



STATE OF CALIFORNIA  
**STANDARD AGREEMENT**  
 STD 213 (Rev 06/03)

AGREEMENT NUMBER <b>08-416</b>
REGISTRATION NUMBER

1. This Agreement is entered into between the State Agency and the Contractor named below:

STATE AGENCY'S NAME

Air Resources Board (ARB, CARB, State)

CONTRACTOR'S NAME

California State University, Fullerton, Auxiliary Services Corporation (CSU Fullerton, CSU, or Contractor)

2. The term of this Agreement is: June 30, 2009 through December 31, 2010

3. The maximum amount of this Agreement is: \$50,000.00  
 Fifty Thousand Dollars and No Cents

4. The parties agree to comply with the terms and conditions of the following exhibits which are by this reference made a part of the Agreement.

Exhibit A – Scope of Work	1 page
Exhibit A, Attachment 1 - Proposal	9 pages
Exhibit B – Budget Detail and Payment Provisions	2 pages
Exhibit B, Attachment 1 – Detailed Budget	1 page
Exhibit C* – General Terms and Conditions	<del>GTC 307 - CIA 101</del>
Exhibit D – Special Terms and Conditions	1 page
Exhibit E – Additional Provisions	3 pages
Exhibit F – Contract Report Format Guidelines	6 pages



Items shown with an Asterisk (\*), are hereby incorporated by reference and made part of this agreement as if attached hereto.

These documents can be viewed at [www.ols.dgs.ca.gov/Standard+Language](http://www.ols.dgs.ca.gov/Standard+Language)

IN WITNESS WHEREOF, this Agreement has been executed by the parties hereto.

<b>CONTRACTOR</b>		California Department of General Services Use Only.
CONTRACTOR'S NAME (if other than an individual, state whether a corporation, partnership, etc.) California State University, Fullerton, Auxiliary Services Corporation		
BY (Authorized Signature) <i>William M. Dickerson</i>	DATE SIGNED (Do not type) 8/25/09	
PRINTED NAME AND TITLE OF PERSON SIGNING William M. Dickerson, Executive Director		
ADDRESS 2600 Nutwood Avenue, Ste., 275 Fullerton, CA 92831		
<b>STATE OF CALIFORNIA</b>		
AGENCY NAME Air Resources Board		
BY (Authorized Signature) <i>Sharon Simmons</i>	DATE SIGNED (Do not type) AUG 26 2009	
PRINTED NAME AND TITLE OF PERSON SIGNING Sharon Simmons, Manager, Contract Services Section		
ADDRESS 1001 I Street, 20 <sup>th</sup> Floor, Sacramento, CA 95814		

Exempt per: SCM 4.04 5(a)

**EXHIBIT A**

**Background**

1. The California State University, Fullerton (CSU or Contractor) agrees to provide the following services for the project entitled "Methane Emissions from the California Crude Oil Operations", which is attached hereto as Attachment 1 and made a part of this Agreement.
2. The project representatives during the term of this agreement will be:

<b>Requesting Agency: ARB</b>	<b>Providing Agency: California State University, Fullerton</b>
Division: Stationary Source Division	Division: Civil and Environmental Engineering
Contact: Joseph Fischer	Contact: Jeff Kuo, Ph.D., P.E.
Address: 1001 I Street, Floor 6 Sacramento, CA 95812	Address: 800 N. State College Blvd. Fullerton, CA 92834
Phone: (916) 445-0071	Phone: (657) 278-3995
Fax: (916) 322-2444	Fax: (657) 278-3995
Email: jofische@arb.ca.gov	Email: jkuo@fullerton.edu

The ARB Contract Administrator is:

The University's Contract Administrator is:

<b>Requesting Agency: ARB</b>	<b>Providing Agency: California State University, Fullerton</b>
Division: Administration Services	Division: Office of Sponsored Programs
Contact: Sue Bayoneta	Contact: Shou-Yinn Cheng
Address: 1001 I Street, Floor 20 Sacramento, CA 95812	Address: 2600 Nutwood Avenue, Ste. 275 Fullerton, CA 92831
Phone: (916) 327-8215	Phone: (657) 278-4103
Fax: (916) 327-2940	Fax: (657) 278-1403
Email: sbayonet@arb.ca.gov	Email: pcheng@fullerton.edu

**EXHIBIT A  
ATTACHMENT 1**

**Methane Emissions from the California Crude Oil Operations – A Proposal**

**Applicant Organization:** *CSU Fullerton Auxiliary Services Corporation  
(fiscal and administrative agent of California State  
University Fullerton)*

**Address:** *2600 E. Nutwood Avenue, Suite 275, Fullerton, CA 92831*

**Performing Organization:** *California State University Fullerton*

**Technical Contact Person:** *Jeff Kuo, Ph.D., P.E.*

*Professor, Dept. of Civil & Environmental Engineering,  
California State University, Fullerton  
800 N. State College Blvd., Fullerton, CA 92834*

**Phone Number:** *(657) 278-3995*  
**Fax Number:** *(657) 278-3995*  
**Email Address:** *jkuo@fullerton.edu*

**Administrative Contact:** *Paulina Tagle  
(for this proposal) Asst. Director, Office of Grants and Contracts*

*California State University, Fullerton  
800 N. State College Blvd., Fullerton, CA 92831*

**Phone Number:** *(657) 278-7679*  
**Fax Number:** *(657) 278-3000*  
**Email Address:** *ptagle@fullerton.edu*

**I. Background**

The California crude oil system is comprised of operations and facilities that extract, process, store, and transport crude oil to refineries. These operations involve the use of various types of oil handling equipment. Over the past ten years there has been a growing need to understand emissions of fugitive methane. Having current, reliable emission factors is one key component of this effort. One of the most recently published documents used to estimate fugitive emissions is the 2004 American Petroleum Institute Compendium of Greenhouse Gas Methodologies for the Oil and Gas Industry (API, 2004). However, the emission factors contained in the compendium were obtained from a 1996 study and original data is no longer available (GRI/EPA 1996). In addition, some sources of emissions were not included in the original study while others may not be applicable to California operations due to regional differences and state or local environmental requirements.

The California Global Warming Solutions Act of 2006 (AB32) establishes a comprehensive program of regulatory and market based mechanisms to achieve real, cost-effective, and quantifiable reductions of greenhouse gases (GHG). AB32 charges the Air Resources Board (ARB) as the agency responsible for monitoring and regulating many GHG emission sources to reduce state GHG emissions to 1990 levels by 2020.

The Air Resources Board has awarded a test contract to a research team, led by Dr. Jeff Kuo of Department of Civil and Environmental Engineering, California State University, Fullerton (CSUF) to conduct sample gathering and emission testing at crude oil facilities in California. This proposal is submitted for ARB's consideration and was prepared in accordance with the ARB's draft Test Plan – Methane Emissions from California Crude Oil Operations (ARB, 2009).

This project requires gathering a minimum of 30 liquid samples for laboratory flash analysis and measuring fugitive methane emission rates using a Hi-Flow Sampler from certain components

Table 1. Priority List of Emission Sources for Testing

<u>Crude Oil Industry Segment</u>	<u>Emissions Sources</u>
Production, Processing, and Storage	Crude Oil Separators
	Crude Oil Storage Tanks
	Well Heads
	Well Cellars
	Drilling Equipment / Operations

such as crude oil well heads. A priority list of sources for testing is shown in Table 1.

## ***II. Objectives of the Project***

The objective of this proposed project is to gather fugitive emission information from crude oil systems in order to improve the California GHG emissions inventory estimates. The results will be used to support regulatory programs that achieve effective emission reductions from crude oil operations, and, consequently, minimize adverse environmental impacts from these potential emissions sources.

## **III. Proposed Approach and Tasks**

This project requires the contractor to conduct in-field sample gathering and fugitive methane testing at crude oil production, processing, and storage facilities. Report writing and data analysis are required to describe test conditions, sample data, and analysis performed on the collected information. The contractor is also required to submit quarterly progress reports and a final report that includes recommendations using the California Energy Commission PIER formatting guidelines. The requirements of the contractor are to:

1. Provide assistance in finalizing the test protocol and the test program
2. Assemble source-test teams
3. Conduct testing at selected facilities (ARB to provide guidance/assistance)
4. Data analysis
5. Project management and report preparation

### **Task 1 – Provide Assistance in Finalizing the Test Protocol and Test Program**

This test plan requires various types of in-field source testing to be conducted at crude oil facilities and operations in California. The testing methodologies and sample gathering procedures required for this test plan are contained in three different test protocols:

- Gas Processors Association: Obtaining Liquid Hydrocarbon Samples for Analysis by Gas Chromatography (flash analysis).
- A Hi-Flow Sampler protocol used to acquire methane concentration and flow rate.
- EPA Method TO-15 to acquire gaseous headspace samples from storage tanks, separators, or similar equipment using an evacuated stainless-steel (SUMMA) canister.

Throughout the test period, additional protocols may be added to this test plan or the above mentioned protocols may require modification. To estimate the accuracy of this testing, the ARB or the CSUF team may suggest alternative testing strategies or protocols to address deficiencies or expand upon the suggested testing methodologies.

### **Task 2 – Assemble Source-Test Teams**

This project requires field activities to be conducted within a relatively short timeframe. Ideally, a two-member team would be preferable. Member 1 would conduct components counts, record information, perform daily log and Member 2 would measure and record emission rates using a Hi-Flow Sampler or gather liquid or gaseous samples for laboratory analysis. The team members will be composed of CSUF students from the Civil and Environmental Engineering Department. The students will receive sufficient training in the operation of the methane-measuring instrument and in health and safety.

Although only two team members will go out to a test site at a given time, the test team will actually consist of four student members. Inclusion of extra student members as backup will make scheduling of field tests more flexible. In addition, this approach also provides learning opportunities to more students who can gain practical experiences of source testing and prepare them better for job markets. The list and background of the selected students will be provided to the ARB later.

### **Task 3 – Conduct Source Tests**

This project requires sample data to be collected from various crude oil operations and facilities in California. We anticipate a need to conduct testing or sampling at 10 facilities, with the majority of these facilities located in southern California and the Bakersfield region.

The source tests will be conducted in two phases: the early-stage sampling phase and the intensive sampling phase. The Early-Stage Sampling Plan for this project calls for gathering no more than 10 liquid samples while concurrently gathering Hi-Flow Sampler data from selected, representative crude oil facilities. It is anticipated that the Early Stage Sampling Plan can be completed after collecting data from no more than four representative facilities in Southern California.

The data collected will be used to conduct an interim assessment where the ARB and the CSUF team will evaluate the data gathered and use the information to improve or modify this test plan and modify or refine the final Sample Plan.

An interim assessment will be performed immediately following the Early-Stage Sampling Plan. The interim assessment is designed to address the following questions:

- Are the measurement quality objectives for accuracy and precision being met?
- Are additional measurement methods or test protocols needed?
- How well does the equipment tested represent the California equipment population?
- Do the sampling objectives appear attainable?

During the interim assessment, the CSUF team will submit data, provide a summary of work conducted, and provide recommendations for further testing. These recommendations will include modifications to the test protocols or may include additional protocols that address required testing necessities. After the interim assessment is completed, the CSUF team may then proceed with the final Sampling Plan.

This sampling plan calls for sampling, testing, and recording information from crude oil facilities that are representative California operations. A list of example equipment was discussed previously in Section 1. Different sources may require different sample-gathering techniques depending upon the type of operation and equipment characteristics. The CSUF team will record the information on standardized data sheets to be included when raw data is submitted to ARB.

The total number of facilities required for this test plan may depend on the amount of time and available funding for this project. If the number of required facilities or samples anticipated for this study exceeds budget or time constraints, this plan may have to be modified to ensure that priority data are collected first. Therefore, the CSUF team will have to provide continuous feedback and supply raw data as it is gathered and analyzed.

The total number of facilities required for this plan is not expected to exceed 10 facilities. However, the test teams will be continuously acquiring data so this number could change throughout the test period. There are two major components to this test plan; liquid sample gathering and Hi-Flow Sampler measuring. A third, but not critical component of this study would be to gather gaseous headspace samples for speciation. An outline of the prioritized sampling plan is shown below in Table 2.

Table 2. Prioritized Sampling Plan

<b><u>Liquid Flash-Sample Gathering</u></b>	<b><u>Hi-Flow Sampler Testing</u></b>
Heavy Crude (10 samples)	Well Heads (all API ranges)
Medium Crude (10 samples)	Well Cellars, Sumps, Pits
Light Crude (10 samples)	Separators & Storage Tanks
Waste Water Tanks (1 sample)	Control Valves, Fittings, Other

The representativeness of the data collected with respect to region will be assessed by comparing characteristics with statewide survey results. Regardless of the amount of data collected, stratification across the population will be a requirement of this plan. A Classification and Regression Tree (CART) or similar analysis may be used to perform the analysis. CART is a statistical procedure for splitting data into smaller groups based on independent variables.

As part of this plan, a CART or similar analysis will be used to create subgroups within the population based on special characteristics (e.g., region, sample results) and average emission rates will be calculated for each subgroup or category. For previous studies in California, population regions were broken down by the Los Angeles basin and the remainder of California. This study may require additional stratification based on the data obtained.

The objective of this study is to gather sample data and information used for estimating fugitive emissions from California crude oil operations. Similar to previous studies, the output is intended to represent typical or average emission rates. Desired outcomes include a better understanding of the quantities of emissions in California and a better understanding of opportunities for potential emission reductions. The objective of this project will be met if the resulting average emissions rates are representative of California operations. Specific quality objectives of data gathering for this study include:

- **Accuracy** – when the Hi-Flow Sampler is calibrated and operated according to the manufacturer's specifications, leak rate determinations must be accurate to within  $\pm 10\%$  of the reading. Laboratory analysis must comply with the minimum specifications included in the attached test protocols
- **Precision** – Hi-Flow measurement precision shall be within 10% and laboratory analysis must comply with the minimum specifications included in the attached test protocols.
- **Representativeness** – measurements and samples must be collected from a mix of equipment and conditions that are reflective of California crude oil operations.
- **Comparability** – all data should be collected and reported using accepted protocols and terminology.
- **Completeness** – the number of collected samples and data should be sufficient enough to fulfill the goals of this study and accurately reflect crude oil operations thereby minimizing uncertainties.

The CSUF team, in conjunction with the ARB, will develop standard data collection forms to be used for collecting data at each facility. The forms will include the following minimum required information:

- Facility identifier (location, contact information, facility type)
- List of components tested or sampled
- General characteristics of equipment tested or sampled

- Type and count of components
- Individual component leak rates if measured using the Hi-Flow Sampler
- A spreadsheet containing the Hi-Flow Sampler output data.
- Digital photographs or drawings to understand testing conditions

In addition to the above-mentioned records, the CSUF team will also supply copies of field notes, quality control data, and instrument calibration records from individual facilities tested or sampled.

Sample gathering and testing will be performed within privately owned facilities. Chain of custody procedures are applicable to retain and protect individual company confidentiality requirements as outlined by ARB in accordance with Title 17, California Code of Regulations, section 91000 to 91022 and the California Public Records Act (Government Code section 6250 et seq.). All data collected is to be protected as confidential and may only be shared between the contractor, the ARB, and individual facilities where the sample data is collected.

#### **Task 4 – Data Analysis**

The source test team will transmit electronic data files back to the data analysis team upon conclusion of source testing at each facility. The data analysis team will promptly analyze the test results. There is also a QA/QC team designated for quality check of data acquisition and analysis. The results will then be given to the report preparation team to produce the source test report. This procedure will speed up the report preparation process and will make it less prone to errors because the data will be reviewed by at least four individuals. All the teams will work directly under the supervision of the PI. The PI will do the final review before the draft is submitted to the ARB.

#### **Task 5 – Project Management and Reports**

Efficient and plentiful communication between the ARB manager and the CSUF team is a pivotal factor in the success of this project. In addition to phone conference and emails, after each facility is sampled or tested, a report will be prepared by the CSUF team and sent to the ARB to monitor progress and make adjustments to the sampling plan. In addition to individual test reports, quarterly reports are required to monitor overall project status. The summation of the individual and quarterly reports will be used by the CSUF team to develop an overall final report with recommendations. A draft final report, describing recommendations for further testing and potential options to reduce fugitive emissions from the crude oil operations, will be submitted to ARB within 45 days of the last source test's completion. A final report will be submitted within 30 days after receiving the comments and suggestions from ARB; all the comments will be incorporated in the final report. A kick-off meeting and one additional meeting are planned between the ARB and the CSUF team.

#### **IV. Schedule**

June 2009: Contract begins

July 2009: Early-Stage Sampling Plan  
August – November 2009: Sampling Plan  
January 2010: Final Report

## V. Qualifications of the CSUF Team

The main task of this project is to conduct emissions sampling and testing at California crude facilities. A well-qualified CSUF team has been assembled and ready to work on this project.

To make this project successful, the key project personnel should have a wealth of training, knowledge, and work experiences in the fields of petroleum, chemical, mechanical, and environmental engineering. The PI of this project, Dr. Jeff Kuo, has a relatively diverse engineering background that covers these four engineering fields. He was originally trained as a process engineer, preparing him well for this project because many aspects of this project are process-oriented. He received a B.S. degree in Chemical Engineering from National Taiwan University, an M.S. degree in Chemical Engineering from the University of Wyoming, and an M.S. in Petroleum Engineering and both an M.S. and a Ph.D. in Environmental Engineering from University of Southern California. He is a registered engineer in California in three different disciplines: civil, mechanical, and chemical engineering.

Dr. Kuo worked in engineering industries for over ten years before joining the Department of Civil and Environmental Engineering at California State University, Fullerton in 1995. His specific experiences relevant to this project include the following (more details about his educational background, work experiences, and research interests can be found at <http://faculty.fullerton.edu/jkuo>):

- **Source Testing and Emission Factors.** He served as the principal project engineer for emission factors of a 2.5-million-dollar project, titled *Pooled Emission Estimation Program* for POTWs in California (to assist wastewater treatment plants in compliance with AB 2588)
  - Leong, L.; Regan, M.; Kuo, J.F.; Wong, E. (1992) "An Overview of the Pooled Emission Estimation Program for POTWs", *Environ. Prog.* V. 11(4), p. 278-287.
- **Fugitive Emissions.** He served in the ASTM Gasket Committee. He also conducted studies and presented several technical papers with regards to gasket tightness and fugitive emissions.
  - Kuo, J.F.; Miskell, C. (1998) "Insights of the New PVRC Gasket Constants", *Proc. 1998 Technical Symposium of the Fluid Sealing Association - Global Sealing Challenges of the 21<sup>st</sup> Century*, April 26-28, Sheraton Music City, Nashville, TN.
  - Kuo, J.F.; J. Chen; Miskell, C. (1997) "Selection of Gasket Tightness to Meet Fugitive Emission Leak Definitions", *Proc. Emission Inventory: Planning for the Future*, Air & Waste Management Assoc., Oct. 28-30, Research Triangle Park, NC.
- **Air Permitting.** He applied for permits and installed several air strippers, thermal oxidizers, activated carbon absorbers, and one flare in California.
- **ARB Experience.** He recently completed an ARB-funded project, *Clearinghouse of Technological Options for Reducing Non-CO<sub>2</sub> GHG Emissions from All Sectors*.
- **Report Preparation.** He has recently completed several technical reports.

- **Kuo, J.** (2008) "Clearinghouse of Technological Options for Reducing Anthropogenic Non-CO<sub>2</sub> Greenhouse Gases Emissions from All Sectors", State of California Air Resources Board, Contract No. CARB 05-328 (384 pages) <http://www.arb.ca.gov/cc/non-co2-clearinghouse/non-co2-clearinghouse.htm>.
- **Kuo, J.** (2008) "Energy Recovery and Emission Reduction of Landfill as in China", United States EPA, Contract No. XA-83362001 (191 pages).
- Leong, L.; **Kuo, J.**; Tang, C.-C. (2008) "Disinfection of Wastewater Effluent – Comparison of Alternative Technologies", Water Environment Federation, Contract No. 04-HHE-4, Alexandria, VA (329 pages).
- **Project Management.** His combined work experiences in an industrial and academic setting prepare him well for managing project of this nature. Under the guidance of the ARB, he will assume the full responsibility of managing the CSUF team himself and has direct communications/contacts with other constituents of the team (not through post-doc or research associates). He is easily reachable and will work closely with the ARB project manager on this project in a cooperative manner.

The PI will be greatly assisted by other key members of the CSUF team. Heath Consultants and Energy Environmental Solutions (EES), a small local source test company, will serve as consultants and provide technical guidance and assistance in sampling when needed. Mr. Curtis Plotkin (MS in Contaminant Hydrogeology), an environmental compliance manager at CSUF, has over twenty years of experience working in the environmental industry, including many refineries in California. He has experience developing and presenting training ranging from Hazard Communication to refinery safety training. Mr. Plotkin's principal responsibility during this project is to provide training with respect to the applicable aspects of CFR 29, 1910.119, Process Safety Management training to the students, allowing them to work safely in crude oil production sites. When needed, the PI will also seek assistance from other CSUF faculty members for assistance, such as gas sample analysis.

There are also four task groups: source testing, data analysis, report preparation, and QA/QC. The members of these four groups are mainly composed of students of the Civil and Environmental Engineering Department. Ms. Dolores Kimball (BS in Business Administration), an Administrative Support at CSUF and a commendable report writer, will assist the PI in source testing and report preparation, respectively.

## **VI. Preliminary Budget**

Since the number of facilities and components to be tested has not been finalized, a precise cost estimate is not feasible at preparation of this proposal. A preliminary cost estimate is shown in the table below, and the assumptions for the estimate follow.

<b>Item</b>	<b><i>Cost Estimate</i></b>
Personnel (PI, students, and support staff)	\$18,297
Travel	\$2,800
Outside laboratory analysis	\$22,400
Office expenses	\$57
Indirect cost	\$6,446
<b>Total:</b>	<b>\$50,000</b>

**Personnel cost.** It is estimated that a total of 450 student work hours will be needed to conduct testing and provide assistance in data analysis, report preparation, and QA/QC. The student will be compensated at \$18/hour, including fringe benefits. So the estimated student labor cost for this project is \$8,100. The maximum overload payment to Dolores Kimball will be \$1,000, including fringe benefits. The PI, Jeff Kuo plans to devote 10% summer 2009, 10% winter 2009, and 5% overload of 2009-2010 academic year on this project. The total personnel cost, including the fringe benefit, is \$18,297.

**Travel.** The estimated travel cost to the test sites is \$2,800. The travel cost for PI to meet the ARB project manager at Sacramento will be covered in this estimate.

**Others.** \$22,400 is budgeted for outside laboratory analysis (including shipping, waste disposal, parts for sampling devices, and other miscellaneous items); \$56 for other expenses (reproduction); and \$6,446 is requested for indirect costs (14.8% of the direct cost).

## **VII. References**

- ARB (2009). Test Plan and Protocol – Methane Emissions from California Crude Oil Operations (draft), California Air Resources Board, May 23, 2009.

## EXHIBIT B

### **BUDGET DETAIL AND PAYMENT PROVISIONS**

#### **1. Invoicing**

- A. For services satisfactorily rendered in accordance with this Agreement and upon receipt and approval of the invoices which properly detail all charges the ARB agrees to compensate the California State University, Fullerton, for actual expenditures incurred in accordance with the rates specified in Exhibit B, Attachment 1, attached hereto.
- B. Invoices shall include the Agreement Number and shall be submitted in triplicate not more frequently than quarterly in arrears to:

Air Resources Board  
Accounting Section  
P.O. Box 2815  
Sacramento, CA 95812

- C. BUDGET FLEXIBILITY: Subject to the prior review and approval of the contract manager, line items shifts of up to \$25,000 or ten percent of the annual contract total, whichever is less, may be made up to a cumulative maximum of \$25,000 or 10%, whichever is less, for all line item shifts over the life of the contract. There must be a substantial business justification for any shifts made. Fund shifts which increase Indirect, Overhead or General Expense line items are prohibited. Line item shifts may be proposed/requested by either the State or the University in writing and must not increase or decrease the total contract amount allocated. Any line item shifts must be approved in writing by the Division Chief of Stationary Source Division, or his or her designee, and must be sent to Contracts Section within 10 days of approval for inclusion in contract folder. If the contract is formally amended, any line item shifts agreed to by the parties must be included in the amendment.

#### **2. Budget Contingency Clause**

- A. It is mutually agreed that if the Budget Act of the current year and/or any subsequent years covered under this Agreement does not appropriate sufficient funds for the program, this Agreement shall be of no further force and effect. In this event, the State shall have no liability to pay any funds whatsoever to Contractor or to furnish any other considerations under this Agreement and Contractor shall not be obligated to perform any provisions of this Agreement.
- B. If funding for any fiscal year is reduced or deleted by the Budget Act for purposes of this program, the State shall have the option to either cancel this Agreement with no liability occurring to the State, or offer an agreement amendment to Contractor to reflect the reduced amount.

## EXHIBIT B

### 3. Payment

- A. Costs for this Agreement shall be computed in accordance with State Administrative Manual Sections 8752 and 8752.1.
- B. Nothing herein contained shall preclude advance payments pursuant to Article 1, Chapter 3, Part 1, Division 3, Title 2 of the Government Code of the State of California.
- C. ARB shall withhold payment equal to ten percent of the total Agreement cost until completion of all work and submission to ARB by University of a final report (including computer diskette copy) approved in accordance with Exhibit F, by ARB. It is University's responsibility to submit an invoice in triplicate with the revised final report for ten percent withheld.
- D. University will be paid for the payment period completed upon receipt, by ARB, of an invoice and progress report satisfying the requirements of this Agreement. The invoice and progress report must be deemed by ARB to reflect reasonable work performed in accordance with the Agreement.
- E. The amount to be paid to University under this Agreement includes all sales and use taxes incurred pursuant to this Agreement. University shall not receive additional compensation for reimbursement of such taxes and shall not decrease work to compensate therefore.

**EXHIBIT B  
ATTACHMENT 1**

**BUDGET DETAIL**

<b>Item</b>	<b>Cost</b>
Personnel (PI, students, and support staff)	\$18,297
Travel	\$2,800
Outside laboratory analysis	\$22,400
Office expenses	\$57
Indirect cost	\$6,446
<b>Total:</b>	<b>\$50,000</b>

## EXHIBIT D

### SPECIAL TERMS AND CONDITIONS

#### 1. Termination

- A. This Agreement may be cancelled at any time by either party, upon thirty (30) days written notice to the other party.
- B. In the case of early termination, the performing agency will submit an invoice in triplicate and a report in triplicate covering services to termination date, following the invoice and progress report requirements of this Agreement. A copy and description of any data collected up to termination date will also be provided to ARB.
- C. Upon receipt of the invoice, progress report, and data, a final payment will be made to the performing agency. This payment shall be for all ARB-approved, actually incurred costs in accordance with Exhibits A and B, and shall include labor, and materials purchased or utilized (including all non-cancellable commitments) to termination date, and pro rata indirect costs as specified in the proposal budget.

#### 2. Disputes

- A. ARB reserves the right to issue an order to stop work in the event that a dispute should arise, or in the event that the ARB gives the performing agency a notice that this Agreement will be terminated. The stop-work order will be in effect until the dispute has been resolved or this Agreement has been terminated.
- B. Any dispute concerning a question of fact arising under the terms of this Agreement which is not disposed of within a reasonable period of time by agency employees normally responsible for the administration of this agreement, shall be brought to the attention of the Executive Officer or designated representative of each agency for joint resolution.

#### 3. Amendments

ARB reserves the right to amend this agreement for additional time and/or additional funding.

## EXHIBIT E

### ADDITIONAL PROVISIONS

#### 1. Reports and Data Compilations

- A. ***With respect to each invoice period, University shall forward to the ARB Contract Administrator, one (1) electronic copy of the progress report and mail one (1) copy of the progress report along with each invoice. (Do not use Express Mail). When emailing the progress report, the "subject line" should state the contract number and the billing period. Each progress report will begin with the following disclaimer:***

*The statements and conclusions in this report are those of the University and not necessarily those of the California Air Resources Board. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.*

- B. Each progress report will also include:
1. A brief narrative account of project tasks completed or partially completed since the last progress report;
  2. A brief discussion of problems encountered during the reporting period and how they were or are proposed to be resolved;
  3. A brief discussion of work planned, by project task, before the next progress report; and
  4. A graph or table showing allocation of the budget and amount used to date.
  5. A graph or table showing percent of work completion for each task.
- C. If the project is behind schedule, the progress report must contain an explanation of reasons and how the University plans to resume the schedule.
- D. Six months prior to Agreement termination date, University will deliver to ARB twenty (20) bound copies of a draft final report. The reports may be stapled or spiral bound, depending on size. The draft final report will conform to Exhibit F.
- E. Within forty-five (45) days of receipt of ARB's comments on the draft Final Report (Exhibit F), University will deliver to ARB's Contract Manager two (2) copies of the Final Report incorporating all reasonable alterations and additions requested by ARB. Upon approval of the amended final report approved by ARB in accordance to Exhibit F, University will within two (2) weeks, deliver to ARB two (2) camera ready UNBOUND originals of a Final Report incorporating all final

## EXHIBIT E

alterations and additions. The final report will conform to the Contract Final Report Format, Exhibit F.

- F. Together with the final report, University will deliver a copy of the report on diskette/CD, using any common word processing software (please specify the software used) and a set of all data compilations as specified by the ARB Contract Manager.
- G. University's obligation under this Agreement shall be deemed discharged only upon submittal to ARB of an acceptable final report in accordance to Exhibit F, report diskette/CD, all required data compilations, and any other project deliverables.
- H. Prior to completion of this Agreement, University shall be entitled to release or make available reports, information, or other data prepared or assembled by it pursuant to this Agreement, in scientific journals and other publications and at scientific meetings, provided however, that a copy of the publication be submitted to ARB for review and comment 45 days prior to such publication. Further, University shall place the disclaimer statement in a conspicuous place on all such reports or publications. Health related reports should include an acknowledgment to the late Dr. Friedman. Nothing in this provision shall be construed to limit the right of State to release information obtained from the University or to publish reports, information, or data in State publications.

### 2. Copyrightable Materials

In recognition of the policy of ARB and University to promote and safeguard free and open inquiry by faculty, students and the members of the public and in furtherance of such policy, both parties agree to the following with respect to rights in data and copyrights under this Agreement:

- A. The term "Subject Data" shall mean all original and raw research data, notes, computer programs, writings, sound recordings, pictorial reproductions, drawings or other graphical representations, and works of any similar nature, produced by University in performance of this Agreement, but specifically excluding "Reports," as defined in this Agreement. Subject Data also excludes financial reports, cost analyses, and similar information incidental to contract administration.
- B. The term "Reports" shall have the meaning assigned to it in this Exhibit F of this Agreement.
- C. Ownership of all Subject Data and copyrights arising from Subject Data shall be vested in University while ownership of all Reports and copyrights arising from the Reports delivered under this Agreement shall be vested in ARB. University agrees to make available to the public for public benefit, to the extent the University shall have the legal right to do so, without license or fee, any scholarly articles which are published from the Subject Data.

## EXHIBIT E

- D. Nothing in this exhibit or Agreement shall be construed to limit the right of University faculty, students or staff to publish the Subject Data in the form of scholarly articles in academic journals nor to affect, abrogate or limit the right of University faculty, staff or students to make use of the Subject Data.

### 3. Travel & Per Diem

- A. Any reimbursement for necessary travel and per diem shall be at the University's approved travel rates.
- B. No foreign travel shall be reimbursed unless prior written authorization is obtained from ARB.

### 4. Meetings

- A. Initial meeting. Before work on the contract begins, the Principal Investigator and key personnel will meet with the ARB Contract Manager and other staff to discuss the overall plan, details of performing the tasks, the project schedule, items related to personnel or changes in personnel, and any issues that may need to be resolved before work can begin.
- B. Progress review meetings. The Principal Investigator and appropriate members of his or her staff will meet with ARB's Contract Manager at quarterly intervals to discuss the progress of the project. This meeting may be conducted by phone.
- C. Technical Seminar. The Contractor will present the results of the project to ARB staff and a possible webcast at a seminar at ARB facilities in Sacramento or El Monte.

### 5. Confidentiality

- A. It is understood that in the course of carrying out this Agreement, State may wish to provide University with proprietary or confidential information of State (Proprietary Information). University agrees to use its best efforts to hold proprietary information in confidence and shall return it to State upon the completion of the project.
- B. This obligation shall apply only to proprietary information that is designated or identified as such in writing by State prior to the disclosure thereof. All proprietary information shall be sent only to the Principal Investigator. Moreover, this obligation shall not apply to any proprietary information which: a) is or becomes publicly known through no wrongful or negligent act on the part of University; b) is already known to University at the time of disclosure; c) independently developed by University without breach of this agreement; or d) is generally disclosed to third parties by State without similar restrictions on such third parties.

## EXHIBIT F

### FINAL REPORT FORMAT

The research contract Final Report (Report) is as important to the contract as the research itself. The Report is a record of the project and its results, and is used in several ways. Therefore, the Report must be well organized and contain certain specific information. ARB reviews all draft Final Reports, paying special attention to the Abstract and Executive Summary. If the ARB finds that the Report does not fulfill the requirements stated in this Appendix, the document will not be approved for release, and final payment for the work completed may be withheld. This Appendix outlines the requirements that must be met when producing the Report.

*Note:* In partial fulfillment of the Final Report requirements, the Contractor shall submit a copy of the Report on a CD in PDF format and in a word-processing format, preferably in Word - Version 6.0 or later. This is in addition to the submission of any paper copies required. The diskette shall be clearly labeled with the contract title, ARB contract number, the words "Final Report", and the date the report was submitted.

*Legibility.* Each page of the approved Final Report must be legible and camera-ready.

*Binding.* The draft Report, including its appendices, must be either spiral bound or stapled, depending on size. The revised Report and its appendices should be spiral bound, except for two unbound, camera-ready originals.

*Cover.* Do not supply a cover for the Report. ARB will provide its standard cover.

*One-sided vs. two-sided.* To conserve paper, both the draft Report and the revised Report, except for the unbound camera-ready copies, should be printed on both sides of the page. The unbound camera-ready copies must be printed on only one side of the page.

*Title.* The title of the Report should exactly duplicate the title of the contract unless a change is approved in writing by the contract manager.

*Spacing.* In order to conserve paper, copying costs, and postage, please use single or one-line (1) spacing.

*Page size.* All pages should be of standard size (8 1/2" x 11") to allow for photo-reproduction.

*Large tables or figures.* Foldout or photo-reduced tables or figures are not acceptable because they cannot be readily reproduced. Large tables and figures should be presented on consecutive 8 1/2" x 11" pages, each page containing one portion of the larger chart.

*Color.* Color presentations are not acceptable; printing shall be black on white only.

*Corporate identification.* Do not include corporate identification on any page of the Final Report, except the title page.

*Unit notation.* Measurements in the Reports should be expressed in metric units. However, for the convenience of engineers and other scientists accustomed to using the British system,

## EXHIBIT F

values may be given in British units as well in parentheses after the value in metric units. The expression of measurements in both systems is especially encouraged for engineering reports.

*Section order.* The Report should contain the following sections, in the order listed below:

Title page  
Disclaimer  
Acknowledgment  
Table of Contents  
List of Figures  
List of Tables  
Abstract  
Executive Summary  
Body of Report  
References  
List of inventions reported and copyrighted materials produced  
Glossary of Terms, Abbreviations, and Symbols  
Appendices

*Page numbering.* Beginning with the body of the Report, pages shall be numbered consecutively beginning with "1", including all appendices and attachments. Pages preceding the body of the Report shall be numbered consecutively, in ascending order, with small Roman numerals.

*Title page.* The title page should include, at a minimum, the contract number, contract title, name of the principal investigator, contractor organization, date, and this statement: "Prepared for the California Air Resources Board and the California Environmental Protection Agency"

*Disclaimer.* A page dedicated to this statement must follow the Title Page:

The statements and conclusions in this Report are those of the contractor and not necessarily those of the California Air Resources Board. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.

*Acknowledgment.* Only this section should contain acknowledgments of key personnel and organizations who were associated with the project. The last paragraph of the acknowledgments must read as follows:

This Report was submitted in fulfillment of [ARB contract number and project title] by [contractor organization] under the [partial] sponsorship of the California Air Resources Board. Work was completed as of [date].

*Table of Contents.* This should list all the sections, chapters, and appendices, together with their page numbers. Check for completeness and correct reference to pages in the Report.

*List of Figures.* This list is optional if there are fewer than five illustrations.

*List of Tables.* This list is optional if there are fewer than five tables.

## EXHIBIT F

*Abstract.* The abstract should tell the reader, in nontechnical terms, the purpose and scope of the work undertaken, describe the work performed, and present the results obtained and conclusions. The purpose of the abstract is to provide the reader with useful information and a means of determining whether the complete document should be obtained for study. The length of the abstract should be no more than about 200 words. Only those concepts that are addressed in the executive summary should be included in the abstract.

Example of an abstract:

A recently developed ground-based instrument, employing light detecting and ranging (lidar) technology, was evaluated and found to accurately measure ozone concentrations at altitudes of up to 3,000 meters. The novel approach used in this study provides true vertical distributions of ozone concentrations aloft and better temporal coverage of these distributions than other, more common methods, such as those using aircraft and ozonesonde (balloon) techniques. The ozone and aerosol measurements from this study, in conjunction with temperature and wind measurements, will provide a better characterization of atmospheric conditions aloft and the processes involved in the formation of unhealthy ozone concentrations than can be achieved with traditional ground-based monitors.

*Executive Summary.* The function of the executive summary is to inform the reader about the important aspects of the work that was done, permitting the reader to understand the research without reading the entire Report. It should state the objectives of the research and briefly describe the experimental methodology[ies] used, results, conclusions, and recommendations for further study. All of the concepts brought out in the abstract should be expanded upon in the Executive Summary. Conversely, the Executive Summary should not contain concepts that are not expanded upon in the body of the Report.

The Executive Summary will be used in several applications as written; therefore, please observe the style considerations discussed below.

Limit the Executive Summary to two pages, single spaced.

Use narrative form. Use a style and vocabulary level comparable to that in *Scientific American* or the *New York Times*.

Do not list contract tasks in lieu of discussing the methodology.

Discuss the results rather than listing them.

Avoid jargon.

Define technical terms.

Use passive voice if active voice is awkward.

Avoid the temptation to lump separate topics together in one sentence to cut down on length.

## EXHIBIT F

The Executive Summary should contain four sections: Background, Methods, Results, and Conclusions, described below:

**THE BACKGROUND SECTION.** For the Background, provide a one-paragraph discussion of the reasons the research was needed. Relate the research to the Board's regulatory functions, such as establishing ambient air quality standards for the protection of human health, crops, and ecosystems; the improvement and updating of emissions inventories; and the development of air pollution control strategies.

**THE METHODS SECTION.** At the beginning of the Methods section, state what was done in general, in one or two sentences.

The methodology should be described in general, nontechnical terms, unless the purpose of the research was to develop a new methodology or demonstrate a new apparatus or technique. Even in those cases, technical aspects of the methodology should be kept to the minimum necessary for understanding the project. Use terminology with which the reader is likely to be familiar. If it is necessary to use

technical terms, define them. Details, such as names of manufacturers and statistical analysis techniques, should be omitted.

Specify when and where the study was performed, if it is important in interpreting the results.

The findings should not be mentioned in the Methods section.

**THE RESULTS SECTION.** The Results section should be a single paragraph in which the main findings are cited and their significance briefly discussed. The results should be presented as a narrative, not a list. This section must include a discussion of the implications of the work for the Board's relevant regulatory programs.

**THE CONCLUSIONS SECTION.** The Conclusions section should be a single short paragraph in which the results are related to the background, objectives, and methods. Again, this should be presented as a narrative rather than a list. Include a short discussion of recommendations for further study, adhering to the guidelines for the Recommendations section in the body of the Report.

*Body of Report.* The body of the Report should contain the details of the research, divided into the following sections:

*Introduction.* Clearly identify the scope and purpose of the project. Provide a general background of the project. Explicitly state the assumptions of the study.

Clearly describe the hypothesis or problem the research was designed to address. Discuss previous related work and provide a brief review of the relevant literature on the topic.

*Materials and Methods.* Describe the various phases of the project, the theoretical approach to the solution of the problem being addressed, and limitations to the work. Describe the design and construction phases of the project, materials, equipment, instrumentation, and

## EXHIBIT F

methodology. Describe quality assurance and quality control procedures used. Describe the experimental or evaluation phase of the project.

*Results.* Present the results in an orderly and coherent sequence. Describe statistical procedures used and their assumptions. Discuss information presented in tables, figures and graphs. The titles and heading of tables, graphs, and figures, should be understandable without reference to the text. Include all necessary explanatory footnotes. Clearly indicate the measurement units used.

*Discussion.* Interpret the data in the context of the original hypothesis or problem. Does the data support the hypothesis or provide solutions to the research problem? If appropriate, discuss how the results compare to data from similar or related studies. What are the implications of the findings? Identify innovations or development of new techniques or processes. If appropriate, discuss cost projections and economic analyses.

*Summary and Conclusions.* This is the most important part of the Report because it is the section that will probably be read most frequently. This section should begin with a clear, concise statement of what, why, and how the project was done. Major results and conclusions of the study should then be presented, using clear, concise statements. Make sure the conclusions reached are fully supported by the results of the study. Do not overstate or overinterpret the results. It may be useful to itemize primary results and conclusions. A simple table or graph may be used to illustrate.

*Recommendations.* Use clear, concise statements to recommend (if appropriate) future research that is a reasonable progression of the study and can be supported by the results and discussion.

*References.* Use a consistent style to fully cite work referenced throughout the Report and references to closely related work, background material, and publications that offer additional information on aspects of the work. Please list these together in a separate section, following the body of the Report. If the Report is lengthy, you may list the references at the end of each chapter.

*List of inventions reported and publications produced.* If any inventions have been reported, or publications or pending publications have been produced as a result of the project, the titles, authors, journals or magazines, and identifying numbers that will assist in locating such information should be included in this section.

*Glossary of terms, abbreviations, and symbols.* When more than five of these items are used in the text of the Report, prepare a complete listing with explanations and definitions. It is expected that every abbreviation and symbol will be written out at its first appearance in the Report, with the abbreviation or symbol following in parentheses [i.e., carbon dioxide (CO<sub>2</sub>)]. Symbols listed in table and figure legends need not be listed in the Glossary.

*Appendices.* Related or additional material that is too bulky or detailed to include within the discussion portion of the Report shall be placed in appendices. If a Report has only one appendix, it should be entitled "APPENDIX". If a Report has more than one appendix, each should be designated with a capital letter (APPENDIX A, APPENDIX B). If the appendices are too large for inclusion in the Report, they should be collated, following the binding requirements

## EXHIBIT F

for the Report, as a separate document. The contract manager will determine whether appendices are to be included in the Report or treated separately. Page numbers of appendices included in the Report should continue the page numbering of the Report body. Pages of separated appendices should be numbered consecutively, beginning at "1".