STATE OF CALIFORNIA

GRANTS/CONTINGENT AWARD REQUEST

CEC-270 (Revised 02/10) CALIFORNIA ENERGY COMMISSION

To: Grants and Loans Office Date: 2/28/2013

Project Manager: Reynaldo Gonzalez Phone Number: 916-327-1334

Office: Energy Generation Research Office Division: Energy Research and Development MS- 43

Project Title: Advanced 6.7 Liter Natural Gas Engine Development

Type of Request: *(check one)*

☒ **New Agreement:** *(include items A-F from below)* Agreement Number: PIR-12-017

Program: PIER NG / Transportation

Solicitation Name and/or Number: PON-12-504-09 (Research and Development of Advanced Natural Gas Engine concepts for Class 3 through Class 7 Fleets Operated in California)

Legal Name of Recipient: Institute of Gas Technology dba Gas Technology Institute

Recipient's Full Mailing Address: 1700 S MT PROSPECT RD.
DES PLAINES, IL 60018-1804

Recipient's Project Officer: John Pratapas Phone Number: 847-768-0820

Agreement Start Date: 6/28/2013 Agreement End Date: 12/31/2014

☐ **Amendment :** *(Check all that apply)* Agreement Number:

- ☐ Term Extension – New End Date:
- ☐ Work Statement Revision *(include Item A from below)*
- ☐ Budget Revision *(include Item B from below)*
- ☐ Change of Scope *(include Items A – F as applicable from below)*
- ☐ Other:

ITEMS TO ATTACH WITH REQUEST:

A. Work Statement
B. Budget
C. Recipient Resolution, if applicable. (Resolution may be requested in Special Conditions if not currently available.)
D. Special Conditions, if applicable.
E. CEQA Compliance Form
F. Other Documents as applicable
- Copy of Score Sheets
- Copy of Pre-Award Correspondence
- Copy of All Other Relevant Documents

California Environmental Quality Act (CEQA)

☒ CEC finds, based on recipient's documentation in compliance with CEQA:
- ☒ Project exempt: 14 CCR section 15061(b)(3) NOE filed:
- ☐ Environmental Document prepared: NOD filed:
- ☐ Other:

☒ CEC has made CEQA finding described in CEC-280, attached

Funding Information:

*Source #1:	NG	Amount:	$ 1,000,000.00	Statute:	11-	FY:	12-13	Budget List #:	501.001F
*Source #2:		Amount:	$	Statute:		FY:		Budget List #:	
*Source #3:		Amount:	$	Statute:		FY:		Budget List #:	

If federally funded, specify federal agreement number:

*** Source Examples include ERPA, PIER-E, PIER-NG, FED, GRDA, ARFVT, OTHER.**

Business Meeting Approval: *(refer to Business Meeting Schedule)*

Proposed Business Meeting Date: 5/8/2013 ☐ Consent ☒ Discussion

Business Meeting Participant: Pilar Magana Time Needed: 5 minutes

Agenda Notice Statement: *(state purpose in layperson terms)*

Possible approval of a ☒ Grant / ☐ Contingent Award to…

Approve agreement PIR-12-017with the Institute of Gas Technology for $1,000,000 to develop and prototype test an ultra-low emission, high performance, best-in-class fuel economy, 6.7 Liter natural gas engine suitable for Class 3 through 7 vehicle applications. The Agreement term is 18 months. (PIER Natural Gas funding)
Contact : Rey Gonzalez. (5 minutes.)

Project Manager	Date	Office Manager	Date	Deputy Director	Date

Exhibit A
WORK STATEMENT

TECHNICAL TASK LIST

Task #	CPR	Task Name
1	N/A	Administration
2		Pre-Alpha Engine Testing
3		Alpha Engine Design and Build
4	X	Alpha Validation Testing and Preliminary Beta Design
5		Data Collection Plan
6		Technology Transfer Activities
7		Production Readiness Plan

KEY NAME LIST

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
1	John Pratapas - GTI		
2		Cummins Westport, Inc.	
3			
4			
5			
6			
7			

GLOSSARY

Term/Acronym	Definition
CAD	Computer Assisted Design
CARB	California Air Resources Board
CH_4	Methane
CO_2	Carbon Dioxide
CO	Carbon Monoxide
CPM	Commission Project Manager
CPR	Critical Project Review
CWI	Cummins Westport Inc
EPA	Environmental Protection Agency
EGR	Exhaust Gas Recirculation
g/bhp-hr	Grams per break horse power-hour
GHG	Greenhouse Gas
Hp	Horsepower
INSITE	Microsoft Windows™ based electronic service diagnostic program

Term/Acronym	Definition
	that allows troubleshooting of Cummins electronic engines.
LBSI	Lean Burn Spark Ignition
N_2O	Nitrous Oxide
NMHC	Non-methane Hydrocarbons
NOx	Oxides of Nitrogen
OEM	Original Equipment Manufacturer
PIER	Public Interest Energy Research
PM	Particulate Matter
RD&D	Research, Development and Demonstration
TWC	Three Way Catalyst
SI	Spark Ignited
SESI	Stoichiometric, EGR, Spark Ignition
Stoichiometric	Ideal combustion whereby fuel and oxygen are completely consumed with no excess of either at the completion of combustion

Problem Statement:
The market demand for natural gas-powered commercial vehicles has increased significantly in recent years. However, the ability to sustain expanded natural gas market penetration is currently constrained by the unavailability of certain matching engine sizes and performance ratings. The range of medium and heavy-duty natural gas engines available to the North American commercial vehicle market is not as comprehensive as the range of diesel engines, for which there is a comprehensive product line of medium and heavy-duty diesel engines over a broad range of engine displacement, power, and torque.

Specifically, there are limited natural gas engines available that are ideally 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. These market segments typically use 6 to 8 liter diesel engines, with a typical ratings range from 200 to 300 hp, and 500 to 750 lb-ft peak torque.

In certain cases such as yard tractors and rear-engine, transit-bus style, Type D school buses, Original Equipment Manufacturers (OEMs) and end-users have elected to use larger engines such as Cummins Westport, Inc.'s (CWI's) 8.9 liter ISL G engine in order to enable partial natural gas engine penetration. However, these vehicles are typically larger and more expensive than the vehicle models typically used in the Class 3 through 7 target markets, and as a result may not be cost-effective for the majority of customers in the target markets. In the majority of cases, installing larger engines is not possible due to physical packaging constraints in the engine bays of the vehicles typically used in these applications.

The ability to maximize natural gas penetration in these markets is compromised by the lack of a natural gas engine technology with the required combination of attributes to satisfy customer requirements for these vehicles. To address the shortage of natural

gas products available to the California commercial vehicle market and to optimize the performance and fuel economy of spark-ignited natural gas engines in Class 5 through 7 truck & bus applications, this project proposes to develop a low-emission, high performance, high efficiency, 6.7 liter natural gas engine. CWI will apply its stoichiometric, exhaust gas recirculation, spark ignition (SESI) technology to the Cummins ISB6.7 diesel engine platform.

Developing this new engine based on the Cummins ISB6.7 diesel engine provides a common platform for diesel and natural gas engine products in the California and North American medium-duty truck market for many years to come. The market penetration of natural gas engines for commercial vehicle applications is greatly enhanced by having common diesel and natural gas base engine platforms. Common base engine platforms enable vehicle OEMs to minimize costs to integrate natural gas engines into their vehicles, by leveraging their diesel engine integration work. Minimizing OEM installation costs enables lower vehicle cost and price, leading to increased OEM availability of natural gas engines and enabling further natural gas penetration in medium-duty commercial vehicle markets.

Goals of the Agreement:
The goal of this Agreement is to design, develop, and demonstrate a pre-commercial spark-ignited natural gas engine with ultra low emissions, high performance, and best in class fuel economy in specific Class 5 through 7 truck and bus duty cycles. The emissions, performance, and fuel economy benefits will be achieved by applying CWI's SESI technology to the Cummins ISB6.7 diesel engine platform. In accordance with the Cummins-prescribed process for early stage technology development, performance will be demonstrated via engine dynamometer testing and vehicle performance simulation modeling.

Objectives of the Agreement:
The objectives of this Agreement are to:

- Design, develop, and demonstrate (on dynamometer) an Alpha stage 6.7 liter medium-duty natural gas engine that can be certified at or below U.S. Environmental Protection Agency (EPA) / California Air Resources Board (CARB) 2013 emission standards grams per break horse power-hour (g/bhp-hr): 0.20 NO_x, 0.14 Non-methane Hydrocarbons (NMHC), 0.01 PM, 15.5 CO.
- Demonstrate a peak rating of 260 hp and 660 lb.-ft. peak torque.
- Improve fuel economy by 5 to 10% when compared to CWI's 5.9 liter lean burn spark ignition natural gas engine sold in the North American market through 2009. This assessment will be measured by analyzing fuel maps over specific Class 5 through 7 truck and school bus duty cycles.
- Demonstrate greenhouse gas (GHG) emissions (CO_2, CH_4 and N_2O) that will enable emission certification at or below the U.S. EPA 2017 GHG emission standards.

TASK 1 ADMINISTRATION

Instructions for Submitting Electronic Files and Developing Software

Electronic File Format
The Recipient will deliver an electronic copy (CD ROM or memory stick or as otherwise specified by the Commission Project Manager (CPM) of the full text of any Agreement products in a compatible version of Microsoft Word (.doc).

The following describes the accepted formats of electronic data and documents provided to the Energy Commission as products and establishes the computer platforms, operating systems, and software versions that will be required to review and approve all software deliverables.

- Data sets will be in Microsoft (MS) Access or MS Excel file format.
- PC-based text documents will be in MS Word file format.
- Documents intended for public distribution will be in PDF file format, with the native file format provided as well.
- Project management documents will be in MS Project file format.

Software Application Development
If this Scope of Work includes any software application development, including but not limited to databases, websites, models, or modeling tools, the Recipient will use the following standard Application Architecture components in compatible versions:

- 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 Energy Commission's Information Technology Services Branch.

Task 1.1 Attend Kick-off Meeting

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

The Recipient shall:

- Attend a "Kick-Off" meeting with the CPM, the Grants Officer, and a representative of the Accounting Office. The Recipient shall bring its Project Manager, Agreement Administrator, Accounting Officer, and others designated by the CPM to this meeting. The administrative and technical aspects of this Agreement will be discussed at the meeting. Prior to the kick-off meeting, the CPM will provide an agenda to all potential meeting participants.

  The administrative portion of the meeting shall include, but not be limited to, the following:
  - Discussion of the terms and conditions of the Agreement
  - Discussion of Critical Project Review (Task 1.2)
  - Match fund documentation (Task 1.6) *No work may be performed until this documentation is in place.*
  - Permit documentation (Task 1.7)
  - Discussion of subcontracts needed to carry out project (Task 1.8)

  The technical portion of the meeting shall include, but not be limited to, the following:
  - The CPM's expectations for accomplishing tasks described in the Scope of Work
  - An updated Schedule of Products
  - Discussion of Progress Reports (Task 1.4)
  - Discussion of Technical Products (Product Guidelines located in Section 5 of the Terms and Conditions)
  - Discussion of the Final Report (Task 1.5)

  The CPM shall designate the date and location of this meeting.

- Submit an updated Schedule of Products, List of Match Funds, and List of Permits to the CPM.

Recipient Products:

- Updated Schedule of Products
- Updated List of Match Funds
- Updated List of Permits

Commission Project Manager Product:

- Kick-Off Meeting Agenda

Task 1.2 Critical Project Review (CPR) Meetings

The goal of this task is to determine if the project should continue to receive Energy Commission funding to complete this Agreement and to identify any needed modifications to the tasks, products, schedule, or budget.

CPRs provide the opportunity for frank discussions between the CPM and the Recipient. The CPM may schedule CPRs as necessary, and CPR costs will be borne by the Recipient.

Participants include the CPM and the Recipient, and may include the Commission Grants Officer, the Energy Research and Development Division technical lead, other Energy Commission staff and Management, and any other individuals selected by the CPM to provide support to the Energy Commission.

The Commission Project Manager shall:

- Determine the location, date, and time of each CPR meeting with the Recipient. These 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 Commission Project Manager.
- Send the Recipient the agenda and a list of expected participants in advance of each CPR. If applicable, the agenda shall include a discussion of both match funding and permits.
- Conduct and make a record of each CPR meeting. One of the outcomes of this meeting will be a schedule for providing the written determination described below.
- Determine whether to continue the project, and if so whether modifications are needed to the tasks, schedule, products, and/or budget for the remainder of the Agreement. If the CPM 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 written determination in accordance with the schedule. The written response may include a requirement for the Recipient to revise one or more products that were included in the CPR.

The Recipient shall:

- Prepare a CPR Report for each CPR that discusses the progress of the Agreement toward achieving its goals and objectives. This report shall include recommendations and conclusions regarding continued work on the project. This report shall be submitted along with any other products identified in this Scope of Work. The Recipient shall submit these documents to the CPM and any other designated reviewers at least 15 working days in advance of each CPR meeting.
- Present the required information at each CPR meeting and participate in a discussion about the Agreement.

Commission Project Manager Products:

- Agenda and a list of expected participants
- Schedule for written determination
- Written determination

Recipient Product:

- CPR Report(s)

Task 1.3 Final Meeting

The goal of this task is to close out this Agreement.

The Recipient shall:

- Meet with Energy Commission staff to present the project findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement.

  This meeting will be attended by, at a minimum, the Recipient, the Commission Grants Office Officer, and the CPM. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the discretion of the CPM.

  The technical portion of the meeting shall involve the presentation of an assessment of the degree to which project and task goals and objectives were achieved, in addition to findings, conclusions, recommended next steps (if any) for the Agreement, and recommendations for improvements. The CPM will determine the appropriate meeting participants.

  The administrative portion of the meeting shall involve a discussion with the CPM and the Grants Officer about the following Agreement closeout items:
  - Disposition of any equipment purchased with Energy Commission funds
  - Energy Commission's request for specific "generated" data (not already provided in Agreement products)
  - Need to document Recipient's disclosure of "subject inventions" developed under the Agreement
  - "Surviving" Agreement provisions
  - Final invoicing and release of retention
- Prepare written documentation of any agreements made between the Recipient and Commission staff during the meeting.
- Prepare a schedule for completing the closeout activities for this Agreement.

Products:

- Written documentation of meeting agreements
- Schedule for completing closeout activities

Task 1.4 Monthly Progress Reports

The goal of this task is to periodically verify that satisfactory and continued progress is made towards achieving the research objectives of this Agreement on time and within budget.

The objectives of this task are to summarize activities performed during the reporting period, to identify activities planned for the next reporting period, to identify issues that may affect performance and expenditures, and to form the basis for determining whether invoices are consistent with work performed.

The Recipient shall:

- Prepare a Monthly Progress Report that summarizes all Agreement activities conducted by the Recipient for the reporting period, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. Each progress report is due to the CPM within 10 days of the end of the reporting period. The recommended specifications for each progress report are contained in the Terms and Conditions of this Agreement.
- In each Monthly Progress Report and invoice, document and verify:
  - Energy Commission funds received by California-Based Entities (CBEs);
  - Energy Commission funds spent in California; and
  - Match fund expenditures

- Also provide synopsis of project progress.

Product:

- Monthly Progress Reports

Task 1.5 Final Report

The goal of the Final Report is to assess the project's success in achieving its goals and objectives, advancing science and technology, and providing energy-related and other benefits to California.

The objectives of the Final Report are to clearly and completely describe the project's purpose, approach, activities performed, results, and advancements in science and technology; to present a public assessment of the success of the project as measured by the degree to which goals and objectives were achieved; to make insightful

observations based on results obtained; to draw conclusions; and to make recommendations for further projects and improvements.

The Final Report shall be a public document. If the Recipient has obtained confidential status from the Energy Commission and will also prepare a confidential version of the Final Report, the Recipient shall perform the following activities for both the public and confidential versions of the Final Report.

The Recipient shall:

- Prepare an Outline of the Final Report.
- Prepare a Final Report following the approved outline and the latest version of the Final Report guidelines which will be provided by the CPM. The CPM shall provide written comments on the Draft Final Report within 15 working days of receipt. The Final Report must be completed at least 90 days before the end of the Agreement Term.
- Submit one bound copy of the Final Report with the final invoice.

Products:

- Draft Outline of the Final Report
- Final Outline of the Final Report
- Draft Final Report
- Final Report

Task 1.6 Identify and Obtain Match Funds

The goal of this task is to ensure that the match funds planned for this Agreement are obtained and applied to this Agreement during the term of this Agreement.

The costs to obtain and document match fund commitments are not reimbursable through this Agreement. Although the Energy Commission budget for this task will be zero dollars, the Recipient may utilize match funds for this task. Match funds shall be spent concurrently or in advance of Energy Commission funds for each task during the term of this Agreement. Match funds must be identified in writing and the associated commitments obtained before the Recipient can incur any costs for which the Recipient will request reimbursement.

The Recipient shall:

- Prepare a letter documenting the match funding committed to this Agreement and submit it to the CPM at least 2 working days prior to the kick-off meeting. 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 such 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 each cash match fund, its source (including a contact name, address and telephone number), and the task(s) to which the match funds will be applied.
- Amount of each in-kind contribution, a description, documented market or book value, its 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 shall identify its owner and provide a contact name, address, telephone number, and the address where the property is located.

- Provide a copy of the letter of commitment from an authorized representative of each source of cash match funding or in-kind contributions that these funds or contributions have been secured. For match funds provided by a grant a copy of the executed grant shall be submitted in place of a letter of commitment.
- Discuss match funds and the implications to the Agreement if they are reduced or not obtained as committed, at the kick-off meeting. 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 letter including the appropriate information to the CPM if during the course of the Agreement additional match funds are received.
- Provide a letter to the CPM within 10 days if during the course of the Agreement existing match funds are reduced. Reduction in match funds must be approved through a formal amendment to the Agreement and may trigger an additional CPR.

Products:

- A letter regarding match funds or stating that no match funds are provided
- Copy(ies) of each match fund commitment letter(s) (if applicable)
- Letter(s) for new match funds (if applicable)
- Letter that match funds were reduced (if applicable)

Task 1.7 Identify and Obtain Required Permits

The goal of this task 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. Although the Energy Commission budget for this task will be zero dollars, the Recipient shall budget match funds for any expected expenditures associated with obtaining permits. Permits must be identified in writing and obtained before the Recipient can make any expenditure for which a permit is required.

The Recipient shall:

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the CPM at least 2 working days prior to the kick-off meeting. If there are no permits required at the start of this Agreement, then state such in the letter. If it is known at the beginning of the Agreement that permits will be required during the course of the Agreement, provide in the letter:
  - A list of the permits that identifies the:
    - Type of permit
    - Name, address and telephone number of the permitting jurisdictions or lead agencies
  - The schedule the Recipient will follow in applying for and obtaining these permits.
- Discuss the list of permits and the schedule for obtaining them at the kick-off meeting and develop a timetable for submitting the updated list, schedule, and copies of the permits. The implications to the Agreement 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 the Progress Reports and will be a topic at CPR meetings.
- If during the course of the Agreement additional permits become necessary, provide an updated list of permits (including the appropriate information on each permit) and an updated schedule to the CPM.
- As permits are obtained, send a copy of each approved permit to the CPM.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the CPM within 5 working days. Either of these events may trigger an additional CPR.

Products:

- Letter documenting the permits or stating that no permits are required
- Updated list of permits as they change during the term of the Agreement (if applicable)
- Updated schedule for acquiring permits as changes occur during the term of the Agreement (if applicable)
- A copy of each approved permit (if applicable)

Task 1.8 Obtain and Execute Subcontracts

The goal of this task is to ensure quality products and to procure subcontracts required to carry out the tasks under this Agreement consistent with the terms and conditions of this Agreement and the Recipient's own procurement policies and procedures. This task will also provide the Energy Commission an opportunity to review the subcontracts to ensure that the tasks are consistent with this Agreement, and that the budgeted expenditures are reasonable and consistent with applicable cost principles.

The Recipient shall:

- Manage and coordinate subcontractor activities.
- Submit a draft of each subcontract required to conduct the work under this Agreement to the Commission Agreement Manager for review.
- Submit a final copy of the executed subcontract.
- If the Recipient decides to add new subcontractors, it shall notify the Commission Agreement Manager.

Products:

- Draft subcontracts
- Final subcontracts

TECHNICAL TASKS

TASK 2 PRE-ALPHA ENGINE TESTING

The goal of this task is to demonstrate that the pre-alpha concept engine design is functional, and to quantify the initial engine performance vs. design targets.

The Recipient shall:

- Prepare a test cell for performance testing.
- Prepare the pre-alpha engine for testing.
- Prepare a Pre-Alpha Demonstration Test Plan that includes but is not limited to: engine performance targets (e.g. power, emissions), a description of the engine tests to be conducted to validate actual performance vs. the targets, and a definition of the engine test cycles to be used in steady-state and transient engine dynamometer test cells.
- Install and operate the pre-alpha engine in an engine dynamometer test cell to obtain initial performance and emissions data relative to the project targets.
- Prepare a Pre-Alpha Engine Demonstration Report that includes but is not limited to documentation of the engine build and demonstration, including: Computer Assisted Design (CAD) models, engine photographs, engine dynamometer and rig testing duty cycles, and engine dynamometer performance and emission results.

Products:

- Pre-Alpha Demonstration Test Plan (No Draft)
- Draft Pre-Alpha Engine Demonstration Report
- Final Pre-Alpha Engine Demonstration Report

TASK 3 ALPHA ENGINE DESIGN AND BUILD

The goal of this task is to apply the knowledge gained from the pre-alpha engine operation to begin mapping and documenting the engine and engine component designs based on modeling analysis, bench tests, and engine laboratory experience. This will lead to the build of representative engines to further assess the design capability to meet targets.

The Recipient shall:

- Prepare detailed designs for engine components in order to achieve the detailed specifications for each component, including factors such as functional performance, stress analysis, weight, cost, and material selection.
- Conduct cross-functional design reviews to ensure that all new components meet the target specifications prior to releasing them into the Cummins engine and parts tracking system at a developmental phase.

- Build engines using Alpha design level hardware and sub-systems.
- Prepare an Alpha Design Report that includes documentation of the Alpha engine design, such as: CAD models, subsystem descriptions, photographs of the Alpha engine, and a description of major design changes (if any) in the Alpha design based on pre-alpha engine experience.

Products:

- Draft Alpha Design Report
- Final Alpha Design Report

TASK 4 ALPHA VALIDATION TESTING AND PRELIMINARY BETA DESIGN

The goal of this task is to conduct testing that will focus on validating the mechanical hardware, control system, ignition system, performance, and emissions aspects of the Alpha design. The design verification process includes component verification through bench and rig testing, accelerated verification through shaker rig testing, and engine dynamometer tests that stress the systems and components. These include thermal variation, abuse, and accelerated endurance and overstress tests.

The Recipient shall:

- Perform engine and rig testing to validate that the electronic control and ignition system (hardware, software, and calibrations) meets the requirements for commercial vehicle operation. Hardware designs (including wire harnesses, sensors, and ignition system components) will be validated and upgraded as required to ensure that the designs meet the installation, operation, and service-access requirements for commercial vehicles.
- Develop software and calibration to create, validate, and release the full electronic feature set defined in consultation with prospective OEM and end-user customers. This task includes integrating the ISB6.7 G engine into INSITE, the Cummins electronic service tool used by service technicians to interface with all Cummins and CWI engines.
- Refine the preliminary engine combustion, performance, and emissions strategies developed in Task 2, in preparation for emission certification and product launch. This task will include developing a comprehensive suite of performance ratings in order to suit a wide range of vehicles, transmissions, and driveline components typically used in the target market segments.
- Perform extensive calibration development and engine testing in an engine dynamometer test cell. This task will include analysis and testing in conjunction with catalyst design and development experts at Cummins Emission Solutions, to confirm the Three Way Catalyst (TWC) design.
- Develop and validate the “end-of-line” engine dynamometer test cycle in preparation for validation testing of all engines, including definition of the applicable pass/fail criteria. Develop detailed fuel maps that will be used

to model the fuel efficiency of the engine with a target of achieving fuel efficiency within 15% of comparable EPA/ CARB-certified, on-highway diesel engines.

- Identify specific hardware options requiring re-design in order to optimize vehicle fit, service access, and/or engine performance based on the results of Alpha testing. Identify and quantify further improvements required for emissions reduction and/or fuel efficiency in order to achieve the product launch targets. Finally, identify performance attributes requiring further development via control system calibration improvements.
- Prepare an Alpha Validation Test Plan that: (1) defines the engine, sub-system, and component-level tests to be conducted to validate the engine; (2) includes descriptions of the engine test cycles to be used in steady-state and transient engine dynamometer test cells; and (3) includes a description of various sub-system and component tests to validate performance versus design targets and pre-determined acceptance criteria.
- Prepare a Validation and Design Report that: (1) documents the results and conclusions from Task 4, including an explanation of emissions, power, torque, fuel economy, and heat rejection data; (2) summarizes how the Alpha-level data compares to the overall project goals and pre-determined acceptance criteria; and (3) identifies areas of the engine design and performance requiring improvement and refinement during the Beta phase of the engine development program.
- Prepare a CPR Report.
- Attend a CPR meeting following the completion of all deliverables in this task (See Task 1.2).

Products:

- Alpha Validation Test Plan (No Draft)
- Draft Validation and Design Report
- Final Validation and Design Report
- CPR Report

TASK 5 DATA COLLECTION AND ANALYSIS

The goals of this task are to collect operational data, analyze the data for economic and environmental impacts, and include the data and analysis in the Final Report.

The Recipient shall:

- Develop a data collection test plan to be included in the Final Report. The plan will include but is not limited to a discussion of the following:
  - Energy savings and estimated cost savings
  - Greenhouse gas reductions
  - Other non-energy benefits
- Provide data on potential job creation, market potential, economic development, and increased state revenue as a result of expected future expansion.
- Provide an estimate of the project's energy savings and other benefits and potential statewide energy savings once market potential has been realized.
- Compare project performance and expectations provided in the proposal with actual project performance and accomplishments.
  Prepare a Data Analysis Report that describes the results and conclusions from the analysis conducted in Task 5, including potential job creation, market sales, energy savings, cost savings, and GHG reductions.

Products:

- Draft Data Analysis Report
- Final Data Analysis Report

TASK 6 TECHNOLOGY TRANSFER ACTIVITIES

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

The Recipient shall:

- Prepare a Technology Transfer Plan that explains how the knowledge gained in this project will be made available to the public. The level of detail expected is least for research-related projects and highest for demonstration projects. Key elements from this report will be included in the Final Report.
- Conduct technology transfer activities in accordance with the Technology Transfer Plan. These activities will be reported in the Monthly Progress Reports.
- Indicate the intended use(s) for and users of the project results.

Products:

- Draft Technology Transfer Plan
- Final Technology Transfer Plan

TASK 7 PRODUCTION READINESS PLAN

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

The Recipient shall:

- Prepare a Draft and Final Production Readiness Plan. The degree of detail in the plan should be proportional to the complexity of producing or commercializing the proposed product and its state of development. As appropriate, the plan will include but not be limited to a discussion of 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”
  - A projected “should cost” for the product when in production
  - The expected investment threshold to launch the commercial product
  - An implementation plan to ramp up to full production

Products:

- Draft Production Readiness Plan
- Final Production Readiness Plan

STATE OF CALIFORNIA

CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) COMPLIANCE

CEC-280 (Revised 02/10) CALIFORNIA ENERGY COMMISSION

Award Number: PON-12-504 Date: 3 / 01 / 2013

Note: The Energy Commission Project Managers Manual includes detailed instructions on how to complete this section, with examples of grants that are "Projects" and are not "Projects". When the Project Manager is completing this section, if questions arise as to the appropriate answers to the questions below, please consult with the Energy Commission attorney assigned to review grants or loans for your division.

1. Is grant/loan considered a "Project" under CEQA? ☒ Yes *(skip to question #2)* ☐ No *(continue with question #1)*

   Please complete the following: *[Public Resources Code (PRC) 21065 and 14 California Code of Regulations (CCR) 15378]:*

   Explain why the grant/loan is ***not*** considered a "Project"? The grant/loan will not cause a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because grant/loan involves:

2. If grant/loan is considered a "Project" under CEQA: *(choose either **IS** or **IS NOT**)*

   ☒ Grant/loan **IS** exempt:

   ☐ Statutory Exemption: *(List PRC and/or CCR section numbers)* _____

   ☐ Categorical Exemption: *(List CCR section number)* _____

   ☒ Common Sense Exemption. *(14 CCR 15061(b)(3))*

   Explain reason why the grant/loan is exempt under the above section:

   The project involves engine development activities that will not have a significant environmental impact.

Please attach draft Notice of Exemption (NOE). Consult with the Energy Commission attorney assigned to your division for instructions on how to complete the NOE.

☐ Grant/loan **IS NOT** exempt. The Project Manager needs to consult with the Energy Commission attorney assigned to your division and the Siting Office regarding a possible initial study.