STATE OF CALIFORNIA
GRANT REQUEST FORM (GRF)
CEC-270 (Revised 12/2019) CALIFORNIA ENERGY COMMISSION

A) New Agreement # EPC-19-059 (to be completed by CGL office)

B) Division	Agreement Manager:	MS-	Phone
ERDD	Quenby Lum	43	916-327-1492

C) Recipient's Legal Name	Federal ID Number
The Regents of the University of California, Riverside	95-6006142

D) Title of Project
Residential Solar+Storage Control Unit for Providing Grid Services and Demand Side Management

E) Term and Amount

Start Date	End Date	Amount
7/18/2020	3/29/2024	$ 939,232

F) Business Meeting Information

☐ ARFVTP agreements $75K and under delegated to Executive Director

Proposed Business Meeting Date 7/8/2020 ☐ Consent ☒ Discussion

Business Meeting Presenter Quenby Lum Time Needed: 5 minutes

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

Agenda Item Subject and Description:
THE REGENTS OF THE UNIVERSITY OF CALIFORNIA, RIVERSIDE. Proposed resolution approving agreement EPC-19-059 with The Regents of the University of California, Riverside for a $939,232 grant and adopting staff's determination that this action is exempt from CEQA. This project will develop and demonstrate a new technology for optimal coordination of a network of autonomous, plug and play, behind-the-meter solar-battery units for residential homes. The units will be designed to perform demand-side management such as load shifting, maximizing solar use, and backup power. Each unit, called 4- Quadrant Plug and Play Cooperative Unit (PQ-CU), is based on solid-state- technology supported by small-scale solar and battery. (EPIC funding)
Contact: Quenby Lum

G) California Environmental Quality Act (CEQA) Compliance

1. 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":

2. If Agreement is considered a "Project" under CEQA:
   a) ☒ Agreement **IS** exempt.

   ☒ Statutory Exemption. List PRC and/or CCR section number: Public Resources Code section 21080.35

   ☒ Categorical Exemption. List CCR section number: Cal. Code Regs., tit 14, § 15301 ; Cal. Code Regs., tit 14, § 15303

   ☒ Common Sense Exemption. 14 CCR 15061 (b) (3)

Explain reason why Agreement is exempt under the above section: California Code of Regulations, title 14, section 15301 ("Existing Facilities") provides that projects which consist of the operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing public or private structures, facilities, mechanical equipment, or topographical features, involving negligible or no expansion of existing or former use, are categorically exempt from the provisions of the California Environmental Quality Act. The project will install the following components in each of 15 existing single family homes: solar photovoltaic (PV) panels to absorb the solar energy and convert it to electricity, commercially available residential lithium-ion battery energy storage to store the electrical energy, power electronic converter to convert DC electricity to AC electricity, electrical panel to provide protection circuit and measurements, and a PQ-CU control box to control the PQ-CU (solar + battery) technology. Installation of solar PV panels will be on the rooftops of existing homes; no ground mounts or otherwise will be used. Installation of the battery storage will require minor alterations to the interior or the exterior of the single-family homes or adjacent garages with no expansion of footprint. Specifically, containerized energy storage units will be installed near the electrical panel in or near the existing garage of each home and connected to the home's rooftop solar. The project will not: 1) result in a significant cumulative impact, 2) have a significant effect on the environment due to unusual circumstances, 3) damage resources within a designated state scenic highway, 4) cause substantial adverse change to the significance of a historical resource, or 5) be located on a listed hazardous waste site. For these reasons, the project will have no significant environmental impact and falls under section 15301.

California Code of Regulations, title 14, section 15303 (New Construction or Conversion of Small Structures) provides that projects which consist of construction and location of limited numbers of new, small facilities or structures; installation of small new equipment and facilities in small structures; and the conversion of existing small structures from one use to another where only minor modifications are made in the exterior of the structure, are categorically exempt from the provisions of the California Environmental Quality Act. The enclosed battery energy storage units to be installed are commercially available, residentially sized lithium-ion batteries with a power rating of approximately 5kW and an energy rating of approximately 13.5kWh. The commercially available battery unit likely to be used for this project is the Tesla Powerwall 2. The dimensions (L x W x D) of the components described above will be approximately as follows: rooftop solar PV panels - approximately 15 panels per home, each panel with the dimensions of approximately 1650 mm x 991 mm x 40 mm (64.96 in x 39.02 in x 1.57 in); enclosed battery energy storage - approximately 1150 mm x 755 mm x 147 mm (45.3 in x 29.6 in x 5.75 in); power electronic converter with safety switch - either SolarEdge converter with the dimensions of approximately 940 mm x 315 mm x 184 mm (37 in x 12.5 in x 7.2 in) or SMA converter with the dimensions of approximately 467 mm x 612 mm x 242 mm (18.4 in x 21.1 in x 9.5 inch); electrical panel - approximately 678 mm x 420 mm x 152 mm (26.7 in x 16.5 in x 6 inch); PQ-CU control box - approximately 356 mm x 305 mm x 204

mm (14 in x 12 in x 8 inch). The small new solar equipment will be installed on the roof of the residence, and the small energy storage equipment will be installed inside the garage, inside another structure associated with the residence, or adjacent to the residence. Installation will only require minor modifications to the exterior of the existing structures. The project will not: 1) impact an environmental resource of hazardous or critical concern, 2) result in a significant cumulative impact, 3) have a significant effect on the environment due to unusual circumstances, 4) damage resources within a designated state scenic highway, 5) cause substantial adverse change to the significance of a historical resource, or 6) be located on a listed hazardous waste site. For these reasons, the project will have no significant environmental impact and falls under section 15303.

The project consists of the installation of electrical components and infrastructure to accommodate a solar energy system and energy storage system at approximately 15 residential sites. The installation of these technologies will not result in the expansion of the existing use of these homes. Vehicle trips associated with the construction of the project will be temporary and the operation of the energy systems will result in a negligible number of regular operational trips for maintenance of the systems. The only sound that might be produced from these systems would be related to the cooling fans for the inverter and battery energy storage, which is not considerable (less than 50 dBA). These technologies are considered to be green technologies and do not produce any known emissions. No adverse effects to water or air quality would occur as a result of the proposed project. As there is no possibility project activity may have a significant effect on the environment, the project falls under the common sense exemption listed in California Code of Regulations, title 14, section 15061(b)(3).

This project will involve the installation of solar energy systems on the roofs of existing buildings and pursuant to Public Resources Code section 21080.35 is exempt from CEQA. The associated equipment will not occupy more than 500 square feet of ground surface and will be located on the same parcel as the solar panels. The project does not involve a federal Clean Water Act permit; streambed alteration permit; or a site that contains plants protected by the Native Plant Protection Act. For these reasons, this project is statutorily exempt from CEQA under Public Resources Code section 21080.35.

The sections 15301, 15303, 15061(b)(3), and 21080.35 exemptions each serve as an independent basis for finding the project exempt.The activity is covered by the general rule that CEQA applies only to projects which have the potential for causing a significant effect on the environment. Where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA.

b) Agreement **IS NOT** exempt. (consult with the legal office to determine next steps)

Check all that apply

- ☐ Initial Study
- ☐ Negative Declaration
- ☐ Mitigated Negative Declaration
- ☐ Environmental Impact Report
- ☐ Statement of Overriding Considerations

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

Legal Company Name:	**Budget**
GRID Alternatives	$ 161,878
Oklahoma State University	$ 320,000
	$
	$

I) List all key partners: (attach additional sheets as necessary)

Legal Company Name:

J) Budget Information

Funding Source	**Funding Year of Appropriation**	**Budget List Number**	**Amount**
EPIC	18-19	301.001F	$939,232
			$
			$
			$

R&D Program Area: ESRO: ETSI TOTAL: $ 939,232

Explanation for “Other” selection

Reimbursement Contract #: Federal Agreement #:

K) Recipient’s Contact Information

1. **Recipient’s Administrator/Officer**

   Name: Hamidreza Nazaripouya

   Address: 1200 Columbia Ave

   City, State, Zip: Riverside, CA 92507-2129

   Phone: 951)781-5764

   E-Mail: hamidn@ucr.edu

2. **Recipient’s Project Manager**

   Name: Hamidreza Nazaripouya

   Address: 1200 Columbia Ave

   City, State, Zip: Riverside, CA 92507-2129

   Phone: 951)781-5764

   E-Mail: hamidn@ucr.edu

L) Selection Process Used

☒ Competitive Solicitation Solicitation #: GFO-19-306

☐ First Come First Served Solicitation Solicitation #:

M) The following items should be attached to this GRF

1.	Exhibit A, Scope of Work		☒ Attached
2.	Exhibit B, Budget Detail		☒ Attached
3.	CEC 105, Questionnaire for Identifying Conflicts		☒ Attached
4.	Recipient Resolution	☒ N/A	☐ Attached
5.	CEQA Documentation	☐ N/A	☒ Attached

Agreement Manager **Date**

Office Manager **Date**

Deputy Director **Date**

Exhibit A
Scope of Work

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2		Analyze the System Requirements, Functional Specifications, and Limitations
3		Enhance and Optimize the PQ-CU Design to Maximize Cost-Effectiveness of the System
4		Develop and Build the Customized Hardware Components of PQ-CU Technology
5		Develop the Software of PQ-CU Unit on Control Hardware Platform
6	X	Integrate Hardware and Software Components, Build the PQ-CU Unit, Run Initial Tests
7		Establish a Test Setup and Test the Operation of PQ-CU to Have it Ready for Field Deployment
8	X	Prepare for Field Demonstration
9		Install PQ-CU Technology in Fifteen Different Residential Sites
10		Demonstrate the Operational Performance of the PQ-CU Technology
11		Evaluation of Project Benefits
12		Technology/Knowledge Transfer Activities
13		Production Readiness Plan

B. Acronym/Term List

Acronym/Term	Meaning
AC	Alternating Current
BTM	Behind the Meter
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
CVR	Conservation Voltage Reduction
DC	Direct Current
Disadvantaged Community	Disadvantaged Community (DAC) is defined as an area representing census tracts scoring in the top 25 % in CalEnviroScreen 3.0. (https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30).
High Fire-Threat District or HFTD	Area that has been designated as having a high fire threat as defined by the CPUC at https://www.cpuc.ca.gov/FireThreatMaps/.
IT	Information Technology
IOU	Investor-Owned Utilities

[1] 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.

Acronym/Term	Meaning
JA12	Title 24 Joint Appendix 12 (JA12) – Qualification Requirements for Battery Storage System
Low-Income Community	Low-income Community is defined as a community within census tracts with median household incomes at or below 80 percent of the statewide median income, or at or below the threshold designated as low-income by the California Department of Housing and Community Development. (http://www.hcd.ca.gov/grants-funding/income-limits/index.shtml)
OT	Operational Technology
PQ-CU	4-Quadrant Plug and Play Cooperative Unit
PV	Photovoltaic
RES	Renewable Energy Resources
TAC	Technical Advisory Committee
Title 24	Building Energy Efficiency Standards (Title 24) https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards
TRL	Technology Readiness Level
TOU	Time of Use
VAR	Volt-Ampere Reactive

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

A. Purpose of Agreement

The purpose of this Agreement is to fund demonstrations to evaluate the operations that residential energy storage systems can provide, including the development of new grid harmonization capabilities, at a minimum of fifteen different residential sites that reside in a minimum of three different climate zones, including coastal, central valley, and northern California.

B. Problem/ Solution Statement

Problem

- Currently, the existing methods for scheduling battery storage systems either focus on providing utility services (e.g., resource adequacy, congestion relief, voltage regulation), or focus on demand side management such as time of use (TOU) management, backup power, and maximizing solar use. Combining these two applications would maximize the value of energy storage to residents and the grid
- In distribution systems, voltage issue is one of the main barriers of high penetration of renewable energy resources, although in many cases the system operators still manage the feeder voltage by curtailing the renewables generation or limiting the installed capacity of these resources.

Solution

- The recipient will develop a control unit (4-Quadrant Plug and Play Cooperative Unit or PQ-CU) that will be included in residential solar plus storage system deployment that meets Title 24 and JA12 requirements. The solar plus storage system will be controlled by a new controller (PQ-CU) developed by the recipient with optimization logic that will enable control of multiple services to achieve benefits for the resident and the grid. The system will be designed to meet Building Energy Efficiency Standards (Title 24) Joint Appendix 12 (JA12) requirements.
- In this project, new use cases and innovative tariff option (i.e., volt-ampere reactive (VAR) tariff) will be developed, and the value of the energy storage participating in daily cycling as well as newly developed grid support will be evaluated in residential sites including Low-Income, Disadvantaged, and Native American tribal communities with a majority in High Fire-Threat Districts.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Develop a cybersecure control platform for behind the meter (BTM) energy storage for interacting with the grid
- Develop a new grid harmonization capability for BTM energy storage systems for dynamic voltage management
- Maximize the value of BTM storage to the resident and grid by combining demand side management capability with a newly developed dynamic grid service and tariff

Ratepayer Benefits:[2] This Agreement will result in the ratepayer benefits:
1) *Increasing energy savings:* This new technology will reduce energy consumption with no impact on consumers' comfort by enabling Conservation Voltage Reduction (CVR), which allows reduction of feeder voltage close to the minimum allowable voltage level.

Technological Advancement and Breakthroughs:[3] This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by:
1) *Maximizing the value of energy storage systems to residential customers and the grid:* by optimizing the participation in the demand side management and grid service simultaneously.

[2] 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).
[3] 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.

2) *Facilitating the high penetration of solar generation:* Voltage volatility caused by solar intermittency and reverse power flow is one of the main barriers that limits solar uptake. The Recipient's platform will control the residential systems to mitigate extreme voltage fluctuations, enabling safer operation on the grid as deployment of these systems increases.
3) *Improving the energy efficiency in the grid:* The platform controls and reduces line and transformer losses on feeders by compensating Watt losses (power factor correction) and voltage related losses. It also enables the reduction of feeder voltage close to the minimum allowable voltage level.
4) *Enhancing the security of the power system operation:* by incorporating advanced cybersecure control framework into BTM assets at the distribution grid edge that is typically vulnerable.

Agreement Objectives

The objectives of this Agreement are to:

- Development of a platform that will enable multiple services by residential solar plus storage system to provide both localized grid and homeowner benefits.
- System technologies must have a field demonstrated Technology Readiness Level (TRL) of at least 6 with the capability to reach a TRL level 7 when entering the demonstration phase of the project.
- Demonstration of the residential energy storage operations at a minimum of fifteen different residential sites in four different climate zones as defined by the CEC's California Building Climate Zone Areas map[4] including coastal, central valley, and northern California.
- Measure and evaluate the benefit of residential energy storage to residents and the grid in this project.

III. 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 V).** 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:

[4] See https://ww2.energy.ca.gov/maps/renewable/building_climate_zones.html.

For products that require a draft version, including the Final Report Outline and Final Report

- Submit all draft products to the CAM for review and comment in accordance with the Project Schedule (Part V). The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- Consider incorporating all CAM comments into the final product. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product.
- Submit the revised product and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period, or approves a request for additional time.

For products that require a final version only

- Submit the product to the CAM for acceptance. The CAM may request minor revisions or explanations prior to acceptance.

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 will 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 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.

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 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.

- 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 progress made on all Agreement activities as specified in the scope of work for the preceding month, including accomplishments, problems, milestones, products, schedule, fiscal status, and 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.

- Submit a monthly or quarterly *Invoice* that follows the instructions in the "Payment of Funds" section of the terms and conditions, including a financial report on Match Fund and in-state expenditures.

Products:
- Progress Reports
- Invoices

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 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 the 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. *(See Task 1.1 for requirements for draft and final products.)*

Recipient Products:
- Final Report Outline (draft and final)

CAM Product:
- Style Manual
- Comments on Draft Final Report Outline
- Acceptance of Final Report Outline

Subtask 1.6.2 Final Report

The Recipient shall:
- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline, Style Manual, and Final Report Template provided by the CAM with the following considerations:
  - Ensure that the report includes the following items, in the following order:
    - Cover page (**required**)
    - Credits page on the reverse side of cover with legal disclaimer (**required**)
    - Acknowledgements page (optional)
    - Preface (**required**)
    - Abstract, keywords, and citation page (**required**)
    - Table of Contents (**required**, followed by List of Figures and List of Tables, if needed)
    - Executive summary (**required**)
    - Body of the report (**required**)

        - References (if applicable)
        - Glossary/Acronyms (If more than 10 acronyms or abbreviations are used, it is required.)
        - Bibliography (if applicable)
        - Appendices (if applicable) (Create a separate volume if very large.)
        - Attachments (if applicable)
    - Ensure that the document is written in the third person.
    - Ensure that the Executive Summary is understandable to the lay public.
        - Briefly summarize the completed work. Succinctly describe the project results and whether or not the project goals were accomplished.
        - Identify which specific ratepayers can benefit from the project results and how they can achieve the benefits.
        - If it's necessary to use a technical term in the Executive Summary, provide a brief definition or explanation when the technical term is first used.
    - Follow the Style Guide format requirements for headings, figures/tables, citations, and acronyms/abbreviations.
    - Ensure that the document omits subjective comments and opinions. However, recommendations in the conclusion of the report are allowed.
    - Include a brief description of the project results in the Abstract.
- Submit a draft of the report to the CAM for review and comment. The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt
- Consider incorporating all CAM comments into the Final Report. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product
- Submit the revised Final Report and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period or approves a request for additional time.
- Submit one bound copy of the *Final Report* to the CAM along with *Written Responses to Comments on the Draft Final Report*.

Products:

- Final Report (draft and final)
- Written Responses to Comments on the Draft Final Report

CAM Product:

- Written Comments on the 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 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 will 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.
    - If different from the solicitation application, provide 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 will request reimbursement.

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 will 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)*

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 shall include the expertise of each proposed TAC member and the value to the project.
- 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.

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.

The TAC shall:

- Help set the project team's goals and contribute to the development and evaluation of its statement of proposed objectives as the project evolves.
- Provide a credible and objective sounding board on the wide range of technical and financial barriers and opportunities.
- Help identify key areas where the project has a competitive advantage, value proposition, or strength upon which to build.
- Advocate on behalf of the project in its effort to build partnerships, governmental support and relationships with a national spectrum of influential leaders.
- Ask probing questions that insure a long-term perspective on decision-making and progress toward the project's strategic goals.

Products:

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

IV. TECHNICAL TASKS

TASK 2: ANALYZE THE SYSTEM REQUIREMENTS, FUNCTIONAL SPECIFICATIONS, AND LIMITATIONS

The goal of this task is to extract the detailed requirements and limitations in the 4-Quadrant Plug and Play Cooperative Unit (PQ-CU) technology design, development, and deployment process in compliance with Title 24 and JA12 requirements. In this task the barriers and risks will be evaluated, and potential solutions or alternatives will be identified.

The Recipient shall:

- Identify electric power distribution system limitations and requirements for PQ-CU accommodation.
- Identify PQ-CU structural and functional specifications, limitations, and requirements to be added to BTM solar plus storage systems at residences in different climate zones.
- Identify the communication requirements, limitations, specifications for PQ-CU.
- Identify limitations, barriers, and risks for PQ-CU technology development and deployment.
- Evaluate the potential solutions to limitations, barriers, risks and identify alternatives.
- Prepare *Requirements, Specifications, and Limitations Report* which shall include the results of the identification and evaluation activities described above.

Products:

- Requirements, Specifications, and Limitations Report

TASK 3: ENHANCE AND OPTIMIZE THE PQ-CU DESIGN TO MAXIMIZE COST-EFFECTIVENESS OF THE SYSTEM

The goal of this task is to optimize the design of PQ-CU for maximum cost-effectiveness.

Subtask 3.1: Design the Control Software Scheme

The goal of this task is to design the control software scheme of PQ-CU and ensure its compatibility with the control hardware.

The Recipient shall:

- Design the Voltage Control to be compatible with VOLTTRON™, or other CAM-approved secure control and communication hardware platform, to reduce the cost of local controller retrofit compatibility.
- Design the Supervisory Control to coordinate the operation of individual PQ-CU.
- Develop a *Voltage Control and Supervisory Control Scheme Report* which shall include a summary of processes completed for the activities described above.

Products:

- Voltage Control and Supervisory Control Scheme Report

Subtask 3.2: Design the Hardware Configuration

The goal of this task is to design the hardware configuration of solar plus storage system based on direct current (DC) coupling and alternating current (AC) coupling of solar photovoltaic (PV) system and battery storage, design the PQ-CU control hardware and protection circuit.

The Recipient shall:

- Design the hardware configuration and optimum size of solar PV systems based on load profile of different sites.
- Optimize design of PQ-CU hardware based on DC coupling and AC coupling.
- Design the control hardware configuration.
- Design the protection scheme, configuration, and circuit.
- Prepare *PQ-CU Hardware Configuration Fact Sheet* which shall include a summary of processes completed for the activities described above.

Products:

- PQ-CU Hardware Configuration Fact Sheet

Subtask 3.3: Design a Robust Cyber-Secure Control Architecture

The goal of this task is to ensure the cybersecurity of the controller to protect the PQ-CUs from malicious cyber-attacks and ensure the large-scale and secure operation of PQ-CUs.

The Recipient shall:

- Design customized communications architectures and interfaces to support standardized and interoperable operation of PQ-CU and its interaction with residential energy storage systems.
- Design a holistic attack-resilient framework and layered cyber-physical solution to ensure the large-scale and secure operation of PQ-CUs.
- High-level cybersecurity analysis of the communications and control architecture.
- Prepare *Cyber-Secure Architecture Design Report* which shall include a summary of processes completed for the activities described above.

Products:

- Cyber-Secure Architecture Design Report

TASK 4: DEVELOP AND BUILD THE CUSTOMIZED HARDWARE COMPONENTS OF PQ-CU TECHNOLOGY

The goal of this task is to develop and build the custom-made hardware components of the PQ-CU technology including controller unit, measurement unit, and protection unit. The design in TASK 3 is the basis of this development.

The Recipient shall:

- Develop the control unit for each PQ-CU and communication interface.
- Develop AC and DC measurement units composed of power meters, voltage transducers and current sensors.
- Develop the protection circuit.
- Prepare *Developed Control Unit, Measurement Units, and Protection Circuit Report* which shall include a summary of processes completed for the activities described above.

Products:

- Developed Control Unit, Measurement Units, and Protection Circuit Report

TASK 5: DEVELOP THE SOFTWARE OF PQ-CU UNIT ON CONTROL HARDWARE PLATFORM

The goal of this task is to develop the coding and programming for the voltage control unit and the supervisory control unit of PQ-CU.

Subtask 5.1: Coding and Programming the Voltage Control Unit of PQ-CU

The goal of this task is to develop the voltage control software compatible with the VOLTTRON hardware or other CAM-approved secure control and communication platform for autonomous, plug and play operation of PQ-CU. The control software will be structured to also enable safe operation, and manage the communication between power electronic converter, battery management system and measurement units.

The Recipient shall:

- Gather and analyze the performance and specification requirements of control hardware platform.
- Design software architecture, and identify the programming language based on requirements and hardware specifications.
- Develop the code for designed voltage control algorithm in Subtask 3.1, and program the hardware.
- Test software functionality through various test cases, find issues, correct, and retest.
- Prepare *Voltage Control Software and Programming the Controller Hardware Report* which shall include a summary of processes completed for the activities described above.

Products:

- Voltage Control Software and Programming the Controller Hardware Report

Subtask 5.2: Coding and Programming the Supervisory Control Unit of PQ-CU
The goal of this task is to develop the supervisory control software compatible with the VOLTTRON or other CAM-approved secure control and communication platform based on the Supervisory Control designed in Subtask 3.1. The supervisory control software will enable optimal scheduling of PQ-CU to participate in both demand side management and voltage grid service.

The Recipient shall:

- Gather and analyze the performance and specification requirements of control hardware platform.
- Design software architecture and identify the programming language based on VOLTTRON, or other CAM-approved platform, hardware specifications and requirements.
- Develop all modules/units of the software, adopt secure coding standards, and implement the code of designed Supervisory Control algorithm in Subtask 3.1.
- Perform functional testing including unit testing, integration testing, and system testing to ensure features and functions specified.
- Program the control unit and test the interoperability of Supervisory Control with PQ-CU Voltage Control.
- Prepare *Supervisory Control Software Report and Test Report* which shall include a summary of processes completed for the activities described above.

Products:

- Supervisory Control Software and Test Report

TASK 6: INTEGRATE HARDWARE AND SOFTWARE COMPONENTS, BUILD THE PQ-CU UNIT, RUN INITIAL TESTS
The goal of this task is to build the PQ-CU unit with all components and to perform preliminary operational testing. This task will integrate and assemble the hardware and

software components of the PQ-CU and will produce one operational unit of the device and perform preliminary testing of its operation before field deployment.

The Recipient shall:

- Interconnect the hardware components including power converter, battery pack, PQ-CU control unit, and measurement unit.
- Establish communication channels between components.
- Test the basic operation of PQ-CU unit in exchanging energy with the grid.
- Prepare *Developed PQ-CU Unit Report* which shall include a summary of processes completed for the activities described above.
- Prepare *CPR Report #1* and participate in CPR Meeting as described in subtask 1.3.

Products:

- Developed PQ-CU Unit Report
- CPR Report #1

TASK 7: ESTABLISH A TEST SETUP AND TEST THE OPERATION OF PQ-CU TO HAVE IT READY FOR FIELD DEPLOYMENT

The goal of this task is to establish a test plan, to test and validate the performance of PQ-CU, and to ensure its readiness for field deployment.

Subtask 7.1 Test and Validate the Performance of PQ-CU in Voltage Management

The goal of this task is to establish a test setup in order to test the dynamic voltage management performance of the PQ-CU under a set of scenarios of power grid conditions described in test plan. The completion of this task will provide the initial test results for the assessment of the PQ-CU performance in providing a new grid harmonization capability.

The Recipient shall:

- Develop validation plan, identify use-case scenarios, and develop test plan.
- Integrate PQ-CU with test setup and perform integration testing and troubleshooting.
- Establish the grid operational conditions in bi-directional power flow grid based on the set of use-case scenarios defined above.
- Develop the protection circuit.
- Single PQ-CU testing and operational performance validation under the set of grid operational conditions established above.
- Prepare *Test Setup Development and PQ-CU Testing Report* which shall include a summary of and results from the activities described above.

Products:

- Test Setup Development and PQ-CU Testing Report

Subtask 7.2: Test the Optimal Dispatching of PQ-CU in Response to Different Use-Case Scenarios

The goal of this task is to test the performance of supervisory control for dispatching the PQ-CU technology, and to have it ready for field deployment. This task will assess the performance of the system with PQ-CU under variable load, solar power profiles, control signal scenarios with uncertainties.

The Recipient shall:

- Develop validation plan for operation of PQ-CU in both demand side management and voltage grid service, identify use case scenarios for coordinated operation testing and validation.
- Expand and finalize test environment setup; configure the test environment to test the system performance on combined grid service capability and demand side management.
- Integrate the PQ-CU technology including voltage controller, communication, and supervisory controller with the test environment.
- Test and validate the operation of PQ-CU based on the scenarios established above.
- Prepare *Testing of Optimal Dispatching of PQ-CU Technology Report* which shall include a summary of and results from the activities described above.

Products:

- Testing of Optimal Dispatching of PQ-CU Technology Report

Subtask 7.3: Test the Performance of the PQ-CU in Response to Cyber-Attacks

The goal of this task is to perform vulnerability assessments, and test the performance of PQ-CU under several cybersecurity use cases to identify the possible vulnerabilities and gaps associated with the architecture, address the gaps and revalidate the cyber-secured operation of PQ-CU.

The Recipient shall:

- Review PQ-CU network architecture, and conduct vulnerability assessments on information technology (IT), operational technology (OT), and management network.
- Run cybersecurity use-cases and evaluate the resistance of the proposed network architecture.
- Identify possible vulnerabilities, address gaps and revalidate the architecture.
- Prepare *Testing the Cybersecurity Operation of PQ-CU Report* which shall include a summary of and results from the activities described above.

Products:

- Testing the Cybersecurity Operation of PQ-CU Report

TASK 8 PREPARE FOR FIELD DEMONSTRATION

The goal of this task is to make the required preparations for each demonstration site including technical data collection, site visits, design, program enrollment, permitting, and agreements. Selected sites shall include a minimum of 15 sites.

Sites locations shall include the following: a minimum of three climate zones, including at least one site in each of the following climate zones as defined by the CEC's California Building Climate Zone Areas map:[5] coastal, central valley, and northern California; site(s) located in and benefiting Disadvantaged Communities and Low-Income Communities as defined herein; site(s) located in Tier 2 or 3 HFTDs as defined herein; and all sites shall be located in an Investor-Owned Utility (IOU) service territory.

The Recipient shall:

- Conduct site visits and determine specific location of equipment.
- Develop plans and designs for each site.
- Enroll each client into all applicable leveraged funding programs.
- Submit all permits and approvals for projects.
- Review final designs, receive approvals, and make necessary agreements with sites.
- Prepare *Field Demonstration Preparation Report* which shall include a summary of the activities described above.
- Prepare *CPR Report #2* and participate in CPR Meeting as described in subtask 1.3.

Products:

- Field Demonstration Preparation Report
- CPR Report #2

TASK 9: INSTALL PQ-CU TECHNOLOGY IN FIFTEEN DIFFERENT RESIDENTIAL SITES

The goal of this task is to complete the on-site installation of the solar, battery storage, and control system at the selected and CAM-approved sites. Installations shall include a combination of demonstrations inside and outside the residences unless there are safety restrictions that prohibit inside the residence installations, and shall also meet Title 24 and JA12 requirements

The Recipient shall:

- Schedule the installation of all components with each individual client.
- Coordinate any and all subcontractors to perform work within the installation and project timeline.
- Perform installation according to the safety and risk management plan.

[5] See https://ww2.energy.ca.gov/maps/renewable/building_climate_zones.html.

- Conduct a detailed quality assurance inspection of all system components after installation.
- Prepare *Installation and Safety and Risk Management Plan Report* which shall include a summary of the activities described above.

Products:

- Installation and Safety and Risk Management Plan Report

TASK 10: DEMONSTRATE THE OPERATIONAL PERFORMANCE OF THE PQ-CU TECHNOLOGY

The goal of this task is to demonstrate the performance of the PQ-CU technology in a practical environment through running a pilot project.

The Recipient shall:

- Commission and operate PQ-CU technology at the approved demonstration sites.
- Assess the capability of daily cycling of PQ-CU technology (load shifting, maximized solar self-utilization, and grid harmonization) to residential sites.
- Develop new use cases and an innovative tariff option (i.e. VAR tariff).
- Develop and use independent control signals or use existing IOU control signals to exercise residential energy management.
- Assess the capability of providing a new grid service, including voltage management, to the grid and customers.
- Assess and compare the capabilities of AC-coupled battery and solar systems with DC-coupled one.
- Gather data and assess the performance of PQ-CU in managing the demand side and providing voltage grid service together.
- Develop and use a data management system that allows the capture of data relevant to assessing the value and impact on the residential customer and the grid as the energy storage system capabilities and innovative tariff are tested, measured, and evaluated.
- Define test plan to quantify and validate performance. Provide a *Measurement and Verification Plan* that will include the collection and measurement and verification (M&V) of data on the installation over the **one-year demonstration period**. The duration of data collection may be reduced with prior CAM written approval. M&V includes plots of charge/discharge power levels, storage efficiencies, ambient temperatures, and PV output as a function of time.
- Prepare *PQ-CU Deployment Performance Report* which shall include the Measurement and Verification Plan described above, and a summary of and results from the other activities described above.

Products:

- Measurement and Verification Plan
- PQ-CU Deployment Performance Report

TASK 11 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.

- 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 have 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:

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

TASK 12 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 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(s) on the project.
- When directed by the CAM, participate in annual EPIC symposium(s) sponsored by the California Energy Commission.
- Provide at least (6) six *High Quality Digital Photographs* (minimum resolution of 1300x500 pixels in landscape ratio) of pre and post technology installation at the project sites or related project photographs.
- Prepare a *Technology/Knowledge Transfer Report* on technology transfer activities conducted during the project.

Products:

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

TASK 13 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:

- Production Readiness Plan (draft and final)

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

RESOLUTION NO: 20-0708-9g

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: THE REGENTS OF THE UNIVERSITY OF CALIFORNIA, RIVERSIDE

RESOLVED, that the State Energy Resources Conservation and Development Commission (CEC) adopts the staff CEQA findings contained in the Agreement or Amendment Request Form (as applicable); and

RESOLVED, that the CEC approves Agreement EPC-19-059 with The Regents of the University of California, Riverside for a $939,232 grant. This project will develop and demonstrate a new technology for optimal coordination of a network of autonomous, plug and play, behind-the-meter solar-battery units for residential homes. The units will be designed to perform demand-side management such as load shifting, maximizing solar use, and backup power. Each unit, called 4-Quadrant Plug and Play Cooperative Unit (PQ-CU), is based on solid-state-technology supported by small-scale solar and battery; and

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

CERTIFICATION

The undersigned Secretariat to the CEC 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 CEC held on July 8, 2020.

AYE:
NAY:
ABSENT:
ABSTAIN:

_____
Cody Goldthrite
Secretariat