California Energy Commission
July 26, 2023 Business Meeting
Backup Materials for Agenda Item No 10c:
Humboldt State University Sponsored Programs Foundation

The following backup materials for the above-referenced agenda item are available in this PDF packet as listed below:

1. Proposed Resolution
2. Grant Request Form
3. Scope of Work

RESOLUTION NO: 23-0726-10c

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION: Humboldt State University Sponsored Programs Foundation

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-23-006 with Humboldt State University Sponsored Programs Foundation for a $2,000,000 grant to develop an environmental monitoring sensor package.The monitoring sensor package will be able to detect debris entanglements with underwater mooring lines, transmit relevant information about the location of the entanglement, and deploy a remotely operated vehicle to inspect, identify, and characterize entangled debris; and

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

CERTIFICATION

The undersigned Secretariat to the CEC does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the CEC held on July 26, 2023.

AYE:
NAY:
ABSENT:
ABSTAIN:

Dated:

_____
Kristine Banaag
Secretariat

STATE OF CALIFORNIA
CALIFORNIA ENERGY COMMISSION

CEC-270 (Revised 9/2022)

GRANT REQUEST FORM (GRF)

A. New Agreement Number

IMPORTANT: New Agreement # to be completed by Contracts, Grants, and Loans Office.

New Agreement Number: EPC-23-006

B. Division Information

1. Division Name: ERDD
2. Agreement Manager: Michelle Slocombe
3. MS-: 51
4. Phone Number: 916-776-0745

C. Recipient's Information

1. Recipient's Legal Name: Humboldt State University Sponsored Programs Foundation
2. Federal ID Number: 94-6050071

D. Title of Project

Title of project: Integrated Monitoring Approach to Reduce Entanglement Hazards for Floating Offshore Wind Developments

E. Term and Amount

1. Start Date: 8/1/2023
2. End Date: 3/31/2027
3. Amount: $2,000,000.00

F. Business Meeting Information

1. Are the ARFVTP agreements $75K and under delegated to Executive Director? No
2. The Proposed Business Meeting Date: 7/12/2023 .
3. Consent or Discussion? Discussion
4. Business Meeting Presenter Name: Mark Danielson
5. Time Needed for Business Meeting: 5 minutes.
6. The email subscription topic is: EPIC (Electric Program Investment Charge).

Agenda Item Subject and Description:

Humboldt State University Sponsored Programs Foundation. Proposed resolution approving agreement EPC-23-006 with Humboldt State University Sponsored Programs Foundation for a $2,000,000 grant to develop an environmental monitoring sensor package, and adopting staff's determination that this action is exempt from CEQA. The monitoring sensor package will be able to detect debris entanglements with underwater mooring lines, transmit relevant information about the location of the entanglement, and deploy a remotely operated vehicle to inspect, identify, and characterize entangled debris. (EPIC funding) Contact: Mark Danielson

G. California Environmental Quality Act (CEQA) Compliance

1. **Is Agreement considered a "Project" under CEQA?**
   Yes

If yes, skip to question 2.

If no, complete the following (PRC 21065 and 14 CCR 15378) and 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 answer the following questions.

a) Agreement **IS** exempt?

Yes

Statutory Exemption?
No

If yes, list PRC and/or CCR section number(s) and separate each with a comma. If no, enter "None" and go to the next question.

PRC section number: None

CCR section number: None

Categorical Exemption?
Yes

If yes, list CCR section number(s) and separate each with a comma. If no, enter "None" and go to the next question.

CCR section number: California Code of Regulations, title 14 section 15301 and California Code of Regulations, title 14 section 15306.

California Code of Regulations, title 14 section 15301 provides that the operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing public or private structures, facilities, mechanical equipment, or topographical features, involving negligible or no expansion of existing or former use is categorically exempt from CEQA. This project will involve research on environmental monitoring sensors to detect debris entanglements with underwater mooring lines done at existing locations and facilities. There will be negligible to no expansion of the existing use of the facilities. For these reasons, the project will not have a significant effect on the environment and the project is categorically exempt under California Code of Regulations, title 14 section 15301.

Cal. Code Regs., tit. 14, sect. 15306 consists of basic data collection, research, experimental management, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource. This project involves research on environmental monitoring sensors to detect debris entanglements with underwater mooring lines done at existing locations and existing laboratory facilities. There will be negligible to no expansion of the existing use of the facilities. For these reasons, the proposed project will have no significant effect on the environment and is categorically exempt under section 15306.

This project does not involve impacts on any particularly sensitive environment; does not involve any cumulative impacts of successive projects of the same type in the

same place that might be considered significant; does not involve unusual circumstances that might have a significant effect on the environment; will not result in damage to scenic resources within a highway officially designated as a state scenic highway; the project site is not included on any list compiled pursuant to Government Code section 65962.5; and the project will not cause a substantial adverse change in the significance of a historical resource. Therefore, none of the exceptions to categorical exemptions listed in CEQA Guidelines section 15300.2 apply to this project and this project will not have a significant effect on the environment.

Common Sense Exemption? 14 CCR 15061 (b) (3)
No

If yes, explain reason why Agreement is exempt under the above section. If no, enter "Not applicable" and go to the next section.

This project will involve research on environmental monitoring sensors to detect debris entanglements with underwater mooring lines done at existing locations and facilities. There will be negligible to no expansion of the existing use of the facilities. For these reasons, the project will not have a significant effect on the environment and the project is categorically exempt under California Code of Regulations, title 14 section 15301.

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

No

If yes, answer yes or no to all that applies. If no, list all as "no" and "None" as "yes".

Additional Documents	Applies
Initial Study	No
Negative Declaration	No
Mitigated Negative Declaration	No
Environmental Impact Report	No
Statement of Overriding Considerations	No
None	Yes

H. Subcontractors

List all Subcontractors listed in the Budget (s) (major and minor). Insert additional rows if needed. If no subcontractors to report, enter "No subcontractors to report" and "0" to funds. **Delete** any unused rows from the table.

Subcontractor Legal Company Name	CEC Funds	Match Funds
Pacific Northwest National Laboratory (United States Department of Energy)	$ 250,000	**$**0
Marine Applied Research and Exploration	$ 600,000	**$**155,600

Subcontractor Legal Company Name	CEC Funds	Match Funds
Triple HS, Inc. DBA H. T. Harvey & Associates	$ 80,673	$16,158
American Bureau of Shipping	$ 50,075	$12,526
Principle Power, Inc.	$ 45,000	$5,000

I. Vendors and Sellers for Equipment and Materials/Miscellaneous

List all Vendors and Sellers listed in Budget(s) for Equipment and Materials/Miscellaneous. Insert additional rows if needed. If no vendors or sellers to report, enter "No vendors or sellers to report" and "0" to funds. **Delete** any unused rows from the table.

Vendor/Seller Legal Company Name	CEC Funds	Match Funds
Cal Poly Humboldt	**$3,727.00**	**$0.00**
Orcina	**$14,105.00**	**$0.00**
Logic Software	**$2,710.00**	**$0.00**

J. Key Partners

List all key partner(s). Insert additional rows if needed. If no key partners to report, enter "No key partners to report." **Delete** any unused rows from the table.

Key Partner Legal Company Name
No key partners to report

K. Budget Information

Include all budget information. Insert additional rows if needed. If no budget information to report, enter "N/A" for "Not Applicable" and "0" to Amount. **Delete** any unused rows from the table.

Funding Source	Funding Year of Appropriation	Budget List Number	Amount
EPIC	21-22	301.001I	$ 2,000,000

TOTAL Amount: $ 2,000,000

R&D Program Area: EGRB: Renewables

Explanation for "Other" selection Not applicable

Reimbursement Contract #: Not applicable

Federal Agreement #: Not applicable

L. Recipient's Contact Information

1. Recipient's Administrator/Officer

Name: Anthony Johnson

Address: 1 HARPST ST

City, State, Zip: ARCATA, CA 95521-8222

Phone: 707-826-5164

E-Mail: Anthony.Johnson@humboldt.edu

3. Recipient's Project Manager

Name: Greyson Adams

Address: 1 HARPST ST

City, State, Zip: ARCATA, CA 95521-8222

Phone: 707-826-4345

E-Mail: gsa58@humboldt.edu

M. Selection Process Used

There are three types of selection process. List the one used for this GRF.

Selection Process	Additional Information
Competitive Solicitation #	GFO-22-401
First Come First Served Solicitation #	Not applicable
Other	Not applicable

N. Attached Items

1. List all items that should be attached to this GRF by entering "Yes" or "No".

Item Number	Item Name	Attached
1	Exhibit A, Scope of Work/Schedule	Yes
2	Exhibit B, Budget Detail	Yes
3	CEC 105, Questionnaire for Identifying Conflicts	Yes
4	Recipient Resolution	No
5	Awardee CEQA Documentation	No

Approved By

Individuals who approve this form must enter their full name and approval date in the MS Word version.

Agreement Manager: Michelle Slocombe

Approval Date: 6/1/2023

Branch Manager: Kevin Uy

Approval Date: 6/2/2023

Director: Delegated to Branch Manager

Approval Date: 6/2/2023

Exhibit A
Scope of Work
Humboldt State University Sponsored Programs Foundation

TASK ACRONYM/TERM LISTS

A. Task List

Task #		Task Name
1		General Project Tasks
2	X	Modeling and Simulation of Entanglements & Development of Detection Algorithm
3		Sensor Package
4	X	Monitoring Package with ROV
5		System Integration and Technology Verification
6		Evaluation of Project Benefits
7		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
CPR	Critical Project Review
CSU	California State University
DSpace	Humboldt Digital Scholar
EPIC	Electric Program Investment Charge
FOSW	Floating Offshore Wind
MS	Microsoft
MoorSEA	Mooring Sensors for Environmental Awareness[2] .
Recipient	Humboldt State University Sponsored Programs Foundation
ROV	Remotely Operated Vehicle
SQL	Structured Query Language
TAC	Technical Advisory Committee

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

A. Purpose of Agreement

The purpose of this Agreement is to develop an environmental monitoring sensor package that will be able to detect debris entanglements with underwater mooring lines, transmit relevant information about the location of the entanglement to the surface, and deploy a remotely operated vehicle (ROV) to inspect, identify, and characterize entangled debris. This novel

[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.

[2] This is the proposed integrated system capable of remotely monitoring FOSW mooring lines for collision and entanglement hazards, identifying entanglements, and deploying a remotely operated vehicle (ROV) to visually inspect and mitigate entanglement hazards.

technology could play a critical role in monitoring and protection activities for marine species and help developers and wildlife protection agencies better understand and mitigate the impacts of floating offshore wind (FOSW) developments deployed at utility scale.

B. Problem/ Solution Statement

Problem

FOSW development along the Pacific Coast will utilize hundreds of mooring lines throughout the water column. These mooring lines create obstructions that pose a possible entanglement or collision hazard to marine life. Potential FOSW energy development areas in northern and central California overlap with known habitats of marine mammals, sea turtles, and seabirds, which are at risk of entanglement with floating cables or entangled debris. Crucial knowledge gaps exist with respect to potential threats to wildlife and ecological communities from FOSW developments. A significant risk to marine life is believed to come from secondary entanglement with ocean debris, which occurs when debris, such as lost fishing gear, becomes entangled on a mooring line. Entangled gear creates a greater hazard to marine life than the mooring line alone due to the potential for buoys and other floating infrastructure to function as an attracting device for fish and other marine life. This attraction in turn increases the likelihood of marine life occupying areas in the water column close to mooring lines, leading to an increase in the chance of becoming entangled by webbing, nets, and knots or other derelict debris or fishing gear wrapped on mooring lines.

Sufficiently responsive environmental monitoring technology has not been developed to address entanglement hazards because this is a novel risk for FOSW that is not prevalent at the same scale in other marine industries. Since the problem of hundreds of deployed mooring lines in close proximity has not been encountered in other marine activities, regulators have not required any technological solution for monitoring, let alone mitigation. This problem must be addressed, as state and federal agencies will soon be considering permit applications for FOSW and may require a method to monitor, if not mitigate, the risk for marine life entanglement. Without any technology available to serve this need offshore wind projects may be denied, delayed, or litigated against, which will ultimately slow the deployment of clean, renewable energy to meet California state goals.

Solution

This project will develop an integrated system of technologies to monitor and identify entanglement risks to marine life. The proposed project will develop sensors that can be integrated into underwater cables and detect when ocean debris is entangled, or an animal has collided with the cable. Once a collision or entanglement is detected, the sensor will be able to transmit this information to a surface station, which would notify a human operator to trigger the deployment of a ROV to visually inspect the location if certain detection parameters are met. A human operator will decide how to mitigate the problem, including immediately relaying information to relevant regulators or wind farm operators. If an injured or entangled animal is identified, the operator can immediately notify regulatory agency personnel. The system will be designed to scale to future capabilities, including direct mitigation involving debris removal by remote operators.

Dedicated, direct entanglement monitoring techniques have not yet been developed, deployed, and verified within the FOSW industry to mitigate entanglement risk, but other monitoring techniques have been employed, including marine mammal acoustic monitoring and cable health

and integrity monitoring.[3,4] The proposed Mooring Sensors for Environmental Awareness — (MoorSEA) would enable direct measurement of entanglement risk, thus overcoming the disadvantages of acoustic and visual marine mammal monitoring that are limited to the detection of vocalizing marine mammals or require optimal oceanographic conditions, respectively. The proposed MoorSEA system will be able to identify collision or entanglement with underwater mooring lines. By shifting the focus from detection of marine life to monitoring mechanical equipment, the proposed technique will not only monitor for marine mammal entanglement but will actively reduce the risk to marine life by assessing and monitoring entanglement hazards while monitoring the status and integrity of floating infrastructure and assets.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Advance environmental monitoring technologies for FOSW by developing a specialized system of integrated monitoring technologies that can detect debris entanglements with underwater mooring lines, send relevant information about entanglement locations to the surface, and subsequently deploy a human operated ROV to inspect possible entanglements.
- Develop a detection algorithm and simulation model capable of assessing and detecting physical inputs from mooring lines impacted by possible obstructions, perturbations, or entanglements specific to FOSW platforms, thereby protecting the diverse ecological communities potentially impacted by FOSW development and associated entanglements.
- Develop a mooring line sensor package, informed by the detection algorithm and capable of withstanding adverse ocean conditions (e.g., foul weather, significant water depth, cold temperatures), to detect collisions and entanglements with marine life or ocean debris. The sensor package, upon detecting inputs or signals associated with potential entanglement, would be capable of communicating to a human operator or other signal receptor, ultimately with the intent of independently deploying an ROV System.
- Develop a single ROV system capable of receiving input from the proposed sensor package and investigating site-specific entanglement risks. The ROV system will be capable of visually inspecting the perceived entanglement threat and relaying findings to a human operator, who can then notify wildlife agencies or begin planning entanglement mitigation efforts.

Ratepayer Benefits:[5] This Agreement will result in the ratepayer benefits of lower cost and increased safety as described below:

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[3]. Aqdam, H.R., Ettefagh, M.M. and Hassannejad, R., 2018. Health monitoring of mooring lines in floating structures using artificial neural networks. *Ocean Engineering, 164*, pp.284-297.

[4]. Pham, H.D., Schoefs, F., Cartraud, P., Soulard, T., Pham, H.H. and Berhault, C., 2019. Methodology for modeling and service life monitoring of mooring lines of floating wind turbines. *Ocean Engineering, 193*, p.106603.

[5]. California Public Resources Code, Section 25711.5(a) requires projects funded by the Electric Program Investment Charge (EPIC) to result in ratepayer benefits. The California Public Utilities Commission, which established the EPIC in 2011, defines ratepayer benefits as (1) improving safety, (2) increasing reliability, (3) increasing affordability, (4) improving environmental sustainability, and (5) improving equity.

- Improve Environmental Sustainability
    - The innovative monitoring tool would reduce the overall environmental impacts of California's electric system, including land and water use, by reducing wildlife collisions and marine debris entanglements.
- Lower costs
    - Alternative approaches to entanglement monitoring would require greater at-sea operations for inspection and removal with human-operated vessels and dive teams. Continuous monitoring is infeasible with human operators due to weather conditions, but even modest levels of human observation would result in significantly higher costs due to vessel rates and crew time.
    - The value of reduced risk of injury or mortality to marine life cannot be easily calculated as an indirect benefit to ratepayers. We expect that the value of reducing entanglement risk is significant, especially for cetaceans that may be migrating through or near offshore wind farms.
    - Efficient and effective environmental monitoring tools will enable faster development and deployment in the nascent FOSW industry by helping to address regulatory and permitting concerns as well as scale-up possibilities. All of these factors may work in concert to support decarbonization goals via the transition to utility scale renewable (non-fossil fuel based) energy systems.
- Increased safety
    - Developing an automated monitoring system of technologies that can be operated independently, theoretically by an onshore individual. This greatly reduces the risk of human health and safety concerns associated with at-sea vessel operations and diving. The proposed technology could operate in a wider range of weather scenarios without posing a safety risk to crews during transport or offshore operations.
    - The proposed system will increase safety for marine wildlife. Currently, the technology does not exist to actively monitor or identify wildlife risk posed by entanglements.

Technological Advancement and Breakthroughs:[6] This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by developing a technology that is expected to support the evaluation of environmental impacts from FOSW and allow the state to work towards the 2-5 GW goals for offshore wind development by 2030 and 25 GW by 2045. Enhanced safety through environmental monitoring of floating assets will help to enhance development and deployment opportunities for FOSW developers, while addressing environmental and regulatory concerns related to entanglement, which may in turn lead to opportunities for additional technological advancement and efficiency within the broader renewable energy field.

Agreement Objectives

The objectives of this Agreement are to:

(See CPUC Decision 21-11-028 at Appendix A, November 18, 2021, https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M425/K515/425515575.PDF).

[6]. California Public Resources Code, section 25711.5(a) also requires EPIC-funded projects to "lead to technological advancement and breakthroughs to overcome the barriers that prevent the achievement of the state's statutory and energy goals..."

- Gather environmental data to develop a mooring simulation to understand mechanical response of cables following collision or entanglement. Aim to model up to 6 scenarios with a high degree of accuracy.
- Using mooring simulation outputs, develop a detection algorithm that can accurately detect entanglements.
- Informed by the detection algorithm, develop and test a mooring line sensor package with electrical and software components to sense stress and vibration along a mooring line.
- Establish a communication protocol for system integration . The integrated system will detect potential entanglements or debris impacts and notify and dispatch an inspection ROV to areas of identified risk (entanglement or debris impacts) along the mooring line. Visual inspection by the ROV will confirm sensor package outputs.
- Develop an ROV capable of deployment in a laboratory setting for purposes of visual inspection and assessment of mooring lines and entangled gear.
- Demonstrate that the system can identify different types of cable interactions and alert a human operator, who could then decide to deploy an ROV for inspection.
- Provide new technology verification through third-party qualification.

II. TASK 1 GENERAL PROJECT TASKS

PRODUCTS

Subtask 1.1 Products

The goal of this subtask is to establish the requirements for submitting project products (e.g., reports, summaries, plans, and presentation materials). Unless otherwise specified by the Commission Agreement Manager (CAM), the Recipient must deliver products as required below by the dates listed in the **Project Schedule (Part V).** All products submitted which will be viewed by the public, must comply with the accessibility requirements of Section 508 of the federal Rehabilitation Act of 1973, as amended (29 U.S.C. Sec. 794d), and regulations implementing that act as set forth in Part 1194 of Title 36 of the Federal Code of Regulations**.** All technical tasks should include product(s). 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, including the Final Report Outline and Final Report

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

For products that require a final version only

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

For all products

- Submit all data and documents required as products in accordance with the following:

Instructions for Submitting Electronic Files and Developing Software:

- **Electronic File Format**
  - Submit all data and documents required as products under this Agreement in an electronic file format that is fully editable and compatible with the California Energy Commission's (CEC) 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.

  The following describes the accepted formats for electronic data and documents provided to the CEC 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.
  - Project management documents will be in MS 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:
  - MS ASP.NET framework (version 3.5 and up). Recommend 4.0.
  - MS Internet Information Services , (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.
  - Structured Query Language (SQL) .
  - MS SQL Server 2008, Stored Procedures. Recommend 2008 R2.
  - MS 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 CEC's Information Technology Services Branch to determine whether the exceptions are allowable.

MEETINGS

Subtask 1.2 Kick-off Meeting

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

The Recipient shall:

- Attend a "Kick-off" meeting with the CAM, the Commission Agreement Officer (CAO), and any other CEC 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;
  - Invoicing and auditing procedures;
  - Administrative products (subtask 1.1);
  - Critical Project Review (CPR) meetings (subtask 1.3);
  - Match fund documentation (subtask 1.7);
  - Permit documentation (subtask 1.8);
  - Subcontracts (subtask 1.9); and
  - Any other relevant topics.

  The technical portion of the meeting will include discussion of the following:
  - The CAM's expectations for accomplishing tasks described in the Scope of Work;
  - An updated Project Schedule;
  - Technical products (subtask 1.1);
  - Progress reports (subtask 1.5);
  - Final Report (subtask 1.6);
  - Technical Advisory Committee (TAC) meetings (subtasks 1.10 and 1.11); and
  - Any other relevant topics.

- Provide *Kick-off Meeting Presentation* to include but not limited to:
  - Project overview (i.e. project description, goals and objectives, technical tasks, expected benefits, etc.)
  - Project schedule that identifies milestones
  - List of potential risk factors and hurdles, and mitigation strategy

- Provide an *Updated Project Schedule, Match Funds Status Letter,* and *Permit Status Letter*, 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:

- Kick-off Meeting Presentation
- Updated Project Schedule *(if applicable)*
- Match Funds Status Letter (subtask 1.7) *(if applicable)*
- Permit Status Letter (subtask 1.8) *(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 CEC 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 CEC 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 CEC.

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 CEC, but they may take place at another location, or may be conducted via electronic conferencing (e.g., WebEx) as determined by the CAM.

The Recipient shall:

- Prepare and submit a *CPR Report* for each CPR meeting that: (1) discusses the progress of the Agreement toward achieving its goals and objectives; and (2) includes recommendations and conclusions regarding continued work on the project.
- Attend the CPR meeting.
- Present the CPR Report and any other required information at each CPR meeting.

The CAM shall:

- Determine the location, date, and time of each CPR meeting with the Recipient's input.
- Send the Recipient a *CPR Agenda* with a list of expected CPR participants in advance of the CPR meeting. If applicable, the agenda will include a discussion of match funding and permits.
- Conduct and make a record of each CPR meeting. Provide the Recipient with a schedule for providing a Progress Determination on continuation of the project.
- Determine whether to continue the project, and if so whether modifications are needed to the tasks, schedule, products, or budget for the remainder of the Agreement. If the CAM concludes that satisfactory progress is not being made, this conclusion will be referred to the Deputy Director of the Energy Research and Development Division.
- Provide the Recipient with a *Progress Determination* on continuation of the project, in accordance with the schedule. The Progress Determination may include a requirement that the Recipient revise one or more products.

Recipient Products:

- CPR Report(s)

CAM Products:

- CPR Agenda(s)

- Progress Determination

Subtask 1.4 Final Meeting
The goal of this subtask is to complete the closeout of this Agreement.

The Recipient shall:
- Meet with CEC 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 procured equipment.
    - The CEC'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 CEC staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide copies of *All Final Products* on a USB memory stick, organized by the tasks in the Agreement.

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

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices
The goals of this subtask are to: (1) periodically verify that satisfactory and continued progress is made towards achieving the project objectives of this Agreement; and (2) ensure that invoices contain all required information and are submitted in the appropriate format.

The Recipient shall:
- Submit a quarterly *Progress Report* to the CAM. Each progress report must:
  - Summarize progress made on all Agreement activities as specified in the scope of work for the preceding month, including accomplishments, problems, milestones, products, schedule, fiscal status, and an assessment of the ability to complete the Agreement within the current budget and any anticipated cost

overruns. See the Progress Report Format Attachment for the recommended specifications.

- Engage in monthly check-in calls with the CAM to discuss, at a minimum:
  - Progress made on all Agreement activities as specified in the Scope of Work for the preceding month, including summaries of accomplishments, problems, milestones, products, schedule, fiscal status, and an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the "Payment of Funds" section of the terms and conditions, including a financial report on Match Funds and in-state expenditures.

Products:

- Progress Reports
- Invoices

Subtask 1.6 Final Report

The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. When creating the Final Report Outline and the Final Report, the Recipient must use the CEC Style Manual provided by the CAM.

Subtask 1.6.1 Final Report Outline

The Recipient shall:

- Prepare a *Final Report Outline* in accordance with the *CEC Style Manual* provided by the CAM.

Recipient Products:

- Final Report Outline (draft and final)

CAM Product:

- CEC Style Manual
- Comments on Draft Final Report Outline
- Acceptance of Final Report Outline

Subtask 1.6.2 Final Report

The Recipient shall:

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline, CEC Style Manual, and Final Report Template provided by the CAM with the following considerations:
  - Ensure that the report includes the following items, in the following order:
    - Cover page (**required**)
    - Credits page on the reverse side of cover with legal disclaimer (**required**)
    - Acknowledgements page (optional)
    - Preface (**required**)
    - Abstract, keywords, and citation page (**required**)

  - Table of Contents (**required**, followed by List of Figures and List of Tables, if needed)
  - Executive summary (**required**)
  - Body of the report (**required**)
  - References (if applicable)
  - Glossary/Acronyms (If more than 10 acronyms or abbreviations are used, it is required.)
  - Bibliography (if applicable)
  - Appendices (if applicable) (Create a separate volume if very large.)
  - Attachments (if applicable)
- Submit a draft of the Executive Summary to the TAC for review and comment.
- Develop and submit a *Summary of TAC Comments on Draft Final Report* received on the Executive Summary. For each comment received, the R ecipient will identify in the summary the following:
  - Comments the R ecipient proposes to incorporate.
  - Comments the R ecipient does propose to incorporate and an explanation for why.
- Submit a draft of the report to the CAM for review and comment. The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt.
- Incorporate all CAM comments into the *Final Report*. If the Recipient disagrees with any comment, provide a *Written Responses to Comments* explaining why the comments were not incorporated into the final product.
- Submit the revised *Final Report* electronically with any Written Responses to Comments within 10 days of receipt of CAM's Written Comments on the Draft Final Report, unless the CAM specifies a longer time period or approves a request for additional time.

Products:
- Summary of TAC Comments on Draft Final Report
- Draft Final Report
- Written Responses to Comments *(if applicable)*
- Final Report

CAM Product:
- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds

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

While the costs to obtain and document match funds are not reimbursable under this Agreement, the Recipient may spend match funds for this task. The Recipient may only spend match funds during the Agreement term, either concurrently or prior to the use of CEC funds. Match funds must be identified in writing, and the Recipient must obtain any associated commitments before incurring any costs for which the Recipient will request reimbursement.

The Recipient shall:
- Prepare a *Match Funds Status Letter* that documents the match funds committed to this Agreement. If no match funds were part of the proposal that led to the CEC awarding this Agreement and none have been identified at the time this Agreement starts, then

state this in the letter.

If match funds were a part of the proposal that led to the CEC awarding this Agreement, then provide in the letter:

- A list of the match funds that identifies:
  - The amount of cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
  - The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the source (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient must identify its owner and provide a contact name, address, telephone number, and the address where the property is located.
  - If different from the solicitation application, provide a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.

- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide a *Supplemental Match Funds Notification Letter* to the CAM of receipt of additional match funds.
- Provide a *Match Funds Reduction Notification Letter* to the CAM if existing match funds are reduced during the course of the Agreement. Reduction of match funds may trigger a CPR meeting.

Products:

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

Subtask 1.8 Permits

The goal of this subtask is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track. Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement, with the exception of costs incurred by University of California recipients. Permits must be identified and obtained before the Recipient may incur any costs related to the use of the permit(s) for which the Recipient will request reimbursement.

The Recipient shall:

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

The list of permits and the schedule for obtaining them will be discussed at the Kick-off meeting (subtask 1.2), and a timetable for submitting the updated list, schedule, and copies of the permits will be developed. The impact on the project if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in progress reports and will be a topic at CPR meetings.

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

Products:

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

Subtask 1.9 Subcontracts

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

The Recipient shall:

- Manage and coordinate subcontractor activities in accordance with the requirements of this Agreement.
- Incorporate this Agreement by reference into each subcontract.
- Include any required CEC 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 each 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, and final)*

TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee

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

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

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

The Recipient shall:

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

Products:

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

Subtask 1.11 TAC Meetings
The goal of this subtask is for the TAC to provide strategic guidance for the project by participating in regular meetings, which may be held via teleconference.

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

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

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

Subtask 1.12 Project Performance Metrics
The goal of this subtask is to finalize key performance targets for the project based on feedback from the TAC and report on final results in achieving those targets. The performance targets should be a combination of scientific, engineering, techno-economic, and/or programmatic metrics that provide the most significant indicator of the research or technology's potential success.

The Recipient shall:

- Complete and submit the project performance metrics section of the *Initial Project Benefits Questionnaire*, developed in the Evaluation of Project Benefits task, to the CAM.
- Present the draft project performance metrics at the first TAC meeting to solicit input and comments from the TAC members.
- Develop and submit a *TAC Performance Metrics Summary* that summarizes comments received from the TAC members on the proposed project performance metrics. The *TAC Performance Metrics Summary* will identify:
    - TAC comments the Recipient proposes to incorporate into the *Initial Project Benefits Questionnaire*, developed in the Evaluation of Project Benefits task.
    - TAC comments the Recipient does not propose to incorporate with an explanation why.
- Develop and submit a *Project Performance Metrics Results* document describing the extent to which the Recipient met each of the performance metrics in the *Final Project Benefits Questionnaire*, developed in the Evaluation of Project Benefits task.
- Discuss the *Project Performance Metrics Results* at the Final Meeting.

Products:

- TAC Performance Metrics Summary
- Project Performance Metrics Results

TECHNICAL TASKS

TASK 2 MODELING AND SIMULATION OF ENTANGLEMENTS & DEVELOPMENT OF DETECTION ALGORITHM

The goal of Task 2 is to develop a simulation model that utilizes pre-existing environmental, oceanographic and physical input data to characterize the underwater interactions of mooring lines with wildlife and ocean debris. The computer simulation will predict the mechanical response of the cable for different types of wildlife collisions and ocean debris entanglements. Output from the simulation will be used to develop a detection algorithm that can use measurements from a mooring cable to identify interactions and entanglements.

Subtask 2.1 –Environmental Data

The goal of this subtask is to gather the input data for the mooring simulation, including but not limited to physical, physiological, technical, and oceanographic data. Data storage and dissemination will occur per the Data Management Plan, **Section V.**, below.

The Recipient shall:

- Gather data that describe the physical parameters of ocean debris that could become entangled in a subsea cable.
- Gather physiological parameters for key, representative wildlife understood to inhabit the project areas (Morro Bay and Humboldt Offshore Wind lease areas) and may have enhanced risk for entanglement with mooring lines.
- Gather technical data on mooring systems and turbine platforms that are needed to develop a mooring simulation.
- Gather representative oceanographic data for calm, moderate, and high sea states that will be used in the mooring simulation.

- Develop a *Technical Approach and Program Scope Memo* to record and convey a high-level summary of the proposed technical approach and scope at the project outset.
- Develop a brief *Environmental Data Memo* to record and convey a high-level summary of the technical approach for gathering environmental input data, as well as task accomplishments to this point. The Environmental Data memo will contribute to Detection Algorithm Technical Memo (2.3), below.

Products:
- Technical Approach and Program Scope Memo
- Environmental Data Memo

Subtask 2.2 – Mooring Line Simulation
The goal of this subtask is to conduct a mooring line simulation that models the vibration and strain of a mooring line in response to a collision or entanglement with ocean debris or wildlife. The simulation will be conducted for a representative selection of ocean debris entanglement and wildlife collisions. The response of the cable will be modeled in multiple sea state conditions.
The Recipient shall:
- Develop a mooring line simulation model that characterizes a mooring line response to a collision or entanglement with ocean debris or wildlife.
- Conduct a mooring line simulation using the information collected under Subtask 2.1.
- Analyze the results of the simulation to determine the required range, sensitivity, type and location of sensors to be installed along a mooring line.
- Develop a brief *Mooring Line Simulation Memo* to record and convey a high-level summary of project accomplishments to this point. Mooring Line Simulation memo will contribute to Detection Algorithm Technical Memo (2.3), below.
- Inputs to the mooring line simulations are expected to include:
    - The geometry and configuration of the floating platform, the mooring cables, and their connections
    - The local water depth, the seabed characteristics, and the type of the connection of the mooring lines with the seabed
    - The subsurface current speed and direction
    - The sea-state wave conditions
    - The wind speed and direction at the turbine height
    - The location, shape, type, and movements of the entanglement
    - Other environmental conditions such as temperature, salinity, etc.

Products:
- Mooring Line Simulation Memo

Subtask 2.3 – Detection Algorithm
The goal of this subtask is to develop a detection algorithm to use the response of mooring line sensors to trigger a warning that an entanglement or collision has occurred on the mooring line.
The Recipient shall:
- Develop a detection algorithm that can be implemented in real time to identify when and where collisions and entanglements occur on a mooring line.
- Evaluate the performance of the detection algorithm by applying it to the mooring line simulation results from Subtask 2.2.

- Refine the detection algorithm to successfully identify encounters of the highest risk.
- Prepare and submit a *Detection Algorithm Technical Memo* which describes the development and functionality of the detection algorithm. The technical memo will include discussion on input parameters for the mooring simulation, modeling of conditions, and results and findings of the mooring simulations.

The simulations will solve the multi-physics governing equations related to hydrodynamics, cable dynamics, aerodynamics, contact dynamics, and environmental interactions (including aquatic animals) involved in the problem and will provide the following outputs:

- The motions/vibrations at any point (sensor location) on the floating platform
- The displacements/vibrations at any point (sensor location) along any of the cables
- The strains/loads at any point (sensor location) along any of the cables

Products:

- Detection Algorithm Technical Memo

Subtask 2.4 – Design Criteria

The goal of this subtask is to develop design criteria for the sensor system using the results from the mooring simulation and application of the detection algorithm. The design criteria will specify the sensor type, sensitivity, detection range, location, and method of integration with a mooring cable.

The Recipient shall:

- Develop preliminary design characteristics of the sensor system.

The design criteria will be developed based on analyzing the simulation data for different scenarios that consider the variabilities such as:

- The type, size, and location of the entanglement
- The wave, current and wind conditions
- The type and location of the sensors

- Prepare and submit a *Sensor Design Criteria Report* that describes the findings from Task 2.
- Prepare and submit a *CPR Report #1* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR meeting.

Products:

- Sensor Design Criteria Report
- CPR Report #1

TASK 3 SENSOR PACKAGE

The goal of Task 3 is to design, fabricate and test a prototypical integrated sensor package that can detect underwater cable interactions and can transmit information to a signal receptor - i.e. the system operator and/or ROV system operator - about the location and type of interaction.

Subtask 3.1 – Procure and Design Sensor Package

The goal of this subtask is to evaluate different sensor technologies against the design criteria identified during Subtask 2.4. The optimal sensor will be selected based on the detection capability, flexibility for integration with future cable designs, and cost. The design of the sensor package will be informed by data from project partner Principle Power to ensure that realistic parameters are considered in relation to integration of the sensor package system design into commercially available floating offshore wind substructures.

The Recipient shall:

- Select a sensor type based on the required specifications identified in Subtask 2.4.
- Prepare and submit *Technical Design Drawings* for the mechanical and electrical components of the sensor package.
- Integrate sensors with a mooring line.
- Develop electrical hardware and software to analyze the measurements with the detection algorithm in real time.
- Integrate sensor with communication hardware to transmit signals to system operator and/or ROV system operator.
- Consider future integration with additional appurtenant environmental monitoring sensors and technologies to facilitate additional environmental data collection, including potential mitigation solutions for in-situ debris removal or management.

Products:

- Technical Design Drawings

Subtask 3.2 – Test Prototype System

The goal of this subtask is to evaluate the prototype system in a laboratory environment.
The Recipient shall:

- Test the performance of the prototype sensor system in a dry lab setting to verify the operation of the mechanical and communication functions.
- Test the performance of the prototype system in a seawater tank in a laboratory setting to simulate an underwater environment and physical interactions with the cable.
- Performance testing will include making perturbations and adding entangled debris to the cable system then monitoring the sensor output to determine if the expected response is received.
- Prepare and submit a draft *Sensor Testing Report* that summarizes the observations and performance of the system and incorporate changes as requested from the CAM in the final *Sensor Testing Report*.

Products:

- Sensor Testing Report (draft and final)

TASK 4 MONITORING PACKAGE WITH ROV

The goal of Task 4 is to develop an ROV system that can inspect and confirm the presence of entangled ocean debris from underwater cables. The mechanical ROV system will be optimized for this use case and the communication and software will be updated to facilitate integration with the overall system operation for laboratory scale testing.

Subtask 4.1 – Develop Design Criteria

The goal of this subtask is to develop quantitative design criteria for the ROV sensors that describe the performance requirements and lead to equipment specifications that will address the detection and observation needs of the system.

The Recipient shall:

- Develop quantitative design criteria for the ROV sensors that describe the performance requirements and thereby lead to equipment specifications. Design criteria may include but is not limited to depth of operation, total cost, types of functions, physical dimensions of the platform and mooring, and speed of movement.
- Ensure the design criteria are reviewed by marine life subject matter experts to confirm the ROV specifications will enable the ROV to correctly identify entanglements and relevant species.

Subtask 4.2 – Develop ROV Hardware Package

The goal of this subtasks is to develop an ROV hardware package which can be affixed to an ROV which in conjunction with the standardized communication protocol, can effectively communicate with the remote human controller and provide visual and other environmental data relevant to the detection goals of the system.

The Recipient shall:

- Develop a *Preliminary Design Approach* for the entire ROV system package that describes system function and concept of operation.
- Build an inspection ROV that meets the design specifications set out in Subtask 4.1.
- Prepare and submit a *ROV Technical Design Report,* including pictures of the ROV system and design criteria from task 4.1, above.
- Prepare and submit a *CPR Report #2* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR meeting.

Products:

- Preliminary Sensor Package Design Approach
- ROV Technical Design Report
- CPR Report #2

Subtask 4.3 – Test Prototype System

The goal of this subtask is to test the sensors and hardware package in conjunction with the standardized communication protocol in a laboratory setting.

The Recipient shall:

- Test the function of the ROV in a laboratory setting to confirm the ability to inspect ocean debris (e.g. derelict fishing nets) on a simulated underwater cable (i.e. cable in a laboratory tank setting that is a scaled version of a mooring line).
- Prepare and submit the draft *ROV Test Report* and incorporate changes as requested from the CAM in the final *ROV Test Report.*

Products

- ROV Test Report (draft and final)

TASK 5 SYSTEM TESTING AND TECHNOLOGY VERIFICATION

The goal of Task 5 is to integrate the sensor package components, the ROV system and the communications protocol into a single system, and test that system in a laboratory environment. The total system will be evaluated by a third party technology verification entity who will provide a new technology qualification through third party verification.

Subtask 5.1 – Laboratory Testing

The goal of this subtask is to test the system in a laboratory setting and have those results and testing methodologies reviewed by a third party standards organization to obtain a new technology qualification.

The Recipient shall:

- Develop testing methodology metrics and procedures and have these reviewed by a third-party standards organization.
- Integrate the detection and communication software of the sensors into a single system to be operated by a human operator.
- Apply the testing methodology to evaluate the performance of the system to inspect, identify, and characterize debris and entanglements from a mooring line in a test tank.

Subtask 5.2 – Data Analysis

The goal of this subtask is to analyze the performance of the system to examine strengths, weaknesses and opportunities for improvement in the system.

The Recipient shall:

- Based on the results of the laboratory testing conducted in Subtask 5.1, analyze the performance of the system against the design criteria developed in Subtask 2.4 and Subtask 4.1. Data storage and dissemination will occur per the Data Management Plan, **Section V.**, below.
- Prepare and submit an *Integrated System Performance Report* that describes the testing results, including testing methodology metrics and approach.

Products

- Integrated System Performance Report (draft and final)

Subtask 5.3 – System Verification

The Recipient shall:

- Ensure the testing results from Subtask 5.1 are reviewed by a third-party standards organization and recommendations for a new technology qualification are provided.
- Ensure a third-party standards organization write a *Technology Qualification Report* that reviews the function of the technology, assesses its applicability to the marine industry, and outlines a pathway to commercialization and technology qualification and submit to the CAM.

Products:

- Technology Qualification Report

TASK 6: EVALUATION OF PROJECT BENEFITS

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

The Recipient shall:

- Complete *the Initial Project Benefits Questionnaire*. The Initial Project Benefits Questionnaire shall be initially completed by the Recipient with 'Kick-off' selected for the 'Relevant data collection period' and submitted to the CAM for review and approval.
- Complete the *Annual Survey* by January 31st of each year. The Annual Survey includes but is not limited to the following information:
    - Technology commercialization progress
    - New media and publications
    - Company growth
    - Follow-on funding and awards received
- Complete the *Final Project Benefits Questionnaire*. The Final Project Benefits Questionnaire shall be completed by the Recipient with 'Final' selected for the 'Relevant data collection period' and submitted to the CAM for review and approval.

- Respond to CAM questions regarding the questionnaire drafts.
- Complete and update the project profile on the CEC's public online project and recipient directory on the Energize Innovation website at www.energizeinnovation.fund, and provide *Documentation of Project Profile on EnergizeInnovation.fund*, including the profile link.
- If the Prime Recipient is an Innovation Partner on the project, complete and update the organizational profile on the CEC's public online project and recipient directory on the Energize Innovation website www.energizeinnovation.fund and provide *Documentation of Organization Profile on EnergizeInnovation.fund*, including the profile link.

Products:

- Initial Project Benefits Questionnaire
- Annual Survey(s)
- Final Project Benefits Questionnaire
- Documentation of Project Profile on EnergizeInnovation.fund
- Documentation of Organization Profile on EnergizeInnovation.fund (if applicable)

TASK 7 TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

The goal of this task is to conduct activities that will accelerate the commercial adoption of the technology being supported under this agreement. Eligible activities include, but are not limited to, the following:

- Scale-up analysis including manufacturing analysis, independent design verification, and process improvement efforts.
- Technology verification testing, or application to a test bed program located in California.
- Legal services or licensing to secure necessary intellectual property to further develop the technology.
- Market research, business plan development, and cost-performance modeling.
- Entry into an incubator or accelerator program located in California.

The Recipient Shall:

- Develop and submit a *Technology Transfer Plan* that identifies the proposed activities the R ecipient will conduct to accelerate the successful commercial adoption of the technology.
- Present the draft *Technology Transfer Plan* to the TAC for feedback and comments.
- Develop and submit a *Summary of TAC Comments* that summarizes comments received from the TAC members on the Draft Technology Transfer Plan. This document will identify:
    - TAC comments the R ecipient proposes to incorporate into the final *Technology Transfer Plan*.
    - TAC comments the R ecipient does not propose to incorporate with an explanation why.
- Submit the final *Technology Transfer Plan* to the CAM for approval.
- Implement activities identified in the final *Technology Transfer Plan*.
- Develop and submit a *Technology Transfer Summary Report* that includes high level summaries of the activities, results, and lessons learned of tasks performed relating to implementing the Final Technology Transfer Plan. This report should not include any proprietary information.

- When directed by the CAM, develop presentation materials for an CEC- sponsored conference/workshop(s) on the project.
- When directed by the CAM, participate in annual EPIC symposium(s) sponsored by the CEC.
- Provide at least (6) six *High Quality Digital Photographs* (minimum resolution of 1300x500 pixels in landscape ratio) of pre and post technology installation at the project sites or related project photographs.

Products:
- Technology Transfer Plan (draft and final)
- Summary of TAC Comments
- Technology Transfer Summary Report (draft and final)
- High Quality Digital Photographs

III. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

IV. DATA MANAGEMENT PLAN

Roles and responsibilities
- The primary responsibility for managing the data will belong to Co-PI Mousaviraad. The Co-PI will have periodic meetings with the research team to monitor the collection of data and adherence to the data management plan.

Expected data types, formats, sources and metadata
- Digital data encompasses a wide variety of information stored in digital form including: experimental, observational, and simulation data; codes, software and algorithms; text; numeric information; images; video; audio; and associated metadata.
- The proposed project is expected to generate data related to computational simulations. The stored data include setup and restart files so that the simulation could be repeated or continued in the future with minimal effort. Post-processing routines for relevant operations with the data sets will also be provided. All the generated experimental data and their associated post-processing routines will be stored as well.
- This project will not involve the acquisition of either animal or human subjects' data.
- In addition to the raw data produced by simulations and experiments, data may be converted and stored in reports such as .doc, .xls and .pdf files. Images will largely be high-resolution image files that will be preserved as .jpg files. It is also planned to create a significant number of animated visualization output files from the high-fidelity simulations – all of which will be included as part of the regular data management plan reviews.
- We will create a naming system for the files that will indicate the metadata. Readme files or similar will include information such as type of code or instrument used to perform a given analysis or experiment. This will also include descriptions of all applicable procedures.

Data protection and period of retention

- We do not anticipate that there will be any significant intellectual property issues involved with the acquisition of the data. In the event that discoveries or inventions are made in direct connection with this data, access to the data will be granted upon request once appropriate invention disclosures and/or provisional patent filings are made.
- After completion of the grant, all data will be published on “Digital Commons”, an open-access institutional repository, where the data will be stored in perpetuity. After the publication of data, Cal Poly Humboldt takes over as the responsible party for data management and storage.

Data dissemination and policies for public access, sharing and publication delays

- We anticipate publishing multiple manuscripts on this research in publications that do not restrict additional use of the data. All significant data sharing for this project will take all measures required to make the digital research data available to and useful for the scientific community, industry, and the public.

Data storage and preservation of access

- All data produced during this grant will be preserved through Humboldt Digital Scholar (DSpace), which provides long-term digital archiving and preservation as a part of the California State University (CSU) Libraries Scholarworks initiative. The goal of CSU’s data collections within DSpace Repository is to encourage the dissemination of research data by making these materials open access.