State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 06-7

January 26, 2006

Agenda Item No.: 06-1-1

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 2596-250, entitled "Process-Based Farm Emission Model for Estimating Volatile Organic Compound Emissions from California Dairies", 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 2596-250 entitled "Process-Based Farm Emission Model for Estimating Volatile Organic Compound Emissions from California Dairies," submitted by the University of California, Davis, for a total amount not to exceed $299,351.

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 2596-250 entitled "Process-Based Farm Emission Model for Estimating Volatile Organic Compound Emissions from California Dairies," submitted by the University of California, Davis, for a total amount not to exceed $299,351.

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 $299,351.

I hereby certify that the above is a true and correct copy of Resolution 06-7, as adopted by the Air Resources Board.

Lori Andreoni

Lori Andreoni, Clerk of the Board

ATTACHMENT A

"Process-Based Farm Emission Model for Estimating Volatile Organic Compound Emissions from California Dairies"

Background

Dairies are a significant source of volatile organic compounds (VOC) emissions in the San Joaquin Valley. Within dairies, there are a number of individual processes that produce VOC emissions. Some of the most important individual dairy sources are the animals themselves, the storage of feed, and the storage and decomposition of the manure produced by the animals. Most of these processes are complex, and accurately measuring the VOC emissions from them is difficult. For this reason, there has historically been substantial uncertainty over the emission estimates that have been made for dairies. This uncertainty has made it difficult to assess the contribution of dairies to total emissions in the San Joaquin Valley and to design and implement effective control measures. In the last few years, additional research has been done to better understand emissions from dairies, but no study has been able to quantify VOC emissions from individual dairy sources, in isolation, as a function of the parameters that most influence the emissions. This project would be the first project to do so.

Objective

The objective of this project is to develop mathematical models to predict VOC emissions from individual processes and sources within dairies. These models would then be used by the ARB and the local air quality management districts to help estimate overall emissions from dairies. Regulatory agencies could then use the models to design strategies based on process-specific estimates of emissions from dairies.

Methods

Experiments will be conducted to measure VOC emissions from the fermentation of animal feed (silage) and from the collection, storage, and decomposition of the animals' manure. The experiments will be designed so that the factors that most influence emissions can be determined so that mathematical relationships between emissions and these factors can be developed. Preliminary experiments will first be conducted in the laboratory to study the VOCs produced at feed silage and manure collection and storage sources. Laboratory-scale experiments will then be conducted to study the chemical profiles of VOCs produced during the decomposition of dairy manure under different conditions (manure characteristics and temperature) and determine the generation rates of VOCs under different storage conditions. Additional larger-scale experiments will then be conducted in the UC Davis environmental chambers.

The VOC emissions model will be developed from the results of the lab and full-scale experiments. The VOC emissions model will include a sub-model for each of the individual dairy processes modeled. VOC emission sub-models will be developed for feed silage, manure production in animal housing, and manure storage. Data from chamber experiments will also be generated to validate the models. Any necessary changes or refinements to the models will be made.

Expected Results
Mathematical models will be developed that can be used to predict VOC emissions from various processes occurring with dairies.

Significance to the Board
The models will allow the staff to improve estimates of baseline emissions from various processes within dairies and to estimate emissions reductions that can be achieved from various control strategies.

Contractor:
University of California, Davis

Contract Period:
24 months

Principal Investigator (PI):
Ruihong Zhang, Ph.D.

Contract Amount:
$299,351

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:
The principal investigator has not done work under contract to the ARB in the past, but has extensive experience in the development of process-based emission models for agricultural-related operations.

Prior Research Division Funding to UCD:

Year	2005	2004	2003
Funding	$499,998	$457,660	$220,896

BUDGET SUMMARY

University of California, Davis

"Process-Based Farm Emission Model for Estimating Volatile Organic Compound Emissions from California Dairies"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 125,646	
2.	Subcontractors	$ 93,280	
3.	Equipment	$ 40,500[1]	
4.	Travel and Subsistence	$ 3,700	
5.	Electronic Data Processing	$ 800	
6.	Reproduction/Publication	$ 300	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 12,400	
9.	Analyses	$ 3,400	
10.	Miscellaneous	$ 2,000	
	Total Direct Costs		$282,026
INDIRECT COSTS			
1.	Overhead	$ 17,325	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$17,325
TOT0AL PROJECT COSTS			**$299,351**

[1] Equipment costs include: one thermal desorption unit for adding to the GC/MS for the gas sample analyses of VOCs, and one chemiluminescence ammonia analyzer for measuring ammonia concentrations in the air, and two incubators to provide controlled environment to do manure storage experiments.

Attachment 1

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: University of California, Berkeley

Description of subcontractor's responsibility: The subcontractor will analyze samples taken from the environmental chambers and bubbles. The analysis will be performed using the subcontractor's proton reaction transfer mass spectrometer. The contractor has developed substantial expertise in the analysis of samples with this instrument.

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	72,631	
2.	Subcontractors	$	0	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	3,000	
5.	Electronic Data Processing	$	0	
6.	Reproduction/Publication	$	0	
7.	Mail and Phone	$	0	
8.	Supplies	$	6,000	
9.	Analyses	$	0	
10.	Miscellaneous	$	3,169	
	Total Direct Costs			$84,800
INDIRECT COSTS				
1.	Overhead	$	8,480	
2.	General and Administrative Expenses	$	0	
3.	Other Indirect Costs	$	0	
4.	Fee or Profit	$	0	
	Total Indirect Costs			$8,480
TOTAL PROJECT COSTS				**$93,280**