STATE OF CALIFORNIA
CONTRACT REQUEST FORM (CRF)
CEC-94 (Revised 01/13) CALIFORNIA ENERGY COMMISSION

A) New Agreement 300-15-006 (To be completed by CGL Office)

B) Division	**Agreement Manager:**	**MS-**	**Phone**
ERDD	Brad Williams	51	916-327-3312

C) Contractor's Legal Name	**Federal ID Number**
The Regents of the University of California, on behalf of the Los Angeles campus	95-6006143

D) Title of Project
Optimizing Use of Non-traditional Waters, Drought Proofing the Electricity System and Improving Snowpack

E) Term and Amount	**Start Date**	**End Date**	**Amount**
	4/1/2016	3/31/2020	$ 1,130,000

F) Business Meeting Information

☐ Operational agreement (see CAM Manual for list) to be approved by Executive Director

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

Proposed Business Meeting Date	3/9/2016	☐ Consent	☒ Discussion
Business Meeting Presenter	Sonya Ziaja	Time Needed:	5 minutes

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

Agenda Item Subject and Description

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA, LOS ANGELES. Proposed resolution approving Agreement 300-15-006 with The Regents of the University of California, on behalf of the Los Angeles campus, for a $1,130,000 contract to fund research that will reduce the stress on current water infrastructure and supply. This will include development of efficient high water recovery desalination processes for non-traditional waters; characterizing the potential for non-traditional water use in California; development of recycled water scenarios for electricity generation; and improving the characterization of California's snowpack.
(EPIC funding) Contact: (Sonya Ziaja will present all three CERC-WET Interagency Agreements)

G) California Environmental Quality Act (CEQA) Compliance

1. Is Agreement considered a "Project" under CEQA?
   ☒ Yes (skip to question 2) ☐ No (complete the following (PRC 21065 and 14 CCR 15378)):
   Explain why Agreement is not considered a "Project":

2. If Agreement is considered a "Project" under CEQA:
   ☒ a) Agreement **IS** exempt. (Attach draft NOE)
   - ☐ Statutory Exemption. List PRC and/or CCR section number:
   - ☒ Categorical Exemption. List CCR section number: Cal. Code Regs., tit 14, § 15301 -- Cal. Code Regs., tit 14, § 15306
   - ☒ Common Sense Exemption. 14 CCR 15061 (b) (3)

   Explain reason why Agreement is exempt under the above section:
   This project will consist of computer modeling, paper studies and pilot testing in existing facilities: Exemptions 15061 (b)(3), 15301, 15306

   Task 2: 15061(b)(3): Consists of a paper study to address non-traditional water market characterization
   Task 3: 15061(b)(3): Consists of a paper study to examine and analyze existing contract structures between water recyclers and thermal power customers. Also consists of computer modeling analyzing multiple water conservation scenarios and their impact on California's electricity generation sector.
   Task 4: 15061 (b)(3): Consists of computer modeling to improve the hydrological models for California. Field monitoring will be used periodically.
   Task 5: 15301 & 15306: Consists of minor alterations to existing facilities for pilot testing of membrane technology and basic data collection with no major disturbance to environmental resources.

   ☐ 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

STATE OF CALIFORNIA
CONTRACT REQUEST FORM (CRF)
CEC-94 (Revised 01/13) CALIFORNIA ENERGY COMMISSION

H) **List all subcontractors (major and minor) and equipment vendors:** (attach additional sheets as necessary)				
Legal Company Name:	Budget	SB	MB	DVBE
Regents of the University of California, on behalf of the Berkeley Campus	$ 115,000	☐	☐	☐
	$	☐	☐	☐

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

J) **Budget Information**			
Funding Source	**Funding Year of Appropriation**	**Budget List No.**	**Amount**
EPIC	15-16	301.001C	$1,130,000
			$
R&D Program Area: EERO: Buildings		TOTAL:	$1,130,000
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

K) **Contractor's Administrator/ Officer**				**Contractor's Project Manager**			
Name:	Florencia O'Brien			Name:	Steve Margulis		
Address:	UCLA Office Of Contracts & Grants BOX 951406, 11000 Kinross Building, Ste. 211			Address:	5732D Boelter Hall		
City, State, Zip:	Los Angeles, CA 90095-1406			City, State, Zip:	Los Angeles, CA 90095-0001		
Phone:	310-206-0807 /	Fax:	- -	Phone:	310-267-5490 /	Fax:	- -
E-Mail:	flora.obrien@research.ucla.edu			E-Mail:	margulis@seas.ucla.edu		

L) Selection Process Used (For amendments, address amendment exemption or NCB, do not identify solicitation type of original agreement.)

☐ Solicitation Select Type Solicitation #: _____ # of Bids: _____ Low Bid? ☐ No ☐ Yes
☐ Non Competitive Bid *(Attach CEC 96)*
☒ Exempt Interagency

M) Contractor Entity Type

☐ Private Company *(including non-profits)*
☒ CA State Agency *(including UC and CSU)*
☐ Government Entity *(i.e. city, county, federal government, air/water/school district, joint power authorities, university from another state)*

N) **Is Contractor a certified Small Business (SB), Micro Business (MB) or DVBE?**	☒ No	☐ Yes
If yes, check appropriate box:	☐ SB ☐ MB	☐ DVBE

O) Civil Service Considerations

☐ Not Applicable (Agreement is with a CA State Entity or a membership/co-sponsorship)
☒ Public Resources Code 25620, et seq., authorizes the Commission to contract for the subject work. (PIER)
☐ The Services Contracted:
- ☐ are not available within civil service
- ☐ cannot be performed satisfactorily by civil service employees
- ☐ are of such a highly specialized or technical nature that the expert knowledge, expertise, and ability are not available through the civil service system.

☐ The Services are of such an:
- ☐ urgent
- ☐ temporary, or
- ☐ occasional nature

that the delay to implement under civil service would frustrate their very purpose.

Justification:
Public Resources Code 25620, et seq., authorizes the Commission to contract for the subject work. (PIER)

P) Payment Method

☒ A. Reimbursement in arrears based on:
☒ Itemized Monthly ☐ Itemized Quarterly ☐ Flat Rate ☐ One-time
☐ B. Advanced Payment
☐ C. Other, explain:

Q) Retention

1. Is Agreement subject to retention?	☒ No	☐ Yes
If Yes, Will retention be released prior to Agreement termination?	☐ No	☐ Yes

R) Justification of Rates

Rates in this agreement are consistent with previously contracted UC rates.

S) Disabled Veteran Business Enterprise Program (DVBE)

1. ☒ Exempt (Interagency/Other Government Entity)
2. ☐ Meets DVBE Requirements DVBE Amount:$ _____ DVBE %: _____
   ☐ Contractor is Certified DVBE
   ☐ Contractor is Subcontracting with a DVBE: _____
3. ☐ Contractor selected through CMAS or MSA with no DVBE participation.
4. ☐ Requesting DVBE Exemption (attach CEC 95)

T) Miscellaneous Contract Information

1. Will there be Work Authorizations?	☒ No	☐ Yes
2. Is the Contractor providing confidential information?	☒ No	☐ Yes
3. Is the Contractor going to purchase equipment?	☐ No	☒ Yes
4. Check frequency of progress reports		
☒ Monthly ☐ Quarterly ☐ _____		
5. Will a final report be required?	☐ No	☒ Yes
6. Is the contract, with amendments, longer than a year? If yes, why?	☐ No	☒ Yes

The Department of General Services has agreed to give the Commission blanket authority to execute multi-year contracts to support the Commission's RD&D Programs.

U) The following items should be attached to this CRF (as applicable)

1. Exhibit A, Scope of Work	☐ N/A	☒ Attached
2. Exhibit B, Budget Detail	☐ N/A	☒ Attached
3. CEC 96, NCB Request	☒ N/A	☐ Attached
4. CEC 30, Survey of Prior Work	☒ N/A	☐ Attached
5. CEC 95, DVBE Exemption Request	☒ N/A	☐ Attached
6. CEQA Documentation	☐ N/A	☒ Attached
7. Resumes	☐ N/A	☒ Attached
8. 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

TASK LIST

Task #	CPR[1]	Task Name
1	N/A	General Project Tasks
2	X	Market Characterization of Non-traditional Waters and Treatment Technologies in California
3	X	Recycled Water Scenarios for Electricity Generation
4	X	Characterization of Snowpack and Snowmelt Runoff in High-Elevation Remote Basins
5	X	High Water-Recovery Desalination of Non-Traditional Waters
6		Evaluation of Project Benefits
7		Technology/Knowledge Transfer Activities

ACRONYMS/GLOSSARY

Specific acronyms and terms used throughout this scope of work are defined as follows:

Acronym	Definition
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CERC-WET	China Clean Energy Research Center-Water Energy Technology
CPR	Critical Project Review
CPUC	California Public Utilities Commission
DOE	U.S. Department of Energy
EPIC	Electric Program Investment Charge
Energy Commission	California Energy Commission
Non-Traditional Waters	i.e. Oil and gas mining wastewaters, water from carbon sequestration, municipal wastewater, brackish groundwater. Waters are available in abundant quantities, but they cannot be used for most industrial, agricultural, and municipal applications without treatment to remove impurities
SWE	Snow Water Equivalent
TAC	Technical Advisory Committee
UAV	unmanned aerial vehicle
UCLA	University of California, Los Angeles

[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.

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

A. Purpose of Agreement

The purpose of this Agreement is to provide Electric Program Investment Charge (EPIC) cost share funding for the Contractor's federally-funded project, which received an award under federal funding opportunity announcement, DE-FOA-0001285, UC-China Clean Energy Research Center: Energy and Water. The purpose of the project is to fund research that will reduce the stress on current water infrastructure and supply. This will include development of high water-recovery desalination processes for non-traditional waters; characterizing the potential for non-traditional water use in California; development of recycled water scenarios for electricity generation; and improving the characterization of California's snowpack. Energy Commission funds will be used to fund tasks identified in this Statement of Work.

B. Problem/ Solution Statement

Problem
The issues to be addressed in this contract include the following:

1. Non-traditional waters are available in abundant quantities, but they cannot be used for most industrial, agricultural and municipal applications without treatment to remove impurities, such as salts, divalent cations, and organic and inorganic compounds. New approaches are needed to manage contaminants and facilitate the greater use of non-traditional waters by lowering costs, reducing environmental impacts and achieving water quality tailored to the specific application. In addition, characterization of the market potential and guidance on the most promising technologies would facilitate the future use of this resource in place of traditional water sources.
2. For over a decade, the Energy Commission has worked with applicants to build new power plants in California to reduce water consumption through the use of recycled water and water efficient technologies such as dry cooling. The "drought proofing" effect of using recycled water has led many power plants in California to be priority customers for the recycled water suppliers. But, it is not currently known what the effects of water conservation will be and how those effects will be distributed on an electricity sector that depends on recycled water providers. If significant water conservation is achieved, as directed by the recently adopted State Water Resources Control Board (SWRCB) regulations or by hypothetical future restrictions, the flows to wastewater treatment plants that produce recycled water could be reduced. Recycled water could also become more valuable to sell on the market to non-energy costumers. Although in the current drought, and with existing conservation measures, there has been little impact on recycled water supplies. More research is needed to clarify the scenarios for a recycled water dependent electricity sector in the context of increased urban conservation that also takes climate change effects into account. It should be noted that the effects are not anticipated to be uniform (Draft 2015 IEPR). The effect of urban water conservation on recycled water will likely be case specific and depend on the source(s) of flow the treatment plant receives.
3. Probabilistic streamflow forecasts are very important to the management of hydropower units. Current methods can result in errors of up to 30 percent. Even in California, these snowpack-derived water resources are located in remote mountain terrain that has a relatively limited in-situ monitoring network. Characterizing these water and hydropower energy resources, and how they are changing, requires a paradigm shift away from

relying solely on scarce in-situ data. For these reasons, the Energy Commission is currently supporting research projects on this topic. The first one (EPC-14-067) uses in-situ snowpack measurements and telemetry to more accurately compute the amount of water contained in the snowpack and to receive and process the information in a near real time basis. The second project (EPC-14-064) makes use of a sophisticated weather model coupled with a module to simulate atmospheric chemistry and the interactions between small particles in the air (aerosols) and clouds. Past work sponsored by the Energy Commission suggests substantial potential forecast improvements simulating aerosols, which are not considered in current weather forecast models. Finally, a third project with UC Irvine through the CERC-WET program will use satellite data and observations to improve a promising technique for large scale hydrological forecasting. A research group from the University of California, Los Angeles (UCLA) supported by U.S. Department of Energy (DOE) has been working to develop novel methodologies that leverage remote sensing measurements, which provide unique information about such regions.

The UCLA work has two main thrusts: i) working toward methods that could provide real time estimates, such as, resource management opportunities and ii) historical reanalysis that can provide new insight for modeling and management of these resources and understanding how they may be changing. The UCLA work on snowpack characterization has consisted of:

- improving snowpack measurement and monitoring process and radiative transfer models for the purposes of converting remote sensing measurements
- investigating snow processes using field measurements
- developing new tools for estimating large scale water stored in seasonal snowpacks from remotely sensed passive microwave, and
- visible/near-infrared-derived snow covered area measurements.

Much of the work to date has focused on the Sierra Nevada and in the areas of method development and validation. Preliminary results are very promising, showing accuracy of estimates derived from the methods developed to be comparable to independent in-situ data, but available at high-resolution (in space and time) over full watersheds. The research team is also currently developing an unmanned aerial vehicle (UAV) platform for remote sensing in mountainous environments, with the goal of automated periodic surveying of snow in remote basins that could be used to augment satellite data. Research needs to be done to illuminate which method or combination of methods will substantially improve forecasting abilities where a reasonable amount of resources are required in a forecasting method used for practical applications.

Solution

The Contractor will:

1. Develop new integrated strategies for high water-recovery desalination under variable water feed conditions. New approaches will optimize desalination operation and performance and assess technical, energy and cost performance of various membranes.
2. Define and characterize the potential for cost-effective treatment and re-use of non-traditional waters in California. Guidance will be provided on the most promising technologies and sectors that could potentially use this resource in place of traditional water sources.
3. Develop and analyze comparative scenarios for the impact of high levels of reliance on recycled water for energy generation under drought and high urban water conservation conditions. The scenarios will be developed with a multidisciplinary perspective. The

analysis will also consider potential changes to contracts between recycled water providers and electricity generators.

4. Expand on methods for improving snowpack monitoring and hydropower management under various conditions. New methodologies will be coordinated with other snowpack monitoring Energy Commission funded projects in order to clarify which methods fit best with which conditions.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

1. Increase use of non-traditional waters in California.
2. Improve reliability of hydropower generation through greater knowledge of snowpack density and volume, and analysis of "best fit" methodologies for snowpack monitoring.
3. Provide the fundamental data needed for decision making tools for energy generation under future drought conditions.

Ratepayer Benefits:[2] This Agreement will result in the ratepayer benefit[s] of greater electricity reliability and lower costs by using non-traditional and recycled waters for electricity generation and other uses. Water pumping, treatment, delivery and use are energy intensive, utilizing 19 percent of the state's electricity, 30 percent of its natural gas and 88 billion gallons of diesel each year. Additionally, the drought exacerbates this as dwindling surface water requires more and more emphasis on groundwater pumping. Electric ratepayers will benefit from advancements in more efficient and lower cost technologies that will enable the use of alternative, non-traditional and recycled water sources for electricity generation and for use by industrial, agriculture and other users. This could result in reductions in energy associated with ground water pumping, and water delivery if local non-traditional or recycled waters could be used.

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:

- Providing a California roadmap to energy and water saving technologies related to non-traditional water sources and identifying key milestones.
- Uncovering the points of flexibility and vulnerability in the recycled water-energy generation nexus, which can be used to inform future technology and policy choices.
- Providing additional coordinated methodologies for snowpack monitoring to further hydropower generation reliability and cost-effectiveness.

[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.

Agreement Objectives

The objectives of this Agreement are to:

- Identify the sources of non-traditional waters in California and their potential for re-use.
- Address key challenges and possible solutions associated with the development of a next generation treatment system for non-traditional waters, such as desalination.
- Quantify the cost, benefits and market readiness of the most promising technologies.
- Develop scenarios that provide insight on the relationship between an electricity sector that is dependent on recycled water, water contracts, and high water conservation (drought) conditions.
- Develop, improve, and coordinate methodologies with the Energy Commission sponsored research discussed above for snowpack monitoring in the Sierra Nevada.

III. TASK 1 GENERAL PROJECT TASKS

DELIVERABLES

Subtask 1.1 Deliverables

The goal of this subtask is to establish the requirements for submitting project deliverables (e.g., reports, summaries, plans, and presentation materials). Unless otherwise specified by the Commission Agreement Manager (CAM), the Contractor must provide deliverables as required below by the dates listed in the **Schedule of Deliverables (Part V).** Deliverables that require a draft version are indicated by marking **"(draft and final)"** after the deliverable name in the "Deliverables" section of the task/subtask. If "(draft and final)" does not appear after the deliverable name, only a final version of the deliverable is required. With respect to due dates within this Scope of Work, **"days"** means working days.

The Contractor shall:

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

- Submit all draft deliverables to the CAM for review and comment in accordance with the Schedule of Deliverables (Part V). The CAM will provide written comments to the Contractor on the draft deliverable within 15 days of receipt, unless otherwise specified in the task/subtask for which the deliverable 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 deliverable.
- Submit the revised deliverable with responses and 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 deliverables that require a final version only

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

For all deliverables

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

Instructions for Submitting Electronic Files and Developing Software:

- **Electronic File Format**
  Submit all data and documents required as deliverables 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 deliverables under this Agreement, and establishes the software versions that will be required to review and approve all software deliverables:
  - 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 Contractor 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 Contractor 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 Contractor 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:
- o Terms and conditions of the Agreement;
- o Deliverables (subtask 1.1);
- o CPR meetings (subtask 1.3);
- o Permit documentation (subtask 1.8);
- o Subcontracts (subtask 1.9); and
- o Any other relevant topics.

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

- Provide an *Updated Schedule of Deliverables, List of Match Funds,* and *List of Permits*, as needed to reflect any changes in the documents.
- If the awarding federal agency conducts similar kick-off meeting, the Contractor will notify the CAM and invite him/her to participate (subject to the awarding federal agency's approval), either by teleconference or in-person. The federal agency's kick-off meeting may also serve as the Energy Commission's kick-off meeting, at the discretion of the CAM.

The CAM shall:
- Designate the date and location of the meeting.
- Send the Contractor a *Kick-off Meeting Agenda*.

Contractor Deliverables:
- Updated Schedule of Deliverables *(if applicable)*
- Updated List of Permits *(if applicable)*

CAM Deliverable:
- 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, deliverables, schedule, or budget. CPR meetings provide the opportunity for frank discussions between the Energy Commission and the Contractor. 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

Contractor, 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 Contractor, but the overall Agreement amount will not increase. CPR meetings generally take place at the Energy Commission, but they may take place at another location, or may be conducted via electronic conferencing (e.g., WebEx) as determined by the CAM.

If the awarding federal agency conducts similar CPR meetings, the Contractor will notify the CAM and invite him/her to participate (subject to the awarding federal agency's approval), either by teleconference or in-person. The federal agency's CPR or equivalent meeting may be used in place of the Commission's CPR meeting, at the discretion of the CAM.

The Contractor shall:

- Prepare a *CPR Report* or equivalent federal agency report with Energy Commission tasks 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 or equivalent federal agency report with Energy Commission tasks along with any other *Task Deliverables* 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 deliverables along with the CPR Report).
- Attend the CPR meeting or equivalent federal agency meeting.
- Present the CPR Report or equivalent federal agency report and any other required information at each CPR meeting.

The CAM shall:

- Determine whether the equivalent federal agency meeting will substitute for the California Energy Commission's CPR meeting. If not, then the CAM will do the following:
  - Determine the location, date, and time of each CPR meeting with the Contractor's input.
  - Send the Contractor 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 Contractor 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, deliverables, 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 Contractor with a *Progress Determination* on continuation of the project, in accordance with the schedule. The Progress Determination may include a requirement that the Contractor revise one or more deliverables.

Contractor Deliverables:

- CPR Report(s) or equivalent federal agency report
- Task Deliverables (draft and/or final as specified in the task)

CAM Deliverables:

- 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 Contractor 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 Contractor 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 deliverables).
    - Need to document the Contractor's disclosure of "subject inventions" developed under the Agreement.
    - "Surviving" Agreement provisions such as repayment provisions and confidential deliverables.
    - Final invoicing and release of retention.
    - Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Contractor and Commission staff during the meeting.
    - Prepare a *Schedule for Completing Agreement Closeout Activities*.
    - Provide *All Draft and Final Written Deliverables* on a CD-ROM or USB memory stick, organized by the tasks in the Agreement.
    - Notify the CAM of any project review meetings conducted by the awarding federal agency, and invite the CAM to participate in the meetings by teleconference or in-person (subject to the awarding federal agency's approval).

Deliverables:

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

- All Draft and Final Written Deliverables

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 Contractor shall:

- Submit a monthly or quarterly Progress Report to the CAM. Report frequency can be adjusted as approved by CAM to align with federal reporting requirements (e.g. Quarterly, Bi-Annual, Annual). 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.
  - Include copies of any federal agency correspondence that occurred during the reporting period. Examples of correspondence include reports, summaries, letters, or emails that discuss project performance, Special Status Reports, Scientific/Technical Conference Papers/Presentations or Proceedings) and the results of project review meetings with the federal agency.
- In lieu of the progress report and with the CAM's approval, submit the progress report submitted to the awarding federal agency and include the items listed in this statement of work that pertain specifically to the California Energy Commission.
- 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.

Deliverables:

- 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 Contractor must use the Style Manual provided by the CAM.

Subtask 1.6.1 Final Report Outline

The Contractor 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 deliverables.)

Contractor Deliverables:

- Final Report Outline (draft and final)

CAM Deliverables:

- Style Manual

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

Subtask 1.6.2 Final Report

The Contractor 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 that discusses the specific Energy Commission-funded research activities, results and conclusions. (required)
    - References (if applicable)
    - Glossary/Acronyms (If more than 10 acronyms or abbreviations are used, it is required.)
    - Bibliography (if applicable)
    - Appendices (to include: a) copy of the final report for each major task in this statement of work, and b) the final reports for the federal-funded portion of the project under the China Clean Energy Research Center-Water Energy Technology (also known as CERC-WET) agreement with the U.S. Department of Energy) (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*.

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

Deliverables:

- Final Report (draft and final)
- Written Responses to Comments on the Draft Final Report
- Draft Federal Report (if applicable)
- Written Confirmation of the Federal Agency's Approval of the Final Federal Report (if applicable)

CAM Deliverable:

- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds (Not applicable)

The goal of this subtask is to ensure that the Contractor 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 Contractor may spend match funds for this task. The Contractor 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 Contractor must obtain any associated commitments before incurring any costs for which the Contractor will request reimbursement.

The Contractor 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 Contractor 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.

Deliverables:

- 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 Contractor may incur any costs related to the use of the permit(s) for which the Contractor will request reimbursement.

The Contractor 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 Contractor 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.

Deliverables:

- 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 Contractor 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).

Deliverables:

- 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 deliverables and provide recommendations for needed deliverable 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 deliverables.

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.

If the awarding federal agency conducts similar TAC meetings, the Contractor will notify the CAM and invite him/her to participate (subject to the awarding federal agency's approval), either by teleconference or in-person. The federal agency's TAC or equivalent meeting may be used in place of the Commission's TAC meetings, at the discretion of the CAM.

The CAM shall:

- Determine whether the equivalent federal agency TAC meetings will substitute for the Energy Commission's TAC Meetings. If the CAM determines that the federal agency TAC meetings are not equivalent then the Contractor shall complete the following:

The Contractor 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.

Deliverables:

- 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. This subtask is only applicable if the CAM determines that Energy Commission TAC meetings will be required.

The Contractor 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.

Deliverables:

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

IV. TECHNICAL TASKS

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

TASK 2: MARKET CHARACTERIZATION OF NON-TRADITIONAL WATERS AND TREATMENT TECHNOLOGIES IN CALIFORNIA

The goal of this task is to provide analysis on the current state of California's non-traditional water sources and to provide feedback on current and future technologies for treating these sources.

The Contractor shall:

- Provide a *Market Characterization Report* that shall include, but not be limited to, the following:
    - Provide a definition of non-traditional waters.
    - Identify the sources (processes and location) and quantities of non-traditional waters generated annually and/or existing in California.
    - Identify current uses such as agricultural, municipal and industrial of non-traditional waters and identify new applications that may be available through current and near-term treatment technologies.
    - Summarize the current state of near-term (5-10 years) non-potable water treatment technologies including those listed below in this task and if/how it benefits California. Leverage past projects from the California Energy Commission and others to the extent possible.
    - Create rating for estimated energy consumption per gallon of non-traditional waters treated (e.g., kWh consumption/gallon of non-traditional waters treated) and estimated time to maturity for each of the technologies listed below. The rating will be an approximate range of values (e.g., time to maturity = 2-5 years, 6-8 years, 9-12 years).

- Estimate cost targets (e.g., in $/1,000Litre of Treated Water, including capital and operating) needed for successful commercialization in California for each of the technologies listed below.
- Identify economic or industrial sectors where prototype testing or demonstration projects will be most technically and economically practicable for use of treated non-traditional waters.
- Discuss for each technology identified below, the technical and regulatory barriers, including any disposal requirements associated with the treatment methodology (e.g., toxic byproducts produced).
  - Potential technologies should include but are not limited to:
  - Capacitive Deionization
  - Removal of Divalent Cations with Graphene Oxide Membranes
  - Forward Osmosis with Ionic Liquids
  - Enhanced Treatment of Desalination Brines
  - System Level Analysis of Non-Traditional Water Management
  - Geochemical Approaches for Managing Non-Traditional Waters
  - High Water-Recovery Desalination of Non-Traditional Waters
  - Other near-term treatment technologies as agreed to with the CAM

- Participate in a CPR Meeting, per subtask 1.3 and prepare *CPR Report #1*

Deliverables:

- Market Characterization Report (draft and final)
- CPR Report #1

TASK 3: RECYCLED WATER SCENARIOS FOR ELECTRICITY GENERATION

The goal of this task is to develop scenarios for a recycled water dependent electricity sector in the context of increased urban water conservation, which also takes climate change effects into account. These scenarios can then be used as a foundation for water-energy decision making in California for adaptation planning and adjusting the electricity sector to the demands of climate change.

Contractor shall:

- Provide a *Scenarios Report for Potentials on Recycled Water Dependent Electricity Sector* that describes the methodology and findings from the scenario development work including, but not limited to:
  - Consideration of all proposed work to be done under Project 5.1 of the CERC-WET Proposal submitted to the DOE.[4]
  - Develop multiple scenarios for California's electricity generation sector that consider the potential consequences for generation if there is a high degree of reliance on recycled water, coupled with various high urban water conservation scenarios. The scenario development should use a multidisciplinary approach that may include at a minimum economic analysis, engineering approaches, and legal analyses.
  - Scenarios should include parameters developed through coordination with other Energy Commission-funded research groups, who are working on probabilistic climate forecasts and hydrologic consequences of climate change.

[4] This proposal was submitted to the Department of Energy (DOE) for funding opportunity DE-FOA-001285: U.S.-China Clean Energy Research Center: Energy and Water

  - Document how consideration was made of institutional and climate change related barriers to successful adoption of alternative water supplies to support reliable electricity generation.
- Provide a *Legal Analysis Report of Recycled Water Contracts for the Electricity Sector* which examines and analyzes the existing contract structure between recycled water suppliers and thermal power costumers, and consider alternative contract structures that may increase the flexibility of the system.
- If requested by CAM, provide a *Copy of Federal Report(s) Submitted to the DOE* containing but not limited to the research items as described in Project 5.1 of the US-China Clean Energy Research Center proposal provided to DOE.
- Participate in a CPR Meeting, per subtask 1.3 and prepare *CPR Report #2*

Deliverables:

- Scenarios Report on Potentials for Recycled Water Dependent Electricity Sector (draft and final)
- Legal Analysis Report of Recycled Water Contracts for the Electricity Sector (draft and final)
- Copy of Federal Report(s) Submitted to the DOE (if applicable)
- CPR Report #2

TASK 4: CHARACTERIZATION OF SNOWPACK AND SNOWMELT RUNOFF IN HIGH-ELEVATION REMOTE BASINS: IMPROVING THE CHARACTERIZATION OF CALIFORNIA'S SNOWPACK FOR WATER AND ENERGY RESOURCE MANAGEMENT

The goal of this task is to develop and make available an additional methodology designed to improve the characterization of the distribution of the Sierra snowpack using satellite data. A large fraction of California's population relies on snowmelt for a majority of their water supply and a significant amount of energy from hydropower. However, even in California, these snowpack-derived water resources are located in remote mountain terrain that has a relatively limited in-situ monitoring network. Characterizing these water and hydropower energy resources, and how they are changing, requires a paradigm shift away from relying solely on scarce in-situ data. Research will focus on developing novel methodologies that leverage remote sensing measurements, which provide unique information about such regions. The work on snowpack characterization has consisted of improving snowpack process and radiative transfer models for the purposes of inverting remote sensing measurements, investigating snow processes using field measurements, and developing new tools for estimating large scale water stored in seasonal snowpacks from remotely sensed passive microwave, and visible/near-infrared-derived snow covered area measurements. The work has two main thrusts:

i. Working toward methods that could provide real-time estimates and (resource management opportunities)
ii. Historical re-analyses that can provide new insight for modeling and management of these resources and understanding how they may be changing.

Research to date has focused on the Sierra Nevada and in the areas of method development and validation. Preliminary results are very promising, showing accuracy of estimates derived from the methods developed by the Principal Investigator and his team to be comparable to independent in-situ data, but available at high-resolution (in space and time) over full watersheds. The research team is also currently developing a UAV platform for remote sensing in mountainous environments, with the goal of automated periodic surveying of snow in remote basins that could be used to augment satellite data.

Probabilistic streamflow forecasts are very important to the management of hydropower units. Current methods can result in errors of up to 30 percent. Research will investigate what method or combination of methods will substantially improve forecasting skills requiring a reasonable amount of resources to have a good chance of making the forecasting method operational for practical applications.

Contractor shall:

- Coordinate information sharing with existing Energy Commission projects including:
    - EPC-14-067, with University of California, Berkeley, which uses in-situ snowpack measurements and telemetry to more accurately compute the amount of water contained in the snowpack and to receive and process the information in a near real time basis.
    - EPC-14-064, with University of California, Riverside, which makes use of a sophisticated weather model coupled with a module to simulate atmospheric chemistry and the interactions between small particles in the air (aerosols) and clouds.
    - Past work sponsored by the Energy Commission suggests substantial potential forecast improvements simulating aerosols, which are not considered in current weather forecast models.
- Provide a *Hydrologic Models and Estimates in California Report* that includes, but is not limited to:
    - Extension of the range of snowpack estimates as submitted to DOE[5] to the full Sierra Nevada. This extends on the proposed research items as described in Task 3.3 of the 2015 US-China Clean Energy Research Center proposal. This research will use satellite data and observations to improve a promising technique for large scale hydrological forecasting.
    - Use the improved snowpack estimates derived in this task to drive hydrologic models and derive streamflow estimates and forecasts that could be used to more accurately predict and manage water and hydropower resources utilized by California (surrounding States) and within California.
- As required by the CAM, participate in research coordination meetings (maximum of four) with other research teams supported by the Energy Commission working on similar topics and with representatives of electric utilities.
- If requested by CAM, provide a *Copy of the Federal Hydrologic Models and Estimates Report* that shall include the research items as described in Task 3.3 of the US-China Clean Energy Research Center proposal provided to DOE.
- Participate in a CPR Meeting, per subtask 1.3 and prepare *CPR Report #3*

Deliverables:

- Hydrologic Models and Estimates in California Report (draft and final)
- Copy of the Federal Hydrologic Models and Estimates Report (if applicable)
- CPR Report #3

[5] This proposal was submitted to the Department of Energy (DOE) for funding opportunity DE-FOA-001285: U.S.-China Clean Energy Research Center: Energy and Water

TASK 5: HIGH WATER-RECOVERY DESALINATION OF NON-TRADITIONAL WATERS

Subtask 5.1: Develop new approaches for multi-stage membrane systems

The goal of this subtask is to evaluate state-of-the-art optimization and control strategies for membrane-based desalination systems (e.g., nanofiltration, reverse osmosis) to achieve higher product water-recovery and reduced energy consumption than conventional reverse osmosis system designs. Optimization objectives will be evaluated with respect to minimizing energy consumption, maximizing water-recovery and treated water quality, and minimizing membrane fouling and scaling. This subtask will also include a review of commercially available ("off-the-shelf") technologies as well as the latest developments in advanced technologies in the scientific literature.

Contractor shall:

- Provide *High Water-Recovery Desalination of Non-Traditional Waters in California Report* that shall include, but not be limited to:
  - Summary of current and past research at the federal, local and private level related to treatment of non-traditional waters in California.
  - Identify which optimized control strategies, for single and multi-stage membrane systems, are most applicable to treat non-traditional waters specific to California.
  - Estimate cost targets associated with different commercially available membrane systems and state-of-the-art control systems (e.g., in $/1,000Litre of treated water, including capital and operating) needed for successful commercialization in California.
  - Summary of locations or industry-types where the approaches identified in this research would be most relevant in California.
- If requested by CAM, provide a *Copy of the Federal Report for Task 5* that [6]shall include the research items as described in Task 5 of the US-China Clean Energy Research Center proposal provided to DOE.
- Participate in a CPR Meeting, per subtask 1.3 and prepare *CPR Report #4.*

Deliverables:

- High Water-Recovery Desalination of Non-Traditional Waters in California Report (draft and final)
- Copy of the Federal Report for Task 5 (if applicable)
- CPR Report #4

Subtask 5.2: Evaluate the Effectiveness of Nano-Structured Membranes

The goal of this subtask is to advance and field-demonstrate the use of novel surface nano-structured membranes to improve operations of high recovery desalination, particularly with respect to membrane fouling/scaling resistance and membrane cleaning effectiveness. Relevant to high recovery desalting, the research will focus on high salinity brackish water with high fouling/mineral scaling propensity, building on UCLA's technology of surface nanostructured membranes for low salinity brackish water sources.

[6] This proposal was submitted to the Department of Energy (DOE) for funding opportunity DE-FOA-001285: U.S.-China Clean Energy Research Center: Energy and Water. Task 5 work centers specifically on Treatment of non-traditional waters

Contractor shall:

- Provide report titled *Effectiveness of Nano-Structured Membranes in Mitigating Fouling in the California Market* that shall include, but not be limited to:
  - Summary of current and past research at the federal, local and private level related to nano-structured membranes and applicability to the California market and its effectiveness in reducing fouling for non-traditional waters, but not limited to high salinity brackish ground waters.
  - Estimate cost targets associated with nano-structured membranes (e.g., in $/1,000Liters, including capital and operating) needed for successful commercialization.
  - Summary of locations where the use of nano-structured membranes would be most relevant in California.
- If requested by CAM, provide a *Copy of the Federal Report for Task 5* that shall include the research items as described in Task 5 of the US-China Clean Energy Research Center proposal provided to DOE.

Deliverables

- Effectiveness of Nano-Structured Membranes in Mitigating Fouling in the California Market (draft and final)
- Copy of the Federal Report for Task 5 (if applicable)

Subtask 5.3: Assess the Integration of Concentrate Treatment/Minimization Strategies

The goal of this subtask is to assess the integration of state-of-art concentrate treatment/minimization strategies and technologies with membrane based desalination processes, and identify the benefits of increased recovery of fresh water relative to the costs of additional treatment.

Contractor shall:

- Provide an *Assessment of Concentrate Treatment/Minimization Strategies in California Report* that shall include, but not be limited to:
  - Identification and discussion of new strategies, data analysis, technical and cost, and energy performance assessments of high recovery membrane desalination via concentrate treatment and applicability to California no-traditional waters.
  - Summary of technical and cost performance assessments from evaluation of integrated concentrate treatment/minimization processes and technologies and identification of promising targets for future test and demonstrations.
- If requested by CAM, provide a *Copy of the Federal Report for Task 5* that shall include the research items as described in Task 5 of the US-China Clean Energy Research Center proposal provided to DOE.

Deliverables

- Assessment of Concentrate Treatment/Minimization Strategies in California Report (draft and final)
- Copy of the Federal Report for Task 5 (if applicable)

TASK 6: EVALUATION OF PROJECT BENEFITS

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

The Contractor shall:

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

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

    - For Information/Tools and Other Research Studies:
        - Outcome of project.
        - Published documents, including date, title, and periodical name.
        - A discussion of policy development. State if the project has been cited in government policy publications or technical journals, or has been used to inform regulatory bodies.
        - The number of website downloads.

  - An estimate of how the project information has affected energy use and cost, or has 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 deliverable 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 Contractor similar questionnaires after the Agreement term ends. Responses to these questionnaires will be voluntary.

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

TASK 7: 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 Contractor 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 on the results of the project.
- Prepare a *Technology/Knowledge Transfer Report* on technology transfer activities conducted during the project.
- Prepare and conduct communication and outreach activities commensurate with organizational mission.

Deliverables:

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

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

RESOLUTION NO: 16-0309-10c

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: UNIVERSITY OF CALIFORNIA, LOS ANGELES

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

RESOLVED, that the Energy Commission approves Agreement 300-15-006 with The Regents of the University of California, on behalf of the Los Angeles campus, for a $1,130,000 contract to fund research that will reduce water-related energy costs as well as relieve stress on water infrastructure and supply. This will include development of efficient high water recovery desalination processes for non-traditional waters; characterizing the potential for non-traditional water use in California; development of recycled water scenarios for electricity generation; and improving the characterization of California's snowpack; and

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

CERTIFICATION

The undersigned Secretariat to the Commission does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the California Energy Commission held on March 9, 2016.

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

Tiffani Winter,
Secretariat