

CONTRACT REQUEST FORM (CRF)

CEC-94 (Revised 01/13)

CALIFORNIA ENERGY COMMISSION



J) Budget Information			
Funding Source	Funding Year of Appropriation	Budget List No.	Amount
NG Subaccount, PIERDD	13-14	501.001H	\$600,000
			\$
R&D Program Area: EGRO: EA		TOTAL:	\$
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

K) Contractor's Administrator/ Officer		Contractor's Project Manager	
Name:	Judy Zhao	Name:	Dan Cayan
Address:	9500 Gilman Drive -- MC0505	Address:	9500 Gilman Drive
City, State, Zip:	LA JOLLA, CA 92093	City, State, Zip:	LA JOLLA, CA 92093-0411
Phone:	858-534-0841 / Fax: - -	Phone:	858-534-4507 / Fax: - -
E-Mail:	jczhao@ucsd.edu	E-Mail:	Dcayan@ucsd.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:

The contract is an interagency agreement which is exempt from civil service considerations.

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

The rates identified in this contract are consistent with the standard negotiated rates between the University of California and the Energy Commission.



s) Disabled Veteran Business Enterprise Program (DVBE)	
1. <input checked="" type="checkbox"/> Exempt (Interagency/Other Government Entity)	
2. <input type="checkbox"/> Meets DVBE Requirements	DVBE Amount:\$ _____ DVBE %: _____
<input type="checkbox"/> Contractor is Certified DVBE	
<input type="checkbox"/> Contractor is Subcontracting with a DVBE:	_____
3. <input type="checkbox"/> Contractor selected through CMAS or MSA with no DVBE participation.	
4. <input type="checkbox"/> Requesting DVBE Exemption (attach CEC 95)	

t) Miscellaneous Contract Information	
1. Will there be Work Authorizations?	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes
2. Is the Contractor providing confidential information?	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes
3. Is the Contractor going to purchase equipment?	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes
4. Check frequency of progress reports	
<input type="checkbox"/> Monthly <input checked="" type="checkbox"/> Quarterly <input type="checkbox"/> _____	
5. Will a final report be required?	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes
6. Is the agreement, with amendments, longer than a year? If yes, why?	<input type="checkbox"/> No <input checked="" type="checkbox"/> 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	<input type="checkbox"/> N/A <input checked="" type="checkbox"/> Attached
2. Exhibit B, Budget Detail	<input type="checkbox"/> N/A <input checked="" type="checkbox"/> Attached
3. CEC 96, NCB Request	<input checked="" type="checkbox"/> N/A <input type="checkbox"/> Attached
4. CEC 30, Survey of Prior Work	<input checked="" type="checkbox"/> N/A <input type="checkbox"/> Attached
5. CEC 95, DVBE Exemption Request	<input checked="" type="checkbox"/> N/A <input type="checkbox"/> Attached
6. CEQA Documentation	<input type="checkbox"/> N/A <input checked="" type="checkbox"/> Attached
7. Resumes	<input type="checkbox"/> N/A <input checked="" type="checkbox"/> Attached
8. CEC 105, Questionnaire for Identifying Conflicts	<input checked="" type="checkbox"/> Attached

_____	_____	_____	_____	_____	_____
Agreement Manager	Date	Office Manager	Date	Deputy Director	Date

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TECHNICAL TASK LIST

Task #	CPR	Task Name
1	N/A	Administration
2		Enhancing and Applying the LOCA Downscaling Technique
3	X	Trends in Cooling Degree Days
4		Development of "Probabilistic" Sea level Rise Projections for the Energy System
5		Developing Drought Scenarios for California
6		Wildfire Scenarios for the Energy System
7		Field Measurements to Estimate Seismic Hazards in the Sacramento/San Joaquin Delta Region
8		Supporting the Inclusion of the Data Generated in Tasks 2, 3, and 4 in Cal-Adapt

GLOSSARY

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

Acronym	Definition
CAM	Commission Agreement Manager
CDD	Cooling Degree Days
CPR	Critical Project Review
Energy Commission	California Energy Commission
EPA	Environmental Protection Agency
IMU	Inertial Motion Unit
LOCA	Localized Constructed Analogs
TAC	Technical Advisory Committee
RCP	Representative Concentration Pathways
UCC.1	Uniform Commercial Code (Financing Statement)
USGS	US Geological Survey
VIC	Variable Infiltration Capacity

Problem Statement

The Contractor [Scripps Institution of Oceanography/UC San Diego] has developed a new statistical downscaling technique for the California Energy Commission, known as Localized Constructed Analogs (LOCA). This new technique is a substantial advance from prior downscaling methods because it is better at simulating extreme events and producing more realistic geographical distributions of precipitation. However, LOCA does not simulate some meteorological factors (e.g., solar radiation, cooling degrees days) that are important to estimate natural gas demand and the potential impacts of climate change to the natural gas system. For example, coastal natural gas facilities are exposed to storms that will increase in frequency with climate change. New quasi probabilistic projections are needed to risk assessments for the coastal natural gas infrastructure located in California. Similarly other weather and climate related factors (e.g., wildfires) will affect natural gas pipelines and other facilities but these scenarios have not been updated since about 2010. Finally, seismic risks in the Sacramento-San Joaquin Delta

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may be higher than expected and more detailed measurements of the movement of the levees is required to produce more accurate estimations of risks. Several important natural gas facilities are located in the Delta.

Goals of the Agreement

The goals of this Agreement are to develop projections and scenarios to be used for California's Fourth Climate Change Assessment.

Objectives of the Agreement

The objectives of this Agreement are to: 1) enhance the prior work done with LOCA by adding the simulation of other variables, such as relative humidity and wind velocity; 2) diagnose changes of cooling degree days (CDD) over the 21st century in key locations in California; 3) develop, using sea level rise projections from available sources including methods of Cayan et al. 2009¹ and Kopp et al. 2014², enhanced, as needed, probabilistic sea level rise projections; 4) develop "drought" scenarios informed by the paleo-record, which involves use of empirical observations to construct a record of the distant past, as well as by publicly available global climate model projections; 5) develop wildfire scenarios using LOCA results as an input; 6) provide support to the detection of levee subsidence in the Sacramento-San Joaquin Delta; and 7) provide the needed support to the Cal-Adapt team at UC Berkeley (<http://cal-adapt.org/>) to display in Cal-Adapt the results from the LOCA and Variable Infiltration Capacity (VIC) models and the probabilistic sea level rise projections.

TASK 1.0 GENERAL PROJECT TASK

MEETINGS

Task 1.1 Attend Kick-off Meeting

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

The Contractor shall:

- Attend a "kick-off" meeting with the Commission Agreement Manager (CAM), the Contracts Officer, and a representative of the Accounting Office. The Contractor shall bring their Project Manager, Contracts Administrator, Accounting Officer, and others designated by the Commission Agreement Manager to this meeting. The administrative and technical aspects of this Agreement will be discussed at the meeting. Prior to the kick-off meeting, the Commission Agreement Manager will provide an agenda to all potential meeting participants.

The administrative portion of the meeting shall include, but not be limited to, the following:

- Terms and conditions of the Agreement
- Critical Project Reviews (CPRs) (Task 1.2)

¹ Dan Cayan et al, *Climate Change Scenarios and Sea Level Rise Estimates for the California 2009 Climate Change Scenarios Assessment*, A paper from the California Climate Change Center, August 2009, [CEC-500-2009-014-F](http://www.cccr.org/CEC-500-2009-014-F).

² Kopp, R.E., et al. 2014. Probabilistic 21st and 22nd century sea-level projections at a global network of tide gauge sites. *Earth's Future* 2: 383–406.

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- Match fund documentation (Task 1.7)
- Permit documentation (Task 1.8)

The technical portion of the meeting shall include, but not be limited to, the following:

- The Commission Agreement Manager's expectations for accomplishing tasks described in the Scope of Work;
- An updated Schedule of Deliverables
- Progress Reports (Task 1.4)
- Technical Deliverables (Task 1.5)
- Final Report (Task 1.6)
- Establish the TAC (Task 1.10)
- TAC Meetings (Task 1.11)

The Commission Contract Manager shall designate the date and location of this meeting.

Contractor Deliverables:

- An Updated Schedule of Deliverables
- An Updated List of Match Funds
- An Updated List of Permits
- Schedule for Recruiting TAC Members

Commission Agreement Manager Deliverables:

- Final Report Instructions

Task 1.2 CPR Meetings

The goal of this task is to determine if the project should continue to receive Energy Commission funding to complete this Agreement and if it should, are there any modifications that need to be made to the tasks, deliverables, schedule or budget.

CPRs provide the opportunity for frank discussions between the Energy Commission and the Contractor. CPRs generally take place at key, predetermined points in the Agreement, as determined by the Commission Agreement Manager and as shown in the Technical Task List above and in the Schedule of Deliverables. However, the Commission Agreement Manager may schedule additional CPRs as necessary, and, if necessary, the budget will be reallocated to cover the additional costs borne by the Contractor, but the overall contract amount will not increase.

Participants include the Commission Contract Manager and the Contractor, and may include the Commission Agreement Officer, the PIER Program Team Lead, other Energy Commission staff and Management as well as other individuals selected by the Commission Agreement Manager to provide support to the Energy Commission.

The Commission Agreement Manager shall:

- Determine the location, date and time of each CPR meeting with the Contractor. These meetings generally take place at the Energy Commission, but they may take place at another location.

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- Send the Contractor the agenda and a list of expected participants in advance of each CPR. If applicable, the agenda shall include a discussion on both match funding and permits.
- Conduct and make a record of each CPR meeting. One of the outcomes of this meeting will be a schedule for providing the written determination described below.
- Determine whether to continue the project, and if continuing, whether or not to modify the tasks, schedule, deliverables and budget for the remainder of the Agreement, including not proceeding with one or more tasks.
- Provide the Contractor with a written determination in accordance with the schedule. The written response may include a requirement for the Contractor to revise one or more deliverable(s) that were included in the CPR.

The Contractor shall:

- Prepare a CPR Report for each CPR that discusses the progress of the Agreement toward achieving its goals and objectives. This report shall include recommendations and conclusions regarding continued work of the projects. This report shall be submitted along with any other deliverables identified in this Scope of Work. Submit these documents to the Commission Agreement Manager and any other designated reviewers at least 15 working days in advance of each CPR meeting.
- Present the required information at each CPR meeting and participate in a discussion about the Agreement.

Contractor Deliverables:

- CPR Report(s)
- CPR deliverables identified in the Scope of Work

Commission Agreement Manager Deliverables:

- Agenda and a List of Expected Participants
- Schedule for Written Determination
- Written Determination

Task 1.3 Final Meeting

The goal of this task is to closeout this Agreement.

The Contractor shall:

- Meet with the Energy Commission to present the findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement.

This meeting will be attended by, at a minimum, the Contractor, the Commission Agreement Officer, and the Commission Agreement Manager. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which

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may be two separate meetings at the discretion of the Commission Agreement Manager.

The technical portion of the meeting shall present findings, conclusions, and recommended next steps (if any) for the Agreement. The Commission Agreement Manager will determine the appropriate meeting participants.

The administrative portion of the meeting shall be a discussion with the Commission Agreement Manager and the Contracts Officer about the following Agreement closeout items:

- What to do with any state-owned equipment (Options)
 - Need to file UCC.1 form re: Energy Commission's interest in patented technology
 - Energy Commission's request for specific "generated" data (not already provided in Agreement deliverables)
 - Need to document 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 schedule for completing the closeout activities for this Agreement.

Deliverables:

- Written documentation of meeting agreements and all pertinent information
- Schedule for completing closeout activities

REPORTING

See Exhibit D, Reports/Deliverables/Records.

Task 1.4 Quarterly Progress Reports

The goal of this task is to periodically verify that satisfactory and continued progress is made towards achieving the research objectives of this Agreement.

The Contractor shall:

- Prepare progress reports which summarize all Agreement activities conducted by the Contractor for the reporting period, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. Each progress report is due to the Commission Agreement Manager within 10 working days after the end of the reporting period. Attachment A-2, Progress Report Format, provides the recommended specifications.

Deliverables:

- Quarterly Progress Reports

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Task 1.5 Test Plans, Technical Reports and Interim Deliverables

The goal of this task is to set forth the general requirements for submitting test plans, technical reports and other interim deliverables, unless described differently in the Technical Tasks. When creating these deliverables, the Contractor shall use and follow, unless otherwise instructed in writing by the Commission Agreement Manager, the latest version of the PIER Style Manual published on the Energy Commission's web site:

<http://www.energy.ca.gov/contracts/pier/contractors/index.html>

The Contractor shall:

- Unless otherwise directed in this Scope of Work, submit a draft of each deliverable listed in the Technical Tasks to the Commission Agreement Manager for review and comment in accordance with the approved Schedule of Deliverables. The Commission Agreement Manager will provide written comments back to the Contractor on the draft deliverable within 10 working days of receipt. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Agreement Manager. The Commission Agreement Manager shall provide written approval of the final deliverable within 5 working days of receipt. Key elements from this deliverable shall be included in the Final Report for this project.

Task 1.6 Final Report

The goal of this task is to prepare a comprehensive written Final Report that describes the original purpose, approach, results and conclusions of the work done under this Agreement. The Commission Agreement Manager will review and approve the Final Report. The Final Report must be completed on or before the termination date of the Agreement. When creating these deliverables, the Contractor shall use and follow, unless otherwise instructed in writing by the Commission Contract Manager, the latest version of the PIER Style Manual published on the Energy Commission's web site:

<http://www.energy.ca.gov/contracts/pier/contractors/index.html>

The Final Report shall be a public document. If the Contractor has obtained confidential status from the Energy Commission and will be preparing a confidential version of the Final Report as well, the Contractor shall perform the following subtasks for both the public and confidential versions of the Final Report.

Task 1.6.1 Final Report Outline

The Contractor shall:

- Prepare a draft outline of the Final Report.
- Submit the draft outline of Final Report to the Commission Contract Manager for review and approval. The Commission Agreement Manager will provide written comments back to the Contractor on the draft outline within 10 working days of receipt. Once agreement has been reached on the draft, the Contractor shall submit the final outline to the Commission Agreement Manager. The Commission Agreement Manager shall provide written approval of the final outline within 5 working days of receipt.

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Deliverables:

- Draft Outline of the Final Report
- Final Outline of the Final Report

Task 1.6.2 Final Report

The Contractor shall:

- Prepare the draft Final Report for this Agreement in accordance with the approved outline.
- Submit the draft Final Report to the Commission Agreement Manager for review and comment. The Commission Agreement Manager will provide written comments within 10 working days of receipt.

Once agreement on the draft Final Report has been reached, the Commission Agreement Manager shall forward the electronic version of this report for Energy Commission internal approval. Once the approval is given, the Commission Agreement Manager shall provide written approval to the Contractor within 5 working days.

- Submit one bound copy of the Final Report with the final invoice.

Deliverables:

- Draft Final Report
- Final Report

MATCH FUNDS, PERMITS, AND ELECTRONIC FILE FORMAT

Task 1.7 Identify and Obtain Matching Funds

The goal of this task is to ensure that the match funds planned for this Agreement are obtained for and applied to this Agreement during the term of this Agreement.

The costs to obtain and document match fund commitments are not reimbursable through this Agreement. While the Natural Gas budget for this task will be zero dollars, the Contractor may utilize match funds for this task. Match funds shall be spent concurrently or in advance of Natural Gas funds during the term of this Agreement. Match funds must be identified in writing, and the associated commitments obtained before the Contractor can incur any costs for which the Contractor will request reimbursement.

The Contractor shall:

- Prepare a letter documenting the match funding committed to this Agreement and submit it to the Commission Agreement Manager at least 2 working days prior to the kick-off meeting:
 1. 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 such in the letter.

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2. 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 each cash match fund, its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied.
 - Amount of each in-kind contribution, a description, documented market or book value, and its 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 shall identify its owner and provide a contact name, address and telephone number, and the address where the property is located.
 - A copy of the letter of commitment from an authorized representative of each source of cash match funding or in-kind contributions that these funds or contributions have been secured.
- Discuss match funds and the implications to the Agreement if they are significantly reduced or not obtained as committed, at the kick-off meeting. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
 - Provide the appropriate information to the Commission Agreement Manager if during the course of the Agreement additional match funds are received.
 - Notify the Commission Agreement Manager within 10 working days if during the course of the Agreement existing match funds are reduced. Reduction in match funds may trigger an additional CPR.

Deliverables:

- A letter regarding Match Funds or stating that no Match Funds are provided
- Letter(s) for New Match Funds
- A copy of each Match Fund commitment letter
- Letter that Match Funds were Reduced (if applicable)

Task 1.8 Identify and Obtain Required Permits

The goal of this task 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 reimbursable under this Agreement. Permits must be identified in writing before the Contractor can incur any costs related to the use of the permit(s) for which the Contractor will request reimbursement.

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The Contractor shall:

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the Commission Agreement Manager at least 2 working days prior to the kick-off meeting:
 1. If there are no permits required at the start of this Agreement, then state such in the letter.
 2. If it is known at the beginning of the Agreement that permits will be required during the course of the Agreement, provide in the letter:
 - A list of the permits that identifies the:
 - Type of permit
 - Name, address and telephone number of the permitting jurisdictions or lead agencies
- Schedule the Contractor will follow in applying for and obtaining these permits.
- The list of permits and the schedule for obtaining them will be discussed at the kick-off meeting, and a timetable for submitting the updated list, schedule and the copies of the permits will be developed. The implications to the Agreement 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 the progress reports and will be a topic at CPR meetings.
- If during the course of the Agreement additional permits become necessary, then provide the appropriate information on each permit and an updated schedule to the Commission Agreement Manager.
- As permits are obtained, send a copy of each approved permit to the Commission Agreement Manager.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the Commission Agreement Manager within 5 working days. Either of these events may trigger an additional CPR.

Deliverables:

- A letter documenting the Permits or stating that no Permits are required
- Updated list of Permits as they change during the Term of the Agreement
- Updated schedule for acquiring Permits as it changes during the Term of the Agreement
- A copy of each approved Permit

Task 1.9 Electronic File Format

The goal of this task is to unify the formats of electronic data and documents provided to the Energy Commission as contract deliverables. Another goal is to establish the computer platforms, operating systems and software that will be required to review and approve all software deliverables.

The Contractor shall:

- Deliver documents to the Commission Agreement Manager in the following formats:
 - Data sets shall be in Microsoft (MS) Access or MS Excel file format.

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- PC-based text documents shall be in MS Word file format.
- Documents intended for public distribution shall be in PDF file format, with the native file format provided as well.
- Project management documents shall be in MS Project file format.

- Request exemptions to the electronic file format in writing at least 90 days before the deliverable is submitted.

Deliverables:

- A letter requesting exemption from the Electronic File Format (if applicable)

Technical Advisory Committee

Task 1.10 Establish the TAC

The goal of this task is to create a technical advisory committee (TAC) for this Agreement.

The TAC should be composed of diverse professionals. The number can vary depending on potential interest and time availability. The exact composition of the TAC may change as the need warrants. TAC members serve at the discretion of the Commission Agreement Manager.

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

- Researchers knowledgeable about the project subject matter
- Members of the trades who 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 project subject matter
- U.S. Department of Energy Research Manager
- Public Interest Environmental Groups
- Utility Representatives
- Members of the relevant technical society committees

The purpose of the TAC is to:

- Provide guidance in research direction. The guidance may include scope of research; research methodologies; timing; coordination with other research. The guidance may be based on:
 - technical area expertise
 - knowledge of market applications
 - linkages between the agreement work and other past, present or future research (both public and private sectors) they are aware of in a particular area.
- Review deliverables. Provide specific suggestions and recommendations for needed adjustments, refinements, or enhancement of the deliverables.
- Evaluate tangible benefits to California of this research and provide recommendations, as needed, to enhance tangible benefits.

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- Provide recommendations regarding information dissemination, market pathways or commercialization strategies relevant to the research products.

The Contractor shall:

- Prepare a draft list of potential TAC members that includes name, company, physical and electronic address, and phone number and submit it to the Commission Agreement Manager at least 2 working days prior to the kick-off meeting. This 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 and ensure that each individual understands the member obligations described above, as well as the meeting schedule outlined in Task 1.11.
- Prepare the final list of TAC members.
- Submit letters of acceptance or other comparable documentation of commitment for each TAC member.

Deliverables:

- Draft List of TAC Members
- Final List of TAC Members
- Letters of acceptance, or other comparable documentation of commitment for each TAC Member

Task 1.11 Conduct TAC Meetings

The goal of this task is for the TAC to provide strategic guidance to this project by participating in regular meetings or teleconferences.

The Contractor shall:

- Discuss the TAC meeting schedule at the kick-off meeting. The number of face-to-face meetings and teleconferences and the location of TAC meetings shall be determined in consultation with the Commission Agreement Manager. This draft schedule shall be presented to the TAC members during recruiting and finalized at the first TAC meeting.
- Organize and lead PAC meetings in accordance with the schedule. Changes to the schedule must be pre-approved in writing by the Commission Agreement Manager.
- Prepare TAC meeting agenda(s) with back-up materials for agenda items.
- Prepare TAC meeting summaries, including recommended resolution of major TAC issues.

Deliverables:

- Draft TAC Meeting Schedule
- Final TAC Meeting Schedule
- TAC Meeting Agenda(s) with Back-up Materials for Agenda Items
- Written TAC meeting summaries, including recommended resolution of major TAC issues

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TECHNICAL TASKS

The Contractor shall prepare all deliverables in accordance with the requirements in Task 1.5. Deliverables not requiring a draft version are indicated by marking “(no draft)” after the deliverable name.

Task 2: Enhancing and Applying the LOCA Downscaling Technique

The goal of this task is to enhance the LOCA downscaling technique to make it more useful for climate impacts and adaptation studies for the natural gas system and the energy system in general. For example, relative humidity and solar radiation have an important impact on heating loads that are currently served in California, mostly by furnaces burning natural gas. Higher winter temperatures will decrease natural gas consumption due to the expected decrease in heating demand but, if as suggested by some models, very cold nights will not disappear but they will become less frequent. Existing studies of cooling energy demand assume that relative humidity will not change in the future, which may be incorrect as suggested by the recent heat waves in California that have been characterized by high nighttime temperatures and the presence of high relative humidity. Increased cooling demand indirectly affects natural gas demand because the fossil fueled power plants in California predominantly consume natural gas.

The Contractor shall:

- Enhance the LOCA model by adding the capabilities to simulate or downscale relative humidity and wind velocities at least at a daily time resolution. Wind will be estimated as a vector (wind speed and direction) at 10 meters above ground and, if feasible, winds at 80 meters. Ground level incoming solar radiation will also be included.
- Use the enhanced LOCA model to downscale first the 10 selected global climate models that will be used for the California Climate Assessment and then the rest (about 20) of the available global climate models. The Representative Concentration Pathways (RCP) selected are RCP 8.5 and RCP 4.5.
- Update the prior probabilistic climate projections to include the new parameters (e.g., relative humidity) estimated for this task.
- Prepare a *Downscaling Report* to documenting the results of activities in this task listed above.
- Produce at least two complete RCP 2.6 climate projections including their associated VIC simulations.
- Update the “probabilistic” climate projections produced by Scripps for the Energy Commission under a prior Interagency Agreement (500-07-042), with the new data sets produced under this task.

Deliverables:

- Downscaling Report

Task 3: Trends in Cooling Degree Days

CDDs affect the demand of natural gas for heating in California. The goal of this task is to estimate how CDD would change in different regions in California and to understand the potential reasons for these potential changes. For example, if the changes are

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associated with conditions associated with less fog in the Central Valley, actual heating demand may go down more than expected due to changes in CDD because this factor does not take into account increases in exposure to solar radiation.

The Contractor shall:

Develop and diagnose changes of CDD using an ensemble of global climate models under different emission scenarios.

This task will:

- Use LOCA downscaled temperatures from global climate models (at least eight) under RCP 8.5 and RCP 4.5 scenarios.
- Perform an analysis to generate CDD data for a set of locations covering California natural gas utility service networks as agreed upon by the CAM.
- Create and submit a *Data File Containing CDD Data* from the analysis in the above bullet.
- Investigate contributions to annual heating degree day changes over time to understand seasonal effects to understand the projected occurrence of extreme high and extreme low heating degree days, and to understand how changes and extremes occur spatially over the California region.
- Prepare a *Technical Memorandum* which includes a discussion on projected changes in CDDs and the reasons for these changes. This memorandum must document the work done under this task as described above. This will be the CPR report.
- Participate in a CPR meeting (per Task1.2 of this agreement)

Deliverables:

- Data File Containing CDD Data (no draft)
- Technical Memorandum (no draft)

Task 4: Development of “Probabilistic” Sea level Rise Projections for the Energy System

The goal of this task is to address some of the deficiencies in prior studies.

This study is important for the Natural Gas System because it may be affected directly or indirectly by sea level rise. As pointed out by a natural gas utility in Southern California, there are coastal underground storage facilities that may be vulnerable to inundation or damaging flooding due to sea level rise and the increased frequency of what is now 1 in 100 storm events that may become very frequent events at the end of this century.

Underground natural gas storage and natural gas transmission lines in the Sacramento/San Joaquin Delta would also be more vulnerable with sea level rise.

There are several sources of information about sea level rise projections, but these projections are presented in the form of very wide ranges (e.g., from 0.2 meters to 2 meters by the end of the century as estimated by the National Oceanic and Atmospheric Administration (NOAA)). However, wide ranges are not very useful for long-term planning

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because they do not include the potential likelihood of the different sea level rise projections.

Fortunately, new scientific papers published in the last several months are starting to fill this void. A notable example is the paper by Kopp et al, 2014³ that develops “probabilistic” sea level rise projections for the United States considering all the factors that affects regional sea levels such as gravitational effects. However, Kopp et al. use historical information to infer the potential effects of tides and storms. Prior work by Scripps for the Energy Commission developed hourly sea level rise projections estimating the effect of astronomical tides, atmospheric pressure, El Nino events, and other factors.

Under this task, the methods of Cayan et al 2009⁴ and Kopp et al. 2014⁵, with modifications, as needed, will be used as a starting point to frame the production of quasi probabilistic sea level rise projections for California. It is important to note that the word “probabilistic” is not referring to real probabilities in the scientific statistical sense, but rather it is understood to be a combination of subjective probability estimation determined from a set of available information, including existing model projections as well as guidance from recognized experts. As such, these “probabilities” are acknowledged to depend upon the mix of scientific tools and information as well as the particular set of experts that are involved.

The probabilistic projections developed under this task do not take into account risk aversion that may necessitate the use of safety factors. Safety factors are not considered in this work because their selection involves policy decisions that are beyond the scope of this research project.

The sea level rise projections created as part of this project are only designed for the research activities in the Energy Commission that are supported to estimate the vulnerability of the energy system to sea level rise and to identify adaptation measures.

The Contractor shall:

- Using methods of Cayan et al. 2008 and Kopp et al. 2014⁶, modified, as needed, consider the effect of astronomical tides, wind, atmospheric pressure, along with larger scale secular sea level rise to be able to estimate short-term fluctuations of sea levels in at least six regions in California including the following three regions: San Francisco Bay area, Los Angeles/San Diego, and Humboldt Bay area.
- Develop quasi probabilistic sea level rise projections for California using the outputs from eight or more global climate models for RCPs 8.5; 4.5; and 2.6. If information about vertical land movement in the six regions in California becomes available, consider this information in the development of the scenarios.

³ Ibid.

⁴ Dan Cayan et al, *Climate Change Scenarios and Sea Level Rise Estimates for the California 2009 Climate Change Scenarios Assessment*, A paper from the California Climate Change Center, August 2009, [CEC-500-2009-014-F](#).

⁵ Kopp, R.E., et al. 2014. Probabilistic 21st and 22nd century sea-level projections at a global network of tide gauge sites. *Earth's Future* 2: 383–406.

⁶ Ibid.

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- Modify the method of Kopp et al., 2014 to consider new scientific information and input received from the CAM and the Technical Advisory Committee formed for this project.
- Consult a small set of other experts, as agreed upon by the Contractor's Principal Investigator (PI) and the CAM, to review methods used to determine the sea level rise projections. The outside experts may suggest methods and projections that could differ from those employed and adopted by the PI's research team. The PI team will provide a rationale for its decision to follow, or not to follow, the recommended sea level rise projections of the experts in producing the ultimate set of sea level projections under this task.
- Evaluate the performance of the sea level projection model(s) employed over the historical record with respect to the occurrence of extreme high hourly and daily sea level events.
- Present the distribution of projected sea level in its time varying form, over the projected period of the 21st century. If it is feasible, estimated "probability" distributions will be provided in the form of mathematical equations to allow the consideration of different design thresholds (e.g., design facilities to withstand events 98% of the time in the next 50 years).
- Prepare a *Probabilistic Sea Level Rise Report* documenting the study conducted under this task as required in the prior bullets.
- Provide a *Compatible File Containing Estimated Sea level Rise Projection Data Sets* to the Cal-Adapt team and, if requested by the CAM, the California GeoPortal.

Deliverables

- Probabilistic Report
- Compatible File Containing Estimated Sea level Rise Projection Data Sets (no draft)

Task 5: Developing Drought Scenarios for California

The goal of this task is to develop long drought scenarios for California to test the reliability of the natural gas system and the energy system in general to these potential droughts.

A recent study (Ault et al., 2014⁷) combining paleoclimatic data and simulations of historical and projected conditions to the end of the century, suggests that the probability of prolonged droughts may be underestimated by the current set of climate scenarios available from the most recent Intergovernmental Panel on Climate Change (IPCC) climate assessment. Under this task, the research team will create extended drought scenarios that include spells of 10 and 30 years having unusually dry conditions. These dry sequences will be constructed by concatenating global climate model dry year sequences, using guidance obtained from historical reconstructions based upon

⁷ Toby R. Ault et al, 2014. Assessing the Risk of Persistent Drought Using Climate Model Simulations and Paleoclimate Data. *Journal of Climate*, **27**, 7529–7549.

Exhibit A

SCOPE OF WORK

paleoclimate proxies. These scenarios will be used as test cases for scenarios that may be considered to have low probability of occurrence but with substantial consequences.

The Contractor shall:

- Develop two drought or extreme scenarios combining the outputs from tasks 1 and 2 to add years with low precipitation to create periods with 10 and 30-year droughts. The 10 and 30-year drought scenarios associated with selected global climate model projections based upon RCP8.5 and RCP 4.5 will be constructed.
- Prepare a *Drought Scenarios for California Report*.
- Prepare and provide to Cal-Adapt and the GeoPortal, a *Compatible File Containing Drought Scenario Data*.

Deliverables:

- Drought Scenarios for California Report
- Compatible File Containing Drought Scenario Data (no draft)

Task 6: Wildfire Scenarios for the Energy System

The goal of this task is to develop wildfire scenarios for California to examine the vulnerability of the energy system and the natural gas system in particular to the potential increase of frequency and intensity of wildfires as expected under a changing climate.

Wildfires can impact the operation of the natural gas system directly or indirectly. For example, the California wildfire of October 2003 in Southern California left approximately 1,000 customers in San Diego County without natural gas service for about one week. Floods resulting from rain in an unprotected area due to wildfires can damage natural gas infrastructure not only from the elevated water levels, but also by the flow of mud and debris that usually accompany these floods. For example, a flood in October 1986 resulted in the rupture of a natural gas pipeline, leaving about 42,300 residences and businesses from Fallon, Nevada to Lake Tahoe without gas for heating and cooking for more than a week. Subsequent studies to be funded by the Energy Commission will use these scenarios to examine the vulnerabilities of the natural gas system to the direct and indirect effects of wildfires.

The Contractor shall:

- Create wildfire risk scenarios for California using statistical methods that incorporates the hydroclimatic variables generated by LOCA. This model should be able to estimate size distribution of wildfires.
- Develop and use separate models for diverse portions of the state--partitioned by coarse characteristics of vegetation, climate and topography--and tile the results together to produce continuous maps of wildfire activities for state and federal fire protection areas within the State.
- Select, at a minimum, the representative climate scenarios that will be used for the California's Fourth Climate Change Assessment.
- Model wildfire monthly on a 1/8th-degree lat/lon grid. Wildfire burned area will be allocated onto the landscape and reported at annual resolution, taking into

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consideration limits imposed by topography, development, and burnable vegetation. Consult with the scientists conducting impacts and adaptation studies for the California's Fourth Climate Change Assessment to assess the need for subareas modeled at 1/16th-degree spatial resolution.

The spatial and temporal extent of 1/16th degree simulations may be limited by computing and data storage resource constraints, given the large number of stochastic replications this simulation work entails.

- Simulate different fuels management options so that users can see the impact of fuels management scenarios on fire risks, emissions, and other variables.
- Use population and development scenarios based on the Integrated Climate and Land Use Scenarios developed by the Environmental Protection Agency (EPA) (ICLUS, US EPA 2009).

If feasible, use the specific population and development scenarios that will be developed for the California's Fourth Climate Change Assessment.

- Study potential integrated wildfire-vegetation scenarios for coastal southern California using the wind data produced by LOCA. In this part of California, autumn wildfire activity is dominated by human ignited fires driven by Santa Ana winds and typically dry conditions at the end of the summer drought.
- Collaborate with the group maintaining Cal-Adapt to display the results generated under this task.
- Provide *Wildfire Data Sets in Format Suitable for Cal-Adapt*, containing output variables related to wildfire activity, including number of fires, burned area, emissions, and property risks.
- Produce a *Wildfire Scenarios for California Report* documenting the results obtained under this task as discussed above.

Deliverables:

- Wildfire Scenarios for California Report
- Wildfire Data Sets in Format Suitable for Cal-Adapt (no draft)

Task 7: Field Measurements to Estimate Seismic Hazards in the Sacramento/San Joaquin Delta Region

The goal of this task is to support more precise measurement of the movement of land in the Sacramento-San Joaquin Delta (Delta) to estimate potential seismic risks.

Multiple factors threaten the integrity of the levee system and associated natural gas infrastructure in the Delta, including subsidence, sea level rise, and seismic activity. The California Energy Commission is actively investigating risks associated with sea level rise and subsidence through a combination of state-of-the-art hydrological modeling and field measurements. However, the recent (August 24, 2014) M6 South Napa earthquake that caused hundreds of millions of dollars in damages, renewed concerns regarding the understanding of seismic hazard and risk in the nearby Delta. Of particular pertinence to the Delta was that the South Napa earthquake surface rupture occurred on a fault that was mapped only partially, and that was not deemed to have high recent seismic activity. The proposed work would leverage an existing contract (500-14-001) with US Geological

Exhibit A
SCOPE OF WORK

Survey (USGS) that will gather measurements of delta and levee subsidence with unprecedented detail in space and time. To provide the level of precision needed for measuring small ground displacements related to tectonic fault slip or creep (cm/yr), the field apparatus will be enhanced with an upgraded inertial motion unit (IMU).

The Contractor shall:

- Using a more precise IMU via this Agreement, support the measurements being conducted by USGS partners, who are working under a separate contract (500-14-001). These field measurements will provide essential inputs to constrain models of evolution of seismic hazards in the Sacramento/San Joaquin Delta. Ultimately, this will offer a much better understanding of the relative contribution of seismic hazard and sea level rise to the overall Delta as it informs best management practice for the natural gas system and other sectors.
- Prepare and give a *PowerPoint Presentation of IMU Analysis Results* at a meeting organized by the CAM.

Deliverable:

- PowerPoint Presentation of IMU Analysis Results (no draft)

Task 8: Supporting the Inclusion of the Data Generated in Tasks 1, 2, and 3 in Cal-Adapt

The goal of this task is to make the results of this Interagency Agreement available to natural gas utilities, natural gas rate payers, and the general public via Cal-Adapt.

The Contractor shall:

- Participate in at least one in-person meeting in Berkeley or Sacramento with the Cal-Adapt team and the CAM, and in a maximum of 10 conference calls with them to make sure the Cal-Adapt team understands how to properly use and characterize the data.
- Provide input on the write-up describing the data in Cal-Adapt
- Review the implementation of the data in Cal-Adapt to make sure that it is technically correct.

Deliverables:

- None for the contract file
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Exhibit A
SCOPE OF WORK, Attachment A-1
Schedule of Deliverables

UCSD / Scripps Institution of Oceanography			
Task Number	Task Name	Deliverable(s)	Due Date
1.0	General Project Task		4/30/2018
1.1	Attend Kick-off Meeting	An Updated Schedule of Deliverables	7/1/2015
		An Updated List of Match Funds	N/A
		An Updated List of Permits	N/A
		Schedule for Recruiting TAC Members	7/30/2015
	Commission Agreement Manager Deliverables	Final Report Instructions	
1.2	CPR Meetings	CPR Report(s)	3/15/2016
		CPR deliverables identified in this Scope of Work	3/15/2016
	Commission Agreement Manager Deliverables	Agenda and a List of Expected Participants	3/1/2016
		Schedule for Written Determination	3/15/2016
		Written Determination	3/30/2016
1.3	Final Meeting	Written documentation of meeting agreements and all pertinent information	4/1/2018
		Schedule for completing closeout activities	4/10/2018
1.4	Quarterly Progress Reports	Quarterly Progress Reports	4/30/2018
1.5	Test Plans, Technical Reports and Interim Deliverables		N/A
1.6	Final Report		
1.6.1	Final Report Outline	Draft Outline of the Final Report	10/3/2017
		Final Outline of the Final Report	10/30/2017
1.6.2	Final Report	Draft Final Report	11/1/2017
		Final Report	11/30/2017
1.7	Identify and Obtain Matching Funds	A letter regarding Match Funds or stating that no Match Funds are provided	N/A
		Letter(s) for New Match Funds	N/A
		A copy of each Match Fund commitment letter	N/A
		Letter that Match Funds were Reduced (if applicable)	N/A

Exhibit A
SCOPE OF WORK, Attachment A-1
Schedule of Deliverables

1.8	Identify and Obtain Required Permits	A letter documenting the Permits or stating that no Permits are required	N/A
		Updated list of Permits as they change during the Term of the Agreement	N/A
		Updated schedule for acquiring Permits as it changes during the Term of the Agreement	N/A
		A copy of each approved Permit	N/A
1.9	Electronic File Format	A Letter requesting exemption from the Electronic File Format (if applicable)	N/A
1.10	Establish the TAC	Draft List of TAC Members	NA
		Final List of TAC Members	7/1/2015
		Letters of acceptance, or other comparable documentation of commitment for each TAC Member	7/15/2015
1.11	Conduct TAC Meetings	Draft TAC Meeting Schedule	7/20/15
		Final TAC Meeting Schedule	7/25/2015
		TAC Meeting Agenda(s) with Back-up Materials for Agenda Items	7/20/15
		Written TAC meeting summaries, including recommended resolution of major TAC issues	8/15/2015
Technical Tasks			
2	Enhancing and Applying the LOCA Downscaling Technique	Draft Downscaling Report	1/1/2016
		Final Downscaling Report	2/1/2016
3	Trends in Cooling Degree Days	Technical Memorandum (CPR report)	2/1/2016
		Data File Containing CDD Data	3/1/2016
4	Development of "Probabilistic" Sea level Rise Projections for the Energy System	Draft Probabilistic Report	2/1/2016
		Final Probabilistic Report	3/1/2016
		Compatible File Containing Estimated Sea level Rise Projection Data Sets	3/1/2016
5	Developing Drought Scenarios for California	Draft Drought Scenarios for California Report	3/1/2016
		Final Drought Scenarios for California Report	4/15/2016
		Compatible File Containing Drought Scenario Data	4/15/2016
6	Wildfire Scenarios for the Energy System	Draft Wildfire Scenarios for California Report	2/1/2016
		Final Wildfire Scenarios for California Report	3/1/2016
		Wildfire Data Sets in Format Suitable for Cal-Adapt	3/1/2016
7	Field Measurements to Estimate Seismic Hazards in the Sacramento/San Joaquin Delta Region	PowerPoint Presentation of IMU Analysis Results	12/1/2016
8	Supporting the Inclusion of the Data Generated in Tasks 1, 2, and 3 in Cal-Adapt	None	1/1/2018

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: UNIVERSITY OF CALIFORNIA, SAN DIEGO

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

RESOLVED, that the Energy Commission approves Agreement 500-14-005 with **The Regents of the University of California, on behalf of the San Diego Campus, Scripps Institution of Oceanography** for a **\$600,000** contract to develop weather related scenarios for the natural gas system for California's Fourth Climate Change Assessment; 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 June 10, 2015.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

Harriet Kallemeyn,
Secretariat