State of California
AIR RESOURCES BOARD

Association between Long-Term Ultrafine Particulate Matter Exposure and Premature Death

RESEARCH PROPOSAL

Resolution 14-19

July 24, 2014

Agenda Item No.: 14-6-1

WHEREAS, the Air Resources Board (ARB) 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 2775-279, titled "Association Between Long-Term Ultrafine Particulate Matter Exposure and Premature Death," has been submitted by the University of California, Davis; and

WHEREAS, the Research Division staff has reviewed Proposal Number 2775-279 and finds that in accordance with Health and Safety Code section 39701, research is needed to provide a state-of-the-science exposure assessment for ultrafine particles based on measurements and regional models and to determine whether ultrafine particles are positively associated with premature death using an epidemiological cohort;

WHEREAS, in accordance with Health and Safety Code section 39705, the Research Screening Committee recommends for funding:

> Proposal Number 2775-279 titled "Association Between Long-Term Ultrafine Particulate Matter Exposure and Premature Death," submitted by the University of California, Davis, for a total amount not to exceed $849,115.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39700 through 39705, hereby accepts the recommendations of the Research Screening Committee and Research Division staff and approves the following:

> Proposal Number 2775-279 titled "Association Between Long-Term Ultrafine Particulate Matter Exposure and Premature Death," submitted by the University of California, Davis, for a total amount not to exceed $849,115.

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 $849,115.

I hereby certify that the above is a true and correct copy of Resolution 14-19 as adopted by the Air Resources Board.

Tracy Jensen

Tracy Jensen, Clerk of the Board

ATTACHMENT A

"Association between Long-Term Ultrafine Particulate Matter Exposure and Premature Death"

Background

Although some ultrafine particulate matter (UFPM) epidemiologic studies have been published, the results are inconsistent, and the studies lacked adequate exposure assessment at the regional level. Some studies have examined associations between short-term UFPM exposure and mortality; however, these studies relied on central site monitors, which were not able to capture regional variation in UFPM levels. There are no corresponding long-term UFP mortality studies, although published results suggest that UFPM may be as toxic as, or possibly more toxic than PM2.5.

The results of the few epidemiologic studies of UFPM are inconsistent, primarily because of the lack of an adequate exposure assessment at the regional level. To date, an adequate exposure assessment has not been conducted, largely because UFP has strong spatial gradients. This is clearly true for California, where ambient concentrations of UFPM have not been adequately characterized by monitoring at the regional level. The proposed study will provide these regional UFPM concentration estimates; moreover, modeled outputs will be validated through comparison with monitored levels. These validated UFPM data then will be matched with an existing epidemiologic cohort. This integration of approaches will fill the critical need for a sound epidemiologic study on the health effects of long-term exposure to UFPM.

Objective

The objective of the proposed study is to perform a state-of-the-science exposure assessment for UFPM's based on measurements and regional models and to determine whether UFPMs are positively associated with premature death in California using an established epidemiological cohort.

Methods

A combination of measurements and model predictions for UFPM concentrations (number, mass, chemical components, sources) will be used to estimate population exposure more accurately than those in previous epidemiological efforts, which relied on central site monitors. UFPM samples will be collected in three California cities, and their composition will be analyzed. Statistical source apportionment calculations will be performed on these samples. UFPM particle number and mass concentrations will be predicted using regional chemical transport models, and these modeled values will be compared with the collected samples, as well as other available UFPM data that have been collected throughout California by Dr. Kleeman and others (for locations including sites in the South Coast Air Basin and the San Joaquin Valley). Concentration fields generated by model predictions will be combined with geocoded addresses from the California Teachers Study to determine whether any feature of ultrafine particles is positively associated with premature mortality. Standard Cox proportional hazard models will be used to quantify all associations.

Expected Results
The UFPM composition and source apportionment measurements generated for a year in the San Francisco Bay Area, Fresno, and Los Angeles will be the most comprehensive assessment of its kind in the world. The comparison of these measurements to regional model predictions will provide a rigorous test of the model capabilities over cities with very different size, sources, and meteorology that should lead to generalizable conclusions regarding model capabilities. The exposure assessment generated by the project activities will be used to test the association between UFPM and premature death.

Significance to the Board
The overall assessment of UFPM effects on human health using robust epidemiological methods will provide a first step towards elucidating the relationship between long-term exposure to UFPM and premature death.

Contractor:
University of California, Davis

Contract Period:
36 months

Principal Investigator (PI):
Michael J. Kleeman, Ph.D.

Contract Amount:
$849,115

Basis for Indirect Cost Rate:
The State and the UC system have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
Dr. Kleeman has a great deal of experience performing the modeling and monitoring described in the current research proposal. He also worked with the co-investigators previously; these collaborators have much experience with the epidemiological cohort that will be used to provide health impacts data for this project. Dr. Kleeman previously has been involved with a number of successful ARB research contracts, three of which he was the sole principal investigator, and three in which he collaborated with other co-investigators.

Prior Research Division Funding to the University of California, Davis:
ARB has funded over 100 successfully completed studies from UC Davis.

Year	2013	2012	2011
Funding	$1,131,716	$4,949,363	$1,394,560

BUDGET SUMMARY

Contractor: University of California, Davis

"Association between Long-Term Ultrafine Particulate Matter Exposure and Premature Death"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 399,777	
2.	Subcontractors	$ 183,416	
3.	Equipment	$ 48,200	
4.	Travel and Subsistence	$ 8,000	
5.	Electronic Data Processing	$ 63,000	
6.	Reproduction/Publication	$ 2,000	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 32,500	
9.	Analyses	$ 18,000	
10.	Miscellaneous	$ 33,895	
	Total Direct Costs		$ 788,788
INDIRECT COSTS			
1.	Overhead	$ 60,327	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 60,327
TOTAL PROJECT COSTS			**$ 849,115**

ATTACHMENT 1

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: Bart Ostro

Description of subcontractor's responsibility: B. Ostro will analyze epidemiological results and write journal articles based on those results.

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	63,491	
2.	Subcontractors	$	0	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	800	
5.	Electronic Data Processing	$	0	
6.	Reproduction/Publication	$	0	
7.	Mail and Phone	$	0	
8.	Supplies	$	0	
9.	Analyses	$	0	
10.	Miscellaneous	$	0	
	Total Direct Costs			$ 64,291
INDIRECT COSTS				
1.	Overhead	$	0	
2.	General and Administrative Expenses	$	0	
3.	Other Indirect Costs	$	0	
4.	Fee or Profit	$	0	
	Total Indirect Costs			$ 0
TOTAL PROJECT COSTS				**$ 64,291**

ATTACHMENT 2

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: Cancer Prevention Institute of California (CPIC)

Description of subcontractor's responsibility: P. Reynolds and colleagues at CPIC will take general exposure fields for the State of California and calculate detailed exposure for members of the California Teachers Study epidemiological cohort.

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 51,296	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 87	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 244	
7.	Mail and Phone	$ 18	
8.	Supplies	$ 216	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 14,322	
	Total Direct Costs		$ 66,183
INDIRECT COSTS			
1.	Overhead	$ 22,942	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 22,942
TOTAL PROJECT COSTS			**$ 89,125**

ATTACHMENT 3

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: Tom Kirchstetter

Description of subcontractor's responsibility: T. Kirchstetter will perform location sample collection for ultrafine particles over a full year and contribute to writing of reports and journal articles summarizing the results. Costs include approximately 1 month of Kirchstetter's time.

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 15,000	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 0	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 0	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 0	
	Total Direct Costs		$ 15,000
INDIRECT COSTS			
1.	Overhead	$ 0	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 0
TOTAL PROJECT COSTS			**$ 15,000**

ATTACHMENT 4

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: University of Southern California

Description of subcontractor's responsibility: USC will perform local sample collection for ultrafine particles over a full year and contribute to writing of reports and journal articles summarizing the results. Costs include student time and a small fraction of the subcontractor's leader's time.

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	10,031	
2.	Subcontractors	$	0	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	0	
5.	Electronic Data Processing	$	0	
6.	Reproduction/Publication	$	0	
7.	Mail and Phone	$	0	
8.	Supplies	$	1,507	
9.	Analyses	$	0	
10.	Miscellaneous	$	0	
	Total Direct Costs			$ 11,538
INDIRECT COSTS				
1.	Overhead	$	3,462	
2.	General and Administrative Expenses	$	0	
3.	Other Indirect Costs	$	0	
4.	Fee or Profit	$	0	
	Total Indirect Costs			$ 3,462
TOTAL PROJECT COSTS				**$ 15,000**