

GRANTS/CONTINGENT AWARD REQUEST



To: Grants and Loans Office

Date: 2/25/2013

Project Mike Kane Phone Number: 916-327-1530
Office Energy Generation Research Office Division: Energy Research and Development MS- 43
Project Integrated Solar PV, Advanced Compressed Air Energy Storage, and Microgrid
Title: Demonstration Project

Type of Request: (check one)

New Agreement: (include items A-F from below) Agreement Number: PIR-12-004
Program: PIER E / Renewables
Community Scale Renewable Energy Development, Deployment and
Solicitation Name and/or Number: Integration (PON-12-502-45)
Legal Name of Recipient: Foresight Renewable Solutions, LLC
Recipient's Full Mailing Address: 657 Mission Street, Suite 504
San Francisco, CA 94105
Recipient's Project Officer: Carlos Pineda Phone Number: 415 495-0700 x205
Agreement Start Date: 6/19/2013 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: _____ NOE filed: _____
 Environmental Document prepared: _____ NOD filed: _____
 Other: _____
 CEC has made CEQA finding described in CEC-280, attached

Funding Information:

*Source #1: PIER-E Amount: \$ 1,749,000.00 Statute: 11- FY: 11-12 Budget List #: 501.027J
*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.

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

Proposed Business Meeting Date: 4/30/2013 Consent Discussion
Business Meeting Participant: Mike Kane Time Needed: 5 minutes

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

Possible approval of a Grant / Contingent Award to...
FORESIGHT RENEWABLE SOLUTIONS. Possible approval of Agreement PIR-12-004 with Foresight Renewable Solutions for a \$1,749,000 grant to demonstrate an above-ground compressed air energy storage system paired with solar PV in a microgrid context at an existing facility. The proposed system will demonstrate intermittency management, peak shaving, load shifting, and the ability to operate in grid-connected and grid-independent modes, and will permit the facility to achieve greater levels of energy security using renewable energy. This agreement includes \$1,243,570 in match funding. (PIER electricity funding) Contact: Mike Kane (5 minutes)

Project Manager Date Office Manager Date Deputy Director Date

Exhibit A WORK STATEMENT

TECHNICAL TASK LIST

Task #	CPR	Task Name
1	N/A	Administration
2		Naval Base Facility Study
3	X	Project Engineering, Design, and Integration
4		Project Implementation, Construction, and Commissioning
5		Project Operation, Data Collection, and Analysis

KEY NAME LIST

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
1	<ul style="list-style-type: none"> • Carlos V. Pineda, Foresight Renewable Solutions, LLC (FRS) • Warren Byrne, FRS 		<ul style="list-style-type: none"> • Navy Engineering and Expeditionary Warfare Center (EXWC) • LightSail Energy
2	<ul style="list-style-type: none"> • Carlos V. Pineda • Warren Byrne 		<ul style="list-style-type: none"> • Navy EXWC • LightSail Energy
3	<ul style="list-style-type: none"> • Carlos V. Pineda • Warren Byrne • Karim Wazni, VP, LightSail Energy 	<ul style="list-style-type: none"> • LightSail Energy 	<ul style="list-style-type: none"> • Navy EXWC
4	<ul style="list-style-type: none"> • Carlos V. Pineda • Warren Byrne • Karim Wazni 	<ul style="list-style-type: none"> • LightSail Energy 	<ul style="list-style-type: none"> • Navy EXWC
5	<ul style="list-style-type: none"> • Carlos V. Pineda • Warren Byrne • Eugene Crank, PE, Research, Development, Testing & Evaluation Team Lead, Navy EXWC 	<ul style="list-style-type: none"> • Navy EXWC 	<ul style="list-style-type: none"> • LightSail Energy

GLOSSARY

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

Term/ Acronym	Definition
CAES	Compressed Air Energy Storage
CBE	California Based Entity
CPM	Commission Agreement Manager
CPR	Critical Project Review
EPC	Engineering, Procurement and Construction
EXWC	Engineering and Expeditionary Warfare Center. EXWC is a division of NAVFAC
FRS	Foresight Renewable Solutions, LLC
Islanding	Operation of the Demonstration Project in periods of utility grid outage, and/or when intentionally disconnected from the utility grid

Exhibit A WORK STATEMENT

Term/ Acronym	Definition
kW	Kilowatts. kW are “capacity” (power that can be produced at a given instant)
kWh	Kilowatt hour. kWhs are “energy” (amount of power produced over time)
Load shifting	Storing energy from solar PV generation, off-peak grid supplied energy, or other energy and dispatching such energy from CAES during peak energy usage periods when utility rates are highest
MUSE	Mobile Utilities Support and Equipment. MUSE is a facility at NBVC of the EXWC.
NAVFAC	Naval Facilities Engineering Command
NBVC	Naval Base Ventura County
Peak shaving	Dispatch of solar PV and/or CAES during peak capacity demand periods, leading to a reduction in demand charges from the utility
PV	Photovoltaic

Problem Statement:

A key barrier to achieving maximum penetration of intermittent renewable generation on utility grids in California is the availability of firming resources needed to maintain grid stability. With increasing penetrations of intermittent renewables at both the distributed community-scale and utility generation scale, renewable intermittency is causing widespread grid stability problems. In addition, grid stability issues are typically exacerbated during natural disasters, major power plant or transmission line outages, and acts of war (either physical or cyber attacks), meaning that high penetrations of renewables can contribute substantially to energy security risk.

Electrical energy storage technologies promise to provide the requisite firming and stabilization resources to grids with high penetrations of intermittent renewables, and to do so without relying on fossil fuels. However, these technologies have low levels of penetration. Commercialized energy storage technologies include two major categories: (1) batteries, which are modular and can be deployed successfully in distributed, community settings but typically have short life spans, low component recyclability, and suffer from high-costs, low energy-density, and toxicity; and (2) pumped hydro and conventional Compressed Air Energy Storage (CAES), which provides high energy density and can be low-cost, but suffers from highly restrictive geographic and scale requirements that continue to prevent broad deployment.

The breakthrough LightSail Energy modular isothermal CAES technology that is the centerpiece of this project promises to provide high energy-density at low cost, using long-lived, low-toxicity mechanical equipment in a modular form factor that can easily be deployed on a distributed, community scale. However, the technology faces barriers typical of the pre-commercial stage, including: “alpha stage” component development, insufficient field testing, insufficient field demonstrations, unproven capital and operating cost estimates, and inadequate consumer knowledge. This proposed “beta” demonstration project is placed at an existing military facility in order to: (1) expand the use of locally available renewable energy, in this case solar photovoltaic (PV); and (2) test, maintain, and deploy community-scale generation equipment at military bases. The project provides an unparalleled opportunity to overcome key barriers while introducing the technology to the military, a critical early-adopter California community.

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Goals of the Agreement:

The goal of this Agreement is to demonstrate the technical and cost-effectiveness of a breakthrough LightSail Energy modular, community-scale, compressed air energy storage technology that is paired with solar PV generation and interconnected to a microgrid with “islanding” capability at the Expeditionary Warfare Center’s (EXWC’s) Mobile Utilities Support and Equipment (MUSE) facility at the Naval Base Ventura County (NBVC) (the “Demonstration Project”).

The project will demonstrate how this hybrid technology configuration can maximize penetration of renewable energy in the MUSE microgrid, while maintaining grid stability, enhancing energy security, and providing substantial utility cost savings. The greater goal is to create a model community-scale hybrid renewables/storage/microgrid technology configuration that can be replicated across a broad range of communities while reducing utility costs that can facilitate a substantial increase in renewable energy penetration in California while creating a more stable, secure and disaster-resilient grid.

Objectives of the Agreement:

The objectives of this Agreement are to:

- Design, develop, and deploy an innovative hybrid project that integrates 150 kilowatts (kW) of solar PV and a modular 250-300 kW/1000 kW-hr CAES system with a microgrid serving the MUSE facility at the NBVC.
- Measure, analyze, and document the capital and operating costs of the hybrid project.
- Verify round-trip efficiency of the CAES of 55 percent while supporting the microgrid in both grid-connected and islanded modes.
- Quantify various operational parameters in terms of power quality (voltage support, and frequency regulation), response time, and operational availability and runtime achievable in island mode; and
- Demonstrate and quantify cost savings to the MUSE facility and NBVC through displacement of utility electrical supply via renewable energy deployment, CAES-enabled load shifting, and peak shaving.

TASK 1 ADMINISTRATION

Instructions for Submitting Electronic Files and Developing Software

Electronic File Format

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

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

- Data sets will be in Microsoft (MS) Access or MS Excel file format.

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- 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 Agreement Manager (CAM), the Commission Agreement Officer, and a representative of the Accounting Office. The Recipient shall bring its Project Manager, Agreement Administrator, Accounting Officer, and others designated by the CAM to this meeting. The administrative and technical aspects of this Agreement will be discussed at the meeting. Prior to the kick-off meeting, the CAM 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)

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

- The CAM'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 CAM 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 CAM.

Recipient Products:

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

Commission Agreement 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 CAM and the Recipient. The CAM may schedule CPRs as necessary, and CPR costs will be borne by the Recipient.

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

The Commission Agreement 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 Agreement 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.

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- 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 CAM concludes that satisfactory progress is not being made, this conclusion will be referred to the Deputy Director of the Energy Research and Development Division.
- Provide the Recipient with a 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 CAM 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 Agreement 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 Agreement Officer, and the CAM. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the discretion of the CAM.

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 CAM will determine the appropriate meeting participants.

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The administrative portion of the meeting shall involve a discussion with the CAM and the Agreement Officer about the following Agreement closeout items:

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

Products:

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

Task 1.4 Monthly Progress Reports

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

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

The Recipient shall:

- Prepare a Monthly Progress Report that summarizes all Agreement activities conducted by the Recipient for the reporting period, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. Each progress report is due to the CAM 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
 - Provide synopsis of project progress.

Product:

- Monthly Progress Reports

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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 CAM. The CAM 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.

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The Recipient shall:

- Prepare a letter documenting the match funding committed to this Agreement and submit it to the CAM 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.
- Develop and execute a Cooperative Research and Development Agreement with Naval Facilities Engineering Command (NAVFAC)
- Provide a letter including the appropriate information to the CAM if during the course of the Agreement additional match funds are received.
- Provide a letter to the CAM 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

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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 CAM 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 CAM.
- As permits are obtained, send a copy of each approved permit to the CAM.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the CAM 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.

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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 – NAVAL BASE FACILITY STUDY

Task 2.1 Draft MUSE Facility Study

The goal of this task is to understand: (1) the operating patterns, electricity needs, and utility costs of the MUSE facility, to serve as a basis for defining Demonstration Project design parameters; and (2) the operating patterns, electricity needs, and utility costs for the larger NBVC.

The Recipient shall:

- Collect approximately three years of historical utility bills from the MUSE facility, and from the NBVC if possible.
- Analyze utility bills to identify average utility rates, demand charges, and other key criteria that will serve as the basis for creating cost savings from the operation of the Demonstration Project.
- Interview, as appropriate, Naval Base Ventura County (NBVC) and MUSE Facility personnel to identify high priority loads that are critical to operation, and to must-run loads.
- Establish project design parameters including: kW size and location of solar PV, kW size and kWh storage capacity of the CAES, and distribution voltage microgrid design.
- Prepare an Interim MUSE Facility Study Report that summarizes the project design parameters and the selection process employed thereto, including identification of key loads or other considerations that resulted in the selections made.
- Prepare key design and equipment parameters for the Demonstration Project and share it with the Energy Commission.
- Prepare an *Initial Project Equipment List* and share it with the Energy Commission.

Products:

- Interim MUSE Facility Study Report (no draft)

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- Key Design and Equipment Parameters (no draft)
- Initial Project Equipment List (no draft)

Task 2.2 Build Operational and Economic Model

The goal of this task is to develop a flexible spreadsheet model of the proposed hybrid technology configuration to predict the operational and financial performance of the system. The model will be designed to accommodate a range of variable inputs including but not limited to: community electricity usage patterns and costs, equipment component capacities, operational characteristics, renewable resource and generation production estimates, and financing assumptions.

The goals of the model are to assist in component sizing and development of operational protocols for the project, and to set operational and financial benchmarks against which to measure actual performance. The model will also be designed to function as a tool that can be used by other communities in planning, designing, and financing similar projects at varying scales and with different host community baseline conditions, including the potential expansion of the project to include other facilities at the NBVC.

The Recipient shall:

- Determine costs of all equipment in the initial equipment list, based on the Demonstration Project design parameters established in Task 2.1.
- Determine operational capabilities of the equipment in the initial equipment list, including megawatt (MW) capacity, megawatt hour (MWh) storage, charging time, response time, power output quality, and islanding capability.
- Determine which MUSE Facility critical loads will be served when the microgrid is islanded from the primary grid and/or in case of grid outage.
- Build an *Operational and Economic Model* in MS Excel that: (1) integrates all of the findings from the draft equipment list and associated operational capabilities detailed in the bullets above; and (2) conducts the appropriate economic analyses (i.e., utility cost savings, system efficiency, financial return on investment, net present value, and payback).
- Prepare a *Final MUSE Facility Study Report* that: (1) includes projected utility cost savings from the operation of the Demonstration Projects, including savings from increased penetration of locally available solar PV, displacement of utility power during peak periods (load shifting), and peak shaving; and (2) indicates which critical loads could be served by the Demonstration Project when in islanded mode and for how long.

Products:

- Project Operational and Economic Model
- Final MUSE Facility Study Report (no draft)

Exhibit A WORK STATEMENT

TASK 3 PROJECT ENGINEERING, DESIGN, AND INTEGRATION

Task 3.1 Identify Net Metering / Utility Approvals

The goal of this task is to identify net metering, utility approvals, or interconnection requirements with the MUSE Facility microgrid, and with the overall utility grid, if necessary.

The Recipient shall:

- Review net metering and interconnection requirements with the EXWC engineers to determine the design, metering, interconnection, and power controls required to: (1) deliver power from behind the meter to the grid; and (2) integrate the proposed equipment with the microgrid.
- Work with EXWC and LightSail engineers to prepare a *Preliminary Electrical One-Line Diagram* for the Demonstration Project.
- Based on the design parameters recommended in Task 2, determine whether a net metering or interconnection application and study process is necessary with the utility – in this case, Southern California Edison.
- If necessary, submit net metering, interconnection application, or other requests for utility approval to Southern California Edison, and provide copies to the Energy Commission.

Products:

- Preliminary Electrical One-line Diagram
- Copies of Requests for Utility Approval (if applicable)

Task 3.2 Complete Engineering Design and Layouts

The goal of this task is to complete engineering design and technology integration for the Demonstration Project, so that the development and construction of the project may be completed in the subsequent phase.

The Recipient shall:

- Work with EXWC and LightSail engineers to detail equipment and component selection in a final Equipment List. The list will include but will not limited to:
 - Compressor/expander using familiar reciprocating piston engine technology, similar in function, operation, and maintenance to diesel engines/generator sets, but requiring no fuel. The patented LightSail design allows isothermal operation, boosting round trip efficiency to 55% or higher.
 - Generator: Commercial, off-the-shelf generator.
 - Air Storage: Compressed air is stored in safe, fiber-wound pressure vessels that withstand puncture without explosion. A modular design will allow incremental additions and multi-MWh bulk storage.
 - Power Electronics: Custom variable frequency drive from Rockwell for power conditioning and grid-tie capability.
 - MicroGrid Interconnection/Interface: The Recipient will determine whether Lockheed Martin or another provider will be involved during this task period.

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- PV Generation: 0.15 MWs of state-of-the-art solar PV modules plus collection system components, inverters, transformers, and interconnection switch-gear appropriate for a utility grade installation.
- Work with a California-based solar PV manufacturer and an installer (minor subcontractors will be managed by the Recipient) to finalize rooftop and carport-mounted designs for the solar PV component of the Demonstration Project. The Recipient will run an informal competitive solicitation among qualifying solar OEMs to deliver the most cost-effective, high quality equipment to the Demonstration Project.
- Work with a California-based Engineering, Procurement and Construction (EPC) Contractor or independent engineer (minor subcontractors will be managed by the Recipient) to prepare stamped project layouts, construction drawings, and one-line diagrams for the Demonstration Project. The Recipient will run an informal procurement similar in design and purpose to that described for the solar subcontractor.
- Provide the following *Project Engineering Design Documents* to the CPM: final equipment and component list, project layout, one-line diagram, operating protocols, and construction drawings.

Products:

- Project Engineering Design Documents

TASK 4 – PROJECT IMPLEMENTATION, CONSTRUCTION AND COMMISSIONING

Task 4.1 Complete Development of the Demonstration Project

The goal of this task is to complete the development of the Demonstration Project, order major equipment, and begin construction.

The Recipient shall:

- Work with EXWC to finalize any micro-grid interconnection design. Note that this should already be complete via the stamped one-line diagram mentioned in Task 3.2 above.
- Work with Southern California Edison to finalize any net metering approval or interconnection studies, and sign one or more net metering/ interconnection agreements, if necessary.
- Provide the CPM with a copy of any *net metering/ interconnection agreements*.
- Obtain any required project permits (see Task 1.7).
- Execute any subcontracts for engineering, procurement, or construction support (see Task 1.8).
- Order Major Equipment from LightSail, from the solar PV OEM, and from any other ancillary or balance of system suppliers.
- Complete a detailed *Construction Schedule* with the EPC Contractor.
- Provide the CPM with a copy of the *Notice to Proceed* (to EPC Contractor).

Products:

- Copy of net metering/interconnection agreement(s) (if applicable)
- Copy of Detailed Construction Schedule
- Copy of the Notice to Proceed

Exhibit A WORK STATEMENT

Task 4.2 Construct and Commission the Demonstration Project

The goal of this task is to manage the construction and complete the commissioning of the Demonstration Project.

The Recipient shall:

- Work with the EPC Contractor, LightSail, and EXWC to manage the delivery and laydown of all equipment.
- Manage the EPC Contractor's civil construction works, which are primarily the installation and bolting down of the CAES units and interconnection piping.
- Manage the EPC Contractor's electrical works, which are primarily the reinforcement of the microgrid, installation of necessary circuit breakers, installation of power controls, and tie to the NVBC grid.
- Manage solar PV OEM's installation of solar PV, which may include rooftop, carport, or ballast-secured solar panels.
- Work with the EPC Contractor and EXWC to improve punch card review, confirming completion of construction works.
- Summarize results of the punch card review in a *Punch Card Review Summary*.
- Work with the EPC Contractor, EXWC, and LightSail on the commissioning of the Demonstration Project and initiation of operations.
- Obtain a *Final Installation Report* from the contractor and submit it to the CPM.
- Prepare a *Commissioning Report* that includes [pictures of the installed equipment, start up procedures, and any significant problems or issues encountered during initial start up].

Products:

- Copy of Punch Card Review Summary
- Final Installation Report (no draft)
- Copy of Commissioning Report (no draft)

Task 5 PROJECT OPERATION, DATA COLLECTION, AND ANALYSIS

The goals of this task are to collect operational data from the Demonstration Project, analyze it for operational viability, quantify the increased penetration of solar PV at the base, evaluate both economic (cost savings) and environmental (displacement of air pollutants and GHG emissions) impacts, and include the data and analysis in the Final Report.

The Recipient shall:

- Develop a Data Collection Test Plan. This plan shall be included in the Task 5 Summary included in the Final Report.
- Troubleshoot any issues identified with respect to data collection and analysis, and correct as necessary to ensure data collection proceeds in accordance with Data Collection Test Plan
- Collect up to six months of throughput, usage, and operations data from the project, including but not limited to:
 - Daily and average kWh of solar PV production per day; and percentage of the solar PV production that supplies the microgrid directly and charges

Exhibit A WORK STATEMENT

- Net capacity factor of solar PV and net kW capacity
- Daily and average CAES charging in kW and kWh (Charging will be broken down by source, e.g. solar, grid, diesel back-up, etc.)
- Daily and average CAES generation in kWh (include the daily and average kW loads)
- Round trip efficiency (percentage) of CAES across various charging / discharging capacities (kW) and sources of charging
- Average operational availability of solar PV and CAES
- Total uptime of the microgrid, and any microgrid failures or disruptions
- Number of islanding events and their cause (i.e., whether the events occurred in accordance with the test plan, through the operational choices of the MUSE facility, or due to grid events (if any))
- Expected air emissions reduction, for example:
 - Greenhouse gases (GHGs), particularly carbon dioxide and methane
 - Oxides of nitrogen
 - Sulfur dioxide
 - Particulate Matter
- Provide data on potential job creation, economic development, and increased state revenue as a result of broader adoption of similar projects.
- Provide a quantified estimate of the project's carbon intensity values for life-cycle GHG emissions.
- Compare any project performance and expectations provided in the project proposal to actual project performance and accomplishments.
- Develop a *Long-Term Operations, Maintenance, and Monitoring Plan* with LightSail and EXWC.
- Transition ownership and operation of the Demonstration Project to EXWC.
- Prepare a *Task 5 Summary* that summarizes the activities performed in this task. (including all data collection and analysis) and include it in the Final Report.

Products:

- Long-Term Operations, Maintenance, and Monitoring Plan (no draft)
- Task 5 Summary (to be included in the Final Report, see Task 1.5)