

**GRANT REQUEST FORM (GRF)**

CEC-270 (Revised 02/13)

CALIFORNIA ENERGY COMMISSION

New Agreement PIR-14-012 (To be completed by CGL Office)

Division	Agreement Manager:	MS-	Phone
ERDD	Pilar Magana	43	916-327-2216

Recipient's Legal Name	Federal ID Number
Olson-Ecologic Engine Testing Laboratories, LLC	95-4850695

Title of Project
Research of Advanced Spark Ignited Prechambers Utilizing Turbulent Jet Ignition

Term and Amount	Start Date	End Date	Amount
	6/1/2015	12/31/2017	\$ 750,000

**Business Meeting Information**
 ARFVTP agreements under \$75K delegated to Executive Director.

Proposed Business Meeting Date	4/8/2015	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
Business Meeting Presenter	Pilar Magana	Time Needed: 5 minutes	

Please select one list serve. Select

**Agenda Item Subject and Description**

OLSON ECOLOGIC. Proposed resolution approving Agreement PIR-14-012 with Olson Ecologic, LLC for a \$750,000 grant to advance development of Jet Ignition prechambers in a natural gas fueled engine suitable for on-road heavy-duty vehicles. (PIER natural gas)

**California Environmental Quality Act (CEQA) Compliance**

1. Is Agreement considered a "Project" under CEQA?  
 Yes (skip to question 2)  No (complete the following (PRC 21065 and 14 CCR 15378)):  
 Explain why Agreement is not considered a "Project":  
 Agreement will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because
2. If Agreement is considered a "Project" under CEQA:  
 a) Agreement **IS** exempt. (Attach draft NOE)  
 Statutory Exemption. List PRC and/or CCR section number: \_\_\_\_\_  
 Categorical Exemption. List CCR section number: \_\_\_\_\_  
 Common Sense Exemption. 14 CCR 15061 (b) (3)  
 Explain reason why Agreement is exempt under the above section:  
 The activity is covered by the general rule that CEQA applies only to projects which have the potential for causing a significant effect on the environment. Where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA.
- b) Agreement **IS NOT** exempt. (Consult with the legal office to determine next steps.)  
 Check all that apply
- |   |   |
|---|---|
| <input type="checkbox"/> Initial Study                  | <input type="checkbox"/> Environmental Impact Report            |
| <input type="checkbox"/> Negative Declaration           | <input type="checkbox"/> Statement of Overriding Considerations |
| <input type="checkbox"/> Mitigated Negative Declaration |   |

**List all subcontractors (major and minor) and equipment vendors: (attach additional sheets as necessary)**

Legal Company Name:	Budget
Omnitek Engineering Corporation	\$ 20,000
Rail Propulsion Systems	\$ 60,000
Michigan State University	\$ 120,406

**List all key partners: (attach additional sheets as necessary)**

Legal Company Name:

**GRANT REQUEST FORM (GRF)**

CEC-270 (Revised 02/13)



Budget Information			
Funding Source	Funding Year of Appropriation	Budget List No.	Amount
NG Subaccount, PIERDD	13-14	501.001H	\$750,000
R&D Program Area:	EGRO: Transportation	TOTAL:	\$750,000
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

Recipient's Administrator/ Officer		Recipient's Project Manager	
Name:	Don Olson	Name:	Michael Naylor
Address:	1370 S ACACIA AVE	Address:	1370 S ACACIA AVE
City, State, Zip:	FULLERTON, CA 92831-5316	City, State, Zip:	FULLERTON, CA 92831-5316
Phone:	714-774-3385 /	Fax:	- -
E-Mail:	dro@ecologiclabs.com	E-Mail:	mnaylor@ecologiclabs.com

Selection Process Used	
<input checked="" type="checkbox"/> Competitive Solicitation	Solicitation #: PON-14-501
<input type="checkbox"/> First Come First Served Solicitation	

The following items should be attached to this GRF	
1. Exhibit A, Scope of Work	<input checked="" type="checkbox"/> Attached
2. Exhibit B, Budget Detail	<input checked="" type="checkbox"/> Attached
3. CEC 105, Questionnaire for Identifying Conflicts	<input checked="" type="checkbox"/> Attached
4. Recipient Resolution	<input checked="" type="checkbox"/> N/A <input type="checkbox"/> Attached
5. CEQA Documentation	<input checked="" type="checkbox"/> N/A <input type="checkbox"/> Attached

Agreement Manager \_\_\_\_\_

Date \_\_\_\_\_

Office Manager \_\_\_\_\_

Date \_\_\_\_\_

Deputy Director \_\_\_\_\_

Date \_\_\_\_\_

## EXHIBIT A Scope of Work

### A. Task List

Task #	CPR <sup>1</sup>	Task Name
1		General Project Tasks
2		Prechamber Design and Manufacture
3		Engine Acquisition, Engine Testing Support System Preparations
4		Preliminary Computational Fluid Dynamics (CFD) Analysis
5	X	First Phase Engine Testing
6		Detailed CFD and Combustion Analysis
7		Second Phase Engine Testing
8	X	Third Phase Engine Testing
9		Evaluation of Project Benefits
10		Technology/Knowledge Transfer Activities

### B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CFD	Computational Fluid Dynamics
CPR	Critical Project Review
EGR	Exhaust Gas Recirculation
FTP	Functional Threshold Power
MSU	Michigan State University
NOx	Nitrogen Oxide
OE	Olson-Ecologic Engine Testing Laboratories
RCM	Rapid Compression Machine
TAC	Technical Advisory Committee
TJI	Turbulent Jet Ignition
TWC	Three Way Catalyst

## I. PURPOSE OF AGREEMENT, PROBLEM/SOLUTION STATEMENT, AND GOALS AND OBJECTIVES

### A. Purpose of Agreement

The purpose of this Agreement is to fund advanced ignition development utilizing both fueled and unfueled Turbulent Jet Ignition (TJI) prechambers in a natural gas fueled engine suitable for on-road heavy-duty vehicles.

<sup>1</sup> Please see subtask 1.3 in Part II of the Scope of Work (General Project Tasks) for a description of Critical Project Review (CPR) Meetings.

# EXHIBIT A

## Scope of Work

### B. Problem/ Solution Statement

#### Problem

The very low fuel cost and efforts to reduce both criterial emissions and greenhouse gases are incentivizing the transition to natural gas as a transportation fuel in heavy-duty on-road applications. Basic conversion of an engine from diesel to natural gas typically results in a reduction of available power and thermal efficiency of over 30%. Operating at higher dilution levels will allow higher engine output and fuel efficiencies but also increases the demands on the ignition system. There is a limit to how dilute a mixture an open chamber spark ignition system can ignite and when operating at these limits, spark plug life is drastically reduced.

Over the past three years there has been a growing body of research and testing around turbulent jet ignition (TJI) systems, but the focus has all been on light-duty engines where the typical low fuel consumption has prevented the noticed improvements from adding enough value to overcome the added complexity and cost.

#### Solution

Olson EcoLogic and its subcontractors will develop advanced fueled and unfueled TJI prechambers for heavy-duty engines operating on natural gas. This will allow much higher levels of air/fuel dilution leading to both lower nitrogen oxides (NOx) emissions and higher thermal efficiencies. Unfueled prechambers operating with cooled exhaust gas recirculation (EGR) and a three way catalyst (TWC) should result in a heavy-duty engine achieving the 0.02 g/hp-hr NOx target at thermal efficiencies approaching the original diesel engine.

Michigan State University will perform detailed computational fluid dynamics (CFD) and Combustion analysis on both fueled and unfueled prechambers for natural gas fueled heavy-duty engines. This analysis will be combined with rigorous engine testing of several configurations of both the prechamber volume and nozzle geometries. By reconfiguring an existing heavy-duty engine test cell with external intake air boosting and controlled back pressure, the full range of lean burn and EGR dilution will be explored. After initial testing to optimize the prechambers, custom high compression pistons will be designed to further capture the benefits of TJI and further increase thermal efficiency.

### C. Goals and Objectives of the Agreement

#### Agreement Goals

The goals of this Agreement are to:

- Develop TJI prechambers that adequately ignite high intake air dilution ratios allowing very low NOx emissions at high engine efficiency for natural gas fueled heavy-duty engines
- Advance the state of the art technology in both fueled and unfueled Turbulent Jet Ignition (TJI) prechambers including exploration of hydrogen as a supplemental fuel and water injection as a way to increase power output

## **EXHIBIT A**

### **Scope of Work**

#### Ratepayer Benefits

The team envisions benefits that will assist the State in addressing California's air quality challenges. This technology is directed to the heavy-duty truck sector which is now dominated by diesel fueled vehicles. The technology will address the main goals of PON-14-501 and early market opportunities are envisioned. The engines will yield reductions in the two key diesel truck emission categories, NOx and Particulate Matter.

Technological Advancement and Breakthroughs This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by further promoting the conversion of heavy-duty on-road vehicles from diesel fuel to natural gas. By recovering a majority of the thermal efficiency lost in the effort to reduce NOx emissions, this increased thermal efficiency not only reduces the payback time for the conversion to natural gas, it also increases available power and extends the vehicle range, which has been a significant impediment to industry transition to these systems.

#### Agreement Objectives

The Team's objectives are:

- To demonstrate functionality and durability of high energy low NOx natural gas engines
- Demonstrate that the NOx emission will approach 0.02 grams per brake-horsepower-hour (bhp-hr)
- Bring to market by 2020 an economical means to convert medium duty and heavy-duty trucks (Classes 3-8) from diesel to natural gas engines with the new prechamber TJI technology

# EXHIBIT A

## Scope of Work

### II. TASK 1 GENERAL PROJECT TASKS

#### PRODUCTS

##### Subtask 1.1 Products

The goal of this subtask is to establish the requirements for submitting project products (e.g., reports, summaries, plans, and presentation materials). Unless otherwise specified by the Commission Agreement Manager (CAM), the Recipient must deliver products as required below by the dates listed in the **Project Schedule (Part V)**. Products that require a draft version are indicated by marking “**(draft and final)**” after the product name in the “Products” section of the task/subtask. If “(draft and final)” does not appear after the product name, only a final version of the product is required. With respect to due dates within this Scope of Work, “**days**” means working days.

##### The Recipient shall:

###### For products that require a draft version

- Submit all draft products to the CAM for review and comment in accordance with the Project Schedule (Part V). The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- Submit the final product to the CAM once agreement has been reached on the draft. The CAM will provide written approval of the final product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- If the CAM determines that the final product does not sufficiently incorporate his/her comments, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

###### For products that require a final version only

- Submit the product to the CAM for approval.
- If the CAM determines that the product requires revision, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

###### For all products

- Submit all data and documents required as products in accordance with the following Instructions for Submitting Electronic Files and Developing Software:
  - **Electronic File Format**  
Submit all data and documents required as products under this Agreement in an electronic file format that is fully editable and compatible with the Energy Commission’s software and Microsoft (MS)-operating computing platforms, or with any other format approved by the CAM. Deliver an electronic copy of the full text of any Agreement data and documents in a format specified by the CAM, such as memory stick or CD-ROM.

## **EXHIBIT A**

### **Scope of Work**

The following describes the accepted formats for electronic data and documents provided to the Energy Commission as products under this Agreement, and establishes the software versions that will be required to review and approve all software products:

- Data sets will be in MS Access or MS Excel file format (version 2007 or later), or any other format approved by the CAM.
  - Text documents will be in MS Word file format, version 2007 or later.
  - Documents intended for public distribution will be in PDF file format. The Recipient must also provide the native Microsoft file format.
  - Project management documents will be in Microsoft Project file format, version 2007 or later.
- 
- ***Software Application Development***  
Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:
    - Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
    - Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
    - Visual Studio.NET (version 2008 and up). Recommend 2010.
    - C# Programming Language with Presentation (UI), Business Object and Data Layers.
    - SQL (Structured Query Language).
    - Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
    - Microsoft SQL Reporting Services. Recommend 2008 R2.
    - XML (external interfaces).

Any exceptions to the Electronic File Format requirements above must be approved in writing by the CAM. The CAM will consult with the Energy Commission's Information Technology Services Branch to determine whether the exceptions are allowable.

## EXHIBIT A Scope of Work

### MEETINGS

#### Subtask 1.2 Kick-off Meeting

The goal of this subtask is to establish the lines of communication and procedures for implementing this Agreement.

#### The Recipient shall:

- Attend a “Kick-off” meeting with the CAM, the Commission Agreement Officer (CAO), and any other Energy Commission staff relevant to the Agreement. The Recipient will bring its Project Manager and any other individuals designated by the CAM to this meeting. The administrative and technical aspects of the Agreement will be discussed at the meeting. Prior to the meeting, the CAM will provide an agenda to all potential meeting participants. The meeting may take place in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

The administrative portion of the meeting will include discussion of the following:

- Terms and conditions of the Agreement;
- Administrative products (subtask 1.1);
- CPR meetings (subtask 1.3);
- Match fund documentation (subtask 1.7);
- Permit documentation (subtask 1.8);
- Subcontracts (subtask 1.9); and
- Any other relevant topics.

The technical portion of the meeting will include discussion of the following:

- The CAM’s expectations for accomplishing tasks described in the Scope of Work;
  - An updated Project Schedule;
  - Technical products (subtask 1.1);
  - Progress reports and invoices (subtask 1.5);
  - Final Report (subtask 1.6);
  - Technical Advisory Committee meetings (subtasks 1.10 and 1.11); and
  - Any other relevant topics.
- Provide an *Updated Project Schedule, List of Match Funds, and List of Permits*, as needed to reflect any changes in the documents.

#### The CAM shall:

- Designate the date and location of the meeting.
- Send the Recipient a *Kick-off Meeting Agenda*.

#### Recipient Products:

- Updated Project Schedule (*if applicable*)

## **EXHIBIT A**

### **Scope of Work**

- Updated List of Match Funds (*if applicable*)
- Updated List of Permits (*if applicable*)

#### **CAM Product:**

- Kick-off Meeting Agenda

#### **Subtask 1.3 Critical Project Review (CPR) Meetings**

The goal of this subtask is to determine if the project should continue to receive Energy Commission funding, and if so whether any modifications must be made to the tasks, products, schedule, or budget. CPR meetings provide the opportunity for frank discussions between the Energy Commission and the Recipient. As determined by the CAM, discussions may include project status, challenges, successes, advisory group findings and recommendations, final report preparation, and progress on technical transfer and production readiness activities (if applicable). Participants will include the CAM and the Recipient, and may include the CAO and any other individuals selected by the CAM to provide support to the Energy Commission.

CPR meetings generally take place at key, predetermined points in the Agreement, as determined by the CAM and as shown in the Task List on page 1 of this Exhibit. However, the CAM may schedule additional CPR meetings as necessary. The budget will be reallocated to cover the additional costs borne by the Recipient, but the overall Agreement amount will not increase. CPR meetings generally take place at the Energy Commission, but they may take place at another location, or may be conducted via electronic conferencing (e.g., WebEx) as determined by the CAM.

#### **The Recipient shall:**

- Prepare a *CPR Report* for each CPR meeting that: (1) discusses the progress of the Agreement toward achieving its goals and objectives; and (2) includes recommendations and conclusions regarding continued work on the project.
- Submit the CPR Report along with any other *Task Products* that correspond to the technical task for which the CPR meeting is required (i.e., if a CPR meeting is required for Task 2, submit the Task 2 products along with the CPR Report).
- Attend the CPR meeting.
- Present the CPR Report and any other required information at each CPR meeting.

#### **The CAM shall:**

- Determine the location, date, and time of each CPR meeting with the Recipient's input.
- Send the Recipient a *CPR Agenda* and a *List of Expected CPR Participants* in advance of the CPR meeting. If applicable, the agenda will include a discussion of match funding and permits.
- Conduct and make a record of each CPR meeting. Provide the Recipient with a *Schedule for Providing a Progress Determination* on continuation of the project.
- Determine whether to continue the project, and if so whether modifications are needed to the tasks, schedule, products, or budget for the remainder of the Agreement. If the CAM concludes that satisfactory progress is not being made, this conclusion will be referred to the Deputy Director of the Energy Research and Development Division.

## **EXHIBIT A**

### **Scope of Work**

- Provide the Recipient with a *Progress Determination* on continuation of the project, in accordance with the schedule. The Progress Determination may include a requirement that the Recipient revise one or more products.

#### **Recipient Products:**

- CPR Report(s)
- Task Products (draft and/or final as specified in the task)

#### **CAM Products:**

- CPR Agenda
- List of Expected CPR Participants
- Schedule for Providing a Progress Determination
- Progress Determination

#### **Subtask 1.4 Final Meeting**

The goal of this subtask is to complete the closeout of this Agreement.

#### **The Recipient shall:**

- Meet with Energy Commission staff to present project findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement. This meeting will be attended by the Recipient and CAM, at a minimum. The meeting may occur in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.

- The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
- The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
  - Disposition of any state-owned equipment.
  - Need to file a Uniform Commercial Code Financing Statement (Form UCC-1) regarding the Energy Commission's interest in patented technology.
  - The Energy Commission's request for specific "generated" data (not already provided in Agreement products).
  - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
  - "Surviving" Agreement provisions such as repayment provisions and confidential products.
  - Final invoicing and release of retention.

## **EXHIBIT A**

### **Scope of Work**

- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide *All Draft and Final Written Products* on a CD-ROM or USB memory stick, organized by the tasks in the Agreement.

#### **Products:**

- Final Meeting Agreement Summary (*if applicable*)
- Schedule for Completing Agreement Closeout Activities
- All Draft and Final Written Products

### **REPORTS AND INVOICES**

#### **Subtask 1.5 Progress Reports and Invoices**

The goals of this subtask are to: (1) periodically verify that satisfactory and continued progress is made towards achieving the project objectives of this Agreement; and (2) ensure that invoices contain all required information and are submitted in the appropriate format.

#### **The Recipient shall:**

- Submit a monthly *Progress Report* to the CAM. Each progress report must:
  - Summarize all Agreement activities conducted by the Recipient for the preceding month, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. See the Progress Report Format Attachment for the recommended specifications.
  - Provide a synopsis of the project progress, including accomplishments, problems, milestones, products, schedule, fiscal status, and any evidence of progress such as photographs.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the “Payment of Funds” section of the terms and conditions. In addition, each invoice must document and verify:
  - Energy Commission funds received by California-based entities;
  - Energy Commission funds spent in California (*if applicable*); and
  - Match fund expenditures.

#### **Products:**

- Progress Reports
- Invoices

#### **Subtask 1.6 Final Report**

## **EXHIBIT A**

### **Scope of Work**

The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. The CAM will review and approve the Final Report, which will be due at least **two months** before the Agreement end date. When creating the Final Report Outline and the Final Report, the Recipient must use a Style Manual provided by the CAM.

#### **Subtask 1.6.1 Final Report Outline**

**The Recipient shall:**

- Prepare a *Final Report Outline* in accordance with the *Style Manual* provided by the CAM.
- Submit a draft of the outline to the CAM for review and comment.
- Once agreement has been reached on the draft, submit the final outline to the CAM. The CAM will provide written approval of the final outline within 10 days of receipt.

**Recipient Products:**

- Final Report Outline (draft and final)

**CAM Product:**

- Style Manual

#### **Subtask 1.6.2 Final Report**

**The Recipient shall:**

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline and the Style Manual provided by the CAM.
- Submit a draft of the report to the CAM for review and comment. Once agreement on the draft report has been reached, the CAM will forward the electronic version for Energy Commission internal approval. Once the CAM receives approval, he/she will provide written approval to the Recipient.
- Submit one bound copy of the Final Report to the CAM.

**Products:**

- Final Report (draft and final)

### ***MATCH FUNDS, PERMITS, AND SUBCONTRACTS***

#### **Subtask 1.7 Match Funds**

The goal of this subtask is to ensure that the Recipient obtains any match funds planned for this Agreement and applies them to the Agreement during the Agreement term.

While the costs to obtain and document match funds are not reimbursable under this Agreement, the Recipient may spend match funds for this task. The Recipient may only spend match funds during the Agreement term, either concurrently or prior to the use of Energy Commission funds. Match funds must be identified in writing, and the Recipient must obtain any associated commitments before incurring any costs for which the Recipient will request reimbursement.

## EXHIBIT A Scope of Work

### The Recipient shall:

- Prepare a *Match Funds Status Letter* that documents the match funds committed to this Agreement. If no match funds were part of the proposal that led to the Energy Commission awarding this Agreement and none have been identified at the time this Agreement starts, then state this in the letter.

If match funds were a part of the proposal that led to the Energy Commission awarding this Agreement, then provide in the letter:

- A list of the match funds that identifies:
  - The amount of cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
  - The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the source (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient must identify its owner and provide a contact name, address, telephone number, and the address where the property is located.
- A copy of a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.
- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide a *Supplemental Match Funds Notification Letter* to the CAM of receipt of additional match funds.
- Provide a *Match Funds Reduction Notification Letter* to the CAM if existing match funds are reduced during the course of the Agreement. Reduction of match funds may trigger a CPR meeting.

### Products:

- Match Funds Status Letter
- Supplemental Match Funds Notification Letter *(if applicable)*
- Match Funds Reduction Notification Letter *(if applicable)*

### Subtask 1.8 Permits

The goal of this subtask is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track. Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement, with the exception of costs incurred by University of California recipients. Permits must be identified and obtained before the Recipient may incur any costs related to the use of the permit(s) for which the Recipient will request reimbursement.

### The Recipient shall:

- Prepare a *Permit Status Letter* that documents the permits required to conduct this Agreement. If no permits are required at the start of this Agreement, then state this in the letter. If permits will be required during the course of the Agreement, provide in the letter:

## **EXHIBIT A**

### **Scope of Work**

- A list of the permits that identifies: (1) the type of permit; and (2) the name, address, and telephone number of the permitting jurisdictions or lead agencies.
- The schedule the Recipient will follow in applying for and obtaining the permits.

The list of permits and the schedule for obtaining them will be discussed at the Kick-off meeting (subtask 1.2), and a timetable for submitting the updated list, schedule, and copies of the permits will be developed. The impact on the project if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in progress reports and will be a topic at CPR meetings.

- If during the course of the Agreement additional permits become necessary, then provide the CAM with an *Updated List of Permits* (including the appropriate information on each permit) and an *Updated Schedule for Acquiring Permits*.
- Send the CAM a *Copy of Each Approved Permit*.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the CAM within 5 days. Either of these events may trigger a CPR meeting.

#### **Products:**

- Permit Status Letter
- Updated List of Permits (*if applicable*)
- Updated Schedule for Acquiring Permits (*if applicable*)
- Copy of each Approved Permit (*if applicable*)

#### **Subtask 1.9 Subcontracts**

The goals of this subtask are to: (1) procure subcontracts required to carry out the tasks under this Agreement; and (2) ensure that the subcontracts are consistent with the terms and conditions of this Agreement.

#### **The Recipient shall:**

- Manage and coordinate subcontractor activities in accordance with the requirements of this Agreement.
- Incorporate this Agreement by reference into each subcontract.
- Include any required Energy Commission flow-down provisions in each subcontract, in addition to a statement that the terms of this Agreement will prevail if they conflict with the subcontract terms.
- If required by the CAM, submit a draft of each *Subcontract* required to conduct the work under this Agreement.
- Submit a final copy of the executed subcontract.
- Notify and receive written approval from the CAM prior to adding any new subcontractors (see the discussion of subcontractor additions in the terms and conditions).

#### **Products:**

- Subcontracts (*draft if required by the CAM*)

## EXHIBIT A Scope of Work

### **TECHNICAL ADVISORY COMMITTEE**

#### **Subtask 1.10 Technical Advisory Committee (TAC)**

The goal of this subtask is to create an advisory committee for this Agreement. The TAC should be composed of diverse professionals. The composition will vary depending on interest, availability, and need. TAC members will serve at the CAM's discretion. The purpose of the TAC is to:

- Provide guidance in project direction. The guidance may include scope and methodologies, timing, and coordination with other projects. The guidance may be based on:
  - Technical area expertise;
  - Knowledge of market applications; or
  - Linkages between the agreement work and other past, present, or future projects (both public and private sectors) that TAC members are aware of in a particular area.
- Review products and provide recommendations for needed product adjustments, refinements, or enhancements.
- Evaluate the tangible benefits of the project to the state of California, and provide recommendations as needed to enhance the benefits.
- Provide recommendations regarding information dissemination, market pathways, or commercialization strategies relevant to the project products.

The TAC may be composed of qualified professionals spanning the following types of disciplines:

- Researchers knowledgeable about the project subject matter;
- Members of trades that will apply the results of the project (e.g., designers, engineers, architects, contractors, and trade representatives);
- Public interest market transformation implementers;
- Product developers relevant to the project;
- U.S. Department of Energy research managers, or experts from other federal or state agencies relevant to the project;
- Public interest environmental groups;
- Utility representatives;
- Air district staff; and
- Members of relevant technical society committees.

#### **The Recipient shall:**

- Prepare a *List of Potential TAC Members* that includes the names, companies, physical and electronic addresses, and phone numbers of potential members. The list will be discussed at the Kick-off meeting, and a schedule for recruiting members and holding the first TAC meeting will be developed.
- Recruit TAC members. Ensure that each individual understands member obligations and the TAC meeting schedule developed in subtask 1.11.
- Prepare a *List of TAC Members* once all TAC members have committed to serving on the TAC.
- Submit *Documentation of TAC Member Commitment* (such as Letters of Acceptance) from each TAC member.

## **EXHIBIT A**

### **Scope of Work**

#### **Products:**

- List of Potential TAC Members
- List of TAC Members
- Documentation of TAC Member Commitment

#### **Subtask 1.11 TAC Meetings**

The goal of this subtask is for the TAC to provide strategic guidance for the project by participating in regular meetings, which may be held via teleconference.

#### **The Recipient shall:**

- Discuss the TAC meeting schedule with the CAM at the Kick-off meeting. Determine the number and location of meetings (in-person and via teleconference) in consultation with the CAM.
- Prepare a *TAC Meeting Schedule* that will be presented to the TAC members during recruiting. Revise the schedule after the first TAC meeting to incorporate meeting comments.
- Prepare a *TAC Meeting Agenda* and *TAC Meeting Back-up Materials* for each TAC meeting.
- Organize and lead TAC meetings in accordance with the TAC Meeting Schedule. Changes to the schedule must be pre-approved in writing by the CAM.
- Prepare *TAC Meeting Summaries* that include any recommended resolutions of major TAC issues.

#### **Products:**

- TAC Meeting Schedule (draft and final)
- TAC Meeting Agendas (draft and final)
- TAC Meeting Back-up Materials
- TAC Meeting Summaries

## **EXHIBIT A**

### **Scope of Work**

#### **III. TECHNICAL TASKS**

Task 2 is intended to be completed concurrently with Task 4 and Task 6. These three tasks are complementary, interactive and iterative and will therefore be completed simultaneously by the Recipient.

##### **Task 2 Prechamber Design and Manufacture**

The goal of this task is to determine prechamber space claim and connections to cylinder head; determine required modifications to cylinder head to operate with prechambers; provide Michigan State with needed physical data to start prechamber analysis, respond to analyses from MSU with improved chambers and nozzle, manufacture both fueled and unfueled pre-chamber sets, and manufacture new sets of optimized prechambers.

##### **The Recipient shall:**

- Analyze sectioned cylinder heads and create piston and cylinder head 3D models
- Determine prechamber outer boundary and design preliminary prechambers
- Manufacture first set of prechambers with:
  - Revise design of prechambers based on input from MSU
  - Full engine set with initial prechamber volume set
  - Two alternate nozzle configurations for single cylinder testing
- Manufacture both fueled and unfueled prechamber sets including:
  - Two complete sets for baseline calibration
  - Four alternate nozzle designs for each set to perform single cylinder evaluation
- Determine final configuration for last full engine
- Manufacture new sets of optimized prechambers

##### **Products:**

- Preliminary Prechamber Design Data
- Cylinder Head Modification Drawings

##### **TASK 3 Engine Acquisition, Engine Testing Support System Preparations**

The goals of this task are to acquire and convert diesel engine to natural gas and the needed support subsystems followed by the installation of these subsystems.

##### **The Recipient Shall:**

- Procure Detroit Diesel Series 50 Detroit Diesel Corporation (DDC) Engine
- Rebuild engine and install natural gas conversion kit
- Develop pressure sensors
- Install Detroit Diesel Engine from Omnitek
  - Incorporate cylinder head with prechamber and pressure sensor adapters
  - Run and check out
- Instrument Test Cell for Combustion Analysis
- Build external boosted intake air, low pressure EGR and controlled backpressure system
  - Determine appropriate airflow and pressure variables.
  - Source computer system and control modules
  - Source required sensors

## **EXHIBIT A**

### **Scope of Work**

- Wire all new sensors, valves and variable frequency drives
- Write control programs and test
- Acquire appropriate compressors, motors, heat exchanges, coolant pumps
- Design belt drives and mounting frames
- Build compressor modules
- Work with vendors to specify and acquire a pair of controllable back pressure valves, one larger course adjustment valve, and one smaller fine adjustment valve
- Fabricate and install custom exhaust plumbing to mount, power and control both backpressure valves
- Work with vender to specify and acquire the appropriate high temperature liquid to air heat exchanger
- Acquire the needed coolant pumps
- Fabricate coolant and exhaust plumbing
- Install water injection and hydrogen prechamber supplemental fuel supply system
- Develop a ***Subsystem Status Report*** that includes an overview of the subsystems developed and data acquired from these subsystems

#### **Product:**

- Subsystem Status Report

#### **TASK 4 Preliminary CFD Analysis**

The goals of this task are to generate initial prechamber configuration data for the first round of prechamber testing.

#### **The Recipient shall:**

- Generate a CFD model of the engine with preliminary prechamber using CONVERGE CFD
- Perform CFD work with the initial prechamber design to improve internal mixing and prechamber filling (no combustion modeling) and provide up to 4 design options
- Build Analysis model of Series 60 engine system for multiple round of analysis
- Develop a ***Prechamber Design Report*** that will include the first iteration prechamber design parameters manufacture in Task 2

#### **Product:**

- Prechamber Design Report

#### **TASK 5 First Phase Engine Testing**

The goal of this task is to generate baseline data of existing engine system, test boost and back pressure system and test the first round of prechambers.

## EXHIBIT A Scope of Work

### The Recipient shall:

- Perform 13 mode and functional threshold power (FTP) testing on standard configuration engine with open chambers and turbocharger installed while capturing cylinder pressure data to establish a base line
- Remove turbocharger and connect test cell boost and back pressure system
  - Shake down external boost and backpressure system replicating turbocharged engine operation
  - Correlate compressor energy consumption data between external boost and turbocharged engine
- Explore EGR and lean burn limits of this engine configuration
- Install first set of prechambers
  - Calibrate engine to operate at lean burn limit with supplemental prechamber fuel
  - Perform 13 mode test
  - Perform two 5 mode single cylinder tests with alternate prechamber nozzles
  - Install 3 way catalyst
  - Calibrate engine to operate at EGR limit with unfueled prechambers
  - Perform 13 mode test with pre catalyst and post catalyst emissions data
- Develop a **First Phase Engine Testing Report** that includes:
  - Baseline Open Chamber Engine Data
  - External Boost Engine Correlation Data
  - EGR and Lean Burn limits for Open Chamber engine
  - First Round Prechamber Results
  - Prediction of optimum compression ratio for TJI prechamber engine

Participate in CPR per Task 1.3

### Products:

- First Phase Engine Testing Report
- CPR Report

### TASK 6 Detailed CFD and Combustion Analysis

The goal of this task is to correlate initial CFD data with empirical engine testing and produce alternate prechamber designs for both EGR operation and lean burn operation.

### The Recipient shall:

- Generate a CFD model of the experimental prechamber design
- Perform CFD work to model the turbulent jet ignition combustion that occurs in the engine experiment
- Validate CFD model with experimental engine results of combustion of the jet ignition process in the engine
- Model up to 2 additional nozzle geometries to improve combustion (enhance burn rate)
- Perform rapid compression machine (RCM) experiments for visualization of the turbulent jet ignition process
- Release second iteration nozzle designs for engine testing

### Product:

## EXHIBIT A Scope of Work

- CFD Model Results
- RCM Visualization Imaging

### **TASK 7 Second Phase Engine Testing**

The goals of this task are (1) to evaluate the engine at a higher compression ratio with revised prechambers (2) evaluate the potential of hydrogen fueled prechambers; and (3) evaluate the potential of higher compression ratios and power levels with water injection.

#### **The Recipient shall:**

- Rebuild the engine with higher compression pistons
  - Design and source higher compression pistons
- Calibrate and test engine , 13 mode and FTP, in lean burn operation with revised fueled prechambers
- Evaluate hydrogen as a supplemental fuel with EGR
- Calibrate and test engine in EGR diluted configuration with un-fueled prechambers
- Select configuration for last full engine test
- Develop a **Second Phase Engine Testing Report** that will include:
  - Second Round Evaluation of fueled prechambers in a lean burn engine
  - Evaluation of the effect of hydrogen as a supplemental prechamber fuel
  - Second Round Evaluation of unfueled prechambers in an EGR diluted engine

#### **Product:**

- Second Phase Engine Testing Report

### **TASK 8 Third Phase Engine Testing**

The goal of this task is to complete the third phase of engine testing.

#### **The Recipient shall:**

- Install optimized prechambers
- Perform 13 mode and FTP engine testing with optimized prechambers
- Perform final water injection evaluation
- Develop a **Third Phase Engine Testing Report** that will include at least:
  - Evaluation of final engine configuration with optimized prechambers
  - Evaluation of possible higher power operations with water injection
- Participate in CPR per Task 1.3.

#### **Product:**

- Third Phase Engine Testing Report
- CPR Report

### **TASK 9 Evaluation of Project Benefits**

The goal of this task is to report the benefits resulting from this project.

## EXHIBIT A Scope of Work

### The Recipient shall:

- Complete three Project Benefits Questionnaires that correspond to three main intervals in the Agreement: (1) *Kick-off Meeting Benefits Questionnaire*; (2) *Mid-term Benefits Questionnaire*; and (3) *Final Meeting Benefits Questionnaire*.
- Provide all key assumptions used to estimate projected benefits, including targeted market sector (e.g., population and geographic location), projected market penetration, baseline and projected energy use and cost, operating conditions, and emission reduction calculations. Examples of information that may be requested in the questionnaires include:
  - For Product Development Projects and Project Demonstrations:
    - Published documents, including date, title, and periodical name.
    - Estimated or actual energy and cost savings, and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
    - Greenhouse gas and criteria emissions reductions.
    - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
    - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
    - A discussion of project product downloads from websites, and publications in technical journals.
    - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
    - Additional Information for Product Development Projects:
      - Outcome of product development efforts, such copyrights and license agreements.
      - Units sold or projected to be sold in California and outside of California.
      - Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
      - Investment dollars/follow-on private funding as a result of Energy Commission funding.
      - Patent numbers and applications, along with dates and brief descriptions.
    - Additional Information for Product Demonstrations:
      - Outcome of demonstrations and status of technology.
      - Number of similar installations.
      - Jobs created/retained as a result of the Agreement.
  - For Information/Tools and Other Research Studies:
    - Outcome of project.
    - Published documents, including date, title, and periodical name.
    - A discussion of policy development. State if the project has been cited in government policy publications or technical journals, or has been used to inform regulatory bodies.

## **EXHIBIT A**

### **Scope of Work**

- The number of website downloads.
  - An estimate of how the project information has affected energy use and cost, or have resulted in other non-energy benefits.
  - An estimate of energy and non-energy benefits.
  - Data on potential job creation, market potential, economic development, and increased state revenue as a result of project.
  - A discussion of project product downloads from websites, and publications in technical journals.
  - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Respond to CAM questions regarding responses to the questionnaires.

The Energy Commission may send the Recipient similar questionnaires after the Agreement term ends. Responses to these questionnaires will be voluntary.

#### **Products:**

- Kick-off Meeting Benefits Questionnaire
- Mid-term Benefits Questionnaire
- Final Meeting Benefits Questionnaire

#### **TASK 10 Technology/Knowledge Transfer Activities**

The goal of this task is to develop a plan to make the knowledge gained, experimental results, and lessons learned available to the public and key decision makers.

#### **The Recipient shall:**

- Prepare an *Initial Fact Sheet* at start of the project that describes the project. Use the format provided by the CAM.
- Prepare a *Final Project Fact Sheet* at the project's conclusion that discusses results. Use the format provided by the CAM.
- Prepare a *Technology/Knowledge Transfer Plan* that includes:
  - An explanation of how the knowledge gained from the project will be made available to the public, including the targeted market sector and potential outreach to end users, utilities, regulatory agencies, and others.
  - A description of the intended use(s) for and users of the project results.
  - Published documents, including date, title, and periodical name.
  - Copies of documents, fact sheets, journal articles, press releases, and other documents prepared for public dissemination. These documents must include the Legal Notice required in the terms and conditions. Indicate where and when the documents were disseminated.
  - A discussion of policy development. State if project has been or will be cited in government policy publications, or used to inform regulatory bodies.
  - The number of website downloads or public requests for project results.
  - Additional areas as determined by the CAM.
- Conduct technology transfer activities in accordance with the Technology/Knowledge

## **EXHIBIT A**

### **Scope of Work**

Transfer Plan. These activities will be reported in the Progress Reports.

- When directed by the CAM, develop *Presentation Materials* for an Energy Commission-sponsored conference/workshop on the results of the project.
- Prepare a *Technology/Knowledge Transfer Report* on technology transfer activities conducted during the project.

#### **Products:**

- Initial Fact Sheet (draft and final)
- Final Project Fact Sheet (draft and final)
- Presentation Materials (draft and final)
- Technology/Knowledge Transfer Plan (draft and final)
- Technology/Knowledge Transfer Report (draft and final)

#### **PROJECT SCHEDULE**

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES  
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: OLSON-ECOLOGIC ENGINE TESTING LABORATORIES, LLC

**RESOLVED**, that the State Energy Resources Conservation and Development Commission (Energy Commission) adopts the staff CEQA findings contained in the Agreement Request Form; and

**RESOLVED**, that the Energy Commission approves Agreement PIR-14-012 from PON-14-501 with **Olson Ecologic, LLC** for a **\$750,000** grant to conduct research and development of technologies to improve fuel transfer efficiency in compressed natural gas vehicles; and

**FURTHER BE IT RESOLVED**, that the Executive Director or his/her designee shall execute the same on behalf of the Energy Commission.

**CERTIFICATION**

The undersigned Secretariat to the Commission does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the California Energy Commission held on April 8, 2015

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

---

Harriet Kallemeyn,  
Secretariat