STATE OF CALIFORNIA

GRANT REQUEST FORM (GRF)

CEC-270 (Revised 10/2015) CALIFORNIA ENERGY COMMISSION

New Agreement EPC-16-016 (To be completed by CGL Office)

Division	Agreement Manager:	MS-	Phone
ERDD	Prab Sethi	43	916-327-1302

Recipient's Legal Name	Federal ID Number
Hyperlight Energy	61-1641815

Title of Project
Commercializing a Disruptively Low Cost Solar Collector

Term and Amount	Start Date	End Date	Amount
	10/14/2016	8/31/2018	$ 750,000

Business Meeting Information			
☐ ARFVTP agreements under $75K delegated to Executive Director.			
Proposed Business Meeting Date	10/12/2016	☐ Consent	☒ Discussion
Business Meeting Presenter	Prab Sethi	Time Needed:	5 minutes
Please select one list serve. EPIC (Electric Program Investment Charge)			

Agenda Item Subject and Description

HYPERLIGHT ENERGY. Proposed resolution approving agreement EPC-16-016 with Hyperlight Energy for a $750,000 grant to develop a low cost Concentrated Solar Power (CSP) collector that will lead to a significant cost reduction by the end of this project. Energy Commission funds will be used as cost share for the federally-funded project.

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":
   Agreement will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because

2. 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 15262, 14 CCR 15303, 14 CCR 15306, and 14 CCR 15329
   ☐ Common Sense Exemption. 14 CCR 15061 (b) (3)
   Explain reason why Agreement is exempt under the above section:
   This project includes 1.) lifecycle testing and validation of upgraded design elements at contractor's existing facility of a small system which will be comprised of a single 1,000 square foot concentrated solar module; 2.) a one acre system, expanding an existing concentrated solar thermal facility at the San Diego State University's (SDSU)Brawley site; and 3.) an engineering design study of a prospective ten acre system at a site such as Coso Geothermal Generating Station.

   Regarding part 2), the Commission funded the existing system through a prior agreement, and filed a Notice of Exemption. For this agreement's expansion of the existing project, SDSU filed a Notice of Exemption citing the categorical exemption of 15 CCR 15329. 15 CCR 15329 exempts the installation of cogeneration equipment at existing facilities of 50 megawatts or less if certain criteria are met. The prior agreement installed a concentrated thermal solar system with a steam engine with less than 1 kW capacity and an absorption chiller. This agreement will scale up the solar collector for research purposes but not create additional power. This activity does not increase air emissions, complies with all federal, state, and local air quality laws, does not result in noticeable noise, and is contiguous to other structures. Thus, Commission staff agree SDSU's conclusion that it is exempt under 15 CCR 15329.

   Part 1), only involves research and testing at contractor's existing facility of a concentrated solar system of 1,000 square feet. This fits within exemptions 14 CCR 15303, 14 CCR 15306 as basic research that does not disturb an environment resource and placement of relatively small new structures at an existing site.

   Part 3) involves preparing a proposed design study but does not fund or approve its implementation, which would have to be done through a separate agreement, funds, and approval. The plan is a paper study that has no legally binding effect on the actions of any agency that might consider it in the future. Accordingly, it is exempt under 15 CCR 15306 and 15 CCR 15262.

   ☐ 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

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

Legal Company Name:	Budget
National Renewable Energy Laboratory (NREL)	$ 127,500
	$
	$
	$
	$
	$
	$
	$
	$

STATE OF CALIFORNIA

GRANT REQUEST FORM (GRF)

CEC-270 (Revised 10/2015) CALIFORNIA ENERGY COMMISSION

List all key partners: (attach additional sheets as necessary)
Legal Company Name:

Budget Information

Funding Source	Funding Year of Appropriation	Budget List No.	Amount
EPIC	15-16	301.001C	$750,000
			$
			$
			$
			$
			$
R&D Program Area: EGRO: Renewables		TOTAL:	$750,000
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #: DE-EE0007342	

Recipient's Administrator/ Officer				**Recipient's Project Manager**			
Name:	John King			Name:	John King		
Address:	11651 Riverside Dr Ste 143			Address:	11651 Riverside Dr Ste 143		
City, State, Zip:	Lakeside, CA 92040-2370			City, State, Zip:	Lakeside, CA 92040-2370		
Phone:	619-564-4303 /	Fax:	- -	Phone:	619-564-4303 /	Fax:	- -
E-Mail:	john.king@hyperlightenergy.com			E-Mail:	john.king@hyperlightenergy.com		

Selection Process Used

☒ Competitive Solicitation Solicitation #: PON-14-308

☐ First Come First Served Solicitation

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 AND ACRONYM/TERM LIST

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2		Initial Performance/Cost Targets and Cost Model Development
3	X	Collector Assembly Key Cost & Performance Validations
4		Phase 1 Technology-to-Market
5	X	Pilot 1 - Brawley Site Plant Process Development and Evaluation
6		Phase 2 Technology-to-Market
7		Pilot 2 –Field Deployment Process Validation
8		Phase 3 Technology-to-Market
9		Evaluation of Project Benefits to California IOU Electric Ratepayers

B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
CSP	Concentrated Solar Power
DOE	United States Department of Energy
Energy Commission	California Energy Commission
EPIC	Electric Program Investment Charge
GPO	Navy Geothermal Program Office
IRR	Internal Rate of Return
TAC	Technical Advisory Committee
TRL	Technology Readiness Level
T2M	Technology to market

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

A. Purpose of Agreement and Project

The purpose of this Agreement is to develop a disruptively low cost Concentrated Solar Power (CSP) collector that will lead to \$99/m^2 cost (as-built system cost including equipment, logistics, and installation/commissioning) for the solar field by the end of this project, and even lower cost by 2020. The dollars per square meter metric (\$/m^2) is used by the CSP technical community when looking at the individual component costs of CSP systems. It is a way to normalize those component costs across applications, locations and project sizes to establish a common basis of comparison, which is one square meter of reflective surface area – irrespective of application, location or project size. A \$99/m^2 collector would be the lowest cost collector on earth. The lowest cost in the current state of the art is \$200/m^2, and there are no other proposals for any

[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.

other concept below $120/m^2 that we have seen. The collector cost is independent from the costs of the receiver, the heat transfer fluid and the power conversion equipment. California Energy Commission funds will be used as EPIC cost share funding for the Recipient's federally-funded project, which received an award under federal funding opportunity announcement DOE-FOA 0001268, and will provide partial support for all tasks.

B. Problem/ Solution Statement

Problem

CSP is a promising form of renewable energy that has been hampered by high solar collector costs and high power block costs.

Solution

This project will advance a low cost solar collector – Hyperlight® - to technology readiness level (TRL) 9 – readiness for commercial deployment. This project solves the problem of high solar collector costs by making a low cost solar collector ready for commercial application. This approach will solve the problem of high power block costs by enabling the use of geothermal power plant turbines that are underutilized because of resource decline at sites. This approach is scalable because there are many such underutilized geothermal power plants in the state of California. While no deployment will happen at a geothermal plant in this project, this work will be a key enabler for such a deployment in the future.

C. Goals and Objectives of the Project

Project Goals

The goal of the project is to:

- Make a disruptively low cost CSP solar collector ready for commercial deployment.

This project includes three stages, two that include a physical installation, and one that is a paper study: 1.) a small system in San Diego which will be comprised of a single 1,000 square foot module used for lifecycle testing and validation of upgraded design elements; 2.) a one acre system, expanding an existing concentrated solar thermal facility at the San Diego State University's (SDSU)Brawley site; and 3.) a front end engineering design (FEED) study of a prospective ten acre system at a site such as Coso Geothermal Generating Station. All three stages are included in the CEC funded work.

Ratepayer Benefits:[2] The project will result in the ratepayer benefits of greater electricity reliability and lower costs by generating additional renewable power at a power plant that operates around the clock, at a price point that is well below solar PV plus batteries[3] . This increases reliability and lowers cost.

[2] California Public Resources Code, Section 25711.5(a) requires projects funded by the 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] Feldman, David, Robert Margolis, Paul Denholm, Joseph Stekli. 2016. Exploring the Potential Competitiveness of Utility-Scale Photovoltaics plus Batteries with Concentrating Slar Power, 2015-2030. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-66592. August 2016.

EXHIBIT A
Scope of Work

An overarching consideration for this project is the State of California's 50% Renewable Portfolio Standard (RPS) goal by 2030. A recent study[4] has shown that a diverse portfolio of resources is a key strategy to meet this goal, including expanded geothermal and CSP. This is because solar PV is impacted by what is commonly known as the duck curve, and battery electric storage as a mitigation strategy is considered to be very high cost. Geothermal CSP hybridization is less impacted by intermittency than solar PV, and can operate around the clock at a price point below PV plus batteries, so it is positioned to save ratepayers money in implementing the 50% RPS, while simultaneously making the grid more reliable by obtaining more power from power plants that operate around the clock.

Technological Advancement and Breakthroughs:[5] The project will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by advancing a low cost CSP collector to commercial availability. The availability of this low cost collector will allow geothermal power plant owners to buy and use this innovative system to boost the output of their plants and provide more renewable energy to the grid.

Project Objectives

The objectives of the project are to:

- Scale up production capability of Hyperlight
- Design build and install a Hyperlight system at 1 MWt scale
- Operate the system and report on performance
- Meet thermal performance to achieve:
    - Total System Annual Solar-to-Thermal Efficiency of 1 acre-module plant greater than 50%
    - Total System Cost (as-built system cost including equipment, logistics, and installation/commissioning) less than \$99/m^2, as described above.

[4] Energy and Environmental Economics, Inc. 2014. "Investigating a Higher Renewables Portfolio Standard in California." San Francisco, California: E3. Accessed January 24th, 2014. http://www.ethree.com/public_projects/renewables_portfolio_standard.php

[5] 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.

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:

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 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.
- Submit the final product to the CAM once agreement has been reached on the draft. The CAM will 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 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.

EXHIBIT A
Scope of Work

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);
  - Permit documentation (subtask 1.7);
  - Subcontracts (subtask 1.8); 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 1.9 and 1.10); and
  - Any other relevant topics.

- Provide an *Updated Project Schedule* 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 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.

If the awarding federal agency conducts similar project review meetings, the Recipient shall notify and invite the Energy Commission project manager to participate, either by teleconference or by actual meeting attendance. The United States Department of Energy (DOE) required meetings can be used in place of the Commission's CPR meetings, at the discretion of the Commission project manager

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; (2) includes recommendations and conclusions regarding continued work on the project; and (3) includes copies of any correspondence with the awarding federal agency that relates to the project's status. Examples of correspondence include reports, summaries, letters, or emails that discuss project performance or the results of project review meetings with the federal agency.
- 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.
- Recipient will provide copies of any DOE correspondence (emails, reports, letters, etc.) that relate to the project status. This includes copies of project performance reviews on Recipient work and summaries and results of project review meetings with DOE.
- Notify the CAM of any project review meetings conducted by the awarding federal agency, and invite the CAM to participate in the meetings by teleconference or in-person (subject to the awarding federal agency's approval).

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 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)
- DOE correspondence and reporting (no draft)

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. If the awarding federal agency conducts similar project review meetings, the Recipient shall notify the CAM and invite him/her to participate, either by teleconference or in-person. The federal agency's meetings may be used in place of the Commission's CPR meetings, at the discretion of the CAM. However, all items listed in this task will need to be covered in the meeting.

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. Include a copy of any federal agency correspondence (e.g., report, summary, letter, or email) that discusses project findings, conclusions, or recommendations.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Copies of all correspondence and reports discussing DOE's findings on the project, and future disposition of the project, if applicable. When directed by the Commission Project Manager, recipient will provide copies of any DOE correspondence (emails, reports, letters, etc.) that relate to project performance.
- Provide *All Draft and Final Written Products* on a CD-ROM or USB memory stick, organized by the tasks in the Agreement.
- Notify the CAM of any project review meetings conducted by the awarding federal agency, and invite the CAM to participate in the meetings by teleconference or in-person.

Products:

- Final Meeting Agreement Summary *(if applicable)*
- Schedule for Completing Agreement Closeout Activities
- All Draft and Final Written Products
- DOE correspondence on project findings and results

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.
  - Provide a synopsis of the project progress, including accomplishments, problems, milestones, products, schedule, fiscal status, and any evidence of progress such as photographs.
  - Include copies of any federal agency correspondence that relates to the project's status. Examples of correspondence include reports, summaries, letters, or emails that discuss project performance and the results of project review meetings with the federal agency.
- In lieu of the monthly progress report and with the CAM's approval, submit one or more progress reports submitted to the awarding federal agency. The federal report(s) must contain information similar to that required in the Energy Commission monthly progress reports. Each Progress Report must contain any reports made to DOE, including summaries of meetings with DOE, as it that relates to the project outcome and performance. Include names and contacts of DOE representatives.
- 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; and
  - Energy Commission funds spent in California *(if applicable)*.

Products:

- Progress Reports
- Copies of DOE reporting and meeting summaries (no draft)
- Invoices

Subtask 1.6 Final Report

The goal of this subtask is to prepare a Final Report that discusses the results of the project, including energy benefits to California ratepayers. The CAM will review and approve the Final Report, which will be due at least **two months** before the Agreement end date.

The Recipient shall:

- Prepare a *Final Report* that follows the Style Manual provided by the CAM and includes the following items, at a minimum:
  - **Cover Page**

- **Summary of Project Purpose and Results**
- **Discussion** that includes the following, at a minimum:
    a. Project goals and the approach to meeting the goals
    b. Activities performed
    c. Project results, including:
        - Success of the project as measured by the degree to which goals and objectives were achieved;
        - How the project has resulted in the ratepayer benefits and technological advancements and breakthroughs identified in the solicitation proposal and Part II of the Scope of Work;
        - Projected cost reduction impact and other benefits resulting from the project, including how the project has supported California's economic development in the near term and the number of jobs created or sustained;
        - How the project results will be used by California industry, markets and others
    d. The project budget, including:
        - The total project cost and the cost share of all funding partners;
        - How the Energy Commission funding was spent on the project, including any unique products and benefits
    e. Observations, conclusions, and recommendations for further RD&D projects and improvements.

- If a *Final Federal Report* is required by the federal agency:
    - Submit a draft of the report to the CAM on the date the draft is due to the federal agency (subject to the federal agency's approval).
    - Submit the approved final version of the report and *Written Confirmation of the Federal Agency's Approval of the Final Federal Report* (e.g., email or letter), upon receipt of the written confirmation.

CAM Product:

- Style Manual

Recipient Products:

- Final Report (draft and final)
- Federal Agency Report (draft and final)
- Written Confirmation of the Federal Agency's Approval of the Final Federal Report
- Additional information needed per Energy Commission agreement.

EXHIBIT A
Scope of Work

PERMITS, AND SUBCONTRACTS

Subtask 1.7 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 1.8 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 1.9 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.

EXHIBIT A
Scope of Work

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 1.10.
- 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 1.10 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

IV. TECHNICAL TASKS

*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.* ***Subtask 1.1 (Products)*** *describes the procedure for submitting products to the CAM.*

TASK 2 - INITIAL PERFORMANCE/COST TARGETS AND COST MODEL DEVELOPMENT

The goal of this task is to develop overall analytical Tools for assessing milestone performance in all Technical Tasks. These Tools consist of three fundamental predictive models: 1) a Concentrating Solar Power (CSP) Thermal Energy Generation Model, 2) a CSP Plant Cost Model, and 3) a Thermal Energy Commodity Sales Model.

The Recipient shall:

- Build a Collector Optomechanical Assembly model that provides baseline assumptions about manufacturing tolerances and corresponding optical accuracy.
- Build a Receiver Assembly Error Model
- Build a Combined Collector/Receiver System Model
- Build a Thermal Energy Delivery (TED) Performance Model
- Build a CSP Thermal Energy Generation Model that will estimate predicted daily average, monthly average, and annual average thermal energy production per acre of the Solar Plant, using a high fidelity solar simulator (e.g. System Advisor Model [SAM]) of a representative solar plant configuration.
- Build a CSP Solar Plant Cost Model that will estimate cost per acre installed of the CSP based on grassroots cost estimation including cost variances and a Thermal Storage Cost model option.
- Build a Thermal Energy Delivery (TED) Custom Cost Model
- Build a Thermal Energy Commodity Sales Model that will provide estimates of the daily average, monthly average, and annual average solar plant revenue options per acre installed of the CSP based on location and market driving factors for optimizing thermal energy sales with and without the thermal storage option.
- Prepare and provide a *Model Report*, which describes each model developed under this task and integrates and summarizes the results from the individual models and predicts performance of the system.

Products:

- Model Report (Draft and Final)

TASK 3 COLLECTOR ASSEMBLY KEY COST & PERFORMANCE VALIDATIONS

The goal of this task is to validate key cost and performance projections from Task 2. This validation will be based on actual development and verification of the associated cost-driver manufacturing and assembly processes for the key Components of the Collector Assembly.

Specifically, the following systems will be developed and evaluated: 1) a low cost, high precision PVC extrusion process for the Collector Pipe, 2) a low cost, quick-assemble system for the optomechanical kinematic bulkhead assembly, and 3) critical process and alignment tools necessary for the Collector assembly. As part of this Task 3, a high cycle testbed will be developed and utilized to conduct accelerated lifetime testing (30+ years equivalent) of optomechanical kinematic assemblies in order to validate optomechanical performance through worst-case simulated conditions through and up to end-of-life.

The Recipient shall:

- *Prepare* and provide a *Production Summary Report,* which integrates and summarizes the results from the individual production and assembly steps as described below.
- Establish PVC Collector Pipe Extrusion
- Conduct Bulkhead Redesign, Fabrication, and Test
- Perform Mirror Characterization and establish Alternative Fabrication Options
- Perform Endcap Redesign, Fabrication, and Test
- Design Calibration Equipment and Process
- Build Basin Testbeds
- Perform Tracking Control System Development
- Perform Life-Cycle Testing
- Establish Brawley Test Site Infrastructure
-
- Participate in CPR and provide a *CPR Report #1* as described in subtask 1.3

Product:

- Production Summary Report (Draft and Final)
- CPR Report #1

TASK 4 PHASE 1 TECHNOLOGY-TO-MARKET

The goal of this task is to develop the business internal rate of return (IRR) cost model for purposes of building and evaluating near-term critical business opportunities associated with the technology. This will include preliminary project development and planning including interface requirements for the baseline site business launch opportunity, and refine business model including identifying key roles for Hyperlight in the value chain and key partnerships to be developed.

The Recipient shall:

- Prepare and provide a *Technology to Market Interim Report*, which summarizes the results of the initial IRR modeling and associated site plans required below
- Perform IRR Evaluation
- Develop a Baseline Site Plan
- Develop a Strategic and Business Plan

Products:

- Technology to Market Interim Report (Draft and Final)

EXHIBIT A
Scope of Work

TASK 5 PILOT 1 - BRAWLEY SITE PLANT PROCESS DEVELOPMENT AND EVALUATION
The goal of this task is to validate key cost and target performance metrics critical for ultimately addressing overall target efficiency and cost metrics. This validation will be based on actual development and verification of the production and deployment processes for a standardized Hyperlight CSP Deployable Field Module at the pre-selected pilot site at SDSU's Brawley facility.

Specifically, the following equipment will be installed and processes will be developed, and evaluated for the standard 1-acre field module1) Production, 2) Packaging and Storage, 3) Site Preparation & Pre-Installation, 4) Transport to Deployment Site, 5) Installation of a 1-acre field module, 6) System Integration, 7) On-Site Calibration, and 8) Verification & Checkout Testing. Once this task establishes a 1 acre-module pilot solar field an ongoing 9) Verification and Validation (V&V) of system performance will be performed at the Brawley pilot site in order to develop accumulated statistics of the 1 acre-module performance and validate the Hyperlight 1 acre-module CSP Thermal Energy Generation Model. In this task, a one acre system will be built at Brawley.

The Recipient shall:

- Prepare and provide a *Commissioning Report*, which summarizes the results of the final Brawley system production run, installation, and commissioning, including all the following activities..
-
- Use the extruder line for tube Production
- Establish a process for Product Handling (Packaging, Storage, & Transport)
- Establish an installation method at the site
- Perform Verification and Validation of System Performance
- Perform Process Redesign
- Develop As-Built Plant Model Development
- Participate in CPR and provide a *CPR Report #2* as described in subtask 1.3

Products:

- Commissioning Report (Draft and Final)
- CPR Report #2

TASK 6 PHASE II TECHNOLOGY-TO-MARKET
The goal of this task is to update the business IRR cost model with and without thermal storage for purposes of evaluating critical business opportunities associated with the Hyperlight technology. The collector cost should lead to a cost of thermal energy of $5 to $10 per mmbtu, depending on site and other conditions. At that price point for heat, a geothermal/Hyperlight® hybrid plant could produce electricity at or below 8¢ per kWh.

EXHIBIT A
Scope of Work

The Recipient shall:

- Prepare and provide a *Technology to Market Report*, which summarizes the results of the updated IRR modeling and business development efforts as described below.
-
- Review Site Integration Installation
- Develop a Strategic Plan
- Perform Business Development to aggressively market the output of Task 5 for California's energy auction, hybrid grid scale energy production/storage, and expanding the geothermal market opportunities, including an update to the estimated up-front project cost, which affects the IRR.
- Develop and deliver an Excel-based Project Cost Model

Products:

- Technology to Market Report (Draft and Final)
- Project Cost Model.

TASK 7 PILOT 2 –FIELD DEPLOYMENT PROCESS VALIDATION

The goal of this Task is to apply the learning from Task 5 – specifically: how much cost/effort was needed in construction/commissioning to achieve the performance needed for commercial viability at larger deployments to develop a front end engineering design (FEED) study for a prospective 10-acre deployment. This field deployment process (for one acre) validation will be critical for subsequent larger deployments.

This Task will result in: 1) Site Integration Interface Specifications, 2) Site Preparation Plan, 3) Installation Plan, 4) Post-Installation Check-Out Procedures, 5) Plant Operations Plan.

The Recipient shall:

- Prepare and provide a front end engineering design (FEED) tudy which includes the following elements:.
-
    - 1) Site Integration Interface Specifications,
    - 2) Site Preparation Plan,
    - 3) Installation Plan,
    - 4) Post-Installation Check-Out Procedures,
    - 5) Plant Operations Plan.

Products:

- FEED study (Draft and Final)

TASK 8 Phase 3 Technology-to-Market

The goal of this task is to complete the business IRR cost model with and without thermal storage associated for a modeled geothermal customer site such as a 10-acre geothermal project site. This IRR cost model will include projections for a prospective 10-acre and for prospective 100+ acre expansion and operations at the modeled geothermal customer site which has not been selected. Additionally, IRR projections will be summarized for additional project opportunities outside of the geothermal boost , that have been identified since Task 6.

EXHIBIT A
Scope of Work

The Recipient shall:

- Perform Business Analysis and Development for model geothermal customer site.
- Prepare and provide a *Technology to Market Report*, which outlines the best path to market for the subject technology.

Products:

- Technology to Market Report (Draft and Final)

TASK 9 EVALUATION OF PROJECT BENEFITS TO CALIFORNIA IOU ELECTRIC RATEPAYERS

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.

o 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
- Performance Summary Report (Draft and Final).

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

References:

Investigating a Higher Renewables Portfolio Standard in California. Energy and Environmental Economics, Inc. (E3 Report), San Francisco, CA. 2014.

RESOLUTION NO: 16-1019-8

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: HYPERLIGHT ENERGY

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

RESOLVED, that the Energy Commission approves Agreement EPC-16-016 with Hyperlight Energy for a $750,000 grant to develop a low cost Concentrated Solar Power (CSP) collector that will lead to significant cost reductions for solar fields. These EPIC funds will be used as cost share funding for the recipient's federally-funded project; 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 October 19, 2016.

AYE: [List of Commissioners]
NAY: [List of Commissioners]
ABSENT: [List of Commissioners]
ABSTAIN: [List of Commissioners]

Cody Goldthrite,
Secretariat