



GRANT REQUEST FORM (GRF)

A) New Agreement # EPC-20-021 (to be completed by CGL office)

B) Division	Agreement Manager:	MS-	Phone
ERDD	Kevin Mori	51	916-327-1475

C) Recipient's Legal Name	Federal ID Number
The Regents of the University of California, on behalf of the San Diego campus	95-6006144

D) Title of Project
LEED: A Lightwave Energy-Efficient Datacenter Phase 2

E) Term and Amount

Start Date	End Date	Amount
3/1/2021	03/29/2024	\$ 425,000

F) Business Meeting Information

ARFVTP agreements \$75K and under delegated to Executive Director
 Proposed Business Meeting Date 4/14/2021 Consent Discussion
 Business Meeting Presenter Kevin Mori 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, SAN DIEGO. Proposed resolution approving agreement EPC-20-021 with The Regents of the University of California, San Diego for a \$425,000 federal cost share grant to continue development of optical switches which have the potential to double the energy efficiency of data centers by increasing data processing efficiency and reducing cooling energy requirements, "and adopting staff's determination that this action is exempt from CEQA".
 (EPIC funding) Contact: Kevin Mori.

G) California Environmental Quality Act (CEQA) Compliance

- Is Agreement considered a "Project" under CEQA?
 - Yes (skip to question 2)
 - No (complete the following (PRC 21065 and 14 CCR 15378)):
 Explain why Agreement is not considered a "Project":
- If Agreement is considered a "Project" under CEQA:
 - a) Agreement **IS** exempt.
 - Statutory Exemption. List PRC and/or CCR section number:
 - Categorical Exemption. List CCR section number: Cal. Code Regs., tit. 14, § 15306
 - Common Sense Exemption. 14 CCR 15061 (b) (3)
 Explain reason why Agreement is exempt under the above section: Cal. Code Regs., tit. 14, sect. 15306 provides that projects which consist of basic data collection, research, experimental management, and resource evaluation



GRANT REQUEST FORM (GRF)

activities, and which do not result in a serious or major disturbance to an environmental resource are categorically exempt from the provisions of the California Environmental Quality Act. The second phase of this project will be conducted in a laboratory setting where modification of existing servers at a datacenter with the lightwave technology will occur. The recipient will collect data on the performance. This project will have no significant impact on the environment and falls within section 15306.

- 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
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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	19-20	301.001G	\$425,000

R&D Program Area: EERO: IAW

TOTAL: \$ 425,000

Explanation for "Other" selection

Reimbursement Contract #: Federal Agreement #: DE-AR0000845

K) Recipient's Contact Information

1. Recipient's Administrator/Officer

Name: Mary Mansfield
Address: 9500 Gilman Dr
MC 0934
City, State, Zip: La Jolla, CA 92093-0411
Phone: 858 534-9482
E-Mail: mamansfield@ucsd.edu

2. Recipient's Project Manager

Name: George Papen
Address: 9500 Gilman Dr
MC 0934
City, State, Zip: La Jolla, CA 92093-0411
Phone: 858-822-1728
E-Mail: gpapen@ucsd.edu



STATE OF CALIFORNIA

GRANT REQUEST FORM (GRF)

CEC-270 (Revised 12/2019)

CALIFORNIA ENERGY COMMISSION

L) Selection Process Used

- Competitive Solicitation Solicitation #: PON-14-308
- First Come First Served Solicitation Solicitation #:

M) The following items should be attached to this GRF

- | | | |
|---|---|--|
| 1. Exhibit A, Scope of Work | <input checked="" type="checkbox"/> | Attached |
| 2. Exhibit B, Budget Detail | <input checked="" type="checkbox"/> | Attached |
| 3. CEC 105, Questionnaire for Identifying Conflicts | <input checked="" type="checkbox"/> | Attached |
| 4. Recipient Resolution | <input checked="" type="checkbox"/> N/A | <input type="checkbox"/> Attached |
| 5. CEQA Documentation | <input type="checkbox"/> N/A | <input checked="" type="checkbox"/> Attached |

Kevin Mori
Agreement Manager

2/9/2021
Date

Virginia Lew
Office Manager

2/9/2021
Date

Linda Spiegel
Deputy Director

2/9/2021
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	X	Implementation of Opera Protocol in UCSD Testbed
3		Report BER of New Rotor Switch
4		Evaluation of Project Benefits

B. Acronym/Term List

Acronym/Term	Meaning
BER	Bit Error Rate
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
ENLITENED	ENergy-efficient Lightwave Integrated Technology Enabling Networks that Enhance Datacenters
Gb/s	Gigabits per second
LEED	Lightwave Energy Efficient Datacenter
PTP	Precision Time Protocol
SOPO	Statement Of Program Objectives
UCSD	University of California at San Diego
TAC	Technical Advisory Committee

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

A. Purpose of Agreement and Project

The purpose of this Agreement is to provide Electric Program Investment Charge (EPIC) cost share funding for the Recipient's federally-funded project, which received an award under federal funding opportunity announcement DE-FOA-0001566 ENLITENED. The purpose of this project is to develop optical technology that can double energy efficiency of datacenters.

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.

Exhibit A

Scope of Work

B. Problem/ Solution Statement

Problem

If current trends continue, the energy used in datacenters will be a substantial fraction of the overall energy used in the country. Current datacenters are not energy efficient because the network cannot deliver enough bandwidth to each server, which results in significant energy inefficiencies.

Solution

The Lightwave Energy-Efficient Datacenter (LEED) project will address this issue by developing new datacenter architectures based on optical switching. These technologies can deliver more bandwidth at the same cost as current networks. This increasing bandwidth means that the server can process more information for the same amount of energy leading to a much more efficient datacenter.

C. Goals and Objectives of the Project

Project Goals

The goal of the project is to double the energy efficiency of a datacenter as measured by the amount of energy to do a specific amount of work.

Ratepayer Benefits:² The project will result in the ratepayer benefit of lower cost by increased energy efficiency. To quantify the total energy savings, the total energy consumption in California in 2015 was 196,194 GWh. Approximately, two percent of this number (the amount datacenter currently use) is 3,920 GWh, which is a conservative estimate of the energy used by datacenters. If the energy efficiency of a datacenter is doubled, then the overall energy savings would be about 1,960 GWh. For a natural-gas generation plant running at a 50% capacity factor, this works out to be about 440 MW, which is an average-sized power plant in California. In addition, avoiding the use of natural gas for power generation will result in greenhouse gas emission and other air emission reductions.

Technological Advancement and Breakthroughs:³ 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 increasing the

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 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.

Exhibit A

Scope of Work

energy efficiency of datacenters. The energy-efficiency improvement realized by LEED is based on three key innovations: (1) A partially configurable optical selector switch, which can provide an unparalleled combination of high port count (> 2000), low insertion loss (~ 2dB), and fast switching time approaching 20 μ s, (2) a multichannel LEED architecture, which, for common datacenter traffic patterns, can deliver bandwidths and flow completion times comparable to a fully-provisioned packet-based-network, and (3) novel packaged energy-efficient, LEED-specific photonics.

Project Objectives

- The project objectives for LEED are organized into three technology thrust areas: The first thrust will develop unique energy-efficient and scalable optical circuit-switched architecture that leverages advanced photonic switching and interconnects while overcoming the critical issues of a realistic control plane for a large port-count optical-circuit switched network, a practical link budget for the interconnects, and the scalability of the switch and interconnect technology beyond a 2023 timeframe.
- The second thrust will demonstrate low-loss, scalable, rate-agnostic optical switch technology that enables both the LEED architecture and the development of broadband wavelength-division multiplexing interconnect technology.
- The third thrust will fabricate packaged, scalable, energy-efficient, broadband, Wavelength Demultiplexer (WDM) transmitters and receivers that have sufficient link margin to be used in LEED without optical amplification. The outcome this interconnect development work is a commercially-viable technology path to per-fiber bandwidths that can scale to rates above 1 Tb/s. When combined with the LEED architecture and switch, this path can realize a practical energy-efficient network.

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.

Exhibit A Scope of Work

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

Exhibit A Scope of Work

- 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.

Exhibit A

Scope of Work

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

Exhibit A Scope of Work

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 will notify the CAM and invite him/her to participate (subject to the awarding federal agency's approval), 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.

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.
- Notify the CAM of any project review meetings conducted by the awarding federal agency, and invite the CAM to participate in the

Exhibit A Scope of Work

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)

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 will notify the CAM and invite him/her to participate (subject to the awarding federal agency's approval), 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.

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

Exhibit A Scope of Work

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*.
- 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 (subject to the awarding federal agency's approval).

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

Exhibit A Scope of Work

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

The Recipient shall:

- Submit a monthly *Progress Report* to the CAM. Each progress report must:
 - Summarize all Agreement activities conducted by the Recipient for the preceding month, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. See the Progress Report Format Attachment for the recommended specifications.
 - Provide a synopsis of the project progress, including accomplishments, problems, milestones, products, schedule, fiscal status, and any evidence of progress such as photographs.
 - 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.
- 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
- 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.

Exhibit A Scope of Work

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

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*)

Exhibit A Scope of Work

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.

Exhibit A Scope of Work

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

- Researchers knowledgeable about the project subject matter;
- Members of trades that will apply the results of the project (e.g., designers, engineers, architects, contractors, and trade representatives);
- Public interest market transformation implementers;
- Product developers relevant to the project;
- U.S. Department of Energy research managers, or experts from other federal or state agencies relevant to the project;
- Public interest environmental groups;
- Utility representatives;
- Air district staff; and
- Members of relevant technical society committees.

The Recipient shall:

- Prepare a *List of Potential TAC Members* that includes the names, companies, physical and electronic addresses, and phone numbers of potential members. The list will be discussed at the Kick-off meeting, and a schedule for recruiting members and holding the first TAC meeting will be developed.
- Recruit TAC members. Ensure that each individual understands member obligations and the TAC meeting schedule developed in subtask 1.10.
- 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.

Exhibit A

Scope of Work

The Recipient shall:

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

Products:

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

III. TECHNICAL TASKS

TASK 2 Implementation of Opera Protocol in UCSD Testbed

The goal of this task is demonstrating the Opera protocol, which was developed in Phase 1 of LEED. It is a synchronously-distributed routing protocol that can rapidly forward latency-sensitive traffic during each network configuration and is a key function for optically-switched networks

The Recipient shall:

- Modify the core Corundum code to support Opera by:
 - Developing code that emulates a circuit switch using a packet switch by encapsulating packets based on a network synchronization protocol (PTP) that is currently implanted on Corundum.
 - Implementing a version of the ROTORLB PROTOCOL, which allows the host to indirect “bulk” traffic through another host.
 - Implementing a version of the OPERA PROTOCOL, which supports low-latency traffic in an all-optical network activities sequentially.
- Provide *Circuit Switch Coding* that includes, but is not limited to:
 - The coding used to emulate the circuit switch.
- Provide a *Protocol Summary Report* that includes, but is not limited to:
 - A summary of the ROTORLB PROTOCOL and the OPERA PROTOCOL implemented in during this project.

Exhibit A Scope of Work

- Discussion of the relevance of used protocols and why these protocols were chosen.
- A summary of the issues encountered running the protocols, if any.
- Discussion of adjustments made to the system resulting from protocol findings.
- Prepare a *CPR Report* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR meeting.

Products:

- Circuit Switch Coding
- Protocol Summary Report
- CPR Report

TASK 3 Report BER of New Rotor Switch

The goal of this task is to demonstrate 10^{-9} bit error rate (BER) of the Phase 2 rotor switch at 10 Gb/s and 25 Gb/s.

The Recipient shall:

- Develop and demonstrate Diagnostic Methods that can measure the per connection bit error rate of the optical switches.
- Provide a *Diagnostic Report* that includes, but is not limited to:
 - Discussion of the diagnostic methods and diagnostic results.
 - Summary of bit error rate measurements on the optical switches.
 - Discussion of actual demonstration energy savings and energy efficiencies at 10 Gb/s and 25 Gb/s and from auxiliary electrical equipment, and potential energy savings for California ratepayers.

Products:

- Diagnostic Report (Draft and Final)

TASK 4 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*.

Exhibit A

Scope of Work

- 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.

Exhibit A Scope of Work

- 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

IV. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: THE REGENTS OF THE UNIVERSITY OF CALIFORNIA, ON
BEHALF OF THE SAN DIEGO CAMPUS

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-20-021 with The Regents of the University of California, on behalf of the San Diego campus, for a \$425,000 grant to match a \$5 million federal grant to continue development of optical switches that have the potential to double the energy efficiency of data centers by increasing data processing efficiency and reducing cooling energy requirements; 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 March 17, 2021.

AYE:

NAY:

ABSENT:

ABSTAIN:

Patricia Carlos
Secretariat