

**CONTRACT REQUESTS FORM (CRF)**

CEC-94 (Revised 5/11)

CALIFORNIA ENERGY COMMISSION



New Contract \_\_\_\_\_  Amendment to Existing Contract: 500-09-027 Amendment Number: 1

Division	Contract Manager:	MS-	Phone	CM Training Date
Energy Research and Development	Johann Karkheck	43	916-327-2457	1/10/2012

Contractor's Legal Name	Federal ID Number
Pacific Gas and Electric Company	94-0742640

Title of Project
Pacific Gas & Electric Energy Storage Demonstration

Term	Start Date	End Date	Amount
New/Original Contract	6/15/2010	12/31/2012	\$ 2,800,000

Line up the Amendment information as best as possible within the following table.

Amendment #	End Date (mm/dd/yy)	Amount
Amendment 1	6/30/2014	\$500,000

#### Business Meeting Information

Proposed Business Meeting Date	5/9/2012	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
Business Meeting Presenter	Consuelo Sichon	Time Needed:	5 minutes

#### Agenda Item Subject and Description

The terms and conditions of this agreement are being modified. Possible approval of Amendment 1 to Contract 500-09-027 with Pacific Gas & Electric to add \$500,000 and 18 months to the contract. This amendment will add a second sodium-sulfur battery energy storage system demonstration and compare the performance of two large-scale battery systems in California to help mitigate the variability of renewable generation on the electric grid. (PIER electricity funding.) Contact: Consuelo Sichon. (5 minutes)

**Business Meeting approval is not required for the following types of contracts:** *Executive Director's signature is required in all cases.*

- Contracts less than \$10k (*Policy Committee's signature is also required*)
- Amendment for a no-cost time extension. Must be first extension, less than one year and original contract less than \$100k.
- Contracts less than \$25k for Expert Witness in Energy Facility licensing cases and amendments.

#### Purpose of Contract or Purpose of Amendment, if applicable

As directed by the Department of General Services, Office of Legal Services, the Exhibit D, Special Terms and Conditions, Disputes Provision is being amended to remove the Binding Arbitration language. In addition, other edits are being made to the remaining language.

A second battery storage system demonstration at PG&E's Vaca-Dixon Substation will be added and its performance will be compared with the battery system at the Hitachi Global Storage Technologies facility in San Jose.

Task 7 of this contract involving an initial study of potential CAES demonstration locations is being deleted because PG&E has obtained an alternate source of funding to do this work.

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**California Environmental Quality Act (CEQA) Compliance**

1. Is Contract considered a "Project" under CEQA?  
 Yes: skip to question 2       No: complete the following (PRC 21065 and 14 CCR 15378):  
 Explain why contract is not considered a "Project":
2. If contract is considered a "Project" under CEQA:  
 a) Contract **IS** exempt. (Draft NOE required)  
 Statutory Exemption. List PRC and/or CCR section number: \_\_\_\_\_  
 Categorical Exemption. List CCR section number: 14 CCR 15303  
 Common Sense Exemption. 14 CCR 15061 (b) (3)  
 Explain reason why contract is exempt under the above section:  
 Class 3 - New construction of limited small new facilities; installation of small, new equipment and facilities in small structures; and conversion of the use of small existing structures (e.g., construction of three or fewer single-family homes in urban areas)  
 b) Contract **IS NOT** exempt. The Contract Manager needs to consult with the Energy Commission attorney assigned to their division and the Siting Office regarding a possible Initial Study.

**Budgets Information**

Contract Amount Funded		Breakdown by FY			Funding Sources			
Funding Source	Amount	FY	Amount	Approved?	Funding Source	FY	Budget List No.	Amount
ARFVTF	\$	11-12	\$500,000	Yes	PIER-E	10-11	501.0271	\$500,000
ECAA	\$		\$					\$
State- ERPA	\$		\$					\$
Federal	\$		\$					\$
PIER - E	\$500,000		\$					\$
PIER - NG	\$		\$					\$
Reimbursement	\$		\$					\$
Other	\$		\$					\$
<b>TOTAL:</b>	<b>\$500,000</b>	<b>TOTAL:</b>	<b>\$500,000</b>				<b>TOTAL:</b>	<b>\$500,000</b>
Reimbursement Contract #:					Federal Agreement			

Contractor's Administrator/ Officer		Contractor's Project Manager	
Name:	Kathie Stefani	Name:	Jon Eric Thalman
Address:	245 Market St Mail Code N10D	Address:	77 Beale St. Rm. 1508
City, State, Zip:	San Francisco, CA 94105-1702	City, State, Zip:	San Francisco, CA 94105-1814
Phone/ Fax:	(415) 972-7057 /	Phone/ Fax:	(415) 973-7691 /
E-Mail:	KAS8@pge.com	E-Mail:	jetg@pge.com

**Contractor Is**

- Private Company (including non-profits)  
 CA State Agency (including UC and CSU)  
 Government Entity (i.e. city, county, federal government, air/water/school district, joint power authorities, university from another state)

**Selection Process Used**

- Solicitation    Select Type    Solicitation #: \_\_\_\_\_ # of Bids: \_\_\_\_\_ Low Bid?  No  Yes  
 Non Competitive Bid (Attach CEC 96)  
 Exempt    Select Exemption

**Civil Service Considerations**

- Not Applicable (Contract is with a CA State Entity or a membership/co-sponsorship)  
 Public Resources Code 25620, et seq., authorizes the Commission to contract for the subject work. (PIER)

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- The Services Contracted:
  - are not available within civil service
  - cannot be performed satisfactorily by civil service employees
  - are of such a highly specialized or technical nature that the expert knowledge, expertise, and ability are not available through the civil service system.
- The Services are of such an:
  - urgent
  - temporary, or
  - occasional nature
 that the delay to implement under civil service would frustrate their very purpose.

**Justification:**

Public Resources Code 25620, et seq., authorizes the Commission to contract for the subject work. (PIER)

**Payment Method**

- A. Reimbursement in arrears based on:
  - Itemized Monthly       Itemized Quarterly       Flat Rate       One-time
- B. Advanced Payment
- C. Other, explain:

**Retention**

1. Is contract subject to retention?  No       Yes  
 If Yes, Do you plan to release retention prior to contract termination?  No       Yes

**Justification of Rates**

The rates are similar to the original contract and with other PIER-funded contracts.

**Disabled Veteran Business Enterprise Program (DVBE)**

1.  Not Applicable
2.  Meets DVBE Requirements      DVBE Amount: \$ 99,000.00      DVBE %: 3
  - Contractor is Certified DVBE
  - Contractor is Subcontracting with a DVBE: Big Ed's Crane Service Inc.
3.  Requesting DVBE Exemption (attach CEC 95)

**Is Contractor a certified Small Business (SB), Micro Business (MB) or DVBE?**

- No       Yes
- If yes, check appropriate box:       SB       MB       DVBE

**Is Contractor subcontracting any services?**

	<input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes		
If yes, give company name and identify if they are a Small Business (SB), Micro Business (MB) and/or DVBE:				
Electric Power Research Institute (EPRI)	<input checked="" type="checkbox"/> No	<input type="checkbox"/> SB	<input type="checkbox"/> MB	<input type="checkbox"/> DVBE
Premier Power Professionals	<input checked="" type="checkbox"/> No	<input type="checkbox"/> SB	<input type="checkbox"/> MB	<input type="checkbox"/> DVBE
S&C Electric Company	<input checked="" type="checkbox"/> No	<input type="checkbox"/> SB	<input type="checkbox"/> MB	<input type="checkbox"/> DVBE
Big Ed's Crane Service Inc.	<input type="checkbox"/> No	<input checked="" type="checkbox"/> SB	<input checked="" type="checkbox"/> MB	<input type="checkbox"/> DVBE
Agile 1	<input checked="" type="checkbox"/> No	<input type="checkbox"/> SB	<input type="checkbox"/> MB	<input type="checkbox"/> DVBE



**Miscellaneous Contract Information**

- 1. Will there be Work Authorizations?  No  Yes
- 2. Is the Contractor providing confidential information?  No  Yes
- 3. Is the contractor going to purchase equipment?  No  Yes
- 4. Check frequency of progress reports  
 Monthly  Quarterly  \_\_\_\_\_
- 5. Will a final report be required?  No  Yes
- 6. Is the contract, with amendments, longer than a year? If yes, why?  No  Yes

The Department of General Services has agreed to give the Commission blanket authority to execute multi-year contracts to support the Commission's RD&D Programs.

# CONTRACT REQUESTS FORM (CRF)



The following items should be attached to this CRF		
1. Scope of Work, Attach as Exhibit A.	<input type="checkbox"/> N/A	<input type="checkbox"/> Attached
2. Budget Detail, Attach as Exhibit B.	<input type="checkbox"/> N/A	<input type="checkbox"/> Attached
3. CEC 96, NCB Request	<input type="checkbox"/> N/A	<input type="checkbox"/> Attached
4. CEC 30, Survey of Prior Work	<input type="checkbox"/> N/A	<input type="checkbox"/> Attached
5. CEC 95, DVBE Exemption Request	<input type="checkbox"/> N/A	<input type="checkbox"/> Attached
6. Draft CEQA Notice of Exemption (NOE)	<input type="checkbox"/> N/A	<input type="checkbox"/> Attached
7. Resumes	<input type="checkbox"/> N/A	<input type="checkbox"/> Attached
8. CEC 105, Questionnaire for Identifying Conflicts		<input type="checkbox"/> Attached
9. CEC 106, IT Component Reporting Form		<input type="checkbox"/> Attached

\_\_\_\_\_  
 Contract Manager                      Date                      Office Manager                      Date                      Deputy Director                      Date

The following signatures are only required when contract approval is delegated to the Executive Office and not approved at a Business Meeting. See Business Meeting Information Section.

\_\_\_\_\_  
 Presiding Policy Committee                      Date                      Associate Policy Committee                      Date                      Executive Director                      Date

## Exhibit A SCOPE OF WORK

Advanced Energy Storage Systems for Enabling California's Smart Grid

### TECHNICAL TASK LIST

Task #	CPR	Task Name
1		Administration
2	X	Install NaS BESS Systems and Prepare an Engineer-of-Record <b>Reports</b>
3		Measure Performance for Load Shaping and Power Quality
4		Reliability Enhancement Assessment
5		Renewable Resource Integration, Load Shaping, and Demand Response Assessment
6		Ancillary Services Assessment
7		<del>Compressed Air Energy Storage (CAES) Geologic Site Verification</del>
8		Technology Transfer Activities

### KEY NAME LIST

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
1		<b><u>Robert Schainker, EPRI</u></b>	
2		Robert Schainker, EPRI	
3		Robert Schainker, EPRI	
4		Robert Schainker, EPRI	
5		Robert Schainker, EPRI	
6		Robert Schainker, EPRI	
7		Robert Schainker, EPRI	
8		Robert Schainker, EPRI	

### GLOSSARY

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

Acronym	Definition
<b><u>ABB</u></b>	<b><u>Asea Brown Boveri</u></b>
<b><u>AC</u></b>	<b><u>Alternating Current</u></b>
AEP	American Electric Power
AGC	Automatic Generation Control
Energy Commission	California Energy Commission
CCM	<del>Commission Contract Manager</del>
CAES	<del>Compressed Air Energy Storage</del>
CPP	Critical Peak Pricing
CPR	Critical Project Review
CPUC	<del>California Public Utilities Commission</del>

Acronym	Definition
<u>CA</u> California ISO	California Independent System Operator
DAS	Data Acquisition System
<b><u>DESS</u></b>	<b><u>Distributed Energy Storage System</u></b>
<b><u>DC</u></b>	<b><u>Direct Current</u></b>
DOE	U.S. Department of Energy
DVBE	Disabled Veterans Business Enterprise Program
<b><u>DYNATRAN</u></b>	<b><u>Dynamic Analysis of Interconnected Systems with Energy Storage</u></b>
EPC	Engineering Procurement Contractor
EPRI	Electric Power Research Institute
ESVT	Energy Storage Valuation Tool
I/A/W	Industrial, Agriculture and Water
IEEE	Institute of Electrical & Electronic Engineers, Inc.
M&E	Measurement and Evaluation
MRTU	Market Redesign and Technology Upgrade
MW	Megawatt
LBNL	Lawrence Berkeley National Laboratory
M&EC	Measurement and Evaluation Committee
NaS	Sodium-Sulfur Battery
NaS BESS	Sodium-Sulfur Battery Energy Storage System
<b><u>NGK</u></b>	<b><u>NGK Insulators, Incorporated</u></b>
NYPA	New York Power Authority
O&M	Operations & <u>and</u> Maintenance
PAC	Project Advisory Committee
PC	Personal Computer
PIER	Public Interest Energy Research
PCS	Power Conversion System
PG&E	Pacific Gas and Electric Company
PDF	Portable Document Format
PPP	Premier Power Professionals
RFP	Request for Proposal
RTP	Real Time Pricing
<b><u>S&amp;C</u></b>	<b><u>S&amp;C Electric Company</u></b>
SCADA	Supervisory Control and Data Acquisition
SCE	Southern California Edison Company
SQL	Structured Query Language (language for structuring and querying databases)
TBD	To be determined
<b><u>UCC1</u></b>	<b><u>Uniform Commercial Code Form 1 National Financing Statement</u></b>
VAR	Volt-amperes reactive

## Problem Statement

California electric utilities need cost-effective and reliable energy storage systems. Such systems have the potential to improve reliability and efficiency of electric delivery by providing power as needed to help balance peak loads, the increasing costs of grid infrastructure, and to mitigate the intermittent nature of many types of renewable generation such as wind and solar. Improvements and advancements have been made to several types of electric energy storage technology. However, electric utilities need more information and data about the use and value of electric energy storage systems before the utilities can be in a position to adopt such systems in sufficient quantities to bring benefits to customers. For example, additional information and data are needed about the following areas:

- Applications to support distribution system capacity expansion and reliability;
- Applications to support energy management and renewable power optimization; and
- The economic value of electric energy storage systems and how best to value and monetize their economic value in the California energy markets.

The set of tasks and efforts detailed below has been developed to enable the Public Interest Energy Research (PIER) Program to meet the identified need for testing and data explained above in order to advance the application and value of electric energy storage systems in California. The Contractor shall obtain that information via two specific projects:

- Deployment and demonstration of a **two** Pacific Gas and Electric Company (PG&E)-owned Sodium-Sulfur Battery Energy Storage Systems (NaS BESS) for distribution and renewable energy support. **The Vaca-Dixon NaS BESS will be located within PG&E's Vaca Dixon Substation near Vacaville, California, and the Yerba Buena NaS BESS will be located at the Hitachi Global Storage Technologies facility in San Jose, California.** and
- ~~Assessment of Compressed Air Energy Storage (CAES) for bulk power and large intermittent renewable generation support, using below ground air storage siting opportunities in California.~~

To enable the full value of ~~these~~ electric energy storage options to be realized in California, an integrated program will be conducted involving field demonstration and monitoring, test and evaluation, costs and benefit assessment, and technology transfer.

## Goals of the Agreement

The goal of the Agreement is to significantly advance the application and understanding of the value of electric energy storage systems in California and to develop information to enable electric utilities to better plan, deploy, use, and monetize the value from these types of assets. Specific goals are to:

- Install a **two** large-scale NaS BESS's for improving service reliability and power quality to electric customers.
- Measure the performance and assess the value of the NaS BESS for improving grid operations, providing ancillary services, and integrating intermittent renewables;
- ~~Perform geologic and geochemical analyses at sites for potential CAES systems;~~
- ~~Analyze CAES geologic results, economics, engineering, thermodynamics and air store power plants to develop preliminary plant designs for an advanced, underground CAES plant in Northern or Central California.~~
- Transfer results and lessons learned to key electric utility stakeholders via briefings and application workshop.

## Objectives of the Agreement

The objectives of the Agreement are to:

- Advance the application of the NaS BESS for electric utility grid support in California:
  - Install and monitor a two large-scale NaS BESS's and document the experience, costs, schedule, performance, and lessons learned;
  - Demonstrate the use of the NaS BESS to enhance service reliability and power quality on the PG&E transmission and distribution system;
  - Demonstrate the use of the NaS BESS to enhance the value of wind and/or solar generation on the PG&E transmission and distribution system.
- **Compare the Vaca-Dixon and Yerba Buena NaS BESS projects to other NaS BESS projects**
- ~~Develop CAES opportunities using below ground air storage site in California (nominally, 300 Megawatt (MW), 10 hours of storage)~~
  - ~~Conduct CAES geologic site verification analyses;~~
  - ~~Develop preliminary CAES plant designs and plant performance estimates, based on the results from the above geologic investigations;~~
  - ~~Identify potential technical and cost risks associated with building a PG&E CAES demonstration plant using below ground air storage system.~~
- Transfer results and lessons learned via a workshop to California utilities to enable energy storage system deployments in California.

## Task 1.0 Administration

### MEETINGS

#### 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 Contractor shall:

- Attend a “kick-off” meeting with the Commission Contract Manager, the Contracts Officer, and a representative of the Accounting Office. The Contractor shall bring their Project Manager, Contracts Administrator, Accounting Officer, and others designated by the Commission Contract 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 Commission Contract 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:

- Terms and conditions of the Agreement
- CPRs (Task 1.2)
- Match fund documentation (Task 1.7)
- Permit documentation (Task 1.8)

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

- The Commission Contract Manager's expectations for accomplishing tasks described in the Scope of Work;
- An updated Schedule of Deliverables
- Progress Reports (Task 1.4)

- Technical Deliverables (Task 1.5)
- Final Report (Task 1.6)

The Commission Contract Manager shall designate the date and location of this meeting.

**Contractor Deliverables:**

- An Updated Schedule of Deliverables
- An Updated List of Match Funds
- An Updated List of Permits

**Commission Contract Manager Deliverables:**

- Final Report Instructions

**Task 1.2 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 if it should, are there any modifications that need to be made to the tasks, deliverables, schedule or budget.

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

Participants include the Commission Contract Manager and the Contractor, and may include the Commission Contracts Officer, the PIER Program Team Lead, other Energy Commission staff and Management as well as other individuals selected by the Commission Contract Manager to provide support to the Energy Commission.

**The Commission Contract Manager shall:**

- Determine the location, date and time of each CPR meeting with the Contractor. These meetings generally take place at the Energy Commission, but they may take place at another location.
- Send the Contractor the agenda and a list of expected participants in advance of each CPR. If applicable, the agenda shall include a discussion on both match funding and permits.
- Conduct and make a record of each CPR meeting. One of the outcomes of this meeting will be a schedule for providing the written determination described below.
- Determine whether to continue the project, and if continuing, whether or not to modify the tasks, schedule, deliverables and budget for the remainder of the Agreement, including not proceeding with one or more tasks. ~~If the Commission Contract Manager concludes that satisfactory progress is not being made, this conclusion will be referred to the Energy Commission's Research, Development and Demonstration Policy Committee for its concurrence.~~
- Provide the Contractor with a written determination in accordance with the schedule. The written response may include a requirement for the Contractor to revise one or more deliverable(s) that were included in the CPR.

**The Contractor 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 deliverables identified in this Scope of Work. Submit these documents to the Commission Contract 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.

**Contractor Deliverables:**

- CPR Report(s)
- CPR deliverables identified in the Scope of Work

**Commission Contract Manager Deliverables:**

- Agenda and a List of Expected Participants
- Schedule for Written Determination
- Written Determination

**Task 1.3 Final Meeting**

The goal of this task is to closeout this Agreement.

**The Contractor shall:**

- Meet with the Energy Commission 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 Contractor, the Commission Contracts Officer, and the Commission Contract Manager. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be two separate meetings at the discretion of the Commission Contract Manager.

The technical portion of the meeting shall present findings, conclusions, and recommended next steps (if any) for the Agreement. The Commission Contract Manager will determine the appropriate meeting participants.

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

- What to do with any state-owned equipment (Options)
- Need to file **Uniform Commercial Code Form 1 National Financing Statement (UCC.1)** UCC.1 form re: **regarding the** Energy Commission's interest in patented technology
- Energy Commission's request for specific "generated" data (not already provided in Agreement deliverables)
- Need to document Contractor's disclosure of "subject inventions" developed under the Agreement
- "Surviving" Agreement provisions, such as repayment provisions and confidential deliverables
- Final invoicing and release of retention
- Prepare a schedule for completing the closeout activities for this Agreement.

**Deliverables:**

- Written documentation of meeting agreements and all pertinent information
- Schedule for completing closeout activities

## REPORTING

See Exhibit D, Reports/Deliverables/Records.

### 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.

#### The Contractor shall:

- Prepare progress reports which summarize all Agreement activities conducted by the Contractor 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 Commission Contract Manager within 10 working days after the end of the reporting period. Attachment A-2, Progress Report Format, provides the recommended specifications.

#### Deliverables:

- Monthly Progress Reports

### Task 1.5 Test Plans, Technical Reports and Interim Deliverables

The goal of this task is to set forth the general requirements for submitting test plans, technical reports and other interim deliverables, unless described differently in the Technical Tasks. When creating these deliverables, the Contractor shall use and follow, unless otherwise instructed in writing by the Commission Contract Manager, the latest version of the PIER Style Manual published on the Energy Commission's web site:

<http://www.energy.ca.gov/contracts/pier/contractors/index.html>

#### The Contractor shall:

- Unless otherwise directed in this Scope of Work, submit a draft of each deliverable listed in the Technical Tasks to the Commission Contract Manager for review and comment in accordance with the approved Schedule of Deliverables. The Commission Contract Manager will provide written comments back to the Contractor on the draft deliverable within 10 working days of receipt. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 5 working days of receipt. Key elements from this deliverable shall be included in the Final Report for this project.

### Task 1.6 Final Report

The goal of this task is to prepare a comprehensive written Final Report that describes the original purpose, approach, results and conclusions of the work done under this Agreement. The Commission Contract Manager will review and approve the Final Report. The Final Report must be completed on or before the termination date of the Agreement. When creating these deliverables, the Contractor shall use and follow, unless otherwise instructed in writing by the Commission Contract Manager, the latest version of the PIER Style Manual published on the Energy Commission's web site:

<http://www.energy.ca.gov/contracts/pier/contractors/index.html>

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

### **Task 1.6.1 Final Report Outline**

#### **The Contractor shall:**

- Prepare a draft outline of the Final Report.
- Submit the draft outline of Final Report to the Commission Contract Manager for review and approval. The Commission Contract Manager will provide written comments back to the Contractor on the draft outline within 10 working days of receipt. Once agreement has been reached on the draft, the Contractor shall submit the final outline to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final outline within 5 working days of receipt.

#### **Deliverables:**

- Draft Outline of the Final Report
- Final Outline of the Final Report

### **Task 1.6.2 Final Report**

#### **The Contractor shall:**

- Prepare the draft Final Report for this Agreement in accordance with the approved outline.
- Submit the draft Final Report to the Commission Contract Manager for review and comment. The Commission Contract Manager will provide written comments within 10 working days of receipt. Once agreement on the draft Final Report has been reached, the Commission Contract Manager shall forward the electronic version of this report for Energy Commission internal approval. Once the approval is given, the Commission Contract Manager shall provide written approval to the Contractor within 5 working days.
- Submit one bound copy of the Final Report with the final invoice.

#### **Deliverables:**

- Draft Final Report
- Final Report

## **MATCH FUNDS, PERMITS, AND ELECTRONIC FILE FORMAT**

### **Task 1.7 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. While the PIER budget for this task will be zero dollars, the Contractor may utilize match funds for this task. Match funds shall be spent concurrently or in advance of PIER funds during the term of this Agreement. Match funds must be identified in writing, and the associated commitments obtained before the Contractor can incur any costs for which the Contractor will request reimbursement.

#### **The Contractor shall:**

- Prepare a letter documenting the match funding committed to this Agreement and submit it to the Commission Contract Manager at least 2 working days prior to the kick-off meeting:
  1. 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.

2. 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 Contractor shall identify its owner and provide a contact name, address and telephone number, and the address where the property is located.
    - 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 significantly 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 Commission Contract Manager if during the course of the Agreement additional match funds are received.
  - Notify the Commission Contract Manager within 10 working days if during the course of the Agreement existing match funds are reduced. Reduction in match funds may trigger an additional CPR.

**Deliverables:**

- A letter regarding Match Funds or stating that no Match Funds are provided
- Letter(s) for New Match Funds
- A copy of each Match Fund commitment letter
- Letter that Match Funds were Reduced (if applicable)

**Task 1.8 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. While the PIER budget for this task will be zero dollars, the Contractor shall show match funds for this task. Permits must be identified in writing and obtained before the Contractor can incur any costs related to the use of the permits for which the Contractor will request reimbursement.

**The Contractor shall:**

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the Commission Contract Manager at least 2 working days prior to the kick-off meeting:
  1. If there are no permits required at the start of this Agreement, then state such in the letter.
  2. 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
  - Schedule the Contractor will follow in applying for and obtaining these permits.
- The list of permits and the schedule for obtaining them will be discussed at the kick-off meeting, and a timetable for submitting the updated list, schedule and the copies of the permits will be developed. 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, then provide the appropriate information on each permit and an updated schedule to the Commission Contract Manager.
- As permits are obtained, send a copy of each approved permit to the Commission Contract Manager.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the Commission Contract Manager within 5 working days. Either of these events may trigger an additional CPR.

**Deliverables:**

- A letter documenting the Permits or stating that no Permits are required
- Updated list of Permits as they change during the Term of the Agreement
- Updated schedule for acquiring Permits as it changes during the Term of the Agreement
- A copy of each approved Permit

**Task 1.9 Electronic File Format**

The goal of this task is to unify the formats of electronic data and documents provided to the Energy Commission as contract deliverables. Another goal is to establish the computer platforms, operating systems and software that will be required to review and approve all software deliverables.

**The Contractor shall:**

- Deliver documents to the Commission Contract Manager in the following formats:
  - Data sets shall be in Microsoft (MS) Access or MS Excel file format.
  - PC-based text documents shall be in MS Word file format.
  - Documents intended for public distribution shall be in PDF file format, with the native file format provided as well.
  - Project management documents shall be in MS Project file format.
- Request exemptions to the electronic file format in writing at least 90 days before the deliverable is submitted.

**Deliverables:**

- A letter requesting exemption from the Electronic File Format (if applicable)

**PAC (Project Advisory Committee)**

**Task 1.10 Establish the PAC**

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

The PAC should be composed of diverse professionals. The number can vary depending on potential interest and time availability. The Contractor's Project Manager and the Commission Contract 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 Commission Contract Manager.

The PAC may be composed of 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 (e.g., designers, engineers, architects, contractors, and trade representatives)
- Public Interest Market Transformation Implementers
- Product Developers relevant to project subject matter
- United-States. 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
  - linkages between the agreement work and other past, present or future research (both public and private sectors) they are aware of in a particular area
- Review deliverables. Provide specific suggestions and recommendations for needed adjustments, refinements, or enhancement of the deliverables.
- 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 Contractor 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 Commission Contract 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 1.11.
- Prepare the final list of PAC members.
- Submit letters of acceptance or other comparable documentation of commitment for each PAC member.

**Deliverables:**

- Draft List of PAC Members
- Final List of PAC Members
- Letters of acceptance, or other comparable documentation of commitment for each PAC Member

**Task 1.11 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 Contractor 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 Commission Contract 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 Commission Contract Manager.
- Prepare PAC meeting agenda(s) with back-up materials for agenda items.
- Prepare PAC meeting summaries, including recommended resolution of major PAC issues.

**Deliverables:**

- Draft PAC Meeting Schedule
- Final PAC Meeting Schedule
- PAC Meeting Agenda(s) with Back-up Materials for Agenda Items (1 hardcopy and in MS Word electronic format)
- Written PAC meeting summaries, including recommended resolution of major PAC issues

**TECHNICAL TASKS**

The Contractor shall prepare all deliverables in accordance with the requirements in Task 1.5. Deliverables not requiring a draft version are indicated by marking “(no draft)” after the deliverable name.

**Sodium-Sulfur (NaS) Battery Energy Storage System Demonstration**

The goal is to deploy, demonstrate, and document a two NaS BESS systems to meet the objectives that would support implementation of the key goals for integration of renewable resources in utility applications. Performance and values of NaS BESS will be measured, assessed, and documented as they relate to the following specific areas:

- 1 – Preparation of Engineer-of-record functions;
- 2 – Reliability Enhancement Assessment;
- 3 – Load Shaping and Power Quality Assessment;
- 4 – Renewable Resource integration, Load Shaping & Demand Response Assessment;
- 5 – Ancillary Services.

**Task 2 Install NaS BESS Systems and Prepare an-Engineer-of-Record Reports**

The goal of this task is to install the NaS BESS systems and prepare a report for each that fully documents the planning, development, construction, performance and early operation of the NaS BESS project-, as well as a separate Comparative Engineer-of-Record report.

The objective of this task is to monitor and document all aspects of the projects so that lessons learned can be transferred to other stakeholders within the State-, as well as to compare the two projects to each other and against other sodium sulfur battery projects in the United States.

**The Contractor Sshall:**

- Engineer, procure, and install the two NaS BESS. The Each BESS will consist of the battery, Power Conversion System (PCS) and other associated equipment. The engineering, procurement, and installation of the each NaS BESS will consist of the following scheduled activities:
  1. Analytical studies, for which the contractor shall obtain technical data, a short circuit study, and a coordination study.

2. Engineering and design work, for which the contractor shall write a system One-line, equipment layout, foundation detailed design, cable & conduit schedule, and equipment specifications.
3. Site Preparation, for which the contractor shall engage in mobilization, clearing & grubbing, grading, preparing conduit ducts, laying ground grid, equipment foundations, station stone, and station fencing.
4. Equipment delivery and installation, for which the contractor shall deliver equipment to the customer site, and install the equipment at the customer site. Equipment consists of battery modules, base, supports, jumpers, and enclosures, AC & DC cable, SSR & CNT controllers & wiring, main power and heater circuit transformers, transfer switches, 21 kV Switchgear, and Power Conversion System (PCS).
5. Testing and commissioning of the BESS, which includes energizing the system, heating the batteries, and commissioning the system.

The Contractor has purchased the majority of aforementioned equipment already, as listed in match funding. The Contractor shall purchase any remaining or replacement equipment with match funding, and will not use CEC funds for purchase of any equipment.

- ~~Perform an Engineer-of-Record function that will produce~~ **Submit** an Engineer-of-Record Report **for each BESS**. ~~This~~ **These** reports will comprise an organized collection of critical engineering (technical and economic) documentation from the initial stages of planning and development through the final construction, performance and operation of this **these** battery energy storage facility **facilities**.
- Gather facts, data, and other information required for the Engineer-of-Record reports from all available sources, including but not limited to the principals in the development of the NaS **BESS** projects:
  - System integrator and PCS supplier (inverter supplier)
  - NGK (battery supplier)
- Gather information on the **Vaca-Dixon and Yerba Buena** projects sufficient to be able to adequately report on the following project aspects:
  - Background studies describing the technical rationale for the projects, including the system studies that motivated development and construction of the projects, as well as initial estimations for required size, placement, performance characteristics and other requirements such as Volt-amperes reactive (VAR) support capabilities.
  - Development of battery and power conditioning system specifications
  - Final engineering, including description of all subsystems (energy storage, power conditioning, and balance-of-plant), major components (such as battery cells) and construction, safety and environmental considerations
  - Compile information describing the delivery and installation of the NaS BESS, including safety considerations, method and route of shipment from Japan; provisions for storage of equipment in the U.S.; importing, siting, permitting and commissioning requirements with emphasis on those unique to California.
  - Monitor the overall, installation, commissioning, and initial operating processes, **including the performance of factory acceptance tests as required by NGK Insulators (NGK) and S&C Electric (S&C), as well as any of the Electric Power Research Institute's (EPRI's) critical Distributed Energy Storage System (DESS) test protocol to verify battery system performance with technical specifications and characterize the overall battery system performance at both sites.**
  - Description of system testing and debugging, with test data as available

- Description of NaS BESS operations
- Preparation of project timelines, including construction and operation schedules
- Preparation of cost summaries, including initial estimates and final project cost
- Preparation of lessons learned from all available parts of the NaS **BESS** project process
- Monitor the NaS BESS installation and deployment program and document experience, costs, schedule performance, and lessons learned.
- Recommendations and conclusions for future NaS **BESS** projects
- **For each project, prepare** Prepare a report comprised of the following sections:
  - Introduction and overview of project
  - Description of the facility
  - History of the project
  - System studies and project rationale
  - Engineering design of facility
  - Procurement of major equipment
  - Fabrication and installation of equipment
  - Field testing and system startup
  - Lessons learned
  - Recommendations
  - References (required) and Bibliography (optional)
- Prepare an appendix to the **each** report including:
  - Technical specification issued at time of initial request-for-proposal
  - Final technical specifications
  - Design review documentation, including blueprints, technical specifications for subsystems and major components
  - Testing plans, procedures and test results
  - Initial test data and analysis of test data
- **Prepare a Comparative Engineer-of-Record Report on the two PG&E NaS BESS projects with each other and with other NaS BESS projects built in the United States (e.g., at New York Power Authority, American Electric Power and at Xcel Energy). This report shall be an organized summary of critical technical engineering and economic cost and benefit data and/or summary information of these NaS BESS projects from their initial stages of planning and development through to the final construction, performance, and operation of these battery facilities.**
- **Gather facts, data, and other available information required for the Comparative Engineer-of-Record report from available sources including, but not limited to, the battery supplier (NGK), the battery AC-DC-AC power conditioning supplier [e.g., S&C, Asea Brown Boveri (ABB)], and the utilities that installed the systems.**
- **Gather facts, data, and other available information to describe the planned versus actual installations at each of the non-PG&E sodium sulfur battery facilities investigated. The project comparative analysis shall include a description of the technical rationale that motivated development and construction of the battery projects, the planned versus actual**

**results of the battery project, to include battery capacity (i.e., megawatts and megawatt-hours), DC-DC efficiency, AC-AC efficiency, AC-AC part load performance, and economic benefits when used for arbitrage duty, spinning reserve duty, frequency regulation duty, VAR support and/or ramping duty. Also, other comparative information gathered and reported on shall include any failure modes experienced, resolutions implemented to correct failure modes, and comparative reliability metrics of the battery facilities.**

- Prepare CPR Report

**The DVBE shall:**

- Provide heavy construction equipment services during the installation of the NaS BESS Systems.

**Deliverables:**

- NaS BESS Demonstration Project Experience Report **for the Vaca-Dixon NaS BESS**
- **NaS BESS Demonstration Project Experience Report for the Yerba Buena NaS BESS**
- **NaS BESS Comparative Engineer-of-Record Report**
- CPR Report

**Task 3 Measure Performance for Load Shaping and Power Quality**

The objective of this task is to use the Supervisory Control and Data Acquisition (SCADA) and metering at the **Yerba Buena** NaS **BESS** installation site for monitoring the composite load profiles and NaS BESS operations. This PG&E installed and owned equipment will provide data that will be analyzed for adequacies of the **Yerba Buena** NaS BESS for load shaping and demand response initiatives. Portable high-resolution power quality monitoring equipment will be installed for a limited time period to capture typical transient operational data. The power quality recording equipment will also be installed if any power quality issues are reported by the customer, Hitachi.

**The Contractor shall:**

- Develop all sensing, metering specifications, hardware and data storage system suitable for fully documenting the load profiles and performance of the **Yerba Buena** NaS BESS
- Compile periodic performance data into an annual performance report.

**Deliverables:**

- Archived system raw data
- Summary performance data suitable for economic analyses of benefits
- Annual report of the performance - Anticipated for two years

**Task 4 Reliability Enhancement Assessment**

The goal of this task is to conduct analysis and assessments to evaluate the reliability enhancement benefits of the **Yerba Buena** NaS BESS on PG&E's customers.

The capabilities of the NaS BESS coupled with the selected location of the installation and California Independent System Operator (CA **California** ISO) energy and ancillary service markets offers many potential value/revenue streams that can be obtained from use of the battery. For a given battery capacity, the Contractor will have to determine how best to utilize the battery given the numerous potential options. For example, providing emergency power during outages may be the highest value proposition for use of the battery during certain periods of the year or times of day. If so, during those periods/hours, only the available battery capacity above the estimated substation load is available for load leveling (energy arbitrage) or providing regulating reserve into the ancillary service market. Tasks on Reliability Enhancement Assessment, Ancillary Services Assessment and Renewable Energy

Enhancement Assessment provide for evaluations of the added value/revenues that are achievable from the Yerba Buena NaS BESS if operated for a particular purpose. In addition to these evaluations of the benefits associated with these potential uses of the Yerba Buena NaS BESS, analysis should be conducted to investigate how to maximize the value of a specific NaS BESS installation (size, capabilities, location) considering all options available.

The capability of the Yerba Buena NaS BESS to provide quick, short-duration discharge and slower, long-duration discharge offers potential reliability benefits. Coupled with the selected sizing of the battery, the Yerba Buena NaS BESS will be able to serve the load during momentary and sustained outages of up to several hours and will obviously have a significant improvement on the reliability of the substation. This work will provide for a quantification of the reliability metrics and the associated value of the reliability improvements.

**The Contractor shall:**

- Review the network diagrams and compile historic data on the frequency and duration of outages on the feeder serviced by the Yerba Buena NaS **BESS** installation and relate outage history to the performance required of the NaS BESS installation. Obtain historical reliability data and the underlying outage records for the Yerba Buena NaS BESS site. The data will be analyzed to determine the reliability improvements on the basis of reliability metrics achieved from the Yerba Buena NaS BESS capabilities for supplying the site load during system outages.
- Remotely review other NaS **BESS** battery installations at New York Power Authority (NYPA) and American Electric Power (AEP) to be sure that lessons-learned at these other NaS battery sites are imbedded into the functional specifications and construction plans of the Yerba Buena NaS battery. This work will include lessons-learned in the areas of the ac-dc-ac inverter system, the overall plant control system, the battery monitoring system, and communication system to grid operators, the battery first start-up conditions, operational experience (e.g., ramp up, ramp down, frequency regulation and VAR support experience), time intervals from full charge to full discharge, spinning reserve conditions (synchronous and non-synchronous, maintenance procedures and off-line storage experience).
- Review and assess operational tests of the Yerba Buena NaS **BESS** installation to meet criteria for enhanced reliability, e.g., detection of the outage condition and load transfer to storage, the performance of the NaS **BESS** installation needed to protect the critical load (e.g., speed of response, discharge duration and profile). They will review all operational tests to ensure that all relaying and control functions are adequate for achieving the reliability improvements calculated above. These assessments will include analysis of the Operations & **and** Maintenance (O&M) requirements to ensure the battery system itself is operational as required; e.g., ensuring that on-site power sources are properly maintained and operational when the utility power source is in an outage condition.
- Prepare a NaS BESS Demonstration Project Distribution Feeder Reliability Enhancement Assessment Report to document items learned from past NaS **BESS** battery installations that have been embedded into the Yerba Buena NaS **BESS** battery project.

**Deliverables:**

- NaS BESS Demonstration Project Distribution Feeder Reliability Enhancement Assessment Report **for the Yerba Buena project**

**Task 5 Renewable Resource Integration, Load Shaping, and Demand Response Assessment**

The objective of this task is to assess the opportunity and value of using NaS batteries to enhance the value of renewable resource integration on the PG&E transmission and distribution system. The value proposition based on time-shifting off-peak wind generation and supplying firm, shaped on-peak power and on providing ramping service in conjunction with rapid changes in renewable power output. The

use of the NaS BESS system to provide additional value streams to renewable resources such as by compensating for short-term variability in the frequency regulation and load following time frames are typically less than the value of providing those services to the system in general where the total system variability is being compensated.

**The Contractor shall:**

- Utilize the analysis framework and historic data specified to assess the value of utilizing the **Yerba Buena** NaS BESS for firming and shaping a portion of the output from a renewable generator (may be actual existing source or an assumed source) electrically close to the **Yerba Buena** NaS BESS installation.
- Propose a means of identifying a representative time series of the varying output of the renewable source (likely a wind plant or distributed wind turbines). The best available data will be utilized in an attempt to represent the actual renewable resource pattern for the area. Potential approaches include utilization of data from an existing wind plants as a proxy or calculation of wind generation output from actual locational wind speed data and an assumed wind turbine generator power curve.
- Analyze available data, as appropriate, to assess the potentials for using the **Yerba Buena** NaS BESS for Load Shaping and Demand Response as compared to other resources.
- Collect the following current and two-year historic data to the location of the **Yerba Buena** NaS BESS Site, in addition to those data collected above:
  - Statistical forecast of two-day-ahead dispatch of “electrically close” renewable resources.
  - Actual dispatch of “electrically close” renewable resources.
  - Actual settlement prices for “electrically close” renewable resources, and for the **Yerba Buena** NaS BESS installation.
- For each of the renewable resource enhancement functions to be demonstrated, e.g., time-shifting wind generation:
  - Establish the **Yerba Buena** NaS BESS duty cycle (battery charge/discharge profile, frequency and duration) based on historic generation data.
  - Identify the **Yerba Buena** NaS BESS control installation interface requirements.
  - Propose appropriate protocols to demonstrate the enhancement function.
  - Identify and support appropriate combinations of enhancement functions (e.g., time-shifting) and **CA California** ISO ancillary services (e.g., regulation control).
- Prepare a report(s) documenting the above for each enhancement function and combination enhancement/ancillary service operating mode demonstrated. To the extent practical, the report(s) will address combined services and the time history of wind penetration on the system.

**Deliverables:**

- Report: Renewable Resource Enhancement Assessment for the **Yerba Buena** NaS BESS Demonstration Project

**Task 6 Ancillary Services Assessment**

The objectives of this task are to assess the possibilities of using NaS BESS to provide ancillary services in the **CA California** ISO market, e.g., regulation control, VAR control, spinning reserve, and black start. As noted in the Task 4 preamble, this task will also provide for an evaluation of how to maximize a selected value (e.g. Service Reliability) of the NaS BESS among the potential value streams, such as load shaping for energy arbitrage or renewable energy optimization, and/or provision of ancillary services into the **CA California** ISO markets. This task will compare the sources of benefits from the **Yerba Buena** NaS BESS site with the methods and valuations from other available and comparable energy storage demonstration projects.

**The Contractor shall:**

- Be responsible for daily operation of the Yerba Buena NaS BESS installation,
- Conduct daily two-day-ahead forecasting and bid valuation tasks,
- Conduct daily settlement tasks, and
- Participate in periodic post-mortem evaluations with EPRI to correct and enhance the ancillary services methodology.
- Collect the following current and two-year historic data applicable to the location of the NaS BESS associated substation:
  - Past CACalifornia ISO ancillary service data for at least one year (e.g., Automatic Generation Control (AGC) data, as impacted by regulation, ramping data, VAR support data, spinning reserve data) that can be used to evaluate and suggest alternative ways to use the NaS BESS battery to provide economic value streams.
  - Design specifications for the grid interface and switching capabilities of the substation.
  - A summary of the method utilized to conduct recently completed evaluation of NaS BESS value streams utilized for selecting the installation site. In addition, contractor shall obtain the site load curves, forecasted dispatch, ancillary service price signal data, etc. used from most recent PG&E valuation exercise.
  - Planned and unplanned outage information.
  - If available, a statistical forecast of two-day-ahead energy and ancillary service market prices (hourly and 5-minute) appropriate for forecasting dispatch and determining offers for the CACalifornia ISO Market Redesign and Technology Upgrade (MRTU) market.
  - If available, contractor shall utilize historic data of regulation controls from 2005, 2006, 2007 and 2008 (number of controls, number of changes in direction, and total MW travel) issued to a “similar” regulating resource to estimate duty impacts on the NaS BESS along with actual market prices for ancillary services.
- For the new CACalifornia ISO MRTU market, in conjunction with PG&E operations:
  - Propose a methodology to dispatch the NaS BESS for regulation or spinning reserve service and confirm that the expected dispatch requirements are compatible with the design of the battery installation.
  - Propose appropriate protocols to demonstrate CACalifornia ISO dispatch and ancillary service delivery,
  - Demonstrate the NaS BESS dispatch capabilities.
  - In conjunction with Task 3 to monitor sub-cycle power quality, identify potential new benefits of ancillary services supplied by the NaS BESS installation that are deemed to have incremental value in excess of conventional means. (e.g., prompt response and precise control enabled by the solid-state power conversion interface with the grid.)
  - Propose a business framework to enable the monetization of the benefits within the California market structure, and support the demonstration of this framework.
  - Support the utilization of the EPRI Energy Storage Valuation Tool (ESVT) to forecast alternative dispatches and their valuations.
- For the readily available and comparable energy storage projects:
  - Utilize an optimizing dispatch program like the EPRI ESVT or the EPRI’s Dynamic Analysis of Interconnected Systems with Energy Storage (DYNATRAN) DynaTran software tool to compare storage operations and valuations with the NaS BESS storage installation.

**Deliverables:**

- Report: NaS BESS Ancillary Service Applications in the CACalifornia ISO Market

**Task 7 Compressed Air Energy Storage (CAES) Geologic Site Verification**

Compressed Air Energy Storage (CAES) plants use off-peak electricity to compress air into an underground geologic formation.

Based on past EPRI work, CAES plants using below ground air stores are economically attractive in 100 MW to 400 MW sizes with storage discharge times in the 4 hour to 20-hour time frame (using an advanced CAES plant design). Thus, CAES plants have the potential to be the most cost-effective option for bulk energy storage applications (when below ground air stores are used). However, there is great uncertainty in the siting potential based on California geologic conditions, core sample geochemistry, siting land requirements, cost estimates and performance estimates of such plants. PG&E and EPRI have reviewed past reports from the California Energy Commission (Energy Commission) and other reports and geologic data in California, and have identified a select set of preferred sites in Northern and Central California that meet the desired criteria for underground CAES. The locations of the sites have been compared to nearby substations, transmission lines, and generation resources.

**The goal of this task is to:**

- Perform geologic and geochemical analyses on the primary site and up to three alternate California sites suited for the deployment of underground CAES technology. If and when the primary site is deemed unsuitable, the next site will receive in-depth analysis while minimum information is collected for the next site in queue.
- Develop preliminary CAES plant designs and plant performance estimates based on California geologic siting conditions.
- Develop preliminary cost estimates to build an underground CAES plant in California.
- Identify potential technical and cost risks associated with building underground CAES plants in California.

**The Contractor Shall:**

- Refine the select set of preferred sites in Northern or Central California based on the geologic and geochemical analyses, cost analyses, permitting constraints, and other practical business and development considerations.
- Perform core sample geochemical investigations, when samples are available, for the most promising underground CAES sites in California;
- Review past and present designs of underground CAES plants using California geologic site conditions and prepare preliminary engineering flow chart diagrams for such plants based on the pressure and flow conditions associated with the preferred California CAES sites;
- Determine and document preliminary estimates for the performance characteristics of these CAES plants;
- Review past and present designs of underground CAES plants using the above information and prepare preliminary engineering cost estimates for building CAES plant in California;
- Identify potential technical and cost risks associated with building underground CAES plants based on the above plant sites and designs.

**Deliverables:**

- Report containing:
  - Sites suitable to build an underground CAES plant in California based on detailed geologic analyses of sites;

- ~~— CAES plant designs, plant performance estimates, and plant cost estimates using the sites identified above;~~
- ~~— Potential technical and cost risks associated with building an underground CAES plant in California.~~

### **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 Contractor shall:**

- Prepare a Technology Transfer Plan. The plan shall explain how the knowledge gained in ~~this~~ **the Yerba Buena** 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.

#### **Deliverables:**

- Draft Technology Transfer Plan
- Final Technology Transfer Plan