

GRANTS/CONTINGENT AWARD REQUEST



To: Grants and Loans Office

Date: 4/10/2012

Project Manager: Anish Gautam

Phone Number: 916-327-2382

Office: Energy Efficiency Research Office

Division: Energy Research and Development

MS- 43

Project Title: Algae-based Treatment of Dairy Wastewater & Generation of Renewable Energy

Type of Request: (check one)

**New Agreement:** (include items A-F from below) Agreement Number: PIR-11-032

Program: PIER NG / Industrial/ Ag/ Water

Solicitation Name and/or Number: PON-11-501-79 (2011 Emerging Technology Demonstration Grant Program (ETDG II))

Legal Name of Recipient: Quantitative BioSciences, Inc

Recipient's Full Mailing Address: 1330 CAMINO DEL MAR  
DEL MAR, CA 92014-2508

Recipient's Project Officer: Natalie Cookson Phone Number: 858-344-7490

Agreement Start Date: 6/29/2012 Agreement End Date: 3/31/2015

**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 15306 NOE filed: to be filed within 10 days of the Business Meeting date

Environmental Document prepared: \_\_\_\_\_ NOD filed: \_\_\_\_\_

Other: \_\_\_\_\_

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

Funding Information:

*Source #1: <u>NG</u>	Amount: <u>\$ 511,996.00</u>	Statute: <u>10-</u>	FY: <u>11-12</u>	Budget List #: <u>501.001E</u>
*Source #2: <u>PIER-NG</u>	Amount: <u>\$ 988,004.00</u>	Statute: <u>11-</u>	FY: <u>11-12</u>	Budget List #: <u>501.001F</u>
*Source #3: _____	Amount: <u>\$ _____</u>	Statute: <u>_____</u>	FY: <u>_____</u>	Budget List #: <u>_____</u>

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: 6/13/2012  Consent  Discussion

Business Meeting Participant: Anish Gautam Time Needed: 5 minutes

Agenda Notice Statement: (state purpose in layperson terms)

Possible approval of a  Grant /  Contingent Award to...

Possible approval of Agreement PIR-11-032 for a grant of \$1,500,000.00 to Quantitative BioSciences, Inc to develop and demonstrate a simple and affordable "turnkey" algae based waste treatment method for California dairies that will produce energy, save water, and reduce greenhouse gas emissions. This project includes \$860,000 in match funding. (PIER natural gas funding) Contact: Anish Gautam. (5 minutes)

## Exhibit A WORK STATEMENT

### WORK STATEMENT

#### TECHNICAL TASK LIST

Task #	CPR	Task Name
1	N/A	Administration
2		Project Initiation
3		Planning and Design
4	X	Construction
5		Test Plan Preparation
6		Testing and Initial Operation
7	X	Performance Evaluation
8		Generalization for Transferability and Documentation
9		Technology Transfer Activities
10		Production Readiness Plan

#### GLOSSARY

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

Term/ Acronym	Definition
AESC	Alternative Energy Systems Consulting
Algae	Photosynthetic organisms that convert sunlight and carbon dioxide to energy
COD	Chemical oxygen demand
CPR	Critical Project Review
M&V	Measurement and Verification
PIER	Public Interest Energy Research
QBI	Quantitative BioSciences, Inc.
RD&D	Research, Development and Demonstration
TSS	Total suspended solids
VO	Van Ommering
VSS	Volatile Suspended Solids

#### Problem Statement:

Untreated wastewater is a largely untapped resource, as it contains almost 10 times more energy than is required to treat it. This project aims to replace the common lagoon approach to agricultural waste treatment with a more energy efficient algae-based system. The current “state-of-the-art” involves transferring liquid manure to a lagoon, and after an acceptable amount of time is allowed to be directly used for crop irrigation. While this approach is inexpensive, it has several shortcomings. Not only are large amounts of greenhouse gases released to the environment, but the waste is often insufficiently treated creating harmful runoff with high levels of nitrogen and phosphorus. In the context of energy efficiency, discarding partially treated waste is discarding potential energy.

## **Exhibit A WORK STATEMENT**

Algae provides an attractive alternative to traditional treatment methods, as an advanced pond system can greatly reduce the cost of proper treatment, increase water quality, reduce greenhouse gas emissions, and generate valuable renewable energy and biomass. Utilizing an algae-based system for waste treatment is a very well studied idea, but the technology has yet to be demonstrated at an agriculturally relevant scale in the US and currently is not commercially available. There are a few municipal waste treatment plants in the US that employ algae technology, such as the St. Helena, CA Treatment Center, but the system has not been optimized and there have not been any research and development (R&D) efforts aimed at improving the process.

The primary barriers to the adoption of this technology are scientific and market related. While the science has been around for decades proving the fundamental benefit of algae for wastewater treatment, the details of the setup, the growth of the algae, and the ultimate use of the biomass in a profitable manner, need to be demonstrated. The generation of large amounts of algae biomass has the potential to be a major economical boost to a farm employing this technology, but so far this aspect of the technology has not been developed.

From a market standpoint, the use of algae to enhance wastewater treatment is simply not available in an easy-to-install and low maintenance package.

### **Goals of the Agreement:**

The goal of this agreement is to develop a demonstration "turnkey" algae waste-water facility. The simple and affordable "turnkey" algae waste-treatment facility should be able to replace the existing lagoon approach to waste treatment on farms. The implementation of these advanced pond systems will be economical and profitable for the agricultural industry, as farms will be able to support higher value crops, offset energy expenses, and use or sell the resulting nutrient-rich algae biomass. The technology will produce energy, save water, and reduce the emission of greenhouse gasses.

### **Objectives of the Agreement:**

The objectives of this agreement are to develop an algae wastewater treatment system that improves the quality of water beyond the traditional approach, reduces greenhouse gas emissions, and produces energy. Water quality testing will be accomplished with standard equipment and the U.S. Environmental Protection Agency approved testing kits, and energy generation will be performed on-site with an existing generator that will provide data on the exact amount of energy that can be produced per volume of waste.

## **TASK 1 ADMINISTRATION**

### **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.

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### **The Recipient shall:**

- Attend a “Kick-Off” meeting with the California Energy Commission (Energy Commission) Project Manager, 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 Energy Commission Project Manager to this meeting. The administrative and technical aspects of this Agreement will be discussed at the meeting. Prior to the kick-off meeting, the Energy Commission Project Manager 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)
- Permit documentation (Task 1.7)

The technical portion of the meeting shall include, but not be limited to, the following:

- The Energy Commission Project Manager’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 Energy Commission Project Manager shall:**

- Designate the date and location of this meeting.

### **Recipient Products:**

- Updated Schedule of Products (no draft)
- Updated List of Match Funds (no draft)
- Updated List of Permits (no draft)

### **Energy Commission Project Manager Product:**

- Kick-Off Meeting Agenda (no draft)

### **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.

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CPRs provide the opportunity for frank discussions between the Energy Commission and the Recipient. CPRs generally take place at key, predetermined points in the Agreement, as determined by the Energy Commission Project Manager and as shown in the Technical Task List above. However, the Energy Commission Project Manager may schedule additional CPRs as necessary, and any additional costs will be borne by the Recipient.

Participants include the Energy Commission Project Manager and the Recipient and may include the Energy Commission Grants Officer, the Public Interest Energy Research (PIER) Program Team Lead, other Energy Commission staff and Management as well as other individuals selected by the Energy Commission Project Manager to provide support to the Energy Commission.

### **The Energy 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.
- Send the Recipient the agenda and a list of expected participants in advance of each CPR. If applicable, the agenda shall include a discussion on 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 continuing, whether or not modifications are needed to the tasks, schedule, products, and/or budget for the remainder of the Agreement. Modifications to the Agreement may require a formal amendment (please see the Terms and Conditions).
- 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 product(s) 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 of the projects. This report shall be submitted along with any other products identified in this scope of work. The Recipient shall submit these documents to the Energy Commission Project Manager 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.

# **Exhibit A WORK STATEMENT**

## **Energy Commission Project Manager Products:**

- Agenda and a list of expected participants (no draft)
- Schedule for written determination (no draft)
- Written determination (no draft)

## **Recipient Product:**

- CPR Report(s) (no draft)

## **Task 1.3 Final Meeting**

The goal of this task is to closeout this Agreement.

### **The Recipient shall:**

- Meet with Energy Commission staff to present the 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 Energy Commission Grants Office Officer, and the Energy Commission Project Manager. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be two separate meetings at the discretion of the Energy Commission Project Manager.

The technical portion of the meeting shall present an assessment of the degree to which project and task goals and objectives were achieved, findings, conclusions, recommended next steps (if any) for the Agreement, and recommendations for improvements. The Energy Commission Project Manager will determine the appropriate meeting participants.

The administrative portion of the meeting shall be a discussion with the Energy Commission Project Manager and the Grants Officer about the following Agreement closeout items:

- What to do with any equipment purchased with Energy Commission funds (Options)
- 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, such as repayment provisions and confidential Products
- Final invoicing and release of retention
- Prepare a schedule for completing the closeout activities for this Agreement

## **Exhibit A WORK STATEMENT**

### **Products:**

- Written documentation of meeting agreements (no draft)
- Schedule for completing closeout activities (no draft)
- CD or flash drive containing all products from this Agreement

### **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 which 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 Energy Commission Project Manager within 10 days of the end of the reporting period. The recommended specifications for each progress report are contained in Exhibit A, Attachment A-2.

### **Product:**

- Monthly Progress Reports (no draft)

### **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 RD&D projects and improvements to the PIER project management processes.

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

## **Exhibit A WORK STATEMENT**

### **The Recipient shall:**

- Prepare an Outline of the Final Report.
- Prepare a Final Report following the approved outline and the latest version of the PIER Final Report guidelines published on the Energy Commission's website at <http://www.energy.ca.gov/contracts/pier/contractors/index.html> at the time the Recipient begins performing this task, unless otherwise instructed in writing by the Energy Commission Project Manager. Instead of the timeframe listed in the Product Guidelines located in Section 5 of the Terms and Conditions, the Energy Commission Project Manager shall provide written comments on the Draft Final Report within fifteen (15) working days of receipt. The Final Report must be completed on or 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 Matching Funds**

The goal of this task is to ensure that the match funds planned for this Agreement are obtained for 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 PIER 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 PIER 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 Energy Commission Project Manager 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

## **Exhibit A WORK STATEMENT**

- match funds will be applied
- Amount of each in-kind contribution, a description, documented market or book value, and 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 and 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.
- 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 the appropriate information to the Energy Commission Project Manager if during the course of the Agreement additional match funds are received.
- Notify the Energy Commission Project Manager 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 (no draft)
- Copy(ies) of each match fund commitment letter(s) (if applicable) (no draft)
- Letter(s) for new match funds (if applicable) (no draft)
- Letter that match funds were reduced (if applicable) (no draft)

### **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 PIER 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 expenditures for which a permit is required.

## **Exhibit A WORK STATEMENT**

### **The Recipient shall:**

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the Energy Commission Project Manager 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 the 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 the appropriate information on each permit and an updated schedule to the Energy Commission Project Manager.
- As permits are obtained, send a copy of each approved permit to the Energy Commission Project Manager.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the Energy Commission Project Manager within 10 days. Either of these events may trigger an additional CPR.

### **Products:**

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

## **TECHNICAL TASKS**

### **TASK 2 PROJECT INITIATION**

#### **Task 2.1 Demonstration Site Verification**

The goal of this task is to verify that the proposed demonstration site can still host the project, or secure a new demonstration site in a California Investor Owned Utility Service Area.

## **Exhibit A WORK STATEMENT**

### **The Recipient shall:**

- Meet with the Van Ommerings (VO) Dairy owners to finalize collaboration plans. Otherwise, secure a new host demonstration site to replace VO Dairy.
- Draw up written final plans for the placement of demonstration wastewater treatment system with all required components and its tie-in to existing machinery on project demonstration site, the schedule and project duration.
- Verify the availability of the VO Dairy owners as well as their staff to help with the construction of the ponds required for the system.

### **Product:**

- Copy of agreement between Recipient and the project demonstration site

### **Task 2.2 Confirm the Measurement & Verification Vendor**

The goal of this task is to confirm the Measurement & Verification (M&V) vendor for the project, or else obtaining a new vendor. The Recipient will work with Alternative Energy Systems Consulting (AESC), a local energy solutions company, to conduct the required measurement and verification evaluation equivalent to California investor-owned utility standards.

### **The Recipient shall:**

- Contact AESC and develop with an itinerary and schedule for the M&V Plan.
- If AESC should become unwilling or unable to perform the M&V for the project, contact other local companies to solidify a partnership for M&V.

### **Product:**

- Copy of agreement with AESC or alternative company

### **Task 2.3 Determine Need to Employ Contingency Plans**

The goal of this task is to ensure that all aspects of the project are progressing according to plan.

### **The Recipient shall:**

- Meet with the VO/demonstration site staff to ensure that the state of the waste management is not significantly altered or that any changes are documented and can be worked into the design of the new system.
- Ensure that permit regulations and construction rules have remained consistent and resolve any new issues that arise related to carrying out the project.
- Secure all required permits per Task 1.7.
- Write and submit confirmation letter(s) to Commission Project Manager affirming that all aspects of the project are as planned or that any issues have been resolved.

# **Exhibit A WORK STATEMENT**

**Product:**

- Copies of Permits
- Written Confirmation Letter(s)

## **TASK 3 PLANNING AND DESIGN**

### **Task 3.1 Site Selection**

The goal of this task is to determine the exact location and layout of the advanced pond system to be constructed and operated on the VO/Demonstration Host Dairy.

**The Recipient shall:**

- Determine Site Selection Details for the field test site including, but not limited to:
  - Precise locations of each pond, including their connections to each other
  - The required distance between ponds to enable accessibility
  - The location of the control system and its connectivity to each component
- Provide copies of the agreement between the Recipient and the Demonstration Host Dairy to the Commission Project Manager.

**Product:**

- Copies of agreement between the Recipient and the Demonstration Host Dairy

### **Task 3.2 Finalize Pond Design Parameters**

The goal of this task is to precisely calculate the required dimensions of each pond to accommodate the full waste load of the VO Dairy/Demonstration Host Dairy.

**The Recipient shall:**

- Determine the parameters required for each of the four ponds:
  - Anaerobic Pond: a 5 meter deep, square pond that promotes sedimentation and anaerobic breakdown of waste, and enables removal of the settled sludge. This pond will be covered to capture the biogas produced during the waste breakdown process, and will be piped through the algae pond and then to the on-site generator to be converted cleanly to electricity.
  - High Rate Pond: a shallow, paddle wheel-mixed raceway pond that promotes algae growth for the uptake of nutrients and release of oxygen to reduce biological oxygen demand, a critical measure of organic matter in waste.
  - Algae Settling Pond: 2 meter deep, unmixed pond for algae settling and removal.
  - Maturation Pond: 2 meter deep square pond for final treatment that

## **Exhibit A WORK STATEMENT**

- Develop and submit a layout map showing the location of each pond to scale on a map of the dairy host site.
- Develop and submit a detailed Project Equipment Specification Spreadsheet containing length, width, depth, slope, and volume of each pond as well as their interconnections and accessibility routes, and other required parameters.

### **Products:**

- Finalized Layout Map
- Project Equipment Specification Spreadsheet

### **TASK 4 CONSTRUCTION**

The goal of this task is to construct, document, and develop established protocols for installing and operating a 4-pond system for the treatment of dairy effluent for the 300-cow volume of waste at the VO/Demonstration Host Dairy.

### **The Recipient shall:**

- Verify that all required permits have been acquired and are active and ready to use.
- Verify that VO/Demonstration Host Dairy has obtained all of the required machinery for pond construction.
- Secure insurance to cover liabilities related to the construction and operation of the wastewater treatment system.
- Perform construction of four ponds as instructed according to maps and detailed spreadsheet in Task 3 with precise dimensions and connectivity. The time taken to come up with exact measurements of all aspects of the system will enable the straightforward construction of each pond as well as their connections to each other and the existing dairy infrastructure (Recipient's Team will perform construction).
- During construction, ensure all required measurement devices, and probes are installed or provisions made for their installation during the testing and performance evaluation phase of the project
- Ensure M&V vendor is participating during construction phase such that required M&V equipment can be installed or provisions made for their installation/use/availability at a later phase of the project.
- Prepare the CPR report per Task 1.2.
- Prepare monthly reports submitted to the Commission Project Manager documenting progress, monthly report should include photographs to document and track the construction progress.
- Submit written confirmation letter stating all construction activities have been completed and project can progress forward.
- Prepare for and attend the CPR meeting per Task 1.2.

# **Exhibit A WORK STATEMENT**

## **Products:**

- Copy of Insurance
- Construction Completion Letter
- CPR Report (no draft)

## **TASK 5 TEST PLAN PREPARATION**

The goal of this task is to derive a precise plan for testing the operation of the treatment system. The project will be continuously monitored and analyzed to ensure that it stays on schedule and is performing as predicted with regard to the primary deliverables of water quality, biomass production, and energy generation. Scientific experiments will be carried out to carefully quantify each of these results over time, as the system's operation is optimized. This project will use on-site tools and technology as well as resources available through the Recipient's partnership with University of California San Diego to evaluate the water quality and to monitor energy production.

## **The Recipient shall:**

- Prepare the Wastewater Treatment Test Plan. This plan will include, but is not limited to:
  - A detailed description of the overall process to be tested. This will lay out each step of the treatment and what is expected as a result of each step.
  - A description of each test required to analyze waste water treatment.
  - A rationale for why the tests are required – a thorough explanation for each test, the expected results, and effect on water quality.
  - An explanation of the technical approach to each test – some require kits, some require probes, and some require constant monitoring equipment. Explain how each test is performed and what it measures.
  - Schedules describing how often each test is required.
  - A complete description of the facilities, equipment, and instrumentation required to conduct the tests.
  - Determine the manner in which the data will be validated, analyzed, and reported.
- The expected results as determined by industry standards as well as the purpose and meaning of each of these tests will be laid out in the Wastewater Treatment Test Plan.
- Ensure M&V vendor, Investor-Owned Utility staff, and other stakeholders have an opportunity to review and comment on the Test Plan.
- Revise the Test Plan as necessary based on stakeholder review and suggestions.
- Submit the revised Wastewater Treatment Test Plan to the Commission Project Manager.

## **Products:**

- Draft Wastewater Treatment Test Plan
- Final Wastewater Treatment Test Plan

## **Exhibit A WORK STATEMENT**

### **TASK 6 TESTING AND INITIAL OPERATION**

The goal of this task is to begin operation of the treatment system, by gradually engaging each component in a systematic fashion. In addition, at this stage the Recipient's team will hook up all of the required testing equipment that will enable the ultimate automation and remote monitoring of its operation.

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

- Closely examine all ponds and test connections to ensure safety and reliability of complete system of ponds.
- Begin to divert waste from the VO/demonstration host dairy lagoon into the pond system, starting with the anaerobic pond. After digestion has taken place to a satisfactory level, release some effluent to the high rate pond, and begin to grow algae. Continue progress to settling pond and finally the maturation pond.
- Hook up all continuous monitoring probes, including probes for temperature, sunlight, dissolved oxygen, pH, and ammonium.
- Begin to collect samples for testing of other parameters, including levels of turbidity, total suspended solids (TSS), volatile suspended solids (VSS), chemical oxygen demand (COD), total nitrogen, ammonia nitrogen, nitrate, nitrite, total phosphorus, reactive phosphorus and alkalinity are determined using Hach TNT test kits and a Hach DR 3900 spectrophotometer. Connect all probes, pumps, and valves to a custom software routine running on a Phidgets SBC2 microcontroller. Set up this controller in a weatherproof station near the treatment system and set it up for wireless, remote access.
- Report to the Commission Project Manager indicating that the construction and initial operation of the wastewater treatment system is working according to specifications and that the project is ready to progress with full performance evaluation.
- Prepare Initial Test Results Report that includes all results from this task; submit results as Initial Testing Results Report.

#### **Products:**

- Draft Initial Testing Results Report
- Final Initial Testing Results Report

### **TASK 7 PERFORMANCE EVALUATION**

The goal of this task is to perform a comprehensive evaluation of the performance of the treatment system. Data will be analyzed throughout the year (summer, fall, winter and spring months) to ensure that the technology is performing as predicted with regard to water quality, biomass production, and energy generation. The system will be continuously modified based on performance goals set forth in the test plan and the results that are observed over time.

## **Exhibit A WORK STATEMENT**

### **The Recipient shall:**

- Continue testing for all essential waste treatment parameters, including temperature, sunlight, dissolved oxygen, pH, ammonium, turbidity, TSS, VSS, COD, total nitrogen, ammonia nitrogen, nitrate, nitrite, total phosphorus, reactive phosphorus and alkalinity.
- Compare results to industry requirements to ensure that treatment is occurring above and beyond regulated standards.
- Regularly monitor all connections and pumps that regulate flow through the treatment system to ensure that proper materials and construction techniques are employed.
- Improve connection and communication of all probes, pumps, and valves to the custom software routine running on a Phidgets SBC2 microcontroller. Ensure that this is remotely accessible and controllable and integrate software routines to enable troubleshooting and diagnoses of any issues that arise.
- Demonstrate the generation of energy using the existing on-site generator to convert captured biogas from the anaerobic pond (cleaned via algae pond) to electricity.
- Work with AESC to conduct the required measurement and verification evaluation equivalent to applicable California investor-owned utility standards. The measurement and verification will collect and analyze sufficient sets of data to determine the following but not limited to:
  - System energy use
  - Energy savings (kWh and therms) per unit waste
  - System dairy waste input capacity (lbs waste/day)
  - System effluent water quality and comparison to lagoon discharge water quality (and comparison to other water sources such as well and municipal)
  - Biogas production (cubic feet per hour, per day of gas production); determination of average higher and lower heating value of gas generated
  - Effectiveness of algae based cleaning of biogas (gas analysis before and after going through algae pond)
  - Emissions production from combustion of algae cleaned produced gas in the existing on-site generator
  - Overall economics (system cost, installation cost, operational and maintenance cost, algae cost, sale of algae biomass as feed/fertilizer)
  - System performance and reliability
  - Other parameters as determined by the M&V vendor, Commission Project Manager, investor-owned utility staff, demonstration site, and other stakeholders
- Prepare M&V Report that includes all the data, results, analysis from yearlong demonstration monitoring period.
- Circulate M&V Report to investor owned utility staff, demonstration site staff

## **Exhibit A WORK STATEMENT**

and other stakeholders for comments and review.

- Submit to Commission Project Manager the M&V Vendor's comprehensive independent measurement and verification report.
- Monthly Progress Reports submitted to the Commission Project Manager, documenting testing results as well as any modifications and improvements that are made to the system's operation.
- Prepare CPR report per Task 1.2.
- Attend CPR meeting per Task 1.2.

### **Products:**

- M&V Report (no draft)
- CPR Report (no draft)

### **TASK 8 GENERALIZATION FOR TRANSFERABILITY AND DOCUMENTATION**

The goal of this task is to integrate the data and design parameters from the completed wastewater treatment system and to develop a set of quantitative and precise guidelines for the generic construction of such a system depending on the specific parameters of each individual client.

### **The Recipient shall:**

- Develop guidelines for the construction of a generic set-up based on a set of parameters including, but not limited to:
  - The current farm set-up, including the manner in which waste is handled
  - The existence of other treatment equipment, such as an anaerobic digester, a covered lagoon, or an electricity generator
  - The volume of waste generated per cow and per day
  - The land availability both generally and specifically near the waste source
  - The required permits and barriers
- Determine the investment required by each client, based on the above parameters
  - The cost of set-up and ongoing operational costs
  - The ongoing protocols required for reliable operation
- Determine the benefits to each client, based on the above parameters
  - The amount of energy to be generated
  - The amount of biomass and profit to be generated
  - A quantification of the improvement in water quality
  - The reduction of greenhouse gasses emitted by their treatment system
  - The cost savings (energy and by-products)
- Prepare Technology Transferability Report to include guidelines for system construction, installation, investment required and benefits.

### **Product:**

- Technology Transferability Report (no draft)

## **Exhibit A WORK STATEMENT**

### **TASK 9 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. The plan shall explain 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 shall be included in the Final Report for this project.
- Conduct technology transfer activities in accordance with the Technology Transfer Plan. These activities shall be reported in the Monthly Progress Reports.

#### **Products:**

- Draft Technology Transfer Plan
- Final Technology Transfer Plan

### **TASK 10 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 Production Readiness Plan discussion should be proportional to the complexity of producing or commercializing the proposed product and its state of development. The plan shall include, as appropriate, but not be limited to:
  - Identification of critical production processes, equipment, facilities, personnel resources, and support systems that will be needed to produce a commercially viable product
  - Internal manufacturing facilities, as well as supplier technologies, capacity constraints imposed by the design under consideration, identification of 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