

**GRANT REQUEST FORM (GRF)**

CEC-270 (Revised 02/13)

CALIFORNIA ENERGY COMMISSION

New Agreement EPC-14-060 (To be completed by CGL Office)

Division	Agreement Manager:	MS-	Phone
ERDD	Jamie Patterson	43	916-327-2342

Recipient's Legal Name	Federal ID Number
San Diego Gas & Electric Company	95-1184800

Title of Project
Borrego Springs- A Future Photovoltaic Based Microgrid

Term and Amount	Start Date	End Date	Amount
	6/22/2015	3/30/2018	\$ 4,724,802

**Business Meeting Information**
 ARFVTP agreements under \$75K delegated to Executive Director.

Proposed Business Meeting Date	4/8/2015	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
Business Meeting Presenter	Jamie Patterson	Time Needed:	10 minutes

Please select one list serve. EPIC (Electric Program Investment Charge)

**Agenda Item Subject and Description**

Proposed resolution approving Agreement EPC-14-060 with San Diego Gas & Electric Company for a \$4,724,802 grant to demonstrate a utility operated high-penetration, renewable-based community microgrid at Borrego Springs in Southern California.

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

- Is Agreement considered a "Project" under CEQA?
  - Yes (skip to question 2)
  - No (complete the following (PRC 21065 and 14 CCR 15378)):
 Explain why Agreement is not considered a "Project":  
 Agreement will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because
- If Agreement is considered a "Project" under CEQA:
  - a) Agreement **IS** exempt. (Attach draft NOE)
    - Statutory Exemption. List PRC and/or CCR section number: \_\_\_\_\_
    - Categorical Exemption. List CCR section number: 14 CCR 15301
    - Common Sense Exemption. 14 CCR 15061 (b) (3)
 Explain reason why Agreement is exempt under the above section:  
 Class 1 - Operation, repair, maintenance, or minor alteration of existing structures or facilities not expanding existing uses. This installation is completely contained within an existing, developed substation site on land that is not environmentally sensitive. There is no expansion of the existing substation site. No historic resources or buildings will be affected. Noise and odors will not be generated by this installation in excess of existing permitted amounts. The installation will not increase traffic to the site. The installations will not require permits for air, water, conditional use, building expansion, hazardous waste, or rezoning.
  - b) Agreement **IS NOT** exempt. (Consult with the legal office to determine next steps.)
 Check all that apply
 

<input type="checkbox"/> Initial Study	<input type="checkbox"/> Environmental Impact Report
<input type="checkbox"/> Negative Declaration	<input type="checkbox"/> Statement of Overriding Considerations
<input type="checkbox"/> Mitigated Negative Declaration	

**List all subcontractors (major and minor) and equipment vendors: (attach additional sheets as necessary)**

Legal Company Name:	Budget
National Renewable Energy Laboratory (NREL)	\$ 599,996
The Regents of the University of California, San Diego	\$ 176,226
Alpha Ten Technologies Inc.	\$ 99,999
Spirae LLC	\$ 797,550
OSISoft, LLC	\$ 95,000
Borrego Springs Chamber of Commerce	\$ 99,999
eiPi10	\$ 67,474
Microgrid Energy Solutions, LLC	\$ 99,999
Wright On Communicaitons	\$ 99,999
Schweitzer Engineering Laboratories, Inc.	\$ 99,999



## Exhibit A Scope of Work

### A. Task List

Task #	CPR <sup>1</sup>	Task Name
1		General Project Tasks
2		Advanced Microgrid Controller Research and Development
3	X	Microgrid System Planning and Design
4		Test Preparations
5		Test Execution
6		Analysis and Results Reporting
7		Evaluation of Project Benefits
8		Technology/Knowledge Transfer Activities
9		Production Readiness Plan

### B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAISO	California Independent System Operator
CAO	Commission Agreement Officer
CHIL	Controller Hardware-in-the-Loop
CPR	Critical Project Review
DER	Distributed Energy Resources
IEEE	Institute of Electrical and Electronic Engineers
PHIL	Power Hardware-in-the-Loop
PMU	Phasor Measurement Unit
PV	Photovoltaic
RTDS	Real-Time Digital Simulator
SAM	Simple Asset Manager
SDG&E	San Diego Gas & Electric Company
TAC	Technical Advisory Committee
UCSD	University of California San Diego

## I. PURPOSE OF AGREEMENT, PROBLEM/SOLUTION STATEMENT, AND GOALS AND OBJECTIVES

### A. Purpose of Agreement

The purpose of this Agreement is to fund a demonstration of a high-penetration, renewable-based microgrid in Borrego Springs, California that will meet the goals of PON 14-301 Group 2: Demonstration of High-Penetration, Renewable-Based Microgrids.

<sup>1</sup> Please see subtask 1.3 in Part III of the Scope of Work (General Project Tasks) for a description of Critical Project Review (CPR) Meetings.

## **Exhibit A Scope of Work**

### **B. Problem/ Solution Statement**

#### **Problem**

Microgrids have been deployed that utilize a variety fossil fuel based generation in limited deployments; typically at small scale and without general applicability. Demonstrating the viability of a microgrid to manage high amounts (up to 100%) of renewable energy to meet the facility/community load while avoiding adverse grid impacts, through the use of a microgrid controller/energy management system has been accomplished with only limited success.

#### **Solution**

The proposed project will be demonstrating a high-penetration, renewable-based microgrid in Borrego Springs, California. The Borrego Springs microgrid project will use two Photovoltaic (PV) systems, a large 26 MW<sub>ac</sub> PV system and a 5 MW<sub>ac</sub> PV system, to enable the islanding of the entire Borrego substation during the day and to maintain critical loads as solar output drops.

This project will also develop, deploy and test the next generation microgrid controller that meets the PON goals and project objectives and this will be commercially available.

### **C. Goals and Objectives of the Agreement**

#### **Agreement Goals**

The goals of this agreement are to:

- Support the deployment of high-penetration, renewable-based microgrids in California's industrial, commercial, and/or mixed use facilities and communities;
- Demonstrate that microgrids can provide value to customers and the grid by enabling higher penetrations of renewable energy than the existing distribution infrastructure supports, while avoiding adverse grid impacts through the use of a microgrid controller/energy management system;
- Demonstrate that microgrids can operate with up to 100% renewable energy supply, and/or export renewable energy during periods of high renewable energy production or low demand;
- Encourage energy efficiency upgrades and demand response to maximize the impact of renewables and avoid the need to export power during periods of over-generation;
- Produce technical and economic microgrid performance data, including documentation of installation issues, operational constraints, and operational performance (such as the number of hours a microgrid can operate independently off the grid);
- Identify barriers to deployment of high-penetration, renewable-based microgrids (such as financing and regulatory requirements) for specific facility/community types, and solutions to the barriers;
- Determine microgrid configurations of renewable generation, energy efficiency, demand response, and energy storage that provide the highest value to owners, ratepayers, and utilities;
- Create a replicable microgrid model by developing lessons learned and best practices;
- Develop use cases that maximize the daily operating value of high-penetration, renewable-based microgrids for customers and the grid, including management of energy storage and demand response to avoid exporting power when the grid experiences periods of over-generation; and

## **Exhibit A Scope of Work**

- Use automation and communication strategies that optimize reliability, safety, customer savings, and environmental benefits.

### Ratepayer Benefits:<sup>2</sup>

This Agreement will result in the ratepayer benefits of: greater electricity reliability, lower costs, and increased safety.

The project will accomplish this by demonstrating that microgrids can provide value to customers and the grid through improved grid resiliency and by enabling higher penetrations of renewable energy than the existing distribution infrastructure supports, while avoiding adverse grid impacts through the use of a microgrid controller/energy management system.

This project aims to identify barriers to deployment of high-penetration, renewable-based microgrids (such as financing and regulatory requirements) for specific facility/community types, and will also provide solutions to the barriers. It will also explore microgrid configurations of renewable generation, energy efficiency, demand response, and energy storage that provide the highest value to owners, ratepayers, and utilities. By performing these tasks the project will facilitate the creation of a replicable microgrid model by developing lessons learned and best practices.

Technological Advancement and Breakthroughs:<sup>3</sup> This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals.

The project will accomplish these energy goals since, as demonstrated, the operations of this microgrid have provided significant value to the residents of Borrego Springs. A single, radial transmission line serves this community and due to severe weather patterns and rugged terrain; it experiences a higher level of outages than normal. The microgrid allows quicker restoration of services to customers in order to sustain critical infrastructure during grid outages. Additionally, it improves the integration of the abundant local renewable resources with the grid. In September of 2013, very severe thunderstorms cut electricity to all 2,800 Borrego Springs customers. The microgrid was able to utilize new smart grid technology to dynamically react to the changing environmental and system conditions. In the aftermath of these storms, the microgrid black-started the community and functioned independently in island mode, supplying vital electricity to the local community through on-site resources while crews repaired the damaged grid.

This demonstration will show the improved commercial viability and innovation of available microgrid technology solutions. Advanced Energy Storage, Electric Vehicle Fleet Management, Electric Vehicle Smart Charging and California independent system operator (CAISO)

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<sup>2</sup> California Public Resources Code, Section 25711.5(a) requires projects funded by the Electric Program Investment Charge (EPIC) to result in ratepayer benefits. The California Public Utilities Commission, which established the EPIC in 2011, defines ratepayer benefits as greater reliability, lower costs, and increased safety (See CPUC "Phase 2" Decision 12-05-037 at page 19, May 24, 2012, [http://docs.cpuc.ca.gov/PublishedDocs/WORD\\_PDF/FINAL\\_DECISION/167664.PDF](http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF)).

<sup>3</sup> California Public Resources Code, Section 25711.5(a) also requires EPIC-funded projects to lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory and energy goals.

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Market Participation applications will allow for improved integration of renewables in both grid connected and island operation. The microgrid will also demonstrate improved EV fleet management and individual EV charging for the benefit of businesses, individual customers and the grid and lastly will provide greater participation of Distributed Energy Resources (DER) in energy markets.

### **Agreement Objectives**

The objectives of this agreement are to:

- 1) Develop microgrid technologies including a controller that will be commercially available. The controller should be able to identify, isolate, and efficiently serve critical loads, as well as use Phasor Measurement Unit (PMU) based control algorithms.
- 2) Island the entire community of Borrego Springs during the day and to drop non-critical loads during the night. Additionally the project will coordinate generation and loads, control storage, prevent export of power during over-generation, and limit other grid impacts such as harmonics, Voltage Ampere-reactive (VAr) imbalances, and steep ramp rates consistent with SDG&E's requirements.
- 3) Develop a microgrid that meets or exceed the U.S. Department of Energy's 2020 goals of commercial-scale microgrid systems capable of reducing the outage time of required loads by >98% at lowest cost while reducing emissions by >20% compared to a diesel backup generator set.
- 4) Enable the "smart inverter" functionality that meets the requirements of Institute of Electrical and Electronic Engineers (IEEE) 1547a or IEEE 1547.8 by partnering with SMA the manufacturer of the 26 MW<sub>ac</sub> PV array inverters.
- 5) Utilize renewable resources to supply 100% of the community's load.
- 6) Reduce energy use by using energy efficiency and demand response where appropriate.
- 7) Include engineering and interconnection infrastructure for additional energy storage devices.

## **II. TASK 1 GENERAL PROJECT TASKS**

### **PRODUCTS**

#### **Subtask 1.1 Products**

The goal of this subtask is to establish the requirements for submitting project products (e.g., reports, summaries, plans, and presentation materials). Unless otherwise specified by the Commission Agreement Manager (CAM), the Recipient must deliver products as required below by the dates listed in the **Project Schedule (Part IV)**. Products that require a draft version are indicated by marking "**(draft and final)**" after the product name in the "Products" section of the task/subtask. If "(draft and final)" does not appear after the product name, only a final version of the product is required. With respect to due dates within this Scope of Work, "**days**" means working days.

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

##### For products that require a draft version

- Submit all draft products to the CAM for review and comment in accordance with the Project Schedule (Part V). The CAM shall provide written comments to the Recipient on

## **Exhibit A Scope of Work**

the draft product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.

- Submit the final product to the CAM once agreement has been reached on the draft. The CAM shall provide written approval of the final product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- If the CAM determines that the final product does not sufficiently incorporate his/her comments, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

### For products that require a final version only

- Submit the product to the CAM for approval.
- If the CAM determines that the product requires revision, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

### For all products

- Submit all data and documents required as products in accordance with the following Instructions for Submitting Electronic Files and Developing Software:

- **Electronic File Format**

Submit all data and documents required as products under this Agreement in an electronic file format that is fully editable and compatible with the Energy Commission's software and Microsoft (MS)-operating computing platforms, or with any other format approved by the CAM. Deliver an electronic copy of the full text of any Agreement data and documents in a format specified by the CAM, such as memory stick or CD-ROM.

The following describes the accepted formats for electronic data and documents provided to the Energy Commission as products under this Agreement, and establishes the software versions that shall be required to review and approve all software products:

- Data sets will be in MS Access or MS Excel file format (Version 2007 or later), or any other format approved by the CAM.
- Text documents will be in MS Word file format, version 2007 or later.
- Documents intended for public distribution will be in PDF file format. The Recipient must also provide the native Microsoft file format.
- Project management documents will be in Microsoft Project file format, version 2007 or later.

- **Software Application Development**

Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:

- Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
- Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
- Visual Studio.NET (version 2008 and up). Recommend 2010.
- C# Programming Language with Presentation (UI), Business Object

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and Data Layers.

- SQL (Structured Query Language).
- Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
- Microsoft SQL Reporting Services. Recommend 2008 R2.
- XML (external interfaces).

Any exceptions to the Electronic File Format requirements above must be approved in writing by the CAM. The CAM will consult with the Energy Commission's Information Technology Services Branch to determine whether the exceptions are allowable.

### MEETINGS

#### Subtask 1.2 Kick-off Meeting

The goal of this subtask is to establish the lines of communication and procedures for implementing this Agreement.

#### The Recipient shall:

- Attend a "Kick-off" meeting with the CAM, the Commission Agreement Officer (CAO), and any other Energy Commission staff relevant to the Agreement. The Recipient will bring its Project Manager and any other individuals designated by the CAM to this meeting. The administrative and technical aspects of the Agreement will be discussed at the meeting. Prior to the meeting, the CAM will provide an agenda to all potential meeting participants. The meeting may take place in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

The administrative portion of the meeting will include discussion of the following:

- Terms and conditions of the Agreement;
- Administrative products (subtask 1.1);
- CPR meetings (subtask 1.3);
- Match fund documentation (subtask 1.7);
- Permit documentation (subtask 1.8);
- Subcontracts (subtask 1.9); and
- Any other relevant topics.

The technical portion of the meeting will include discussion of the following:

- The CAM's expectations for accomplishing tasks described in the Scope of Work;
  - An updated Project Schedule;
  - Technical products (subtask 1.1);
  - Progress reports and invoices (subtask 1.5);
  - Final Report (subtask 1.6);
  - Technical Advisory Committee meetings (subtasks 1.10 and 1.11); and
  - Any other relevant topics.
- Provide an *Updated Project Schedule*, *List of Match Funds*, and *List of Permits*, as needed to reflect any changes in the documents.

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### **The CAM shall:**

- Designate the date and location of the meeting.
- Send the Recipient a *Kick-off Meeting Agenda*.

### **Recipient Products:**

- Updated Project Schedule (*if applicable*)
- Updated List of Match Funds (*if applicable*)
- Updated List of Permits (*if applicable*)

### **CAM Product:**

- Kick-off Meeting Agenda

### **Subtask 1.3 Critical Project Review (CPR) Meetings**

The goal of this subtask is to determine if the project should continue to receive Energy Commission funding, and if so whether any modifications must be made to the tasks, products, schedule, or budget. CPR meetings provide the opportunity for frank discussions between the Energy Commission and the Recipient. As determined by the CAM, discussions may include project status, challenges, successes, advisory group findings and recommendations, final report preparation, and progress on technical transfer and production readiness activities (if applicable). Participants will include the CAM and the Recipient, and may include the CAO and any other individuals selected by the CAM to provide support to the Energy Commission.

CPR meetings generally take place at key, predetermined points in the Agreement, as determined by the CAM and as shown in the Task List on page 1 of this Exhibit. However, the CAM may schedule additional CPR meetings as necessary. The budget will be reallocated to cover the additional costs borne by the Recipient, but the overall Agreement amount will not increase. CPR meetings generally take place at the Energy Commission, but they may take place at another location, or may be conducted via electronic conferencing (e.g., WebEx) as determined by the CAM.

### **The Recipient shall:**

- Prepare a *CPR Report* for each CPR meeting that: (1) discusses the progress of the Agreement toward achieving its goals and objectives; and (2) includes recommendations and conclusions regarding continued work on the project.
- Submit the CPR Report along with any other *Task Products* that correspond to the technical task for which the CPR meeting is required (i.e., if a CPR meeting is required for Task 2, submit the Task 2 products along with the CPR Report).
- Attend the CPR meeting.
- Present the CPR Report and any other required information at each CPR meeting.

### **The CAM shall:**

- Determine the location, date, and time of each CPR meeting with the Recipient's input.
- Send the Recipient a *CPR Agenda* and a *List of Expected CPR Participants* in advance of the CPR meeting. If applicable, the agenda will include a discussion of match funding and permits.
- Conduct and make a record of each CPR meeting. Provide the Recipient with a *Schedule for Providing a Progress Determination* on continuation of the project.
- Determine whether to continue the project, and if so whether modifications are needed to the tasks, schedule, products, or budget for the remainder of the Agreement. If the

## **Exhibit A Scope of Work**

CAM concludes that satisfactory progress is not being made, this conclusion will be referred to the Deputy Director of the Energy Research and Development Division.

- Provide the Recipient with a *Progress Determination* on continuation of the project, in accordance with the schedule. The Progress Determination may include a requirement that the Recipient revise one or more products.

### **Recipient Products:**

- CPR Report(s)
- Task Products (draft and/or final as specified in the task)

### **CAM Products:**

- CPR Agenda
- List of Expected CPR Participants
- Schedule for Providing a Progress Determination
- Progress Determination

### **Subtask 1.4 Final Meeting**

The goal of this subtask is to complete the closeout of this Agreement.

### **The Recipient shall:**

- Meet with Energy Commission staff to present project findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement. This meeting will be attended by the Recipient and CAM, at a minimum. The meeting may occur in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.

- The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
- The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
  - Disposition of any state-owned equipment.
  - Need to file a Uniform Commercial Code Financing Statement (Form UCC-1) regarding the Energy Commission's interest in patented technology.
  - The Energy Commission's request for specific "generated" data (not already provided in Agreement products).
  - Need to document the 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.

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- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide *All Draft and Final Written Products* on a CD-ROM or USB memory stick, organized by the tasks in the Agreement.

### **Products:**

- Final Meeting Agreement Summary (*if applicable*)
- Schedule for Completing Agreement Closeout Activities
- All Draft and Final Written Products

## **REPORTS AND INVOICES**

### **Subtask 1.5 Progress Reports and Invoices**

The goals of this subtask are to: (1) periodically verify that satisfactory and continued progress is made towards achieving the project objectives of this Agreement; and (2) ensure that invoices contain all required information and are submitted in the appropriate format.

### **The Recipient shall:**

- Submit a monthly *Progress Report* to the CAM. Each progress report must:
  - Summarize all Agreement activities conducted by the Recipient for the preceding month, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. See the Progress Report Format Attachment for the recommended specifications.
  - Provide a synopsis of the project progress, including accomplishments, problems, milestones, products, schedule, fiscal status, and any evidence of progress such as photographs.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the “Payment of Funds” section of the terms and conditions. In addition, each invoice must document and verify:
  - Energy Commission funds received by California-based entities;
  - Energy Commission funds spent in California (*if applicable*); and
  - Match fund expenditures.

### **Products:**

- Progress Reports
- Invoices

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### **Subtask 1.6 Final Report**

The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. The CAM will review and approve the Final Report, which will be due at least **two months** before the Agreement end date. When creating the Final Report Outline and the Final Report, the Recipient must use a Style Manual provided by the CAM.

#### **Subtask 1.6.1 Final Report Outline**

**The Recipient shall:**

- Prepare a *Final Report Outline* in accordance with the *Style Manual* provided by the CAM.
- Submit a draft of the outline to the CAM for review and comment.
- Once agreement has been reached on the draft, submit the final outline to the CAM. The CAM will provide written approval of the final outline within 10 days of receipt.

**Recipient Products:**

- Final Report Outline (draft and final)

**CAM Product:**

- Style Manual

#### **Subtask 1.6.2 Final Report**

**The Recipient shall:**

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline and the Style Manual provided by the CAM.
- Submit a draft of the report to the CAM for review and comment. Once agreement on the draft report has been reached, the CAM will forward the electronic version for Energy Commission internal approval. Once the CAM receives approval, he/she will provide written approval to the Recipient.
- Submit one bound copy of the Final Report to the CAM.

**Products:**

- Draft Final Report
- Final Report

**CAM Product:**

- Comments on Draft Final Report

### ***MATCH FUNDS, PERMITS, AND SUBCONTRACTS***

#### **Subtask 1.7 Match Funds**

The goal of this subtask is to ensure that the Recipient obtains any match funds planned for this Agreement and applies them to the Agreement during the Agreement term.

While the costs to obtain and document match funds are not reimbursable under this Agreement, the Recipient may spend match funds for this task. The Recipient may only spend match funds during the Agreement term, either concurrently or prior to the use of Energy

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Commission funds. Match funds must be identified in writing, and the Recipient must obtain any associated commitments before incurring any costs for which the Recipient shall request reimbursement.

### **The Recipient shall:**

- Prepare a *Match Funds Status Letter* that documents the match funds committed to this Agreement. 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 this 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 cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
  - The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the 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 must identify its owner and provide a contact name, address, telephone number, and the address where the property is located.
- A copy of a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.
- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide a *Supplemental Match Funds Notification Letter* to the CAM of receipt of additional match funds.
- Provide a *Match Funds Reduction Notification Letter* to the CAM if existing match funds are reduced during the course of the Agreement. Reduction of match funds may trigger a CPR meeting.

### **Products:**

- Match Funds Status Letter
- Supplemental Match Funds Notification Letter (*if applicable*)
- Match Funds Reduction Notification Letter (*if applicable*)

### **Subtask 1.8 Permits**

The goal of this subtask 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, with the exception of costs incurred by University of California recipients. Permits must be identified and obtained before the Recipient may incur any costs related to the use of the permit(s) for which the Recipient shall request reimbursement.

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### The Recipient shall:

- Prepare a *Permit Status Letter* that documents the permits required to conduct this Agreement. If no permits are required at the start of this Agreement, then state this in the letter. If permits will be required during the course of the Agreement, provide in the letter:
  - A list of the permits that identifies: (1) the type of permit; and (2) the name, address, and telephone number of the permitting jurisdictions or lead agencies.
  - The schedule the Recipient shall follow in applying for and obtaining the permits.

The list of permits and the schedule for obtaining them will be discussed at the Kick-off meeting (subtask 1.2), and a timetable for submitting the updated list, schedule, and copies of the permits will be developed. The impact on the project 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 progress reports and will be a topic at CPR meetings.

- If during the course of the Agreement additional permits become necessary, then provide the CAM with an *Updated List of Permits* (including the appropriate information on each permit) and an *Updated Schedule for Acquiring Permits*.
- Send the CAM a *Copy of Each Approved Permit*.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the CAM within 5 days. Either of these events may trigger a CPR meeting.

### Products:

- Permit Status Letter
- Updated List of Permits (*if applicable*)
- Updated Schedule for Acquiring Permits (*if applicable*)
- Copy of each Approved Permit (*if applicable*)

### Subtask 1.9 Subcontracts

The goals of this subtask are to: (1) procure subcontracts required to carry out the tasks under this Agreement; and (2) ensure that the subcontracts are consistent with the terms and conditions of this Agreement.

### The Recipient shall:

- Manage and coordinate subcontractor activities in accordance with the requirements of this Agreement.
- Incorporate this Agreement by reference into each subcontract.
- Include any required Energy Commission flow-down provisions in each subcontract, in addition to a statement that the terms of this Agreement will prevail if they conflict with the subcontract terms.
- If required by the CAM, submit a draft of each *Subcontract* required to conduct the work under this Agreement.
- Submit a final copy of the executed subcontract.
- Notify and receive written approval from the CAM prior to adding any new subcontractors (see the discussion of subcontractor additions in the terms and conditions).

### Products:

- Subcontracts (*draft if required by the CAM*)

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- Final Subcontracts

### **TECHNICAL ADVISORY COMMITTEE**

#### **Subtask 1.10 Technical Advisory Committee (TAC)**

The goal of this subtask is to create an advisory committee for this Agreement. The TAC should be composed of diverse professionals. The composition will vary depending on interest, availability, and need. TAC members will serve at the CAM's discretion. The purpose of the TAC is to:

- Provide guidance in project direction. The guidance may include scope and methodologies, timing, and coordination with other projects. The guidance may be based on:
  - Technical area expertise;
  - Knowledge of market applications; or
  - Linkages between the agreement work and other past, present, or future projects (both public and private sectors) that TAC members are aware of in a particular area.
- Review products and provide recommendations for needed product adjustments, refinements, or enhancements.
- Evaluate the tangible benefits of the project to the state of California, and provide recommendations as needed to enhance the benefits.
- Provide recommendations regarding information dissemination, market pathways, or commercialization strategies relevant to the project products.

The TAC may be composed of qualified professionals spanning the following types of disciplines:

- Researchers knowledgeable about the project subject matter;
- Members of trades that 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 the project;
- U.S. Department of Energy research managers, or experts from other federal or state agencies relevant to the project;
- Public interest environmental groups;
- Utility representatives;
- Air district staff; and
- Members of relevant technical society committees.

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

- Prepare a *List of Potential TAC Members* that includes the names, companies, physical and electronic addresses, and phone numbers of potential members. The list will be discussed at the Kick-off meeting, and a schedule for recruiting members and holding the first TAC meeting will be developed.
- Recruit TAC members. Ensure that each individual understands member obligations and the TAC meeting schedule developed in subtask 1.11.
- Prepare a *List of TAC Members* once all TAC members have committed to serving on the TAC.
- Submit *Documentation of TAC Member Commitment* (such as Letters of Acceptance) from each TAC member.

## **Exhibit A Scope of Work**

### **Products:**

- List of Potential TAC Members
- List of TAC Members
- Documentation of TAC Member Commitment

### **Subtask 1.11 TAC Meetings**

The goal of this subtask is for the TAC to provide strategic guidance for the project by participating in regular meetings, which may be held via teleconference.

### **The Recipient shall:**

- Discuss the TAC meeting schedule with the CAM at the Kick-off meeting. Determine the number and location of meetings (in-person and via teleconference) in consultation with the CAM.
- Prepare a *TAC Meeting Schedule* that will be presented to the TAC members during recruiting. Revise the schedule after the first TAC meeting to incorporate meeting comments.
- Prepare a *TAC Meeting Agenda* and *TAC Meeting Back-up Materials* for each TAC meeting.
- Organize and lead TAC meetings in accordance with the TAC Meeting Schedule. Changes to the schedule must be pre-approved in writing by the CAM.
- Prepare *TAC Meeting Summaries* that include any recommended resolutions of major TAC issues.

### **Products:**

- TAC Meeting Schedule (draft and final)
- TAC Meeting Agendas (draft and final)
- TAC Meeting Back-up Materials
- TAC Meeting Summaries

## **III. TECHNICAL TASKS**

### **TASK 2 ADVANCED MICROGRID CONTROLLER RESEARCH AND DEVELOPMENT**

The goals of this task are for SDG&E and Spirae to employ Spirae's Wave™ Control platform to serve as the microgrid controller for Borrego Springs. The core algorithms used in Wave™ are complete, but additional applications (Apps) with advanced capabilities are being proposed to be developed by Spirae and SDG&E to address specific issues present or foreseen within SDG&E's service territory. Each of these Apps will be jointly developed and later used by SDG&E and incorporated into Spirae's commercial product offering, which will provide significant value to other utilities that are facing similar issues or expect to in the near future.

Additionally, Spirae shall work with OSIsoft and University of California San Diego (UCSD) to evaluate their innovative controls development for incorporation in their microgrid.

### **The Recipient shall:**

- Install the following applications:

**Wave™ Application Advanced Energy Storage**

## **Exhibit A Scope of Work**

The Application is intended to integrate a variety of energy storage types, e.g. chemical (batteries: lithium ion or lead acid) and kinetic (flywheels) to support grid objectives or to support microgrid islanding. Spirae is performing testing on a variety of storage configurations to assess their ability to meet multiple value streams which provides a potential justification of capital investments in batteries for resiliency. This App will allow the batteries to operate in tandem with the 26 MW<sub>ac</sub> PV to support the Borrego Springs loads during the day, and in tandem with the diesel generators at night to support critical loads, while minimizing diesel generation operations

### **Wave™ Application Electric Vehicle, EV, Fleet Management**

This Application will be developed to enable optimization of EV charging to support fleet and utility objectives. EV charging will be optimized based on daily load profiles of the system, so as to alleviate stress on the distribution system and satisfy CAISO objectives. With this App, Spirae and SDG&E shall enable sharing of information between EV fleet operators (such as Frito Lay) and SDG&E to coordinate EV charging at times that are optimal for both parties. New business models will be tested and would be of significant value to other utilities, particularly those in similar regulatory environments.

### **Wave™ Application Electric Vehicle Smart Charging**

SDG&E and Spirae shall co-develop this Application to leverage EVs to manage various grid issues such as transformer stress and peak load through coordinated charging, without adversely impacting individual EV drivers. Testing the viability of these new service offerings will prove valuable for SDG&E as it seeks to lead innovation in the industry and be useful for other utilities that may adopt many of the same new service-based approaches.

### **Wave™ Application CAISO Market Participation**

Spirae and SDG&E shall develop an interface to enable CAISO to view the DER assets, and their capabilities, within in the Borrego Springs microgrid system. This interface built into the Wave™ controller may be used by SDG&E throughout their system. This capability will enable CAISO and SDG&E to utilize Borrego Springs' assets to support various market-level functions. Recipient shall create a *Letter of Acceptance for the Wave applications*.

- Evaluate the possible inclusion of the following innovative controls for incorporation into a Wave™ Asset Manager control platform:
  1. Oscillation mitigation control  
As demonstrated using UCSD data, microgrids can experience large and frequent and significant oscillations. These can be mitigated using less than one twentieth of the peak power in the oscillation by controlled injection and absorption of power by batteries. The oscillation mitigation controller is quiescent with no active power output until the oscillation is detected. The controller then outputs power out of phase with the oscillation like noise cancellation technology dampens audio noise.
  2. Decoupled frequency and voltage control  
Frequency and voltage decoupling control will be implemented using a patented method of controlling coupled systems. Specifically real and reactive power changes are adjusted in response to changes in frequency and voltage. This algorithm will augment the asset controller for each DER inside the microgrid in either islanded or in-grid connected mode. The controllers operate autonomously with identical frequency and

## **Exhibit A Scope of Work**

voltage set-points. However, each controller can have a different absolute angle set-point based on signals sent from the Control Area Manager. The control is based on model reference dead-time compensated controller technology and uses the identified model based on the realization method. The control model changes every time a new event is detected on the local microgrid network.

### 3. Event detection and realization modeling

New methods of event detection developed at UCSD will be implemented at the primary controller, or Simple Asset Manager (SAM), level using frequency and voltage and current phasors and the methods include rate of change and level changes. An adaptive Finite Impulse Response filter estimates the one step ahead filtered estimate of the rate of change of the variable. If the prediction error exceeds the six sigma value, an event is declared. Immediately after each event clears, a realization function is used to determine the “state” matrices describing the event. These are the direct parameters used in the decoupled frequency and voltage controller. The “state” matrices identified by this method are guaranteed to provide a reduced order model that truly represents dynamic behavior of the system. The event detection software includes automatic control of the main breaker at the point of common coupling with the grid. PMUs are installed on each side of the breaker and used to re-synchronize to the grid from the island mode or provide a planned disconnection from the area Electric Power System. The angle, rate of change of angle (frequency), angle acceleration, and voltage area are used to determine switching permissives with relay operation of the breaker. Recipient shall create an *Asset Manager Evaluation Letter of Acceptance*.

#### **Product:**

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

- Letter of Acceptance for the Wave applications
- Asset Manager Evaluation Letter of Acceptance

### **TASK 3 MICROGRID SYSTEM PLANNING AND DESIGN**

The goal of this task is to plan and design the Borrego Springs Microgrid to island the entire community during the day, reduce to critical loads at night and utilizing energy storage minimize the generator operations.

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

- Work with the key stakeholders including Borrego Springs Chamber of Commerce and other key stakeholders to help define the area’s critical loads such as cool zones, gas stations, grocery stores, restaurants, etc to limit the microgrid to less than a 5 MW peak load. This will allow SDG&E to charge the energy storage systems during the day to allow for islanded operation as the solar production reduces and ceases. Recipient shall create a *Document Outlining critical loads in the Borrego Springs area*.
- Install additional monitoring devices and Supervisory Control and Data Acquisition switches in Borrego Springs to facilitate fault identification and the isolation/restoration of critical loads. Key infrastructure feeding critical loads will be strengthened to increase the likelihood that they will survive any natural disaster. Additional work will be performed to ensure equipment compliance with local environmental ordinances. Recipient shall create a *Borrego Infrastructure Upgrades Letter of Completion*.

## **Exhibit A Scope of Work**

- Integrate Spirae's microgrid controller with its existing Oracle Network Management System. This will allow operators to view the microgrid from within the existing operational environment. This will facilitate microgrid operations and visibility. Recipient shall create a *Spirae and Oracle Integration Letter*.
- Evaluate and develop as a first for the industry, the necessary functional change in operation of classical autonomous Outage Management Systems in light of microgrid and Smart Grid operation which operates with varying degrees of expansion of technologies. Recipient shall create a *Distribution Operations Functional Change List*.
- Work collaboratively with Spirae and the CAISO on market activities to identify tools, techniques and equipment to provide visibility of the microgrid to the CAISO. Additionally explore how the CAISO could leverage the microgrid as a larger grid resource. Recipient shall create a Summary of Market Activities.
- Participate in a CPR meeting per Subtask 1.3. Prepare a *CPR Report for Task 3* per Subtask 1.3.

### **Products:**

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

- Document outlining critical loads in the Borrego Springs area
- Borrego Infrastructure Upgrades Letter of Completion
- Spirae and Oracle Integration Letter
- Distribution Operations Functional Change List
- Summary of Market Activities
- CPR Report for Task 3

### **TASK 4 TEST PREPARATIONS**

The goal of this task is to create a test plan for the microgrid using a Real-Time Digital Simulator (RTDS) as the test system to determine the types of tests to run and the expected results.

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

- Use IEEE 1547 to create a *Table of Possible Test Methods and Expected Results*.
- Make the necessary arrangements; prepare test equipment and methods needed for plan execution. This includes preparations for testing of microgrid controllers to be observed and audited by a Technical Advisory Committee (TAC). Recipient shall create a *Document on Preparations for Test Plan Execution*.

### **Products:**

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

- Table of Possible Test Methods and Expected Results (Draft and Final)
- Document on Preparations for Test Plan Execution

### **TASK 5 TEST EXECUTION**

The goal of this task is to create a detailed test execution plan and perform the tests described therein.

## **Exhibit A Scope of Work**

### **The Recipient shall:**

- Validate that the microgrid controller meets the functional requirements.
- Test (at NREL, Spirae's InteGrid Test and Development Lab and SDG&E's Integrated Test Facility) using controller hardware-in-the-loop (CHIL) and power hardware-in-the-loop (PHIL) methods.
- Use a real-time digital simulator (RTDS), the microgrid controller, interfaces to the inputs and outputs of the RTDS, the microgrid controller, and external data gathering equipment.
- Execute in real-time a software model of the community power system on the RTDS. The RTDS will communicate with the microgrid controller in real-time, providing for a closed-loop simulation of the microgrid controller with the community microgrid power system.
- Utilize the labs' physical assets, which will be connected to the RTDS and microgrid controller to perform PHIL testing, including natural gas and diesel generators, photovoltaic simulators, photovoltaic and battery inverters, batteries or battery simulators, electric vehicle supply equipment and electric vehicles.
- Test both grid connected and islanded operation. Recipient shall create a *Controller R&D Demonstration Document*.

### **Products:**

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

- Execute the RTDS Test Plan for microgrid simulation
- Controller R&D Demonstration Document

### **TASK 6 ANALYSIS AND RESULTS REPORTING**

The goal of this task is to analyze the results of the test execution and provide the necessary reports to fulfill the obligations of the research.

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

- Determine a baseline case for the "emissions" and "system energy efficiencies" targets involving no distributed generation and having utility provision of all electrical and thermal energy consumed by loads. Appendix 12 of the PON provides the baseline CO<sub>2</sub> marginal emissions factors and energy consumption that will be utilized. Result of the simulation tests will provide the after microgrid controller reference data. Recipient shall document the *Performance Baseline Data for Borrego Springs Data*.
- Operate the microgrid system for one (1) year.
- Periodically download operational data from the microgrid system. Data downloads will occur, at a minimum, once at commissioning and quarterly thereafter as well as immediately after any islanding event.
- Analyze the data to ensure that the system is functioning correctly.
- Measure and archive all available data in the microgrid for use in base-lining, testing, and performance analysis. Recipient shall create a *Measurement Data Retrieval, Archiving and Analysis Completion Letter*
- Perform calculations and analysis of simulation results to demonstrate controller performance in accordance with Task 3.0 Advanced Microgrid Controller R&D. Recipient shall provide a short *Performance Evaluation of the Controller*.

## Exhibit A Scope of Work

### Products:

#### The Recipient shall provide:

- Performance Baseline Data for Borrego Springs
- Measurement Data Retrieval, Archiving and Analysis Completion Letter
- Performance Evaluation of the Controller

### TASK 7 EVALUATION OF PROJECT BENEFITS

The goal of this task is to report the benefits resulting from this project.

#### The Recipient shall:

- Complete three Project Benefits Questionnaires that correspond to three main intervals in the Agreement: (1) *Kick-off Meeting Benefits Questionnaire*; (2) *Mid-term Benefits Questionnaire*; and (3) *Final Meeting Benefits Questionnaire*.
- Provide all key assumptions used to estimate projected benefits, including targeted market sector (e.g., population and geographic location), projected market penetration, baseline and projected energy use and cost, operating conditions, and emission reduction calculations. Examples of information that may be requested in the questionnaires include:
  - For Product Development Projects and Project Demonstrations:
    - Published documents, including date, title, and periodical name.
    - Estimated or actual energy and cost savings, and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
    - Greenhouse gas and criteria emissions reductions.
    - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
    - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
    - A discussion of project product downloads from websites, and publications in technical journals.
    - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
    - Additional Information for Product Development Projects:
      - Outcome of product development efforts, such copyrights and license agreements.
      - Units sold or projected to be sold in California and outside of California.
      - Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
      - Investment dollars/follow-on private funding as a result of Energy Commission funding.
      - Patent numbers and applications, along with dates and brief descriptions.
    - Additional Information for Product Demonstrations:
      - Outcome of demonstrations and status of technology.
      - Number of similar installations.
      - Jobs created/retained as a result of the Agreement.

## Exhibit A Scope of Work

- For Information/Tools and Other Research Studies:
  - Outcome of project.
  - Published documents, including date, title, and periodical name.
  - A discussion of policy development. State if the project has been cited in government policy publications or technical journals, or has been used to inform regulatory bodies.
  - The number of website downloads.
  - An estimate of how the project information has affected energy use and cost, or has resulted in other non-energy benefits.
  - An estimate of energy and non-energy benefits.
  - Data on potential job creation, market potential, economic development, and increased state revenue as a result of project.
  - A discussion of project product downloads from websites, and publications in technical journals.
  - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Respond to CAM questions regarding responses to the questionnaires.

The Energy Commission may send the Recipient similar questionnaires after the Agreement term ends. Responses to these questionnaires will be voluntary.

### **Products:**

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

- Kick-off Meeting Benefits Questionnaire
- Mid-term Benefits Questionnaire
- Final Meeting Benefits Questionnaire

### **TASK 8 TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES**

The goal of this task is to develop a plan to make the knowledge gained, experimental results, and lessons learned available to the public and key decision makers.

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

- Prepare an *Initial Fact Sheet* at start of the project that describes the project. Use the format provided by the CAM.
- Prepare a *Final Project Fact Sheet* at the project's conclusion that discusses results. Use the format provided by the CAM.
- Prepare a *Technology/Knowledge Transfer Plan* that includes:
  - An explanation of how the knowledge gained from the project will be made available to the public, including the targeted market sector and potential outreach to end users, utilities, regulatory agencies, and others.
  - A description of the intended use(s) for and users of the project results.
  - Published documents, including date, title, and periodical name.
  - Copies of documents, fact sheets, journal articles, press releases, and other documents prepared for public dissemination. These documents must include the Legal Notice required in the terms and conditions. Indicate where and when the

## **Exhibit A Scope of Work**

documents were disseminated.

- A discussion of policy development. State if project has been or will be cited in government policy publications, or used to inform regulatory bodies.
- The number of website downloads or public requests for project results.
- Additional areas as determined by the CAM.
- Conduct technology transfer activities in accordance with the Technology/Knowledge Transfer Plan. These activities will be reported in the Progress Reports.
- When directed by the CAM, develop *Presentation Materials* for an Energy Commission-sponsored conference/workshop on the results of the project.
- Prepare a *Technology/Knowledge Transfer Report* on technology transfer activities conducted during the project.

### **Products:**

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

- Initial Fact Sheet (draft and final)
- Final Project Fact Sheet (draft and final)
- Presentation Materials (draft and final)
- Technology/Knowledge Transfer Plan (draft and final)
- Technology/Knowledge Transfer Report (draft and final)

### **TASK 9 Production Readiness Plan**

The goal of this task is to determine the steps that will lead to the manufacturing of technologies developed in this project or to the commercialization of the project's results.

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

- Prepare a *Production Readiness Plan*. The degree of detail in the plan should be proportional to the complexity of producing or commercializing the proposed product, and to its state of development. As appropriate, the plan will discuss the following:
  - Critical production processes, equipment, facilities, personnel resources, and support systems needed to produce a commercially viable product.
  - Internal manufacturing facilities, supplier technologies, capacity constraints imposed by the design under consideration, design-critical elements, and the use of hazardous or non-recyclable materials. The product manufacturing effort may include "proof of production processes."
  - The estimated cost of production.
  - The expected investment threshold needed to launch the commercial product.
  - An implementation plan to ramp up to full production.
  - The outcome of product development efforts, such as copyrights and license agreements.
  - Patent numbers and applications, along with dates and brief descriptions.
  - Other areas as determined by the CAM.

### **Products:**

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

- Production Readiness Plan (draft and final)

STATE OF CALIFORNIA

STATE ENERGY RESOURCES  
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: SAN DIEGO GAS & ELECTRIC COMPANY

**RESOLVED**, that the State Energy Resources Conservation and Development Commission (Energy Commission) adopts the staff CEQA findings contained in the Agreement Request Form; and

**RESOLVED**, that the Energy Commission approves Agreement EPC-14-060 from PON-14-301 with **San Diego Gas & Electric Company** for a **\$4,724,802** grant to demonstrate a utility operated high-penetration, renewable-based community microgrid at Borrego Springs in Southern California; and

**FURTHER BE IT RESOLVED**, that the Executive Director or his/her designee shall execute the same on behalf of the Energy Commission.

**CERTIFICATION**

The undersigned Secretariat to the Commission does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the California Energy Commission held on April 8, 2015.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

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Harriet Kallemeyn,  
Secretariat