

Exhibit A
SCOPE OF WORK

TECHNICAL TASK LIST

Task #	CPR	Task Name
1	N/A	Administration
2		Development of a hydrologic model for FERC relicensing
3		Analysis of hydropower project facilities vulnerability and potential effects on downstream environment
4		Project Outreach

KEY NAME LIST

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
1	Josh Viers, Cathryn Lawrence		
2	Josh Viers, Cathryn Lawrence		
3	Josh Viers, Cathryn Lawrence		
4	Josh Viers, Cathryn Lawrence		

GLOSSARY

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

Acronym	Definition
BCSD	Bias correction and spatial downscaling
CCM	Energy Commission Contract Manager
CPR	Critical Project Review
EIS	Environmental Impact Statements
FERC	Federal Energy Regulatory Commission
GAMS	General Algebraic Modeling System
NEPA	National Environmental Protection Act
PIER	Public Interest Energy Research
PG&E	Pacific Gas and Electric Company
UCC.1	Uniform Commercial Code (Financing Statement)
VIC	Variable Infiltration Capacity model

Problem Statement

It has been well documented that future climate will not mirror past climate due to global warming, and that global air temperatures are expected to warm by approximately 0.2°

Celsius per decade.¹ However, climate change is not considered for environmental impact statements (EIS) needed for compliance with the National Environmental Protection Act (NEPA), although Section 1502.22 of the EIS regarding incomplete or unavailable information states that agencies should evaluate reasonable and foreseeable effects on the human environment (NEPA, 1978). This statute influences hydropower licensing by the Federal Energy Regulatory Commission (FERC), which regularly files an EIS through their administration of the Federal Power Act. To date, however, FERC has not included a climate change alternative within the NEPA scoping process to incorporate expected future changes on hydropower operations and the downstream environment.

Goals of the Agreement

The overall goal of this proposed agreement is to provide valid scientific information pertaining to the impacts of climate change on hydropower operations and their downstream environmental impacts to promote the inclusion of climate change in the future FERC hydropower relicensing processes.

The energy sector is the main source of greenhouse gas emissions in California and, therefore, must contribute to the identification of potential climate change impacts and the development of coping and adaptation strategies. In addition, climate change will substantially affect energy generation and demand. Hydropower is an important renewable energy, supplying California 12.4% of its total electricity in 2008.²

The Energy Commission is expressly mandated by Executive Orders and statutes to engage in climate change research. Governor's Executive Order S-3-05 mandates the Energy Commission to engage in climate change research and provide scientific information to the Climate Change Action team's biennial climate change impacts assessment reports to the Governor and the State Legislature. Executive Order S-13-08 and the recently adopted California Climate Adaptation Strategy orders the Energy Commission to continue supporting climate change research to provide the scientific basis for the development of adaptation strategies for California. The Section 25620 (b) of the Public Resources Code orders the Energy Commission's Public Interest Energy Research program to support research endeavors "that are not adequately provided for by competitive and regulated energy markets."

Objectives of the Agreement

The objectives of this proposed agreement are to: A) develop a hydrologic model linking daily climate-driven Variable Infiltration Capacity model (VIC) rainfall-runoff data to daily project operations and impacts on human and environmental water uses; B) analyze

¹ Hansen, J., M. Sato, R. Ruedy, K. Lo, D.W. Lea, M. Medina-Elizade. 2006. Global temperature change. PNAS 103(39), 14288-14293. DOI: 10.1073/pnas.0606291103.

² This figure includes both in-state and imported hydroelectricity for the year 2008. Source: "Total Electricity System Power" California Energy Commission. http://energyalmanac.ca.gov/electricity/total_system_power.html Accessed on April 8, 2010.

model results to identify which project facilities and operations are most vulnerable to impacts associated with climate change; and C) analyze potential effects on the downstream environment from project operations modified to compensate for altered hydrology.

Over 300 hydropower dams in California are regulated by FERC. Over half of these projects will expire by 2020 and new licenses must comply with today's environmental laws and standards. Because of the long life span of hydropower projects license -- 30 to 50 years -- the relicensing is the only time to affect much needed changes in the project's operation in relation to power generation, water quality, ecological health, and recreational functions. Therefore, FERC re-licensing is a major opportunity to adapt the regulation of hydropower facilities to changing state water and environmental needs in the face of climate change. The state has a significant involvement in these re-licensing activities through the preparation of local and regional water quality and quantity plans as well as various environmental and resource agencies.

TASK 1.0 ADMINISTRATION

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 Contract Manager, 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 Contract 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 Contract 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
- CPRs (Task 1.2)
- 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 Contract 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)

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

Commission Contract 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 Contract Manager and as shown in the Technical Task List above and in the Schedule of Deliverables. However, the Commission Contract 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 Contracts Officer, the PIER Program Team Lead, other Energy Commission staff and Management as well as other individuals selected by the Commission Contract Manager to provide support to the Energy Commission.

The Commission Contract 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.
- 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. If the Commission Contract Manager concludes that the project needs a formal amendment or that satisfactory progress is not being made and the project needs to be ended, these conclusions will be referred to the Commission's Research, Development and Demonstration Policy Committee for its concurrence.
- 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 Contract 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 Contract 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 Contracts Officer, and the Commission Contract Manager. The technical and administrative aspects of Agreement closeout will be discussed at the meeting,

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

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

The administrative portion of the meeting shall be a discussion with the Commission Contract 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 Contract 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

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 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 Contractor shall:

- Unless otherwise directed in this Scope of Work, submit a draft of each deliverable listed in the Technical Tasks to the Commission Contract Manager for review and comment in accordance with the approved Schedule of Deliverables. The Commission Contract 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 Contract Manager. The Commission Contract 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 Contract 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 Contract 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 Contract Manager. The Commission Contract Manager shall provide written approval of the final outline within 5 working days of receipt.

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 Contract Manager for review and comment. The Commission Contract Manager will provide written comments within 10 working days of receipt.

Once agreement on the draft Final Report has been reached, the Commission Contract Manager shall forward the electronic version of this report for Energy Commission internal approval. Once the approval is given, the Commission Contract 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 PIER 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 PIER 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 Contract 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.
 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 Contract Manager if during the course of the Agreement additional match funds are received.

- Notify the Commission Contract 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.

The Contractor shall:

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the Commission Contract 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 Contract Manager.
- As permits are obtained, send a copy of each approved permit to the Commission Contract Manager.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the Commission Contract 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 Contract Manager in the following formats:
 - Data sets shall be in Microsoft (MS) Access or MS Excel file format.
 - 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 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 DEVELOPMENT OF A HYDROLOGIC MODEL FOR FERC RELICENSING

The goal of this task is to develop a hydrologic model linking daily climate-driven Variable Infiltration Capacity (VIC) rainfall-runoff data to daily project operations and impacts on human and environmental water uses. The results of this task will improve understanding of local sensitivity to climate change, how hydrologic dynamics are likely to change with climate change, and impacts to other water users and instream ecosystems. The model outputs will provide important scientific evidence of climate change that could become valuable part of NEPA required environmental impacts statements during a hydropower relicensing process.

The study site is the Yuba River Development Project, which is due for relicensing in 2016, and will be filing a relicensing application by April 2014. The model, when completed, will be able to apply to any other suitable relicensing projects. The Contractor will consult with the Energy Commission Contract Manager (CCM) to expand the modeling efforts, if deemed necessary or feasible, to cover nearby hydropower projects such as Pacific Gas and Electric Company's (PG&E) Narrows #1 Project, Nevada Irrigation District's Yuba-Bear Hydroelectric Project, PG&E's Drum-Spaulding Project, and additional non-FERC jurisdictional facilities.

The Contractor shall:

- Engage in dialogue with the Yuba County Water Agency, the operating authority for the projects, to explore the operational implications of climate warming for hydropower and environmental water management in the context of FERC relicensing. If possible, the CCM will assist the research team by providing access to the Agency's technical staff
- Expand the dialogue to other neighboring project operators, as many as possible
- Develop a hydrologic model on the Yuba River Development Project. This project is comprised of 2 reservoir, 2 diversion dams, 3 powerhouses, and associated conveyance and recreation facilities. The new model will incorporate the following models and their respective hydrologic properties:
 - Variable Infiltration Capacity (VIC) model: VIC is a macroscale, distributed parameter, physically based hydrologic model with a bias correction and spatial downscaling (BCSD) approach that operates on a daily timescale. Using the latest iteration of this model provided by Ed Maurer's group at the Santa Clara University, run the model with A2 (higher emissions) and B1 (lower emission) using the Parallel Climate Model, which has a relatively low sensitivity of global and regional temperature to greenhouse gas forcing, and NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) model, which has a relatively high sensitivity to greenhouse gas forcing. If deemed necessary, other combinations will be explored and executed. The Contractor shall consult the CCM in selecting the most reliable combinations model runs from VIC
 - Water Evaluation and Planning System (WEAP21) for Sierra Nevada's regulated river conditions: WEAP21 is an integrated, climate-forced, rainfall-runoff model that explicitly incorporates water demands and water resource operations using a

- priority-weighting scheme. It operates on a weekly time step, and has previously been applied to California's Sacramento and San Joaquin Rivers to improve understanding of climate warming on water resource management
- General Algebraic Modeling System (GAMS) model of Yuba River Development Project operations: GAMS facilitates sensitivity analysis and optimization. This model of the Yuba Project is currently being developed by UC Davis researchers with input data from the YCWA
- Investigate potential impacts to environmental, recreational, and water supply flow requirements
- Broaden the scope of modeling activity, if deemed necessary, to include other larger operations of neighboring projects to assess climate change impacts
- Prepare a technical memo entitled Hydrologic Model for FERC relicensing

Deliverables:

- Technical memorandum: "Hydrologic Model for FERC relicensing"

TASK 3 ANALYSIS OF HYDROPOWER PROJECT FACILITIES VULNERABILITY AND POTENTIAL EFFECTS ON DOWNSTREAM ENVIRONMENT

The goal of this task is to analyze the vulnerability of hydropower project facilities under a warming climate and also to assess its potential effects on downstream ecosystems.

The Contractor shall:

- Estimate climate change impacts on project operations via the use of below metrics:
 - Magnitude and timing of Yuba River Development Project hydropower generation using annual average generation and weekly average generation
 - Revenue losses from climate-induced operational changes using monthly varying wholesale electricity prices
- Estimate climate change impacts on downstream ecosystems using below metrics:
 - Annual and seasonal changes to water deliveries (acre-feet/month) and associated scarcity costs (dollars/year) to be borne by urban and agricultural demands
 - Uncontrolled flows (reservoir spills) for measuring changes in flooding incidence for downstream communities (acre-feet/year)
 - Monthly average instream flow dedications (cubic-feet/month)
 - Days that the flow exceeds liveable ranges for invertebrates, amphibians, and fish (count/year)
 - Weeks river temperature exceeds 21 degrees Celsius (count/year)
 - Volume of cold-water pool in large reservoirs (acre-feet/month)
 - Compare the likelihood of instream flow releases outside of the tolerance range (e.g., extremely low and high flow events) for insect communities, amphibians, and fish communities
- Estimate climate change impacts on recreational values:
 - Number of weeks in which flows are in boatable range for whitewater runs
- Prepare a technical memorandum entitled Analysis of hydropower project facilities vulnerability and potential effects on downstream environment under climate change

Deliverables:

- Technical memorandum: “Analysis of hydropower project facilities vulnerability and potential effects on downstream environment under climate change”

TASK 4 PROJECT OUTREACH

The goal of this task is to make the knowledge gained and lessons learned available to the scientific community, decision-makers, and interested public.

The Contractor shall:

- If requested by the CCM, present the findings of this project at the annual PIER Climate Change Conference held in Sacramento, California
- Provide the Commission Project Manager with project-related informational materials such as PowerPoint file(s), other project-related informational materials, as requested by the Commission Project Manager

Deliverables:

- PowerPoint file(s), other project-related informational materials, as requested by the Commission Project Manager (no draft)