

## Exhibit A WORK STATEMENT

### TECHNICAL TASK LIST

Task #	CPR	Task Name
1	N/A	Administration
2	X	VRFB / Fuel Cell Integration Test Preparation
3	X	VRFB Energy Storage Equipment Installation
4	X	VRFB / Fuel Cell Integration Test Implementation
5	X	VRFB / Fuel Cell Integration Performance Analysis
6		Dynamic Energy Storage Modeling
7		Economic Benefits Assessment
8		Technology Transfer Activities
9		Production Readiness Plan

### KEY NAME LIST

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
1	Charles Toca	Dan Donaldson	
2	Charles Toca	Dan Donaldson, Dr. Richard L. Hack, Dr. Fabian Mueller, Dr. G. S. Samuelsen	
3	Charles Toca	Dan Donaldson	DSRWT, PEI
4	Charles Toca	Dan Donaldson	DSRWT, PG&E
5	Charles Toca	Dan Donaldson, Dr. Richard L. Hack, Dr. Fabian Mueller, Dr. G. S. Samuelsen	UCI
6		Dr. Richard L. Hack, Dr. Fabian Mueller, Dr. G. S. Samuelsen	UCI
7	Charles Toca	Dan Donaldson, Dr. Richard L. Hack, Dr. Fabian Mueller, Dr. G. S. Samuelsen	UCI
8	Charles Toca	Dan Donaldson	PG&E
9	Charles Toca	Dan Donaldson	PEI

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### GLOSSARY

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

<b>Term/ Acronym</b>	<b>Definition</b>
A & E	Architect and Engineering
CPR	Critical Project Review
DEI	DEI Distributing Company
DSRWT	Dublin/San Ramon Services District's Regional Wastewater Treatment Facility in Pleasanton, CA
Energy Commission	California Energy Commission
IEEE	Institute of Electrical and Electronics Engineers
PAC	Project Advisory Committee
PG&E	Pacific Gas & Electric Company
PIER	Public Interest Energy Research
RD&D	Research, Development and Demonstration
UCI	University of California, Irvine
US&R	Utility Savings & Refund, LLC
VRFB	Vanadium redox-flow battery

### Problem Statement:

Energy storage systems will become increasingly necessary to address intermittent supply of power from renewable sources as California attempts to reach the Renewable Energy Standard goal of 20% renewably generated electricity by 2010 and 33% by 2020. The main problem is the cost of energy storage systems and the current limited use – primarily used for peak shaving, which has limited value.

This project demonstrates the increased value of energy storage when combined with on-site fuel cell power generation. The project will integrate a 3.6 MWh vanadium redox flow battery (VRFB) storage system with existing fuel cells at the Dublin/San Ramon Services District's Regional Wastewater Treatment Facility (DSRWT) in Pleasanton, California. The following table summarizes how integrating VRFB energy storage with fuel cells addresses two key issues with fuel cells:

<b>Problem</b>	<b>How Addressed with VRFB</b>
<ul style="list-style-type: none"> <li>Fuel cell capacity is limited by the minimum power demand of a facility. The implementation of high performance fuel cells (molten carbonate and solid oxide) is typically undersized compared to a facility's mid and peak loads owing to the lack of turndown on the fuel cell (e.g., fuel cell systems need to</li> </ul>	<ul style="list-style-type: none"> <li>VRFB has the ability to store energy for delivery as needed, which will allow for fuel cell installations with capacities in excess of the base load. The result will be increased on-site, renewably-generated power and a decreased demand for power from the grid, particularly during peak hours</li> </ul>

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Problem	How Addressed with VRFB
<p>operate at full load all of the time) and the difficulties in exporting any excess power back to the grid. Additional power generation potential is not realized.</p>	
<ul style="list-style-type: none"> <li>• “Nuisance trips” can occur several times a month when a fuel cell goes off-line due to power quality problems or dips in demand below fuel cell capacity. This leads to higher energy costs due to increased energy demand from the grid when the fuel cell is down and requires the utility to maintain infrastructure to absorb increased demand.</li> </ul>	<ul style="list-style-type: none"> <li>• VRFB can respond quickly to variations in generation and power quality, resulting in a reduction of “nuisance trips.” This will increase the efficiency of the fuel cell and decrease demand from the grid, resulting in lower energy costs.</li> </ul>

### Goals of the Agreement:

The goal of this Agreement is to demonstrate the multiple benefits of integrating VRFB energy storage systems with fuel cell technology (molten carbonate and solid oxide). This project proposes to demonstrate that integrating these two technologies will provide flexibility in mitigating, minimizing, or eliminating electric power imports from the grid, particularly at peak times. This will reduce operating costs and maximize the effectiveness of the fuel cells. The VRFB will also improve power quality, increasing up-time for the fuel cells, which can be unreliable on hot summer days.

### Objectives of the Agreement:

The objectives of this Agreement are to demonstrate that the integration of VRFB energy storage systems with fuel cell technology can provide highly flexible, rapid charge/discharge electric energy storage for the customer and provide flexibility to:

- Mitigate peak grid energy loads by capturing the base load output of the fuel cells during lower facility demand periods and/or the lower cost grid electric period during off-peak.
- Provide a resource for facility load management and demand response to grid upsets or critical power periods announced by the local utility.
- Mitigate peak power demands (both real power and reactive power [aka “kilowatts” and “VARS”]) in response to the operation of large on-site motors used for fluid pumping and aeration of the digestion tanks at the host site, Dublin/San Ramon Services District’s Regional Wastewater Treatment Facility (DSRWT) facility.

The performance objectives of the project are to demonstrate:

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- An 80% reduction in fuel cell down-time resulting in increased fuel cell reliability and an increase in the percentage of grid power that can be met with fuel cell technology.
- An 80% reduction of peak utility demand charges.
- Overall energy bill cost reduction by 20-25%.
- An increase of 25% in the ability to increase utilization of fuel cell generation above the base load requirements of a facility.
- The ability of a dynamical energy storage and grid simulation model to assess the impacts of energy storage on the grid.

### **Product Guidelines:**

For complete product guidelines, refer to Section 5 in the Terms and Conditions.

### **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.

#### **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

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- 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.

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.

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- 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). If the Energy Commission Project Manager concludes that satisfactory progress is not being made, this conclusion will be referred to the Energy Commission's Research, Development and Demonstration (RD&D) Policy Committee for its concurrence.
- 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.

### **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

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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

### **Products:**

- Written documentation of meeting agreements (no draft)
- Schedule for completing closeout activities (no draft)

### **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

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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.

### **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

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#### **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 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.

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## 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.

## 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.

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- 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)

### **Professional Advisory Committee (PAC)**

#### **Task 1.8 Establish the PAC**

The goal of this task is to create an advisory committee for this Agreement.

The PAC shall be composed of diverse professionals. The number can vary depending on potential interest and time availability. The Recipient's Project Manager and the Energy Commission Project Manager shall act as co-chairs of the PAC. The exact composition of the PAC may change as the need warrants. PAC members serve at the discretion of the Energy Commission Project Manager.

The PAC may be composed of, but is not limited to, qualified professionals spanning the following types of disciplines:

- Researchers knowledgeable about the project subject matter.
- Members of the trades who will apply the results of the project (for example, designers, engineers, architects, contractors, and trade representatives).
- Public Interest Market Transformation Implementers.
- Product Developers relevant to project subject matter.
- U.S. Department of Energy Research Manager.
- Public Interest Environmental Groups.
- Utility Representatives.
- Members of the relevant technical society committees.

The purpose of the PAC is to:

- Provide guidance in research direction. The guidance may include scope of research; research methodologies; timing; coordination with other research. The guidance may be based on:
  - Technical area expertise
  - Knowledge of market applications
  - Links between the agreement work and other past, present or

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future research (both public and private sectors) they are aware of in a particular area

- Review products. Provide specific suggestions and recommendations for needed adjustments, refinements, or enhancement of the products.
- Evaluate tangible benefits to California of this research and provide recommendations, as needed, to enhance tangible benefits.
- Provide recommendations regarding information dissemination, market pathways or commercialization strategies relevant to the research products.

### **The Recipient shall:**

- Prepare a draft list of potential PAC members that includes name, company, physical and electronic address, and phone number and submit it to the Energy Commission Project Manager at least 2 working days prior to the kick-off meeting. This list will be discussed at the kick-off meeting and a schedule for recruiting members and holding the first PAC meeting will be developed.
- Recruit PAC members and ensure that each individual understands the member obligations described above, as well as the meeting schedule outlined in Task 1.9.
- Prepare the final list of PAC members.
- Submit letters of acceptance or other comparable documentation of commitment for each PAC member.

### **Products:**

- Draft List of PAC Members
- Final List of PAC Members
- Letters of acceptance, or other comparable documentation of commitment for each PAC Member (no draft)

### **Task 1.9 Conduct PAC Meetings**

The goal of this task is for the PAC to provide strategic guidance to this project by participating in regular meetings or teleconferences.

### **The Recipient shall:**

- Discuss the PAC meeting schedule at the kick-off meeting. The number of face-to-face meetings and teleconferences and the location of PAC meetings shall be determined in consultation with the Energy Commission Project Manager. This draft schedule shall be presented to the PAC members during recruiting and finalized at the first PAC meeting.
- Organize and lead PAC meetings in accordance with the schedule. Changes to the schedule must be pre-approved in writing by the Energy Commission Project Manager.
- Prepare PAC meeting agenda(s) with back-up materials for agenda items.

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- Prepare PAC meeting summaries, including recommended resolution of major PAC issues.

### **Products:**

- Draft PAC Meeting Schedule
- Final PAC Meeting Schedule
- PAC Meeting Agenda(s) with Back-up Materials for Agenda Items (no draft)
- Written PAC meeting summaries, including recommended resolution of major PAC issues (no draft)

### **TECHNICAL TASKS**

#### **TASK 2 VRFB / FUEL CELL INTEGRATION TEST PREPARATION**

The goal of this task is to develop standardized testing procedures, performance measures and reporting mechanisms in compliance with utility standards to demonstrate the benefits of integrating VRFB energy storage technology with fuel cells (molten carbonate and solid oxide). A standardized protocol will be developed to facilitate technology transfer into the marketplace and rapid market adoption. A customized test plan will be developed that will include specifications and requirements for integration at the DSRWT facility, with Pacific Gas & Electric (PG&E) serving as the utility.

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

- Prepare the Standardized VRFB/ Fuel Cell Integration Test Plan. This test plan shall use Institute of Electrical and Electronics Engineers (IEEE) and utility standards and shall include, but not be limited to:
  - A description of the process to be tested;
  - The rationale for why the tests are required;
  - Predicted performance based on calculations or other analyses;
  - Test objectives and technical approach;
  - A test matrix showing the number of test conditions and replicated runs;
  - A description of the facilities, equipment, and instrumentation required to conduct the tests;
  - A description of test procedures, including: parameters to be controlled and how they will be controlled; parameters to be measured and instrumentation to measure them; calibration procedures to be used; recommended calibration interval; and maintenance of the test log;
  - A description of the data analysis procedures;
  - A description of quality assurance procedures;
  - Contingency measures to be considered if the test objectives are not met; and
  - A description of how contract performance objectives will be evaluated.
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- Prepare a DSRWT VRFB/ Fuel Cell Integration Test Plan utilizing the Standardized VRFB/ Fuel Cell Integration Test Plan as a template and customizing for the DSRWT site.
- Submit the DSRWT VRFB/ Fuel Cell Integration Test Plan to PG&E, Energy Commission Agreement Manager and others for review and comment. Coordinate and confirm measurement and verification methodology of the VRFB/ fuel cell system operation with PG&E.
- Revise and finalize the DSRWT VRFB/Fuel Cell Integration Test Plan based on comments from PG&E, Energy Commission Agreement Manager and others.
- Participate in a CPR as per Task 1.2

### **Products:**

- Draft Standardized VRFB / Fuel Cell Integration Test Plan
- Final Standardized VRFB / Fuel Cell Integration Test Plan
- Draft DSRWT VRFB / Fuel Cell Integration Test Plan
- Final DSRWT VRFB / Fuel Cell Integration Test Plan

### **TASK 3 VRFB ENERGY STORAGE EQUIPMENT INSTALLATION**

The goal of this task is to prepare the DSRWT facility for VRFB installation, and install and test the VRFB system to ensure it is ready for implementation of the integrated VRFB / fuel cell energy testing. This task includes: procuring subcontractors for the design and construction of the physical facility; ordering VRFB equipment; parts assembly; and installing, setting up and testing the VRFB energy storage at the DSRWT facility.

### **The Recipient shall:**

- Prepare a list of governmental agencies and contacts who are involved in approving the installation. The list will include, but not be limited to the following information: agency name, contact name, contact title, phone number, email address, and mailing address.
- Review the DSRWT facility to determine the requirements and specifications for VRFB installation, including, but not limited to, the following issues:
  - VRFB sizing requirements
  - Fuel cell integration specifications
  - Space allocation and location
  - Insurance and indemnity
  - Equipment installation and removal
  - Regulatory and environmental impacts
  - Permitting requirements
  - Equipment specifications definition and list
  - Vendor data requirements / equipment budget
  - Access to the site
- Configure VRFB energy storage according to DSRWT fuel cell integration requirements and specifications and submit order to vendor for manufacture.

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- (The approximate order fulfillment time for manufacture of the VRFB energy storage system is anticipated to be 8 months. Components will be shipped to California for a 3-4 week final assembly process before installation at the DSRWT site. During manufacture and assembly, the physical facility will be built at the DSRWT facility in preparation for installation as defined below).
- Design facility (including piping and electrical) and select general contractor.
- Conduct site survey and prepare facility design.
- Develop scope of work and project management schedule.
- Competitively select an architect and engineering (A&E) firm to complete design specifications.
- Solicit bids from local contractors to build the VRFB energy storage facility and award contract.
- Hold design review meeting. The meeting will include the DSRWT facility owner, all subcontractors, and relevant agency representatives. The goal of the meeting will be to report on the equipment delivery status, present the A&E firm's final report and identify the general contractor.
- Prepare the VRFB Pre-Installation Report. This report shall include, but not be limited to, the following:
  - Summary of A&E firm's final design report
  - General contractor selection
  - Equipment manufacture / assembly / delivery status
  - Significant issues encountered and how they were addressed
  - Photographs as appropriate
- Hold a construction management progress meeting. The goal of the meeting will be to review construction status prior to equipment installation. The meeting will include the DSRWT facility owner, all subcontractors, and relevant agency representatives.
- Install, startup and test the VRFB energy storage system.
- Install the VRFB system at the DSRWT facility.
- Complete major installations of piping and facility construction.
- Obtain agency permit sign-off.
- Conduct system testing.
- Prepare the VRFB Installation Report. This report shall include, but not be limited to, the following:
  - List of activities performed
  - Significant issues encountered and how they were addressed
  - Updates to projected installation completion date
  - Photographs as appropriate
- Hold a construction management progress meeting. The goal of the meeting will be to review construction status once permits have been obtained. The meeting will include the DSRWT facility owner, all subcontractors, and relevant agency representatives.
- Participate in a CPR as per Task 1.2.

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## **Products:**

- Agency Contact List (no draft)
- Draft VRFB Pre-Installation Report
- Final VRFB Pre-Installation Report
- Draft VRFB Installation Report
- Final VRFB Installation Report

## **TASK 4 VRFB/ FUEL CELL INTEGRATION TEST IMPLEMENTATION**

The goal of this task is to implement measurement and verification testing protocols (developed in accordance to IEEE and utility standards) on the integrated VRFB energy storage/ molten carbonate fuel cell system to demonstrate energy efficiency and cost savings. A test report will be generated that will include data gathered during testing and methods used.

### **The Recipient shall:**

- Conduct testing according to the DSRWT VRFB/ Fuel Cell Integration Test Plan
- Prepare the DSRWT VRFB/ Fuel Cell Integration Test Report. This report shall include, but is not be limited to, the following:
  - Description of test results and to what degree the goals were achieved
  - Discussion of implications of test results
  - Recommendations for future installations
  - Recommendations for further study
  - Photographs as appropriate
  - Participate in a CPR as per Task 1.2
  -

### **Products:**

- Draft DSRWT VRFB / Fuel Cell Integration Test Report
- Final DSRWT VRFB / Fuel Cell Integration Test Report

## **TASK 5 VRFB / FUEL CELL INTEGRATION PERFORMANCE ANALYSIS**

The goal of this task is to analyze the performance of the integrated VRFB energy storage/ fuel cell system. Data analysis will include reporting on effects of the installation of the VRFB on the site's energy needs, the fuel cell operation, and the impacts on the grid relative to power quality. The performance report will be used for technology development and to demonstrate that integrating VRFB energy storage with fuel cells is ready for the marketplace.

### **The Recipient shall:**

- Conduct performance analysis according to the DSRWT VRFB/ Fuel Cell Integration Test Plan
- Prepare the DSRWT VRFB/ Fuel Cell Integration Performance Report. This report shall include, but not be limited to, the following:
  - Description of test results and to what degree the goals were achieved

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- Discussion of implications of test results
- Recommendations for future installations at the DSRWT facility
- Recommendations for further study at the DSRWT facility
- Photographs as appropriate
- Participate in a CPR as per Task 1.2

### **Products:**

- Draft DSRWT VRFB/ Fuel Cell Integration Performance Report
- Final DSRWT VRFB/ Fuel Cell Integration Performance Report

### **TASK 6 DYNAMIC ENERGY STORAGE MODELING**

The goal of this task is to develop a dynamic model for the storage system that can be used for grid simulation modeling to assess the impacts of energy storage.

Model development will utilize first principles of system and monitored parameters to develop a dynamic model for the flow battery. This model, developed in MatLab Simulink, would then be compatible with various other models developed by University of California, Irvine (UCI) (grid, renewable energy such as solar, wind, distributed generation, combined heat and power, and fuel cells) and can be used to develop macro grid models. The impacts of the flow battery energy storage system can then be modeled with various scenarios. It is proposed that development of a robust model will be a primary effort, with some preliminary modeling of the effects of deployment of the flow battery in a heavily renewable source supported grid as a secondary effort.

### **The Recipient shall:**

- Develop software that will model impact of energy storage on grid. The software shall include written instructions for data input and use.
- Prepare a Grid Simulation Model Report. The Report shall include, but not limited to, the following:
  - Goal of simulation modeling
  - Description of software features and model parameters simulated
  - Description of results from modeling
  - Recommendations for energy storage use
  - Recommendations for further study
- 

### **Products:**

- Draft Grid Simulation Model Report
- Final Grid Simulation Model Report
- Computer software with written instructions for data input and use of the software (no draft)
- 

### **TASK 7 ECONOMIC BENEFITS ASSESSMENT**

The goal of this task is to assess the multiple benefits to California of integrating VRFB energy storage technology with molten carbonate fuel cells. To bring this technology to

## **Exhibit A WORK STATEMENT**

the marketplace, the Economic Benefits Report developed as a part of this task will be distributed to California utilities and industrial customers.

### **The Recipient shall:**

- Prepare an Economic Benefits Report. The Report will include, but not be limited to, the following:
  - Impact of integration of VRFB energy storage and molten carbonate fuel cell technology on:
    - Peak savings
    - Energy efficiency
    - Renewable energy use
    - Increase fuel cell use
    - Reductions in operation and maintenance costs (O&M)
    - Demand savings on the utility bill
  - A cost / benefit analysis at the site level and for utilities
  - Technology deployment recommendations
- Present Economic Benefits Report to PG&E and other utilities

### **Products:**

- Draft Economic Benefits Report
- Final Economic Benefits Report

### **TASK 8 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 9 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.

## **Exhibit A WORK STATEMENT**

### **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