STATE OF CALIFORNIA

GRANTS/CONTINGENT AWARD REQUEST

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

To: Grants and Loans Office Date: 9/9/2011

Project Manager: David Effross Phone Number: 916-327-1314
Office: Energy Generation Research Office Division: Energy Research and Development MS- 43
Project Title: Algae OMEGA: Offshore Membrane Enclosures for Growing Algae

Type of Request: *(check one)*

☐ **New Agreement:** *(include items A-F from below)* Agreement Number:
Program: PIER NG / Transportation
Solicitation Name and/or Number:
Legal Name of Recipient: NASA Ames Research Center
Recipient's Full Mailing Address: Mail Stop 239-15
Mountain View, CA 94043
Recipient's Project Officer: Jonathan Trent Phone Number: 650-604-3686
Agreement Start Date: 9/1/2009 Agreement End Date: 12/15/2011

☒ **Amendment :** *(Check all that apply)* Agreement Number: PIR-08-047
- ☒ Term Extension – New End Date: 12/1/2012
- ☐ 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: NOE filed:
- ☐ Environmental Document prepared: NOD filed:
- ☐ Other:

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

Funding Information:

*Source #1:	Amount: $	Statute:	FY:	Budget List #:	
*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: 10/19/2011 ☒ Consent ☐ Discussion
Business Meeting Participant: David Effross Time Needed: minutes

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

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

Possible approval of Amendment 2 to Agreement PIR-08-047 with NASA Ames Research Center for a 12-month no-cost time extension to December 1, 2012. This will allow the recipient to complete the deployment of the demonstration modules for contained algal growth and dewatering in an ocean environment. There is no change to the total amount of the agreement. Contact: David Effross.

Project Manager	Date	Office Manager	Date	Deputy Director	Date

Proposed Amendment between California Energy Commission and NASA Ames Research Center

Title: Algae OMEGA: Offshore Membrane Enclosures for Growing Algae
Amount: $0.00
Term: 12 months
Contact: David Effross
Committee Meeting: 9/15/2011

Recommendation

Approve this no-cost time extension amendment with NASA Ames Research Center for 12 months to complete demonstration. The scope of the project has not changed. Staff recommends placing this item on the consent calendar of the Commission Business Meeting.

Issue

This contract needs to be extended to complete the deployment of the demonstration modules for contained algal growth and dewatering in an ocean environment.

Background

Algae OMEGA was PIER Transportation's highest scoring submission for PON-08-008, the Advanced Biosynthetic Transportation Fuel Production solicitation. Research is proceeding well, but ocean deployment will take longer than anticipated, particularly during the winter weather season.

Proposed Work

The goal of this project is to demonstrate the feasibility of using OMEGA systems as a sustainable carbon-neutral supply of liquid fuels by meeting the following four milestones: 1. Module Integrity Testing to ensure a robust mechanical design; 2. Dewatering Functionality Test to prove the capacity of the forward osmosis membranes to concentrate the algae in situ; 3. In Situ Growth Test to demonstrate the viability of growing sufficient fuel quantities of algae in the OMEGA modules; and 4. Harvest and Lipid Extraction and Scale-up to demonstrate the feasibility of scaling up this technology to meet transportation needs in California.

OMEGA is an innovative approach to growing microalgae in sufficient quantities to significantly contribute to the production of biofuels. Each OMEGA algae module is a plastic enclosure filled with nutrient-rich effluent from wastewater outfalls that will be deployed in a marine environment and used to cultivate oil-producing algae. Unlike closed bioreactors on land that must be robust structures and require energy for temperature control and mixing, the OMEGA system uses the surrounding water for structural support and the heat capacity for temperature regulation. Surface waves provide the energy for mixing. By deploying a contained freshwater culture in marine environments, salinity gradients can be used to concentrate nutrients and dewater the algae by osmosis. In addition, marine ecosystems will not be significantly impacted by the accidental release or escape of the freshwater algae being cultivated because strains will be chosen that cannot thrive in salt water.

Issues of land use, cooling, mixing, water, and some of the costs can be addressed by moving the algae cultivation system offshore, using closed photo-bioreactors made of inexpensive, flexible plastic enclosures we refer to as OMEGA modules. Land is obviously not an issue in offshore environments,

cooling and temperature control is provided by the heat capacity of the surrounding ocean, and mixing is provided by wave energy. The need for freshwater in the OMEGA system is provided by using wastewater from municipal wastewater treatment facilities. The OMEGA system we envision would provide tertiary treatment of the wastewater before it is released into the ocean. In addition, the algae that will be harvested for biofuels will also allow the nutrients in the wastewater to be recovered and returned to land as fertilizer. Algae are also taking up carbon dioxide from the atmosphere as they grow and this carbon can be sequestered if the algal remains, after the oils are removed, are pyrolysed to produce biochar, a beneficial soil remediant.

Justification and Goals

This project "[will develop, and help bring to market] advanced transportation technologies that reduce air pollution and greenhouse gas emissions beyond applicable standards, and that benefit electricity and natural gas ratepayers" (Public Resources Code 25620.1.(b)(1)), (Chapter 512, Statues of 2006)).

This will be accomplished by:

- demonstrating the feasibility of using an algae-based system as a sustainable carbon-neutral supply of California-produced liquid transportation fuels

Schedule of Products and Due Dates

Task Number	Task Name	Product(s)	Start Date	Due Date
1.1	**Attend Kick-off Meeting**			
		Updated Schedule of Products	1/4/2010	1/14/2010
		Updated List of Match Funds	1/4/2010	1/14/2010
		Updated List of Permits	1/4/2010	1/14/2010
		Kick-off Meeting Agenda (CEC)	1/4/2010	1/14/2010
1.2	**Critical Project Review Meetings**			
	1st CPR Meeting	CPR Report	7/1/2010	7/15/2010
		Agenda and a list of expected participants (CEC)	7/1/2010	7/15/2010
		Schedule for written determination (CEC)	7/1/2010	7/15/2010
		Written determination (CEC)	7/15/2010	7/29/2010
	2nd CPR Meeting	CPR Report	1/11/2012	5/11/2012
		Agenda and a list of expected participants (CEC)	2/8/2012	5/6/2012
		Schedule for written determination (CEC)	2/10/2012	5/12/2012
		written determination (CEC)	2/20/2012	6/12/2012
1.3	**Final Meeting**			
		Written documentation of meeting agreements	11/5/2012	11/26/2012
		Schedule for completing closeout activities	11/5/2012	11/26/2012
1.4	**Monthly Progress Report**	Monthly Progress Reports	Upon full execution of agreement	The 1th of each month during the approved term of this agreement
1.5	**Final Report**			
		Draft Outline of the Final Report	8/31/2012	9/10/2012
		Final Outline of the Final Report	9/10/2012	9/17/2012
		Draft Final Report	9/17/2012	10/15/2012
		Final Report	10/15/2012	11/15/2012
1.6	**Identify and Obtain Matching Funds**			
		Letter regarding match funds or stating that no match funds are provided	5/15/2010	9/23/2011
		Copy(ies) of each match fund commitment letter(s) (if applicable)	5/15/2010	9/23/2011
		Letter(s) for new match funds (if applicable)	5/15/2010	1/15/2012
		Letter that match funds were (reduced if applicable)	5/15/2010	Within 10 days of identifying new match funds
1.7	**Identify and Obtain Required Permits**			
		Letter documenting the permits or stating that no permits are required	9/15/2011	5/15/2012
		A Copy of each approved permit (if applicable)	9/15/2011	5/15/2012
		Updated list of permits as they change during the term of the agreement (if applicable)	No Change	No Change
		Updated schedule for acquiring permits as changes occur during the term of the agreement (if applicable)	7/15/2011	7/15/2011
2	**TECHNICAL TASKS**			
2.1	**Set up Wet Lab and Outside Tanks**			
		Letter confirming that test facilities have been established	6/1/2010	6/1/2011

Schedule of Products and Due Dates

Protocol for safely conducting experiments with municipal wastewater	6/1/2010	7/1/2010
Interim progress report	9/25/2011	10/15/2011

Schedule of Products and Due Dates

2.2	**OMEGA Integrity Tests**		
	Test Plan	10/20/2011	11/2/2011
	Multiple OMEGA designs at different scales	10/20/2011	11/10/2011
	Criteria for building OMEGA's that will withstand conditions at sea	10/22/2011	2/10/2012
	Functional Moorings in approved locations	10/3/2011	10/20/2011
	Interim progress report	12/15/2011	1/29/2012
2.3	**Filling, Dewatering, and Harvesting Tests**		
	Test Plan	6/15/2011	11/15/2011
	Interim progress report	10/25/2011	11/15/2011
	Critical Design Review meeting report	12/15/2011	12/15/2011
2.4	**Algae Growth and Lipid extraction**		
	Test Plan	9/26/2011	1/15/2012
	Lipid production from biomass and other products	9/26/2011	3/15/2012
	Interim progress report	12/15/2011	5/15/2012
	Critical Review meeting report	12/15/2011	6/15/2012
2.5	**Ocean Deployment and scale up**		
	Test Plan	10/1/2011	10/22/2011
	Precedent for using OMEGAs in California costal waters	9/1/2011	12/15/2011
	Report of growth and fouling production at sea		3/15/2012
	Information about the impact of OMEGAs on marine ecosystem	12/15/2012	12/15/2012
	Critical Interim progress report for OMEGA feasibility	12/15/2012	12/15/2012
3.1	**Technology Transfer and Commercialization Activities**		
	Technology Transfer Plan (No Draft)	12/4/2011	12/15/2012