific concentrations of primary particles and to understand the processes that form secondary particles in the air. Real-time single particle analysis using ATOFMS is capable of discriminating among sources based on characteristic particles and particle populations that are irretrievably mixed in conventional filter and impactor samples. This study builds on the ATOFMS instrumentation and expertise developed at UCR with ARB support, with the goal of detecting motor vehicle aerosols in ambient air and discriminating their diesel and gasoline vehicle components in quasi-real time.

Contractor:
University of California, San Diego

Contract Period:
36 months

Principal Investigator (PI):
Dr. Kimberly Prather

Contract Amount:
$333,790

Co-funding:
No co-funding is provided. However, project has cost savings through a cooperative effort with ongoing major diesel studies (ARB testing at MTA, ARCO EC-Diesel, CRC Project E55/59).

Basis for Indirect Cost Rate:
The indirect cost rate of 10 percent is a negotiated rate agreed to by the State and the University of California campuses.

Past Experience with this Principal Investigator:
Staff has extensive experience with Dr. Prather. Her program is in the forefront of particle analysis and her work is well-published.

Prior Research Division Funding to the University of California, San Diego:

Year	2000	1999	1998
Funding	$0	$0	$0

BUDGET SUMMARY

University of California, San Diego

"Determination of the Contributions of Light-Duty and Heavy-Duty Vehicle Emissions to Ambient Particles in California"

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	189,900	
2.	Subcontractors	$	0	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	41,000	
5.	Electronic Data Processing	$	0	
6.	Reproduction/Publication	$	0	
7.	Mail and Phone	$	0	
8.	Supplies	$	50,000	
9.	Analyses	$	0	
10.	Miscellaneous	$	24,800[1]	
	Total Direct Costs			$305,700
INDIRECT COSTS				
1.	Overhead	$	28,090	
2.	General and Administrative Expenses	$	0	
3.	Other Indirect Costs	$	0	
4.	Fee or Profit	$	0	
	Total Indirect Costs			$28,090
TOTAL PROJECT COSTS				**$333,790**

[1] Components to maintain operation of 3 ATOFMSs