

**GRANT REQUEST FORM (GRF)**

CEC-270 (Revised 02/13)

CALIFORNIA ENERGY COMMISSION

New Agreement PIR-15-008 (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
Institute of Gas Technology dba Gas Technology Institute	36-2170137

Title of Project
Development, Integration, and Demonstration of 6.7 Liter Natural Gas Engine in Medium Heavy-Duty Vehicles

Term and Amount	Start Date	End Date	Amount
	4/1/2016	3/31/2019	\$ 1,000,000

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

Proposed Business Meeting Date	3/9/2016	<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**

INSTITUTE OF GAS TECHNOLOGY DBA GAS TECHNOLOGY INSTITUTE (GTI). Proposed resolution approving agreement PIR-15-008 with Institute of Gas Technology dba Gas Technology Institute (GTI) for a \$1,000,000 grant to integrate and demonstrate a production intent 6.7 liter medium-duty natural gas engine that will be capable of meeting future 2018 EPA heavy-duty on-board diagnostic requirements.

**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":

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: Cal. Code Regs., tit 14, § 15306  
 Common Sense Exemption. 14 CCR 15061 (b) (3)  
 Explain reason why Agreement is exempt under the above section:  
 This project consists of the testing and development of a natural gas engine with work primarily being performed in a laboratory, including dynamometer testing. Some on-road testing of vehicles will be completed, however this will be completed through existing vehicle fleets and the impact is expected to be minimal.  
 b) Agreement **IS NOT** exempt. (Consult with the legal office to determine next steps.)  
 Check all that apply  
 Initial Study  Environmental Impact Report  
 Negative Declaration  Statement of Overriding Considerations  
 Mitigated Negative Declaration

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

Legal Company Name:	Budget
Cummins Westport, Inc.	\$ 925,000
	\$

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

Legal Company Name:
The Regents of the University of California, on behalf of the Riverside Campus

**Budget Information**

Funding Source	Funding Year of Appropriation	Budget List No.	Amount
NG Subaccount, PIERDD	14-15	501.0011	\$1,000,000
			\$
R&D Program Area: EGRO: Transportation		TOTAL:	\$1,000,000
Explanation for "Other" selection			

**GRANT REQUEST FORM (GRF)**



Reimbursement Contract #:				Federal Agreement #:			
<b>Recipient's Administrator/ Officer</b>				<b>Recipient's Project Manager</b>			
Name:		Kate Jauridez		Name:		Ted Barnes	
Address:		1700 S Mount Prospect Rd		Address:		1700 S Mount Prospect Rd	
City, State, Zip:		Des Plaines, IL 60018-1804		City, State, Zip:		Des Plaines, IL 60018-1804	
Phone:		847-768-0905 /		Phone:		847-544-3405 /	
Fax:		- -		Fax:		- -	
E-Mail:		Kate.Jauridez@gastechnology.org		E-Mail:		ted.barnes@gastechnology.org	

<b>Selection Process Used</b>			
<input checked="" type="checkbox"/> Competitive Solicitation		Solicitation #: GFO-15-503	
<input type="checkbox"/> First Come First Served Solicitation			

<b>The following items should be attached to this GRF</b>			
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 type="checkbox"/> N/A	<input checked="" type="checkbox"/> Attached	

\_\_\_\_\_ Agreement Manager      \_\_\_\_\_ Date      \_\_\_\_\_ Office Manager      \_\_\_\_\_ Date      \_\_\_\_\_ Deputy Director      \_\_\_\_\_ Date

## EXHIBIT A Scope of Work

### I. TASK ACRONYM/TERM LISTS

#### A. Task List

Task #	CPR <sup>1</sup>	Task Name
1		General Project Tasks
2		Heavy Duty On-Board Diagnostics Compliance
3	X	Vehicle Integration
4		Vehicle Demonstration
5		Evaluation of Project Benefits
6		Technology/Knowledge Transfer Activities
7		Production Readiness Plan

#### B. Acronym/Term List.

Acronym/Term	Meaning
AEB	Application Engineering Bulletin
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CARB	California Air Resources Board
CH <sub>4</sub>	Methane
CPR	Critical Project Review
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
CWI	Cummins Westport Inc.
ECU	Engine Control Unit
EPA	Environmental Protection Agency
GHG	Greenhouse Gas
g/bhp-hr	Grams per brake horsepower-hour
HD-OBD	Heavy Duty On-Board Diagnostics
ISB6.7 G	Dedicated natural gas version of the Cummins ISB diesel engine for heavy-duty vehicle applications
OBD	On-Board Diagnostics
OEM	Original Equipment Manufacturer
NMHC	Non-methane hydrocarbons
N <sub>2</sub> O	Nitrous Oxide
NOx	Nitrogen Oxides
PM	Particulate Matter
Stoichiometric	Ideal combustion whereby fuel and oxygen are completely consumed with no excess of either at the completion of combustion
SI	Spark Ignited
TAC	Technical Advisory Committee

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

## **EXHIBIT A Scope of Work**

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

#### **A. Purpose of Agreement**

The purpose of this Agreement is for the development, integration and demonstration of production intent advanced version of the Cummins Westport Inc. (CWI) ISB6.7 G natural gas engine meeting the 2018 Environmental Protection Agency (EPA) Heavy-Duty On-Board Diagnostics (HD-OBD) requirements and continuing to meet California Air Resources Board's (CARB's) Optional Low NOx 0.1 g/bhp-hr emissions level. This project lays the foundation for follow-on work to further reduce the NOx emissions from the current 0.1 g/bhp-hr level by 90% to 0.02 g/bhp-hr, the lowest of the CARB Optional Low NOx standards.

#### **B. Problem/Solution Statement**

##### **Problem**

The market demand for natural gas powered commercial vehicles has increased significantly in recent years. The unavailability of certain matching engine sizes and performance ratings has constrained the expansion of natural gas vehicle penetration and led to a Energy Commission funded project to develop a 6.7 liter stoichiometric spark ignited (SI) natural gas engine by CWI referred to as the ISB6.7 G. This engine is scheduled for full production in April of 2016 and is suited for Class 5 through 7 commercial vehicle markets including pickup and delivery trucks, utility trucks, school buses, shuttle buses, yard tractors, and specialized municipal works vehicles such as street sweepers. The production launch of the ISB6.7 G will start with Original Equipment Manufacturer (OEM) partner Thomas Built Bus in the C2 school bus platform. Further integration work is required to expand the vehicle OEM offerings of this engine in the Medium-Heavy Duty market.

US Environmental Protection Agency (EPA) and California Air Resource Board (CARB) require On-Board Diagnostics (OBD) to be implemented in heavy duty alternative fueled vehicles for 2018 model year. Heavy duty diesel vehicles were required to implement OBD for model year 2013 vehicles while implementation in alternative fueled heavy duty vehicles was delayed till 2018 due to the immense development burden of this new level of diagnostics and the comparatively small volume of heavy duty alternative fueled vehicles being manufactured.

The OBD system monitors all emissions impacting components on the vehicle to ensure the vehicle remains below pre-determined emissions thresholds throughout the life of the vehicle. OBD also aides with the diagnosis of emissions related faults and repair of emissions equipment. This in turn protects the environment from excess emissions due to engine issues and prevents costly progressive engine damage. If an issue is detected by the OBD system, the operator is notified through a "Check Engine" warning on the vehicle dash and the operator is expected to bring the vehicle in for repair. The OBD system stores information about the fault and relays this information to a technician when connected to the engine control unit. This allows for more efficient troubleshooting and quicker and more accurate repairs. Development of HD-OBD to meet 2018 EPA & CARB regulations for alternative fueled heavy duty vehicles is required for continued sales and market expansion from January 1, 2018 and beyond.

## **EXHIBIT A Scope of Work**

### **Solution**

The Recipient and their subcontractor propose to utilize the production model year 2016 ISB6.7 G SI natural gas engine and further develop an advanced version of this engine with HD-OBD to meet 2018 EPA & CARB regulations for alternative fueled heavy duty vehicles.

A number of tasks will be completed to address integration issues currently preventing the ISB6.7 G from being utilized in vehicle OEM models such as street sweepers and shuttle buses. These tasks will further expand available engine options such as a remote mounted engine control unit (ECU) which allows the ISB6.7 G to work within existing vehicle chassis and also the compatibility with a hydrostatic drive which was utilized in street sweeper applications.

This engine will then be deployed in a number of vehicles in multiple applications including street sweeper, shuttle bus and school bus in California where the development tasks conducted will be utilized in real world operation and validated over a variety of duty cycles applicable to those vehicles (i.e. Shuttle Bus, Sweeper, and School Bus) with the performance measured and assessed. CWI will be targeting existing end-users of CWI ISB6.7 G engines and also those that may currently be utilizing ISB6.7 diesel engines and wanting to convert their fleet to natural gas.

### **C. Goals and Objectives of the Agreement**

#### **Agreement Goals**

The goals of this Agreement are to design, develop, and demonstrate a pre-commercial SI natural gas engine with EPA 2018 HD-OBD while continuing to have CARB Optional Low NOx 0.1g emissions, high performance, and best-in-class fuel economy in specific Class 5 through 7 truck and bus duty cycles. The HD-OBD compliance will be achieved by utilizing the production CWI ISB6.7 G engine and further developing to meet the 2018 EPA HD-OBD requirements. The engine will then be integrated and deployed in a number of field test vehicles in California to be operating in actual operation and duty cycles applicable to the vehicle intended use and the performance and emissions will be measured and compared with the project goals.

Ratepayer Benefits: This Agreement will result in the ratepayer benefit(s) of an increase in natural gas products available to the California commercial vehicle market. By further developing and subsequently commercializing a HD-OBD compliant low emission, high performance, high efficiency, 6.7 liter natural gas engine for these applications, a viable alternative to diesel engines currently serving this market will be made available. The natural gas engines currently available to serve these applications, consisting mostly of after-market conversions, are not considered optimized for fuel efficient performance. Accordingly, the natural gas ratepayers will be insured of air quality improvements from those who purchase the proposed new 6.7 liter natural gas engines in the future. Users are expected to directly benefit by cost savings per mile traveled. HD-OBD will not only monitor the engine emissions control systems to ensure the ultra-low emissions are maintained throughout the life of the engine, but if an issue is identified, the operator is notified and the HD-OBD system aides with the efficient diagnostics and repair of the issue, thereby reducing the downtime and maintenance costs and avoiding further escalating issues if left unchecked.

## **EXHIBIT A**

### **Scope of Work**

Natural gas ratepayers will also benefit from reduced consumption of diesel fuel as the 6.7 liter natural gas engine displaces diesel in the target market application. Natural gas use will lessen petroleum imports used for the affected duty cycle market. This reduced demand for diesel should enable gasoline production from capacity constrained refinery industry which should help mitigate volatility in gasoline prices.

Greenhouse gas (GHG) emissions and particulate matter from natural gas engines will also be lowered compared to diesel engines. Based on the fuel efficiency targets and the various well-to-wheel GHG emission pathways specified by CARB's Low Carbon Fuel Standard program, CNG-fueled, ISB6.7 G-powered vehicles are expected to reduce composite GHG emissions (CO<sub>2</sub>e) by at least 23% versus comparable diesel-powered vehicles on a well-to-wheels basis. The magnitude of the GHG emissions reduction enabled by ISB6.7 G-powered vehicles will increase considerably over time as renewable natural gas pathways comprise more of the California natural gas fuel mix. Unlike diesel engines, the emissions control technology on natural gas engines required to meet the 2010 NO<sub>x</sub> specifications will not require the use of urea reagent. This will help California ratepayers as urea is used for fertilizer and increased demand for vehicles will put pressure on prices paid by farmers.

California ratepayers will also benefit from the proposed advanced, high efficiency natural gas engine technology as it is integrated with other technological advancements under development including advanced power trains, hybrid vehicle platforms and waste heat recovery. These improvements will result in further reductions in fossil energy used for transportation and emissions of GHGs.

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 through the displacement of petroleum in the transportation sector and strengthening a pathway for GHG reduction.

The engine platform utilized in this project for further development to be HD-OBD compliant is uniquely suited for Class 5 through 7 commercial vehicle markets because it has the right attributes (displacement, weight, envelope size, and performance) to appeal to this broad customer base. It will have the ability to operate with biomethane in blends or with 100% biomethane without modification of engine hardware or calibrations, provided that the fuel composition meets CWI's fuel specifications while meeting EPA 2018 HD-OBD requirements for alternative fuels. The current fleet of medium and heavy-duty trucks in California is approximately 632,000 and with the release of the ISB6.7 G, along with the other natural gas engines developed by CWI, the majority of future vehicle acquisitions in this sector will have the opportunity to select natural gas instead of gasoline or diesel as a fuel source.

Another key initiative of the California Energy Report<sup>2</sup> supported by this project is energy security. The use of natural gas as a vehicle fuel directly leads to the energy security of California and the country. Two scenarios were established in the IEPR Report in respect to the potential of future alternative fuel use in the state and this engine would assist in the goal of meeting the higher alternative fuel use path.

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<sup>2</sup> California Energy Commission, 2011. 2011 Integrated Energy Policy Report. Publication Number: CEC-100-2011-001-CMF

## **EXHIBIT A**

### **Scope of Work**

In respect to future energy policy, this engine platform will be available for the application of the CWI developed Near Zero NOx technology that has been applied to the ISL G engine and scheduled to be commercially available in Q2 2016. The common architecture of the ISB6.7 G lays the foundation to apply this 0.02g NOx technology to the smaller displacement engine and would result in NOx emissions lower than any other internal combustion engine utilized in transportation.

#### **Agreement Objectives**

The objectives of this Agreement are to:

- Design, develop, and demonstrate a Production Intent 6.7 liter medium duty natural gas engine that can be certified to be compliant with the EPA 2018 HD-OBD requirements while continuing to be certified at or below CARB Optional Low NOx standard 0.1g: 0.1 NOx, 0.14 NMHC, 0.01 PM, 15.5 CO.
- Demonstrate GHG emissions (CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O) that will enable emissions certification at or below the U.S. EPA 2017 GHG emissions standards.
- Demonstrate a peak rating of 260 horsepower and 660 lbs-ft peak torque.

# EXHIBIT A

## Scope of Work

### 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, including the Final Report Outline and Final Report

- 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.
- Consider incorporating all CAM comments into the final product. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product.
- Submit the revised product and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period, or approves a request for additional time.

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

- Submit the product to the CAM for acceptance. The CAM may request minor revisions or explanations prior to acceptance.

##### 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.

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:

## **EXHIBIT A**

### **Scope of Work**

- 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.

#### **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

## **EXHIBIT A**

### **Scope of Work**

- 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*)
- 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.

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- 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.
- 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.

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- 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.
- 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 progress made on all Agreement activities as specified in the scope of work for the preceding month, including accomplishments, problems, milestones, products, schedule, fiscal status, and 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.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the "Payment of Funds" section of the terms and conditions, including a financial report on Match Fund and in-state expenditures.

#### Products:

- Progress Reports
- Invoices

### Subtask 1.6 Final Report

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 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 the Style Manual provided by the CAM.

## EXHIBIT A Scope of Work

### 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. (See *Task 1.1* for requirements for draft and final products.)

#### Recipient Products:

- Final Report Outline (draft and final)

#### CAM Product:

- Style Manual
- Comments on Draft Final Report Outline
- Acceptance of Final Report Outline

### Subtask 1.6.2 Final Report

#### The Recipient shall:

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline, Style Manual, and Final Report Template provided by the CAM with the following considerations:
  - Ensure that the report includes the following items, in the following order:
    - Cover page (**required**)
    - Credits page on the reverse side of cover with legal disclaimer (**required**)
    - Acknowledgements page (optional)
    - Preface (**required**)
    - Abstract, keywords, and citation page (**required**)
    - Table of Contents (**required**, followed by List of Figures and List of Tables, if needed)
    - Executive summary (**required**)
    - Body of the report (**required**)
    - References (if applicable)
    - Glossary/Acronyms (If more than 10 acronyms or abbreviations are used, it is required.)
    - Bibliography (if applicable)
    - Appendices (if applicable) (Create a separate volume if very large.)
    - Attachments (if applicable)
  - Ensure that the document is written in the third person.
  - Ensure that the Executive Summary is understandable to the lay public.
    - Briefly summarize the completed work. Succinctly describe the project results and whether or not the project goals were accomplished.
    - Identify which specific ratepayers can benefit from the project results and how they can achieve the benefits.
    - If it's necessary to use a technical term in the Executive Summary, provide a brief definition or explanation when the technical term is first used.

## **EXHIBIT A**

### **Scope of Work**

- Follow the Style Guide format requirements for headings, figures/tables, citations, and acronyms/abbreviations.
- Ensure that the document omits subjective comments and opinions. However, recommendations in the conclusion of the report are allowed.
- Include a brief description of the project results in the Abstract.
  
- Submit a draft of the report to the CAM for review and comment. The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt
- Consider incorporating all CAM comments into the Final Report. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product
- Submit the revised Final Report and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period or approves a request for additional time.
- Submit one bound copy of the *Final Report* to the CAM along with *Written Responses to Comments on the Draft Final Report*.

#### **Products:**

- Final Report (draft and final)
- Written Responses to Comments on the Draft Final Report

#### **CAM Product:**

- Written Comments on the Draft Final Report

### ***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.

#### **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.,

## EXHIBIT A Scope of Work

- 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:
  - 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.

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### **Scope of Work**

#### **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*)

### **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.

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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.

#### **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.

## **EXHIBIT A**

### **Scope of Work**

#### **Products:**

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

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### III. TECHNICAL TASKS

*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. **Subtask 1.1 (Products)** describes the procedure for submitting products to the CAM.*

#### **TASK 2: Heavy Duty On-Board Diagnostics Compliance**

The goal of this task is to develop and validate the HD-OBD monitoring software that is mandated for near-term commercialization in order to ensure the engine emissions control system operates correctly and to detect malfunctions prior to emissions exceeding a set of emissions thresholds.

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

- Develop the HD-OBD algorithms used to monitor the emissions control hardware and sensors.
- Develop the diagnostic calibrations used to detect malfunctions of the emissions control hardware.
- Validate the correct operation of the HD-OBD system and correct identification of malfunctions exceeding the threshold levels.
- Conduct and record applicable data to fulfill HD-OBD certification compliance.
- Prepare a *HD-OBD Compliance Report* which includes but is not limited to the following:
  - Identifies the key emissions control system components.
  - Identifies the key monitors developed and thresholds.
  - Summary of the data from the certification tests and an assessment to show the system is meeting the HD-OBD requirements.

##### **Products:**

- HD-OBD Compliance Report

#### **TASK 3: Vehicle Integration**

The goals of this task are to develop solutions to integrate the ISB6.7 G with OEM vehicle chassis/applications not currently offered and to develop and convey key installation information to the OEM customers in these applications.

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

- Develop the necessary hardware to remote mount the ECU and validate to ensure it meets any engine requirements including ignition harness length limitations, utilized in a shuttle bus application.
- Conduct the necessary tuning and validation to ensure compatible / acceptable operation of the ISB6.7 G engine in a vehicle equipped with a Hydrostatic Drive system used in Street Sweepers to control auxiliary equipment.
- Create and/or modify the necessary Application Engineering Bulletins (AEB) necessary to convey engine requirements to the vehicle OEM when using this engine option.
- Prepare an *Engine Option Design Report* which summarizes the engine options design requirements, the solution developed to achieve these requirements and the information needed to convey to the vehicle OEM through the AEB.

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#### **Products:**

- Engine Option Design Report (draft and final)

#### **TASK 4: Vehicle Demonstration**

The goal of this task is to identify suitable fleets to participate with the demonstration aspect of this project, prepare and deploy between 3 and 18 vehicles in a variety of vehicle chassis and representing market segments such as Sweeper, Shuttle Bus and School Bus. Vehicles will be equipped with the engine options developed in Task 3, if applicable, and production intent HD-OBD system developed in Task 2, and conduct vehicle demonstrations for a period not less than 6 months acquiring both performance and emissions data to validate the requirements of this project.

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

- Develop a *Demonstration Plan* outlining the following but not limited to:
  - Fleets and locations of the demonstration vehicles.
  - Vehicles make, model and application.
  - General type of operation and general duty cycle.
  - In-use emissions test plan including on-road testing as well as chassis dynamometer testing, if necessary to detect low NOx levels.
- Through Cummins distributor, Cummins Pacific, and for each demonstration vehicle, conduct the necessary modifications, either through engine repower or up-fit, to the demonstration vehicles to ensure they are equipped with the ISB6.7 G engine with necessary engine options and data loggers.
- Support the operation of the demonstration vehicles for a period of at least 6 months, recording data the following data but not limited to:
  - Fuel consumption reporting.
  - Maintenance information.
  - Engine and HD-OBD Fault code information.
- Perform in-use emission testing including on-road as well as chassis dynamometer testing, if necessary to detect low NOx levels.
- Prepare a *Demonstration Summary Report* capturing the following but not limited to:
  - Mileage accumulation.
  - Fuel economy summary.
  - Key maintenance findings, if any.
  - Summary of HD-OBD learnings and improvements.
  - Emissions data.

#### **Products:**

- Demonstration Plan (draft and final)
- Demonstration Summary Report

#### **TASK 5: Evaluation of Project Benefits**

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

#### **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,

## **EXHIBIT A**

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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.
  - 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.

## **EXHIBIT A**

### **Scope of Work**

- 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 6: 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 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)

## **EXHIBIT A**

### **Scope of Work**

- Technology/Knowledge Transfer Plan (draft and final)
- Technology/Knowledge Transfer Report (draft and final)

#### **TASK 7: Production Readiness Plan**

The goal of this task is to determine the steps that will lead to the manufacturing of technologies developed in this project or to the commercialization of the project's results.

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

- Prepare a *Production Readiness Plan*. The degree of detail in the plan should be proportional to the complexity of producing or commercializing the proposed product, and to its state of development. As appropriate, the plan will discuss the following:
  - Critical production processes, equipment, facilities, personnel resources, and support systems needed to produce a commercially viable product.
  - Internal manufacturing facilities, supplier technologies, capacity constraints imposed by the design under consideration, design-critical elements, and the use of hazardous or non-recyclable materials. The product manufacturing effort may include "proof of production processes."
  - The estimated cost of production.
  - The expected investment threshold needed to launch the commercial product.
  - An implementation plan to ramp up to full production.
  - The outcome of product development efforts, such as copyrights and license agreements.
  - Patent numbers and applications, along with dates and brief descriptions.
  - Other areas as determined by the CAM.

##### **Products:**

- Production Readiness Plan (draft and final)

#### **IV. PROJECT SCHEDULE**

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES  
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: GAS TECHNOLOGY INSTITUTE

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

**RESOLVED**, that the Energy Commission approves Agreement PIR-15-008 with Institute of Gas Technology dba Gas Technology Institute for a \$1,000,000 grant to integrate and demonstrate a production intent 6.7 liter medium-duty natural gas engine that will be capable of meeting future CARB on-road heavy-duty vehicle emission requirements); 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 March 9, 2016.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

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Tiffani Winter,  
Secretariat