STATE OF CALIFORNIA

GRANT AMENDMENT REQUEST FORM (GARF)

CEC-277 (Revised 12/2019) CALIFORNIA ENERGY COMMISSION

Original Agreement # EPC-17-023 Amendment # 2

Division	Agreement Manager:	MS-	Phone
ERDD	Kaycee Chang	51	916-327-1509

Recipient's Legal Name	Federal ID #
RCAM Technologies, Inc.	85-3257046

Revisions: (check all that apply)	**Additional Requirements**
☐ Term Extension New End Date: 6/30/2022	Include revised schedule and complete items A, B, C, & F below.
☐ Budget Augmentation Amendment Amount: $ 0	Include revised budget and complete items A, B, C, D, & F below.
☐ Budget Reallocation	Include revised budget and complete items A, B, C, & F below.
☐ Scope of Work Revision	Include revised scope of work and complete items A, B, C, E, & F below.
☐ Change in Project Location or Demonstration Site	Include revised scope of work and complete items A, B, C, E, & F below.
☒ Novation/Name Change of Prime Recipient	Include novation documentation and complete items A, B, C, & F below.
☐ Terms and Conditions Modification	Include applicable exhibits with bold/underline/ strikeout and complete items A, B, C, & F below.

A) Business Meeting Information

Business Meeting approval is not required for the following types of Agreements:

☐ Minor amendments delegated to Executive Director per December 2013 Resolution

Proposed Business Meeting Date 3/17/2021 ☒ Consent ☐ Discussion

Business Meeting Presenter Rizaldo Aldas Time Needed: minutes

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

Agenda Item Subject and Description:

RCAM TECHNOLOGIES, INC.

Proposed resolution approving a novation amendment #2 to grant agreement EPC-17-023, under which the Recipient is Jason Cotrell dba RCAM Technologies, to RCAM Technologies, Inc. RCAM Technologies, Inc. is a Delaware corporation incorporated in 2020. Mr. Cotrell and the project team will continue ultra-tall wind turbine tower research under the new entity. There are no changes to the scope of work. (EPIC funding) Contact: Rizaldo Aldas.

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

Legal Company Name:	Budget
The Regents of the University of California, Irvine Campus	$ 762,378
Philip J Barutha	$ 0
	$

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

Legal Company Name:

D) Budget Information (only include amendment amount information)

Funding Source	Funding Year of Appropriation	Budget List Number	Amount
			$
			$
			$

R&D Program Area: EGRO: Renewables TOTAL: $ 0

Explanation for “Other” selection

Federal Agreement #:

1. **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”:

2. 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:

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

   Explain reason why Agreement is exempt under the above section: The Energy Commission made CEQA findings pertaining to this grant, including that it is exempt under CEQA, when it approved grant EPC-17-023 at a Business Meeting on 11/08/2017. The laboratory work is exempt from CEQA under California Code of Regulations, title 14, section 15306. The proposed changes through this amendment involve a change of Recipient, schedule, and end date. These changes will not result in any impact to the environment beyond those already considered when this grant was originally approved, and do not change the applicability of the categorical exemption under 14 C.C.R. § 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

E) The following items should be attached to this GARF (as applicable)

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

_____ _____
Agreement Manager **Date**

_____ _____
Office Manager **Date**

_____ _____
Deputy Director **Date**

EXHIBIT A
Scope of Work

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2		Additively Manufactured Concrete and Tower Design Requirements
3		Preliminary Structural Performance Characteristics for a Baseline and Two RCAM Methods
4		Preliminary Design and Analysis of Baseline and RCAM Hybrid Ultra-Tall Towers
5	X	Conceptual Design of RCAM Manufacturing Process, Printer Head, Production Printer Configuration, and Trade Study
6		RCAM Head Experiment Design and Assembly
7		Manufacture, Assemble, and Laboratory Test RCAM Beam and Subscale RCAM Tower Assemblies
8		Technoeconomic, Market Analyses, and Stakeholder Outreach
9		Evaluation of Project Benefits
10		Technology/Knowledge Transfer Activities
11		Production Readiness Plan

B. Acronym/Term List

Acronym/Term	Meaning
Automated RCAM	RCAM that embeds horizontal and vertical reinforcements in concrete during additive manufacturing in a controlled manner.
Baseline Tower	A hybrid tower design, made using conventional precast concrete manufacturing methods, used to assess the technological and economical merits of the RCAM tower technology.
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
Energy Commission	California Energy Commission
Hybrid tower	A wind turbine tower that has a large diameter concrete lower section, and a smaller diameter steel upper section.
ERDC	Engineer Research and Development Center
CERL	Construction Engineering Research Laboratory
LCOE	Levelized cost of wind energy
RCAM	Reinforced Concrete Additive Manufacturing
Random RCAM	RCAM that embeds short randomly distributed fibers in concrete printing.
TAC	Technical Advisory Committee
Ultra-Tall Tower	A wind turbine tower with a hub height of between 140-m to 170-m.

[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

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

A. Purpose of Agreement

The purpose of this Agreement is to develop, demonstrate, and test a reinforced concrete additive manufacturing (RCAM) technology for building low cost ultra-tall wind turbine towers onsite at a wind plant. The proposed construction technology will reduce technological and economic barriers to upgrading, repowering, and expanding wind power generation in California by enabling cost effective deployment of taller towers that capture more wind energy from faster winds aloft in both high-quality and low-quality wind resource regions.

B. Problem/ Solution Statement

Problem

Large wind turbines benefit from economies of scale from larger components such as wind turbine towers, but are constrained by transportation size and weight. Overhead traffic signals, road width and weight regulations limit conventional steel tubular towers to sub-optimal diameters of 4.3 meters (14 feet). As a result, the average conventional wind turbine tower height installed in the U.S. is slightly over 80-meters tall. Deployment of taller towers that capture more wind energy from faster winds aloft. For example, an ultra-tall 140-meter tower increases the amount of energy produced by more than 21%, compared to a conventional 80-meter steel tower at a site with moderate wind shear. However, no ultra-tall steel or concrete towers have been installed in California due to their high manufacturing and assembly costs.

Solution

The Recipient will work on the development of a RCAM technology that eliminates the transportation and logistics constraints by manufacturing structurally efficient large diameter towers within the wind plant using light weight reinforcement methods. The towers are made with locally available cementious materials supplied by standard concrete trucks or an existing concrete batch plant within the wind plant used for casting conventional tower foundations.

The RCAM technology is faster and safer while providing new transformative design possibilities that reduce cost. Concrete additive manufacturing uses less concrete than conventional construction, less labor, and eliminates concrete forms. The low cost tall towers capture faster winds aloft, and can be inexpensively designed for longer lifespans thereby expanding deployment and repowering possibilities. For example, an ultra-tall 140-meter RCAM tower is projected to reduce the levelized cost of wind energy (LCOE) by 11% in a low-wind speed region compared to an 80-meter tower without increasing rotor diameter.

C. Goals and Objectives of the Agreement

Agreement Goals

The goal of this agreement is to reduce technological and economic barriers to upgrading, repowering, and expanding wind power generation in California by enabling cost effective deployment of taller towers that capture more wind energy from faster winds aloft in both high-quality and low-quality wind resource regions.

Ratepayer Benefits:[2] This Agreement will result in the ratepayer benefit of greater electricity reliability, lower costs, and increased safety by funding applied research and development of a technology that enables cost effective deployment of taller towers that capture more wind energy from faster winds aloft in both high-quality and low-quality wind resource regions. The additional electricity generated lowers the overall LCOE. In addition, the automated fabrication technology increases wind plant construction safety by reducing the chance of wind plant construction accidents by reducing the human interactions with large equipment and structures.

Technological Advancement and Breakthroughs:[3] This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by developing an onsite reinforced concrete additive manufacturing technology that enables cost effective deployment of taller towers that eliminate transportation logistics constraints limiting the height of conventional technologies. The proposed manufacturing technology is faster and safer while providing new transformative design possibilities that reduce cost by using less concrete and labor than conventional construction, and by eliminating concrete forms.

Agreement Objectives

The objectives of this Agreement are to develop a RCAM manufacturing technology that when scaled-up and commercialized will:

1. Fabricate the lower half of a hybrid ultra-tall wind turbine tower on-site, in one day at half of the cost of conventional steel towers.
2. Reduce the levelized cost of wind generated electricity in a low wind speed site by 11 percent.
3. Increase the California wind capacity deployment potential for new sites and repowered sites nearly tenfold (from 6 GW to 60 GW).

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.

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

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

EXHIBIT A
Scope of Work

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 Energy Commission's software and Microsoft (MS)-operating computing platforms, or with any other format approved by the CAM. Deliver an electronic copy of the full
  - text of any Agreement data and documents in a format specified by the CAM, such as memory stick or CD-ROM.

  The following describes the accepted formats for electronic data and documents provided to the Energy Commission as products under this Agreement, and establishes the software versions that will be required to review and approve all software products:
  - Data sets will be in MS Access or MS Excel file format (version 2007 or later), or any other format approved by the CAM.
  - Text documents will be in MS Word file format, version 2007 or later.
  - Documents intended for public distribution will be in PDF file format.
  - The Recipient must also provide the native Microsoft file format.
  - Project management documents will be in Microsoft Project file format, version 2007 or later.

- **Software Application Development**

  Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:
  - Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
  - Microsoft Internet Information Services (IIS), (version 6 and up)

Recommend 7.5.
- Visual Studio.NET (version 2008 and up). Recommend 2010.
- C# Programming Language with Presentation (UI), Business Object and Data Layers.
- SQL (Structured Query Language).
- Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
- Microsoft SQL Reporting Services. Recommend 2008 R2.
- XML (external interfaces).

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

MEETINGS

Subtask 1.2 Kick-off Meeting

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

The Recipient shall:

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

  The administrative portion of the meeting will include discussion of the following:
  - Terms and conditions of the Agreement;
  - Administrative products (subtask 1.1);
  - CPR meetings (subtask 1.3);
  - Match fund documentation (subtask 1.7);
  - Permit documentation (subtask 1.8);
  - Subcontracts (subtask 1.9); and
  - Any other relevant topics.

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

- Provide an *Updated Project Schedule, List of Match Funds,* and *List of Permits*, as needed to reflect any changes in the documents.

The CAM shall:

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

Recipient Products:

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

CAM Product:

- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings

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

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

The Recipient shall:

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

The CAM shall:

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

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

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

Recipient Products:

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

CAM Products:

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

Subtask 1.4 Final Meeting

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

The Recipient shall:

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

  The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.
  - The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
  - The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
    - Disposition of any state-owned equipment.
    - Need to file a Uniform Commercial Code Financing Statement (Form UCC-1) regarding the Energy Commission's interest in patented technology.
    - The Energy Commission's request for specific "generated" data (not already provided in Agreement products).
    - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
    - "Surviving" Agreement provisions such as repayment provisions and confidential products.
    - Final invoicing and release of retention.

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

Products:

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

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices

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

The Recipient shall:

- Submit a monthly *Progress Report* to the CAM. Each progress report must:
    - Summarize progress made on all Agreement activities as specified in the scope of work for the preceding month, including accomplishments, problems, milestones, products, schedule, fiscal status, and an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. See the Progress Report Format Attachment for the recommended specifications.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the "Payment of Funds" section of the terms and conditions, including a financial report on Match Fund and in-state expenditures.

Products:

- Progress Reports
- Invoices

Subtask 1.6 Final Report

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

Subtask 1.6.1 Final Report Outline

The Recipient shall:

- Prepare a *Final Report Outline* in accordance with the *Style Manual* provided by the CAM. *(See Task 1.1 for requirements for draft and final products.)*

Recipient Products:

- Final Report Outline (draft and final)

CAM Product:

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

Subtask 1.6.2 Final Report

The Recipient shall:

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline, Style Manual, and Final Report Template provided by the CAM with the following considerations:
  - Ensure that the report includes the following items, in the following order:
    - Cover page (**required**)
    - Credits page on the reverse side of cover with legal disclaimer (**required**)
    - Acknowledgements page (optional)
    - Preface (**required**)
    - Abstract, keywords, and citation page (**required**)
    - Table of Contents (**required**, followed by List of Figures and List of Tables, if needed)
    - Executive summary (**required**)
    - Body of the report (**required**)
    - References (if applicable)
    - Glossary/Acronyms (If more than 10 acronyms or abbreviations are used, it is required.)
    - Bibliography (if applicable)
    - Appendices (if applicable) (Create a separate volume if very large.)
    - Attachments (if applicable)
  - Ensure that the document is written in the third person.
  - Ensure that the Executive Summary is understandable to the lay public.
    - Briefly summarize the completed work. Succinctly describe the project results and whether or not the project goals were accomplished.
    - Identify which specific ratepayers can benefit from the project results and how they can achieve the benefits.
    - If it's necessary to use a technical term in the Executive Summary, provide a brief definition or explanation when the technical term is first used.
  - Follow the Style Guide format requirements for headings, figures/tables, citations, and acronyms/abbreviations.
  - Ensure that the document omits subjective comments and opinions. However, recommendations in the conclusion of the report are allowed.
  - Include a brief description of the project results in the Abstract.

- Submit a draft of the report to the CAM for review and comment. The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt
- Consider incorporating all CAM comments into the Final Report. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product
- Submit the revised Final Report and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period or approves a request for additional time.
- Submit one bound copy of the *Final Report* to the CAM along with *Written Responses to Comments on the Draft Final Report*.

Products:

- Final Report (draft and final)

- Written Responses to Comments on the Draft Final Report

CAM Product:
- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds

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

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

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

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

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

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

Subtask 1.8 Permits
The goal of this subtask is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track. Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement, with the exception of costs incurred by University of California recipients. Permits must be identified and obtained before the Recipient may incur any costs related to the use of the permit(s) for which the Recipient will request reimbursement.

The Recipient shall:

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

  The list of permits and the schedule for obtaining them will be discussed at the Kick-off meeting (subtask 1.2), and a timetable for submitting the updated list, schedule, and copies of the permits will be developed. The impact on the project if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in progress reports and will be a topic at CPR meetings.
- If during the course of the Agreement additional permits become necessary, then provide the CAM with an *Updated List of Permits* (including the appropriate information on each permit) and an *Updated Schedule for Acquiring Permits*.
- Send the CAM a *Copy of Each Approved Permit*.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the CAM within 5 days. Either of these events may trigger a CPR meeting.

Products:

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

Subtask 1.9 Subcontracts
The goals of this subtask are to: (1) procure subcontracts required to carry out the tasks under this Agreement; and (2) ensure that the subcontracts are consistent with the terms and conditions of this Agreement.

The Recipient shall:

- Manage and coordinate subcontractor activities in accordance with the requirements of this Agreement.
- Incorporate this Agreement by reference into each subcontract.
- Include any required Energy Commission flow-down provisions in each subcontract, in addition to a statement that the terms of this Agreement will prevail if they conflict with the subcontract terms.

- If required by the CAM, submit a draft of each *Subcontract* required to conduct the work under this Agreement.
- Submit a final copy of the executed subcontract.
- Notify and receive written approval from the CAM prior to adding any new subcontractors (see the discussion of subcontractor additions in the terms and conditions).

Products:

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

TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)

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

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

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

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

The Recipient shall:

- Prepare a *List of Potential TAC Members* that includes the names, companies, physical and electronic addresses, and phone numbers of potential members. The list 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.

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

IV. TECHNICAL TASKS

*Products that require a draft version are indicated by marking **"(draft and final)"** after the product name in the "Products" section of the task/subtask. If "(draft and final)" does not appear after the product name, only a final version of the product is required. **Subtask 1.1 (Products)** describes the procedure for submitting products to the CAM.*

This project includes mechanical design studies, engineering analyses, and techno economic analyses of concrete wind turbine tower designs. The project also includes fabrication and testing of concrete tower sections at a civil engineering laboratory using a robotic arm. Up to six tower sections will be fabricated. Two of the concrete tower sections will be assembled and fastened together using steel tendons. The assembly will be bolted to the civil engineering laboratory strong floor or wall for load testing.

EXHIBIT A
Scope of Work

TASK 2: ADDITIVELY MANUFACTURED CONCRETE AND TOWER DESIGN REQUIREMENTS

The goal of this task is to review and summarize the available literature and knowledge required for developing, demonstrating, and testing a RCAM technology. Information will be gathered on additively manufacturing of concrete and concrete tower design by literature review and stakeholder discussions. The information will be collected from publicly available documentation and project stakeholder discussions.

The Recipient shall:

- Review available tower design reports, codes and standards
- Review available literature on additive manufacturing of concrete structures.
- In coordination with CAM, prepare and conduct one-day stakeholder precursory workshop to review and discuss with key stakeholders and subject matter experts 1) the RCAM technology status, technical challenges, performance, market potential, and status of competing wind turbine tower and concrete manufacturing technologies, 2) the project scope of work and project progress to date, 3) the wind plant construction and assembly process requirements, and 4) the ultra-tall tower height (between 140-meters and 170-meters) at which to perform subsequent design studies and techno economic analyses.
    - Perform necessary workshop planning, logistics and communications to stakeholders, e.g. wind plant owners, experts in concrete additive manufacturing.
    - Utilize appropriate organization's network to distribute information and awareness of the project and workshop.
    - Document workshop findings to guide subsequent tasks.
- Attend site visits and informative activities such as:
    - Participate in concrete printing activities at the U.S. Army Engineer Research and Development Center - Construction Engineering Research Laboratory (ERDC-CERL).
    - Visit a wind plant construction site.
    - Attend conferences and workshops related to tall towers, and additive manufacturing of concrete to participate in technical discussions.
- Prepare the *State of Additively Manufactured Concrete Tower Report* that includes but is not limited to the following:
    - Bibliography analysis of additively manufactured concrete tower.
    - Summary of technical information on additively manufactured concrete tower and tower design requirements.
    - Summary of most relevant tower design documents, standards and codes identified.
    - Summary of technical information from site visits, Conferences and workshops on concrete additive manufacturing.
    - Key lessons learned from the stakeholder workshop, and discussion with stakeholders, site visits, conferences and workshops.

Product:

- State of Additively Manufactured Concrete Tower Report (Draft and Final)

TASK 3: PRELIMINARY STRUCTURAL PERFORMANCE CHARACTERISTICS FOR A BASELINE AND TWO RCAM METHODS

The goal of this task is to determine the preliminary structural performance characteristics necessary to develop preliminary designs in Task 4 and to inform trade studies and down selection (narrow down the choices) of an RCAM process in Task 5. The project team will perform analytical and/or finite element analysis-based computer simulation to predict the structural performance characteristics (identified in Task 2) for wind towers manufactured with the baseline methods and the two RCAM methods—Random RCAM and Automated RCAM.

The Recipient shall:

- Perform analytical and finite element analysis-based computer simulation to predict the structural performance characteristics of wind towers manufactured using methods that include but are not limited to:
    - A baseline precast method.
    - Random RCAM that embeds short randomly distributed fibers in concrete printing.
    - Automated RCAM that embeds horizontal and vertical reinforcements in concrete during additive manufacturing in a controlled manner.
- Verify the predicted structural performance characteristics using available standards, codes or reports reviewed and selected in Task 2.
- Identify key uncertainties in the structural performance predictions through parameter studies, and determine the follow-on analyses and structural tests.
- Prepare a *Preliminary Structural Performance Report* that includes but is not limited to the following:
    - Summary of preliminary modeling of the structural performance characteristics of wind towers manufactured with the baseline and the RCAM methods.
    - Description of key uncertainties in the modeling and results.
    - Identification of follow-on analyses or tests needed to reduce uncertainties.

Product:

- Preliminary Structural Performance Report (Draft and Final)

TASK 4: PRELIMINARY DESIGNS AND ANALYSES OF BASELINE AND RCAM ULTRA-TALL HYBRID TOWERS

The goal of this task is to create a preliminary design for the lower half for three ultra-tall hybrid tower designs at a height of between 140 meters to 170 meters, including a baseline precast tower (“baseline tower”) and two RCAM towers. Approximately the top half of the towers will be assumed to be a tapered conventional steel tower section with a base diameter of nominally 4.3 meters that is easily transported over the road. This Agreement will design the bottom concrete portion of the tower. This Agreement will use existing design(s) for the top steel tower section, and will not involve significant design changes to the top section. All other wind turbine parameters will be the same between the designs except for the foundation. The foundation design will reflect the innovation possibilities resulting from the larger tower diameter.

The Recipient shall:

- Identify the tower specification and loads for an ultra-tall wind turbine tower.
- Prepare a *Tower Specification and Loads Document for an Ultra-Tall Wind Turbine Tower Report* that documents the tower specification and loads for an ultra-tall wind turbine tower.

- Scale up the preliminary design of the Department of Energy100-meter hybrid precast tower to an ultra-tall baseline tower to use as a comparison design.
- Perform a preliminary design of an ultra-tall random RCAM hybrid tower.
- Perform a preliminary design of an ultra-tall automated RCAM hybrid tower.
- Perform initial techno-economic analysis comparisons of the baseline and RCAM towers that include process modeling, engineering design, and economic evaluation to provide quantitative and qualitative understanding of the technology's economic viability.
- Prepare a *Preliminary Baseline and RCAM Hybrid Towers Design Report* that includes, but not limited to:
    - Description of the three preliminary ultra-tall tower designs: a baseline hybrid tower, random RCAM hybrid tower, and automated RCAM hybrid tower.
    - Comparison and analysis of the baseline tower preliminary design with the preliminary designs of the random RCAM and the automated RCAM hybrid towers.
    - A techno-economic LCOE analysis of wind plants built with each of the three designs.

Products:

- Tower Specification and Loads Document for an Ultra-Tall Wind Turbine Tower Report
- Preliminary Baseline and RCAM Hybrid Towers Design Report (Draft and Final)

TASK 5: CONCEPTUAL DESIGN OF RCAM MANUFACTURING PROCESS, PRINTER HEAD, PRODUCTION PRINTER CONFIGURATION, AND TRADE STUDY

The goals of this task are to: 1) further develop the automated and random manufacturing processes, 2) further develop the design solutions for the components and system comprising the RCAM printer and RCAM printer head (the printer head is the component at the end of the robotic arm that controls the flow and shape of the concrete additive material), 3) perform a trade study to identify the most balanced technical solution among the set of identified solutions, and 4) select one RCAM manufacturing process for further development, demonstration and testing. This task includes several engineering design studies necessary to compare and select a balanced technical solution for the RCAM manufacturing process, printer configuration, and RCAM printer head that will be fabricated and tested in subsequent tasks.

The Recipient shall:

- Further develop conceptual design variants for the random and automated RCAM manufacturing processes and printer head.
- Further develop conceptual design variants for the RCAM proprietary printer configuration.
- Identify the relevant criteria to be included in the trade study.
- Identify performance measures and metrics needed for the trade study. The trade study will help defining and illuminating what factors are truly the most influential to the success of the RCAM technology, such as RCAM printer cost, manufacturing material cost, manufacturing speed, manufacturing process repeatability, tower strength, tower stiffness, and other metrics and performance measures to be determined.
- Compare the RCAM printer head designs in trade study. The main components for this study include but are not limited to the body, additive material orifices and feed system, and actuators.

- Compare the RCAM printer configuration designs in trade study. The main components for this study include but are not limited to a commercially available robotic arm, a workpiece positioner to position the tower, a commercial concrete pump, and the fabricated RCAM printer head.
- Down select the most promising printer configuration for further technical detailing and costing.
- Down select the most promising RCAM manufacturing process and print head for further development.
- Prepare a *RCAM Design Down Selection Report* that contains but is not limited to describing:
    - The random and automated RCAM manufacturing processes and head conceptual designs.
    - The conceptual design of the RCAM printer configurations considered.
    - The trade study process, measures, metrics, outcome and recommendation.
- Prepare a *CPR Report* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR meeting

Products:

- RCAM Design Down Selection Report (Draft and Final)
- CPR Report

TASK 6: RCAM HEAD EXPERIMENT DESIGN AND ASSEMBLY

The goals of this task are to: 1) Design the experiment, 2) fabricate, procure, and assemble the necessary experimental equipment, and 3) verify equipment operation. The project team will design and assemble the experiments needed to test and verify the selected RCAM head.

The Recipient shall:

- Set the experiment objectives.
- Select the process variables to test.
- Perform the RCAM printer head detailed design.
- Fabricate the RCAM printer head that includes but not limited to machine and assemble the components of the RCAM printer head including the body, additive material orifices and feed system, and actuators.
- Design and fabricate the post tensioning system.
- Design and fabricate the structural test equipment.
- Select and competitively procure or lease the robot and concrete pumping equipment.
- Attend robot and concrete equipment training.
- Draft a *RCAM Head Detailed and Assembly Test Plan* that includes but is not limited to
    - Experiment objectives of the RCAM head.
    - Assembly diagrams for the fabrication equipment.
    - Assembly diagrams for the structural test equipment.
    - Establish a safe operating procedure for the RCAM head experiments.
- Assemble the experimental fabrication equipment.
- Verify fabrication equipment operation in a number of trial runs until determining that will be sufficient to verify operation of the equipment necessary for fabrication of test articles in Task 7.

Products:

- Detailed RCAM Head Design and Assembly Test Plan (Draft and Final)

TASK 7: MANUFACTURE, ASSEMBLE, AND LABORATORY TEST RCAM BEAM AND SUBSCALE RCAM TOWER ASSEMBLIES

The goal of this task is to build and test subscale RCAM tower assemblies in order to validate or calibrate the finite element computational models, and the manufacturing process assumptions for the RCAM concrete tower sections. The updated computational models and assumptions will then be used in the subsequent Task 8 to inform the RCAM concrete tower sections design, which will serve as a basis for the wind-plant techno economic analyses. The steel portion of the towers will not be tested because the current models for the steel material and components are well understood and verified.

The primary Task 7 activities include: 1) manufacture RCAM test articles and control specimens, 2) assemble and post-tension representative subscale concrete tower assemblies, 3) structurally test the concrete tower assemblies using existing structural testing laboratory facilities, 4) compare the concrete subscale tower assembly test results with finite element model predictions and 5) validate or calibrate the model assumptions and parameters using the test results.

The recipient shall:

- Print concrete beams for shear, bending, and cold joint tests. The RCAM printer will be use to fabricate a series of subscale beams and conical test articles up to the maximum size constraints of the robotic arm, structural testing capabilities, or other physical constraints that may be determined.
- Test the beams using laboratory structural testing equipment to characterize their structural performance.
- Manufacture partial RCAM tower sections.
- Stack and post-tension at least two of the partial tower sections to create a partial RCAM tower assembly.
  Perform static test the RCAM tower assembly by bolting the assembly to the laboratory strong floor or wall and applying static loads.
- Compare test results with computer model simulation results. The test data will be compared to the modeling results, and the model assumptions and parameters will be validated or calibrated to reflect the effect of manufacturing process (e.g. layer by layer) on the mechanical behavior of the printed concrete components.
- Compare the test results to the baseline concrete tower performance.
- Update the computer model assumptions to reflect the test results
- Prepare a *RCAM Beam and Tower Assembly Test Report* that includes but is not limited to
  - A description of the testing procedures.
  - Key testing data.
  - A comparison of testing results to computer models.
  - Recommendations for future testing and analysis.

Products:

- RCAM Beam and Tower Assembly Test Report (Draft and Final)

TASK 8: TECHNOECONOMIC, MARKET ANALYSES AND STAKEHOLDER OUTREACH

The goal of this task is to update the technoeconomic analyses from task 4 for the RCAM tower to aid the production readiness plan. Recipient will update the wind plant construction assumptions and tower designs based on the test results in Task 7, and estimate the production cost of its full-scale printer system based on discussions with stakeholders about the prototype gantry system and vendor estimates.

- Update the wind plant construction assumptions and tower designs based on test results.
- Estimate production cost of the RCAM printer configuration.
- Conduct a market analysis that includes but is not limited to the identification of potential RCAM tower customers, California installation sites, and competitive tower pricing, as well as any remaining RCAM technology commercialization barriers and risks.
- Update the wind plant LCOE analysis.
- Prepare a *Technoeconomic and Market Analyses Report* and presentation that includes but is not limited to:
    - The revised wind plant construction assumptions.
    - The estimated production costs of a full-scale RCAM printer configuration.
    - The updated LCOE analysis results.
    - The results and recommendation found in the technoeconomic analysis.
    - The results and recommendation found in the market analysis.
- In coordination with CAM, prepare and conduct one-day stakeholder workshop to present and discuss project results with stakeholders.
    - Perform necessary workshop planning, logistics and communications to stakeholders, e.g. wind plant owners, experts in concrete additive manufacturing.
    - Utilize appropriate organization's network to distribute information and awareness of the project and workshop.
- Prepare *Concrete Additive Manufacturing Stakeholder Workshop Notes* to include the results and key lessons learned from the Stakeholder Workshop.

Products:

- Technoeconomic and Market Analyses Report (Draft and Final)
- Concrete Additive Manufacturing Stakeholder Workshop Notes

TASK 9: EVALUATION OF PROJECT BENEFITS

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

The Recipient shall:

- Complete three Project Benefits Questionnaires that correspond to three main intervals in the Agreement: (1) *Kick-off Meeting Benefits Questionnaire*; (2) *Mid-term Benefits Questionnaire*; and (3) *Final Meeting Benefits Questionnaire*.
- Provide all key assumptions used to estimate projected benefits, including targeted market sector (e.g., population and geographic location), projected market penetration, baseline and projected energy use and cost, operating conditions, and emission reduction calculations. Examples of information that may be requested in the questionnaires include:

    - <u>For Product Development Projects and Project Demonstrations:</u>
        - Published documents, including date, title, and periodical name.

- Estimated or actual energy and cost savings, and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
- Greenhouse gas and criteria emissions reductions.
- Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
- Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
- A discussion of project product downloads from websites, and publications in technical journals.
- A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Additional Information for Product Development Projects:
    - Outcome of product development efforts, such copyrights and license agreements.
    - Units sold or projected to be sold in California and outside of California.
    - Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
    - Investment dollars/follow-on private funding as a result of Energy Commission funding.
    - Patent numbers and applications, along with dates and brief descriptions.
- Additional Information for Product Demonstrations:
    - Outcome of demonstrations and status of technology.
    - Number of similar installations.
    - Jobs created/retained as a result of the Agreement.

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

- Respond to CAM questions regarding responses to the questionnaires.

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

EXHIBIT A
Scope of Work

Products:

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

TASK 10: TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

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

The Recipient shall:

- Prepare an *Initial Fact Sheet* at start of the project that describes the project. Use the format provided by the CAM.
- Prepare a *Final Project Fact Sheet* at the project's conclusion that discusses results. Use the format provided by the CAM.
- Prepare a *Technology/Knowledge Transfer Plan* that includes:
  - An explanation of how the knowledge gained from the project will be made available to the public, including the targeted market sector and potential outreach to end users, utilities, regulatory agencies, and others.
  - A description of the intended use(s) for and users of the project results.
  - Published documents, including date, title, and periodical name.
  - Copies of documents, fact sheets, journal articles, press releases, and other documents prepared for public dissemination. These documents must include the Legal Notice required in the terms and conditions. Indicate where and when the documents were disseminated.
  - A discussion of policy development. State if project has been or will be cited in government policy publications, or used to inform regulatory bodies.
  - The number of website downloads or public requests for project results.
  - Additional areas as determined by the CAM.
- Conduct technology transfer activities in accordance with the Technology/Knowledge Transfer Plan. These activities will be reported in the Progress Reports.
- When directed by the CAM, develop *Presentation Materials* for an Energy Commission-sponsored conference/workshop(s) on the project.
- When directed by the CAM, participate in annual EPIC symposium(s) sponsored by the California Energy Commission.
- Provide at least (6) six *High Quality Digital Photographs* (minimum resolution of 1300x500 pixels in landscape ratio) of pre and post technology installation at the project sites or related project photographs.
- Prepare a *Technology/Knowledge Transfer Report* on technology transfer activities conducted during the project.

Products:

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

TASK 11: PRODUCTION READINESS PLAN

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

The Recipient shall:

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

Products:

- Production Readiness Plan (draft and final)

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

NOVATION AGREEMENT
for EPIC grant number EPC-17-023
March 2021

This Novation Agreement is made and entered into by RCAM Technologies, Inc., a Delaware corporation formed in 2020, with a principal address of 5490 Tenino Avenue, Boulder, Colorado 80303, and with a California office at 2372 Morse Ave., Suite 358, Irvine, California 92614 (hereinafter "Transferee"); Jason Cotrell, a sole proprietor doing business as RCAM Technologies, located at 2372 Morse Ave., Suite 358, Irvine, California 92614 (hereinafter "Transferor"), and the State Energy Resources Conservation and Development Commission (hereinafter "Energy Commission"), a California State Agency located at 1516 Ninth Street in Sacramento, California. The Transferor, Transferee, and Energy Commission are collectively referred to in this Novation Agreement as the "Parties."

The Effective Date of this Novation Agreement is the date the Energy Commission signs it. The Energy Commission shall be the last of the Parties to sign and shall only sign if the Novation Agreement is approved by the Energy Commission at a Commission Business Meeting.

A. Recitals:

1) In 2018, the Energy Commission and Jason Cotrell, a sole proprietor dba RCAM Technologies, entered into an Electric Program Investment Charge-funded grant agreement, designated Energy Commission Number EPC-17-023, for an amount of $1,249,982. The purpose of the Grant is to develop and test a reinforced concrete additive manufacturing (RCAM) technology in a laboratory, with the ultimate purpose of building low-cost, ultra-tall, wind turbine towers onsite at a wind power plant.

2) As used in this Novation Agreement, the words "Agreement," "Agreement EPC-17-023," or "Grant" refer to the original Agreement and any and all subsequent modifications and amendments to it that occurred prior to the Effective Date of this Novation Agreement.

3) The Transferee has requested this Novation Agreement to accurately reflect the business changes that it and the Transferor have undergone (and/or current circumstances for them), which are summarized as follows:
   - Jason Cotrell, as a sole proprietor dba RCAM Technologies, desired to overcome the typical limitations of sole proprietorship, such as unlimited personal liability and greater difficult in attracting investment and financing, compared to a corporation.
   - On August 4, 2020, RCAM Technologies, Inc. was organized as a corporation in Delaware.
   - On September 21, 2020, RCAM Technologies, Inc. registered with the California Secretary of State to do business in California.

- On December 20, 2020, RCAM Technologies, Inc. filed a Statement of Information with the California Secretary of State.

B. In consideration for the mutual promises contained in this Novation Agreement, the Parties agree as follows:

1) Transferor hereby assigns, transfers, conveys, and delivers to Transferee all of Transferor's rights, title, and interest in the Grant. Transferor further agrees to cooperate in transmitting within a reasonable time to Transferee any necessary data, reports, information, dedicated hardware, software, supplies, materials, equipment, or anything else collected, developed, used, or purchased under the Grant, and to perform all other actions necessary to enable Transferee to assume its responsibilities under the Grant pursuant to this Novation Agreement.

2) Transferor represents that it has fulfilled all obligations, including but not limited to delivering products and making any payments, applicable to and binding on Transferor under the Grant as of the Effective Date of this Novation Agreement.

3) Transferee hereby accepts such assignment and agrees to assume all of Transferor's rights, duties, liabilities, and obligations in, to, and under the Grant.

4) Transferee agrees to be bound to the terms and conditions of the Grant as if Transferee was the original recipient of the Grant. The Transferee also assumes all obligations and liabilities of, and all claims against, the Transferor under the Grant as if the Transferee were the original party to the Grant.

5) Transferor, Transferee and Energy Commission hereby agree that this Novation Agreement shall constitute a novation of the obligations of Transferor under the Grant. Accordingly, all of the rights, duties and obligations of Transferor under the Grant are hereby extinguished. Energy Commission recognizes Transferee as Transferor's successor in interest in and to all of Transferor's rights, duties and obligations in, to and under the Grant.

6) The Transferee ratifies all previous actions taken by the Transferor with respect to the Grant, with the same force and effect as if the action had been taken by the Transferee.

7) The Energy Commission recognizes the Transferee as the Transferor's successor in interest in and to the Grant and will now work with the Transferee on completing the work under the Grant. The Transferee by this Novation Agreement becomes entitled to all rights, titles, and interests of the Transferor in and to the Grant as if the Transferee were the original party to the Grant. The term "Recipient" as used in the Grant, shall refer to the Transferee. Accordingly, all of Transferor's rights, duties, and obligations under the Grant are hereby extinguished.

8) The Parties agree that they will take those actions reasonably necessary to carry out the matters contemplated by this Novation Agreement or any of its provisions.

9) All payments and reimbursements previously made by the Energy Commission to the Transferor, and all other previous actions taken by the Energy Commission under the Grant, shall be considered to have discharged those parts of the Energy Commission's obligations under the Grant. All payments and reimbursements made by the Energy Commission after the Effective Date in the name of or to the Transferor shall have the same force and effect as if made to the Transferee, and shall constitute a complete discharge of the Energy Commission's obligations under the Grant to the extent of the amounts paid or reimbursed.

10) The Transferor and the Transferee agree that the Energy Commission is not obligated to pay or reimburse either of them for, or otherwise give effect to, any costs, taxes, or other expenses, or any related increases, directly or indirectly arising out of or resulting from the transfer or this Novation Agreement, other than those that the Energy Commission in the absence of this transfer or Novation Agreement would have been obligated to pay or reimburse under the terms of the Grant.

11) The Grant shall remain in full force and effect, except as modified by this Novation Agreement.

12) If any term, condition, or provision in this Novation Agreement is found to be invalid, unlawful or unenforceable to any extent, the Parties shall endeavor in good faith to agree to such amendments that will preserve, as far as possible, the intentions expressed in this Novation Agreement. If the Parties fail to agree on such an amendment, such invalid term, condition or provision will be severed from the remaining terms, conditions and provisions, which will continue to be valid and enforceable to the fullest extent permitted by law.

13) This Novation Agreement contains the entire agreement of the Parties and supersedes all previous communications, representations, understandings and agreements, either oral or written, between the parties with respect to said subject matter.

14) This Novation Agreement may not be amended, except by a writing signed by the Parties.

15) This Novation Agreement may be executed in counterparts, each of which so executed will be deemed to be an original and such counterparts together will constitute one and the same agreement.

16) This Novation Agreement will be interpreted and construed in accordance with the laws of the State of California and the United States of America, without regard to conflict of law principles. Any and all disputes arising out of this Agreement will be resolved in California. All disputes arising out of this Agreement will be subject to the exclusive jurisdiction of the state and federal courts located in or nearest to

Sacramento, California, and each Party hereby consents to the personal jurisdiction and venue thereof. By agreeing to the exclusive jurisdiction of the state and federal courts in California, the Energy Commission does not waive its rights to have any disputes first brought before the Government Claims Program, nor does it waive its rights to any other administrative remedies to which it is entitled.

17) This Novation Agreement shall be deemed to have been prepared equally by the Parties, and it and its individual provisions shall not be construed or interpreted more favorably for one party on the basis that another party prepared it.

18) California Taxpayer Access to Publicly Funded Research Act

a. As a condition of this Novation Agreement, the Recipient agrees to fully comply with the California Taxpayer Access to Publicly Funded Research Act (California Government Code sections 13989 et seq., the "Act") and provisions of this section, which apply to publications describing knowledge, an invention, or technology funded within the scope of Agreement EPC-17-023.

b. For purposes of complying with the Act and this section of the Novation Agreement, the following definitions shall apply.

1) "Peer-Reviewed Manuscript" means a manuscript after it has been peer reviewed and in the form in which it has been accepted for publication in a scientific journal.

2) "Research Grant" in the Act and "this Agreement" in this section mean the Agreement EPC-17-023.

3) "State Agency" in the Act means the Energy Commission.

c. The Recipient shall provide for free public access to any Peer-Reviewed Manuscript developed within the scope of this Agreement.

d. The Recipient shall ensure that any publishing or copyright agreements concerning Peer-Reviewed Manuscripts:

1) Fully comply with California Government Code section 13989.6;

2) Do not conflict with the Energy Commission's rights under this Agreement;

3) Secure for the Energy Commission the rights provided under this Agreement, including the rights to Intellectual Property; and

4) Recognize the free public access to the Peer-Reviewed Manuscript.

e. The Recipient shall report to the Energy Commission the final disposition of any Peer-Reviewed Manuscript, including but not limited to if it was published; when

it was published; where it was published; and, when the 12-month time period expires, where the Peer-Reviewed Manuscript will be available for open access.

f. Not later than 12 months after the official date of publication, or sooner if specified in the Schedule of Products, the Recipient shall make available to the Energy Commission an electronic version of any Peer-Reviewed Manuscript that is developed within the scope of this Agreement.

g. The Recipient shall make publicly accessible an electronic version of any Peer-Reviewed Manuscript that is developed within the scope of this Agreement, not later than 12 months after the official date of publication, on a repository approved in writing by the Energy Commission, including but not limited to the University of California's eScholarship Repository at the California Digital Library; the California State University's ScholarWorks at the Systemwide Digital Library; or PubMed Central. The Recipient shall notify the Energy Commission when the Peer-Reviewed Manuscript is available on an Energy Commission-approved repository.

h. If the Recipient is unable to ensure that its Peer-Reviewed Manuscript is accessible on an Energy Commission-approved, publicly accessible repository, the Recipient may comply by providing the manuscript to the Energy Commission not later than 12 months after the official date of publication.

i. For any publications other than a Peer-Reviewed Manuscript, (herein referred to as "Other Publications") including scientific meeting abstracts, developed within the scope of this Agreement, the Recipient shall:

   1) Provide an electronic version of the Other Publications to the Energy Commission not later than 12 months after the official date of publication.

   2) Ensure that any publishing or copyright agreements concerning Other Publications:

      i. Do not conflict with the Energy Commission's rights under this Agreement.

      ii. Secure for the Energy Commission the rights provided under this Agreement, including the rights to Intellectual Property.

j. The Act states that "Grantees are authorized to use grant money for publication costs, including fees charged by a publisher for color and page charges, or fees for digital distribution." Recipient agrees that for purposes of this Agreement, the Recipient is only authorized to use funds under this Agreement, including Matching funds, for these purposes if the expenses are included in this Agreement's Budget and meet the other Agreement requirements for payment, including that the Commission will only reimburse the Recipient for expenditures

incurred during the Agreement term. If these expenses are not included in the Budget, both parties must agree and amend the Budget to include such expenditures before Recipient is authorized to use Agreement funds, either reimbursable expenses or match, for these purposes.

k. Should a conflict exist between the terms in this Section 18 of this Novation Agreement and other terms of Agreement EPC-17-023, the terms in this section prevail.

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IN WITNESS WHEREOF, by signing below, the Parties hereby agree to the above terms and conditions of this Novation Agreement and intend to be legally bound thereby.

Jason Cotrell, a sole proprietor doing business as RCAM Technologies (Transferor)

TRANSFEROR'S NAME (If other than an individual, state whether a corporation,

BY *(Authorized Signature)*	DATE SIGNED *(Do not type)*
✍	✍

NAME AND TITLE OF PERSON SIGNING
Jason Cotrell

ADDRESS
2372 Morse Ave., Suite 358, Irvine, California 92614

RCAM Technologies, Inc. (corporation) (Transferee)

TRANSFEREE'S NAME (If other than an individual, state whether a corporation, partnership, etc)

BY *(Authorized Signature)*	DATE SIGNED *(Do not type)*
✍	✍

NAME AND TITLE OF PERSON SIGNING

ADDRESS

STATE OF CALIFORNIA

AGENCY NAME
State Energy Resources Conservation and Development Commission

BY *(Authorized Signature)*	DATE SIGNED *(Do not type)*
✍	✍

NAME AND TITLE OF PERSON SIGNING
Adrienne Winuk, Contracts, Grants, and Loans Office Manager

ADDRESS
1516 Ninth Street, MS-18
Sacramento, CA 95814-5512

RESOLUTION NO: 21-0317-1d

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: RCAM TECHNOLOGIES, INC.

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 a novation substituting RCAM Technologies, Inc. for Jason Cotrell dba RCAM Technologies, under Agreement EPC-17-023, as set forth in the attached Novation Agreement. Mr. Cotrell and the project team will continue ultra-tall wind turbine tower research under the new entity. There are no changes to the scope of work; 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 Commission does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the CEC held on March 17, 2021.

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

_____
Patricia Carlos
Secretariat