STATE OF CALIFORNIA

GRANTS/CONTINGENT AWARD REQUEST

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

To: Grants and Loans Office Date: 2/27/2013

Project Manager: David Effross Phone Number: 916-327-1314

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

Project Title: Interra Reciprocating Reactor to Produce Low-Cost Renewable Natural Gas

Type of Request: *(check one)*

☒ **New Agreement:** *(include items A-F from below)* Agreement Number: Assigned by G&L Office

Program: PIER NG / Transportation

Solicitation Name and/or Number: PON-12-506-07 (Renewable Natural Gas Transportation Fuel Production Systems with Value Added Co-Products/-Benefits)

Legal Name of Recipient: Interra Energy, Inc.

Recipient's Full Mailing Address: 6456 OSLER ST.
SAN DIEGO, CA 92111-5412

Recipient's Project Officer: Thomas Del Monte Phone Number: 858-384-2418

Agreement Start Date: 6/1/2013 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 15303 NOE filed:
- ☐ Environmental Document prepared: NOD filed:
- ☐ Other:

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

Funding Information:

*Source #1:	NG	Amount: $ 818,147.00	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: David Effross Time Needed: 5 minutes

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

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

INTERRA, INC. Possible approval of Agreement PIR-12-021 with Interra Energy, Inc. for a $818,147 grant to develop a low-cost, pyrolysis-based biomass conversion technology called the Reciprocating Reactor, which will produce renewable natural gas and biochar. The agreement will include $228,146 in match funding. (PIER natural gas funding) Contact: David Effross. (5 minutes)

Project Manager	Date	Office Manager	Date	Deputy Director	Date

Exhibit A
Scope of Work

TECHNICAL TASK LIST

Task #	CPR	Task Name
1		Administration
2		Pre-Construction
3	X	Construction
4	X	System Testing
5		Data Collection and Analysis
6		Technology Transfer Activities
7		Production Readiness Plan

KEY NAME LIST

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
1	Kenny Key – Interra		
1	Thomas Del Monte – Interra		
2	Thomas Del Monte – Interra		
2		Prof. Asfaw Beyene – SDSU	
3	Thomas Del Monte – Interra		
3		Adept Process Services, Inc.	
4	Thomas Del Monte – Interra		
4		Prof. Asfaw Beyene – SDSU	
4			SDSU – Imperial Valley Campus Renewable Energy Generation Training and Demonstration Center
5	Thomas Del Monte – Interra		
5		Prof. Asfaw Beyene - SDSU	
6	Kenny Key – Interra		
6	Thomas Del Monte – Interra		

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
6		Prof. Asfaw Beyene – SDSU	
7	Kenny Key – Interra		
7	Thomas Del Monte – Interra		

GLOSSARY

Specific terms and acronyms used throughout this scope of work are defined as follows:

Term/ Acronym	Definition
APS	Adept Process Services, Inc.
Btu	British thermal unit
CAM	Commission Agreement Manager
CPR	Critical Project Review
NO_x	Oxides of Nitrogen
RPM	Revolutions Per Minute
scf	Standard cubic foot
VFD	Variable Frequency Drive

Problem Statement:

A significant technical problem associated with all pyrolysis-based biomass conversion technologies is the low heat of reaction of pyrolysis and the resulting inability to create a thermally self-sufficient continuous reaction. Current methods of addressing this have fatal drawbacks that substantially and negatively affect the overall viability of the technology in the California market. This project will demonstrate a unique pressurized pyrolysis biomass reactor called "the Reciprocating Reactor", which will overcome these shortcomings. The Reciprocating Reactor is able to surpass a thermal efficiency threshold in biomass pyrolysis (previously thought impossible in practice) and achieve a continuous and self-sustaining biomass pyrolysis reaction without requiring combustion or oxidization reactions internally or externally by uniquely recovering the heat potential stored within the phase change of steam to liquid water. This level of thermal efficiency in biomass has been described as the "ideal carbonizing process." If successful, the demonstration of our technology will cause a paradigm-shifting change in the understanding of the boundaries of what is possible with biomass pyrolysis processing.

Goals of the Agreement:

The primary goal of this project is to demonstrate the fundamental merits of the Reciprocating Reactor's design by producing the highest quantity of biochar on an input/output basis and the highest end-quality gas on an energy density basis (btu/scf) of all publicly-known continuous feed thermochemical conversion technology, without the use of chemical catalysts, separate gas upgrading processes, external heat input, or air/oxygen injection for combustion heat makeup. Alternatively, if some air injection into the reactor is required to maintain system temperature, the goal regarding the quantity of biochar remains. The gas quality goal then changes to the very high success

probability goal of producing a fuel gas of an energy density sufficient to be directly fed into ultra-low NOx emitting microtrubine power generating units such as Capstone or FlexEnergy microturbines without chemical catalyst or external upgrading processes.

The goal of the agreement will be met by completing the construction of a demonstration size Reciprocating Reactor and testing it under cold conditions, followed by hot conditions. During the testing period, seven experiments will be carried out, including gas and biochar output yields and quality measurements.

Objectives of the Agreement:
The objectives of this project are to gather quantitative data and to verify that the system can achieve performance goals. With these technological goals met, the economic value of the technology can be fully defined. The following is the list of R&D Objectives and Performance Goals separated into cold and hot tests.

Cold Tests R&D Objectives and Technical Performance Goals:

- **R&D Objective 1:** Determine how the additional supporting weight of the inner-reactor tube and feed screw affect torsional requirements of the reciprocating auger drive system. Performance Goal 1 below will provide empirical validation of a novel modeling technique developed specifically for reciprocating augers.
  - **Performance Goal 1:** No greater required torque (from rest) than 1,650 lb*ft and no less than 1,500 lb ft under empty, cold conditions.
- **R&D Objective 2:** Determine maximum fill level of heat-exchange zone of reactor.
  - **Performance Goal 2:** Demonstrate ability to achieve at a minimum of 80% fill level of biochar in heat-exchange zone.
- **R&D Objective 3:** Determine the appropriate feed/reciprocating auger ratio under cold conditions to allow for estimation of ratio under “hot” operational conditions.
  - **Performance Goal 3:** Maintain stable (+/- 10%) feed auger-to-reciprocating auger RPM ratio while maintaining heat-exchanger fill level of at least 80% from minimum to maximum throughput conditions.
- **R&D Objective 4:** Determine the maximal bulk material particle size the system can process without a jamming or lock-up event and determining where that blockage will likely occur.
  - **Performance Goal 4:** Demonstrate ability to continuously convey bulk material of at least 4” minus without jamming under cold conditions.

Hot Tests R&D Objectives and Technical Objectives:

During hot tests, the operational variables to be tested include temperature, pressure, feedstock type, and feedstock size distribution. For temperature, 750º F, 932º F, and 1,110º F will be tested. Low, medium, and high pressure will be 1 atm, 5 atm, and 10 atm. Also, feedstock particle specs will be 6, 4, and 2 inch minus (@10% moisture on a dry basis) under the temperature and pressure permutations, making 27 total distinct operating condition regimes. Each test below will be

conducted to ensure that the Reciprocating Reactor is held steady for at least 10 minutes under all 27 operating permutations.

- **R&D Objective 5:** Determine optimal throughput rate with zero (if possible) or minimum air injection under the 27 operating permutations.
  - **Performance Goal 5:** Maintain a minimum of 7,000 lbs/hr throughput (dry basis) throughout all 27 permutations without diluting gas energy density below 270 btu/scf.
- **R&D Objective 6:** Determine gas composition variation under the 27 operating permutations.
  - **Performance Goal 6:** Maintain energy density of gas at above 270 btu/scf at all likely operational permutations.
- **R&D Objective 7:** Determine biochar yield ratio under 27 operating permutations.
  - **Performance Goal 7:** Confirm dry biochar yield at or above 35% of the weight of the biomass feedstock on a dry basis under all likely operational permutations.

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 CCM) 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 Commission Project Manager (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:
  - o 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 a 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 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-CONSTRUCTION

Task 2.1 Finalize the Procurement Budget and List

The goal of this task is to finalize the list of parts and materials, update quotes from vendors, and receive approval from the CPM prior to proceeding with procurement.

The Recipient Shall:

Obtain binding bids from all suppliers and prepare a Procurement Report that describes all parts and materials to be purchased. This document will include but not be limited to:

- Copies of binding bids
- A description of each item
- Test protocols, specifications, and codes applicable to each item
- Delivered cost quote for each item

Products:

- Procurement Report (no draft)

Task 2.2 Finalize Site Plan
The goal of this task is to finalize the construction and testing plans and how they relate to the physical location where the demonstration unit will be constructed.

The Recipient Shall:
Prepare a to-scale Site Schematic in Microsoft Visio that illustrates the location of installed equipment and testing. The Site Schematic will include snapshots of the site layout at various stages of the project, corresponding to the tasks in this document.

Products:
- Site Schematic (no draft)

Task 2.3 Approval to Proceed with Construction
The goal of this task is to gain approval to proceed with construction.

The Recipient Shall:
Provide an Approval Request for Procurement Commencement in the form of a letter that includes but is not limited to written documentation of the finalized Procurement Bill of Materials budget and the finalized Site Schematic.

Products:
- Approval Request for Procurement Commencement

TASK 3 CONSTRUCTION

Task 3.1 System Procurement, Assembly, and Fabrication
The goals of this task are to procure the parts necessary to build the Reciprocating Reactor, fabricate any needed parts, and assemble the parts.

Task 3.1.1 Parts Procurement and Payment Request Form

The Recipient Shall:
- Use the approved Procurement Report to procure all parts and equipment. Procurement will involve arrangement for their shipment to/collection at the APS industrial yard.
- Prepare a Final List of Procured Parts and Equipment.

Products:
- Final List of Procured Parts and Equipment

Task 3.1.2 Fabrication and Subsystem Assembly
The goal of this task is to fabricate all necessary parts and assemble all subsystems.

The Recipient Shall:

- Fabricate all pieces needing fabrication, assemble the structure Reciprocating Reactor assembly for Experiments 1-3 (see Task 4.2), and install a Variable Frequency Drive (VFD).
- Complete final assembly after Experiment 3 (see Task 4.2).
- Obtain pictures of all assembled parts and systems for inclusion in the CPR Report.

Products:

- Pictures of all assembled parts and systems (to be included in the CPR Report)

Task 3.2 - System Installations and Commissioning

The goal of this task is to fully install and commission the demonstration unit.

The Recipient Shall:

- Install the subsystems into their final demonstration configurations, including:
  - Mechanical and Electrical Infrastructure
  - Major System Installs (Forge, Ancillary, Upgrading, Analyzing)
  - Electrical Supply
  - Instrumentation and Control
- Produce documentation of the final demonstration unit in the form of videos and pictures, for inclusion in the CPR Report.

Products:

- Video and picture documentation of installation (to be included in the CPR Report)

TASK 4 SYSTEM TESTING

Task 4.1 Test Preparation

The goal of this task is to organize the team and supplies in preparation for conducting experiments known as Cold Testing and Hot Testing.

Task 4.1.1 System Commissioning/Finalize Cold Tests Plan and Schedule/Procure Testing Supplies

The goals of this task are to start and run the Reciprocating Reactor system for at least three hours, finalize the Cold Tests Plan and the Hot Tests Plan and schedules, and to procure testing supplies.

The Recipient Shall:

- Conduct a hot run of the system.
- Produce a Cold Test Plan that includes a schedule and description of all planned tests.
- Mount a large white board visible at the demonstration location. The plan and schedule will be written on the white board.

- Prepare a Cold Tests Plant Report that includes a schedule and explication of all planned tests
- Procure and arrange for delivery of small batches of wood chips corresponding to 2”, 3”, 4”, 5”, 6” and 7” minus specs for the Cold Tests.
- Arrange for delivery of large orders of wood chips at three staggered times, in the sizes of 2”, 4”, and 6” minus specs for the Hot Tests.
- Create biochar for testing heat-exchange zone fill rates.
- Produce video and pictures documenting hot test, cold test, and biochar creation, for inclusion in the CPR Report.

Products:
- Cold Tests Plan Report (no draft)
- Video and picture documentation to be included in CPR

Task 4.1.2 System “Shake Down” Tests/Runs
The goals of this task are to start up the Reciprocating Reactor, train the team on its safe operation, and run diagnostic tests to ensure proper operation prior to starting Hot Tests.

The Recipient Shall:
- Start up the system to full operating conditions and finalize the procedure for its operation.
- Conduct diagnostic tests.
- Prepare a Final Start-up, Operation, and Shut–down Procedures Report
- Train the team on the safe operation of the Reciprocating Reactor.

Products:
- Final Start-up, Operation, and Shut–down Procedures Report (no draft)

Task 4.1.3 Refine System Controls
The goal of this task is to make any necessary modifications, additions, or subtractions to the control system.

The Recipient Shall:
- While conducting the Shake Down runs, determine whether any refinements need to be made to the control system and instrumentation, and implement those refinements if necessary.
- Prepare an Implemented Refinements to Control System and Instrumentation Report that describes and explains all implemented changes and refinements.

Products:
- Implemented Refinements to Control System and Instrumentation Report (no draft)

Task 4.2 Conduct Test Schedules
The goal of this task is to conduct the Experiments 1-7, as described below.

The Recipient Shall:

- Conduct Experiments 1 through 7:
    1. Auger Horsepower Baselines when Empty: This is an experiment to determine proper calibrations of the VFD.
    2. Inner Reactor RPM-to-Throughput Curve: This tests the ability of the various components to work with each other for optimum productivity.
    3. Assembled Reciprocating Reactor Horsepower when Empty: This is an experiment to ensure that the unit can be started from the stopped position and can maintain a steady RPM.
    4. Solids Velocity in Turnaround and Heat-Exchange Zones: This tests the ability of the unit to stop and come back on line.
    5. Determining Upper and Lower Bounds of Auger RPM Ratios: This experiment determines the maximum augur speeds.
    6. Maximum Particle Size and Discovering "Pinch Points": This experiment determines the maximum particle size that can be fed into the unit, and identifies bottlenecks in the system flow. If no failure events occur at the 4" minus bulk material spec, Performance Goal 4 is achieved.
    7. Twenty-Seven Operational Conditions: This experiment collects operational data on three different sizes of wood chips, under three different temperatures and three different pressures. All of the permutations together equal twenty seven.

- Prepare and submit a Test Experiments Report that includes experiment results and conclusions, along with a discussion of whether the Technical Performance Goals listed in pages 3 through 4 of this Scope of Work were achieved.

Products:

- Test Experiments Report (no draft)

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 based on input from the CPM. The plan will include but not limited to a discussion of the following:
    - Energy savings and estimated cost savings
    - Greenhouse gas reductions
    - Other non-energy benefits

- Provide data on quality of gas (Btu/scf) quantity of biochar (input/output) overall project economics and environmental impacts (e.g., air quality, waste and water)
- 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 to actual project performance and accomplishments with a discussion of whether the Performance Goals stated in the Goal Section were achieved.
- Prepare a Data Analysis Report that includes all of the information in the Recipient Shall section, as a minimum.

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 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. 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: PIR-12-021 Date: 3 / 1 / 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)* 14 CCR 15303

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

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

   The project involves the fabrication, installation, and testing of a pyrolysis-based biomass conversion technology.

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.