

GRANT REQUEST FORM (GRF)CEC-270 (Revised 10/2015)
COMMISSION

CALIFORNIA ENERGY

New Agreement PIR-18-002 (To be completed by CGL Office)

ERDD	Reta Ortiz	43	916-327-1494
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The Regents of the University of California, on behalf of the Los Angeles Campus	95-6006143
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Seismic Risk Assessment and Management of Natural Gas Storage and Pipeline Infrastructure in CA

6/14/2019	6/30/2022	\$ 3,485,255
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<input type="checkbox"/> ARFVTP agreements under \$75K delegated to Executive Director.

Proposed Business Meeting Date	5/8/2019	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
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Business Meeting Presenter	Yahui Yang	Time Needed:	5 minutes
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Please select one list serve. NaturalGas (NG Research Program)

Agenda Item Subject and Description

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA, LOS ANGELES. Proposed resolution approving agreement PIR-18-002 with the Regents of the University of California, Los Angeles for a \$3,485,255 grant to develop a seismic risk quantification methodology and tool for natural gas storage and pipeline infrastructure, and adopting staff's determination that this action is exempt from CEQA. The recipient team will quantify the earthquake ground motion, fault displacement hazard, landslide and liquefaction risks for California natural gas infrastructure. The tool can be used by the end-user to identify, prioritiz, and mitigate seismic risks before and after seismic events. Contact: Reta Ortiz (PIER natural gas funding)

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, § 15306
- ☒ Common Sense Exemption. 14 CCR 15061 (b) (3)

Explain reason why Agreement is exempt under the above section:

This project will assess the potential impacts that earthquake hazards could have on California's gas infrastructure. Project activities include computer modeling and creation of a software tool that will identify and mitigate risks before an earthquake happens. The project does not involve any field work or any other activities that could cause direct or foreseeable indirect physical changes to the environment.

This project is therefore exempt under CEQA Guidelines Section 15061(b)(3), the "common sense exemption", because it can be seen with certainty that there is no possibility that the project will have a significant effect on the environment. This project is also categorically exempt under CEQA Guidelines Section 15306 as a project that consists of basic data collection, research and resource evaluation activities which does not result in a serious or major disturbance to an environmental resource. Further, none of the exceptions listed in CEQA Guidelines Section 15300.2 apply to this project.

☐ b) Agreement **IS NOT** exempt. (Consult with the legal office to determine next steps.)

Check all that apply

- ☐ Initial Study ☐ Environmental Impact Report
- ☐ Negative Declaration ☐ Statement of Overriding Considerations
- ☐ Mitigated Negative Declaration

GRANT REQUEST FORM (GRF)

Legal Company Name:	Budget
California Geological Survey	\$ 97,500
Linda Alatik Consulting	\$ 192,402
University of Southern California	\$ 242,500
Lettis Consultants International, Inc.	\$ 102,478
University of Texas, Austin	\$ 143,750
California Institute of Technology	\$ 142,500
D.G. Honegger Consulting	\$ 267,500
DNV GL USA, Inc.	\$ 1,149,363
	\$

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

Legal Company Name:

Funding Source	Funding Year of Appropriation	Budget List No.	Amount
NG Subaccount, PIERDD	17-18	500.001L	\$910,000
NG Subaccount, PIERDD	17-18	501.001L	\$2,575,255
			\$
			\$
			\$
			\$
R&D Program Area: ESRO: ETSI			\$3,485,255
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

Name:	Flora O'Brien	Name:	Yousef Bozorgnia
Address:	PO BOX 11000	Address:	PO Box 420
City, State, Zip:	LOS ANGELES, CA 90011-0019	City, State, Zip:	Los Angeles, CA 90095-1593
Phone:	310-206-0807 /	Fax:	- -
E-Mail:	flora.obrien@research.ucla.edu	E-Mail:	yousef.bozorgnia@ucla.edu

☒ Competitive Solicitation
 Solicitation #: GFO-18-502

☐ First Come First Served Solicitation

1. Exhibit A, Scope of Work	<input checked="" type="checkbox"/> Attached
2. Exhibit B, Budget Detail	<input checked="" type="checkbox"/> Attached
3. CEC 105, Questionnaire for Identifying Conflicts	<input checked="" type="checkbox"/> Attached
4. Recipient Resolution	<input checked="" type="checkbox"/> N/A <input type="checkbox"/> Attached
5. CEQA Documentation	<input checked="" type="checkbox"/> N/A <input type="checkbox"/> Attached

Agreement Manager

Date

Office Manager

Date

Deputy Director

Date

EXHIBIT A Scope of Work

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR ¹	Task Name
1		General Project Tasks
2	X	Development of Computer Tool with Continuous Engagement and Acceptance of End-users
3		Quantification of Ground Motion Hazard
4		Probabilistic Fault Displacement Hazard
5		Geo-Hazards from Landslides & Liquefaction
6		Seismic Resistance Development Including Soil-Structure Interaction
7	X	Quantification of Risks
8		Mitigation Strategies
9		Evaluation of Project Benefits
10		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
FEA	Finite Element Analysis
PFDH	Probabilistic fault displacement hazard
PSHA	Probabilistic seismic hazard analysis
Resistance/ Fragility	Resistance of the pipe wall to loading and strain from ground movement. This term is also known as fragility.
TAC	Technical Advisory Committee

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

A. Purpose of Agreement

The purpose of this Agreement is to fund research that will improve current Seismic Risk Assessment of Natural Gas Storage and Pipeline Infrastructure by addressing earthquake hazards (i.e., ground shaking and displacement from surface faulting, landslides, and liquefaction) and their effects on California gas infrastructure.

B. Problem/ Solution Statement

Problem

Natural Gas Storage and Pipeline Infrastructure may be affected by seismic events such as

¹ Please see subtask 1.3 in Part III of the Scope of Work (General Project Tasks) for a description of Critical Project Review (CPR) Meetings.

EXHIBIT A

Scope of Work

earthquakes or landslides. United States Geological Survey predicts that “California has more a than 99% chance of having a magnitude 6.7 or larger earthquake within the next 30 years”.

Assessing seismic risks of gas infrastructures is difficult because:

- Data used to quantify seismic hazards has significant uncertainties,
- Standard risk assessments are either quantitative using Finite Element Analysis (FEA) software (however they are slow in development and costly) or there are simple models (but they are subjective),
- It is difficult to take into account the correlation with other non-seismic hazards. Non-seismic hazards (e.g. corrosion) have an effect on the resistance of gas infrastructure to earthquakes and landslides.

Solution

The proposed solution will use state of the art seismic hazards assessments and Bayesian network to quantify the seismic risk of natural gas storage and pipeline infrastructure. Bayesian network methodology is particularly well suited for this problem because:

- Bayesian networks deal with uncertain data particularly well,
- Bayesian networks are ideal to capture and integrate knowledge from multiple sources. Such sources in our case include:
 - Earthquake hazards (ground motion, fault rupture hazard, landslide and liquefaction)
 - FEA analysis (pipe and components resistance/fragility)
 - Other non-seismic hazards (already quantified in previous Energy Commission projects conducted by these proposal team members) that have an impact on the resistance of the gas infrastructure under seismic events.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to

1. Apply state-of-the-art procedures to define hazards that threaten gas storage and pipeline infrastructure, including fault rupture, landslides, and liquefaction;
2. Formulate a performance-based risk management approach that is sufficiently flexible, yet quantitative, and test the methodology in collaboration with the partnering pipeline and storage facility operators in California;
3. Implement the new risk management approach into an easy-to-use, free, open source, software tool;
4. Develop a guidance document to help use the software tool;
5. Document the results and transfer the knowledge gained to gas pipeline and storage facility operators.

Ratepayer Benefits: This Agreement will result in the ratepayer benefits of (1) **greater gas supply reliability** by predicting where the state’s gas infrastructure could fail and identifying the most appropriate mitigative action, (2) **lower costs** by reducing the need for costly site-specific risk assessments and help decision makers determine the most cost effective means to achieve acceptable seismic performance (3) **increased safety** by providing a software tool to key decision makers and (4) **health benefits** by reducing the probability of accidental release of natural gas.

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Technological Advancement and Breakthroughs: 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 capturing knowledge from multiple domains of expertise and combining it into one simple risk assessment software.

1. This project will combine expertise from multiple research teams to capture all geotechnical threats to gas pipeline and gas storage systems (i.e., earthquake ground motion, fault rupture displacement, landslide and liquefactions).
2. The model created will be able to outperform the speed of detailed analyses and outperform quality of simple qualification tools.
3. This project will capture knowledge from a wide field of expertise by including interaction among threats. Pipeline Research Council International pointed these interactions among threats as the greatest source of uncertainty in failure predictions.
4. The open source software tool will integrate real time seismic activity and therefore will be able to perform predictions (before earthquake) and failure analysis (after earthquake).

Agreement Objectives

The objectives of this Agreement are to:

- Develop a risk assessment methodology that quantifies the earthquake ground motion, fault displacement hazard, landslide and liquefaction risks for California gas infrastructure (i.e., gas pipeline and natural gas storage),
- Create a tool that utilizes the risk assessment methodology to help identify, prioritize, and mitigate earthquake impacts to natural gas infrastructure both before and after a seismic event is detected.

III. TASK 1 GENERAL PROJECT TASKS

PRODUCTS

Subtask 1.1 Products

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

The Recipient shall:

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

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

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- Submit the revised product and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period, or approves a request for additional time.

For products that require a final version only

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

For all products

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

Instructions for Submitting Electronic Files and Developing Software:

○ **Electronic File Format**

- Submit all data and documents required as products under this Agreement in an electronic file format that is fully editable and compatible with the Energy Commission's software and Microsoft (MS)-operating computing platforms, or with any other format approved by the CAM. Deliver an electronic copy of the full text of any Agreement data and documents in a format specified by the CAM, such as memory stick or CD-ROM.

The following describes the accepted formats for electronic data and documents provided to the Energy Commission as products under this Agreement, and establishes the software versions that will be required to review and approve all software products:

- Data sets will be in MS Access or MS Excel file format (version 2007 or later), or any other format approved by the CAM.
- Text documents will be in MS Word file format, version 2007 or later.
- Documents intended for public distribution will be in PDF file format.
- The Recipient must also provide the native Microsoft file format.
- Project management documents will be in Microsoft Project file format, version 2007 or later.

○ **Software Application Development**

Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:

- Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
- Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
- Visual Studio.NET (version 2008 and up). Recommend 2010.
- C# Programming Language with Presentation (UI), Business Object and Data Layers.
- SQL (Structured Query Language).
- Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
- Microsoft SQL Reporting Services. Recommend 2008 R2.
- XML (external interfaces).

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

MEETINGS

Subtask 1.2 Kick-off Meeting

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

The Recipient shall:

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

The administrative portion of the meeting will include discussion of the following:

- Terms and conditions of the Agreement;
- Administrative products (subtask 1.1);
- CPR meetings (subtask 1.3);
- Match fund documentation (subtask 1.7);
- Permit documentation (subtask 1.8);
- Subcontracts (subtask 1.9); and
- Any other relevant topics.

The technical portion of the meeting will include discussion of the following:

- The CAM's expectations for accomplishing tasks described in the Scope of Work;
 - An updated Project Schedule;
 - Technical products (subtask 1.1);
 - Progress reports and invoices (subtask 1.5);
 - Final Report (subtask 1.6);
 - Technical Advisory Committee meetings (subtasks 1.10 and 1.11); and
 - Technology Transfer
 - Any other relevant topics.
- Provide an *Updated Project Schedule, List of Match Funds, and List of Permits*, as needed to reflect any changes in the documents.

The CAM shall:

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

Recipient Products:

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

EXHIBIT A

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CAM Product:

- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings

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

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

The Recipient shall:

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

The CAM shall:

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

Recipient Products:

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

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CAM Products:

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

Subtask 1.4 Final Meeting

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

The Recipient shall:

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

The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.

- The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
- The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
 - Disposition of any state-owned equipment.
 - Need to file a Uniform Commercial Code Financing Statement (Form UCC-1) regarding the Energy Commission's interest in patented technology.
 - The Energy Commission's request for specific "generated" data (not already provided in Agreement products).
 - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
 - "Surviving" Agreement provisions such as repayment provisions and confidential products.
 - Final invoicing and release of retention.
- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide *All Draft and Final Written Products* on a CD-ROM or USB memory stick, organized by the tasks in the Agreement.

Products:

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

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices

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

The Recipient shall:

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

Products:

- Progress Reports
- Invoices

Subtask 1.6 Final Report

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

Subtask 1.6.1 Final Report Outline

The Recipient shall:

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

Recipient Products:

- Final Report Outline (draft and final)

CAM Product:

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

Subtask 1.6.2 Final Report

The Recipient shall:

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

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- Preface (**required**)
- Abstract, keywords, and citation page (**required**)
- Table of Contents (**required**, followed by List of Figures and List of Tables, if needed)
- Executive summary (**required**)
- Body of the report (**required**)
- References (if applicable)
- Glossary/Acronyms (If more than 10 acronyms or abbreviations are used, it is required.)
- Bibliography (if applicable)
- Appendices (if applicable) (Create a separate volume if very large.)
- Attachments (if applicable)
- Ensure that the document is written in the third person.
- Ensure that the Executive Summary is understandable to the lay public.
 - Briefly summarize the completed work. Succinctly describe the project results and whether or not the project goals were accomplished.
 - Identify which specific ratepayers can benefit from the project results and how they can achieve the benefits.
 - If it's necessary to use a technical term in the Executive Summary, provide a brief definition or explanation when the technical term is first used.
- Follow the Style Guide format requirements for headings, figures/tables, citations, and acronyms/abbreviations.
- Ensure that the document omits subjective comments and opinions. However, recommendations in the conclusion of the report are allowed.
- Include a brief description of the project results in the Abstract.
- Submit a draft of the report to the CAM for review and comment. The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt
- Consider incorporating all CAM comments into the Final Report. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product
- Submit the revised Final Report and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period or approves a request for additional time.
- Submit one bound copy of the *Final Report* to the CAM along with *Written Responses to Comments on the Draft Final Report*.

Products:

- Final Report (draft and final)
- Written Responses to Comments on the Draft Final Report

CAM Product:

- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds

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

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

The Recipient shall:

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

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

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

Products:

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

Subtask 1.8 Permits

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

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The Recipient shall:

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

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

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

Products:

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

Subtask 1.9 Subcontracts

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

The Recipient shall:

- Manage and coordinate subcontractor activities in accordance with the requirements of this Agreement.
- Incorporate this Agreement by reference into each subcontract.
- Include any required Energy Commission flow-down provisions in each subcontract, in addition to a statement that the terms of this Agreement will prevail if they conflict with the subcontract terms.
- If required by the CAM, submit a draft of each *Subcontract* required to conduct the work under this Agreement.
- Submit a final copy of the executed subcontract.
- Notify and receive written approval from the CAM prior to adding any new subcontractors (see the discussion of subcontractor additions in the terms and conditions).

Products:

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

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TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)

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

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

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

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

The Recipient shall:

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

Products:

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

EXHIBIT A

Scope of Work

Subtask 1.11 TAC Meetings

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

The Recipient shall:

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

The TAC shall:

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

Products:

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

EXHIBIT A

Scope of Work

IV. TECHNICAL TASKS

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

TASK 2 – DEVELOPMENT OF COMPUTER TOOL WITH CONTINUOUS ENGAGEMENT AND ACCEPTANCE OF END-USERS

The goals of this task are to (i) establish the requirements needed for the computer software tool by engaging the end users from the beginning of the agreement, (ii) collect and implement end-user feedback throughout the project to continuously improve and update the computer software tool, and (iii) develop a comprehensive software platform for Natural Gas Infrastructure risk assessment and proactive risk management. The computer tool will be posted on the recipient's website for public access. The proposed software platform will enable users to:

1. Develop or upload needed models and databases;
2. Conduct risk assessment at different levels of complexity and sophistication, depending on the needs and objectives of the analysis; and
3. Use the platform as a decision support system for gas infrastructure proactive risk management, including dynamic risk monitoring, tracking and use of leading risk indicators, and determination of mitigation strategies. The capabilities will be available as a desktop application, through handheld devices, and in control room as a risk and integrity dashboard.

The Recipient shall:

- Convene an end-user group to include at a minimum, investor owned utilities in California, California Public Utilities Commission and Division of Oil, Gas and Geothermal Resources staff, and other related stakeholders.
- Hold an end-user workshop to define the computer software tool capabilities and functional features.
- Analyze the requirements for the computer software tool and establish a software development plan and detail requirements and the development plan in a *Computer Tool Requirements and Development Plan* report.
- Hold bi-annual meetings with the end-user group to assess user feedback and additional capabilities required for the tool.
- Develop and update the Desktop Open-Source Risk Assessment Software by incorporating feedback from end-user group
- Conduct test and verification of software
- Develop and provide *User Guide* for the software, which will include instructions and examples.
- Work with CAM to develop a *Public Workshop Participant List* and, hold a Public Workshop to present the software tool and conduct user acceptance test.
- Provide training to utility partners and other stakeholders
- Write an *End-User Tool Report* detailing the user guide, comments from public workshop, results of user acceptance test, market adoption plan, and training materials and activities.
- Prepare and provide *CPR Report #1* and participate in CPR Meeting as described in subtask 1.3

Products:

- User Guide
- Computer Tool Requirements and Development Plan

EXHIBIT A

Scope of Work

- Public Workshop Participant List
- End-user Tool Report
- CPR Report #1

TASK 3 QUANTIFICATION OF GROUND MOTION HAZARD

The goal of this task is to quantify earthquake ground motion hazard over the entire State of California in a manner that is appropriate for risk analyses of distributed infrastructure as well as single storage sites.

The Recipient shall:

- Implement rupture directivity using the Third California Earthquake Rupture Forecast seismic sources
- Carry out hazard and scenario ground motion analyses of grid sites across the State
- Compute non-ergodic site response for use in Probabilistic Seismic Hazard Analysis (PSHA) and scenario ground motion analyses
- Compute PSHA results at fine grid points to cover the entire State of California
- Electronically tabulate the PSHA results to be used in the computer module
- Develop a framework for non-ergodic path effects
- Develop a Computer Module to access the computed PSHA results
- Produce a *Ground Motion Hazard Report* detailing the research results for Directivity Model, Non-Ergodic Site Response, PSHA, Non-ergodic Path Effects, Computer Module to access the ground motion results, and Ground Motion Computer Module

Products:

- Ground Motion Hazard Report

TASK 4 PROBABILISTIC FAULT DISPLACEMENT HAZARD

The goals of this task are to (1) develop a database of fault displacement hazard, and (2) use it to develop a probabilistic fault displacement hazard (PFDH) model.

The Recipient shall:

- Expand the existing empirical database of fault displacements
- Host a community planning workshop
- Validate several simulation methods against empirical data collected by the project team
- Perform forward simulations for a selected subset of scenarios to supplement the empirical dataset
- Develop Predictive Model for Fault Displacements
- Prepare a *Probabilistic Fault Displacement Hazard Report* summarizing the Empirical Fault Displacement Data, the Outcome of the Workshop, Validation of Simulations, Simulated Fault Displacement Data, and Predictive Model for Fault Displacements

Products:

- Probabilistic Fault Displacement Hazard Report

TASK 5 GEOHAZARDS FROM LANDSLIDES & LIQUEFACTION

The goal of this task is to define on a spatial grid the probability that landslide or liquefaction

EXHIBIT A

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geohazards are triggered and the probability distribution of potential displacement and direction of displacement conditional on triggering.

The Recipient shall:

- **Subtask 5.1 Probabilistic Landslide Hazard Model**
 - Host a community planning Landslide Hazard Workshop
 - Develop required information for spatial analysis of landslide hazard, including digital elevation models, geologic maps, geology-shear strength correlations, and ground motions for scenario events.
 - Develop a tool that operates on a spatial grid conditional (for each grid point) on slope gradient, geologic unit, groundwater depth, and ground motion parameter. This tool will provide a map of displacement vectors (i.e., magnitude and direction of displacement by location).
 - Perform forward analyses for scenario events from Task 2 to estimate landslide hazards for use in Task 5.
 - Prepare a *Probabilistic Landslide Hazard Report* including the outcome of the Landslide Hazard Workshop, the Regional Scale Landslide Hazard Analysis Tool, and Landslide Hazards for California natural gas infrastructure.
- **Subtask 5.2 Probabilistic Liquefaction Hazard Model**
 - Host a community planning Liquefaction Hazard Workshop
 - Develop required information for spatial analysis of liquefaction hazard (aside from groundwater), including digital elevation models, geologic maps, and ground motions for scenario events.
 - Develop procedures to interrogate high temporal and spatial resolution satellite data to estimate soil moisture and depth to groundwater.
 - Apply existing liquefaction hazard models with the input information compiled above to estimate probability of liquefaction triggering and probabilistic distribution of lateral spread displacements.
 - Develop new liquefaction hazard models using deep learning methods with the input information available in California
 - Using existing and newly developed procedures, perform forward analyses for scenario events from Task 2 to estimate liquefaction hazards for use in Task 5.
 - Produce a *Probabilistic Liquefaction Hazard Report* detailing the outcome of the Liquefaction Hazard Workshop, Procedure for Analysis of Groundwater Depths for Use in Regional-Scale Liquefaction Hazard Assessment, Procedure for Analysis of Liquefaction Hazards at Regional Scales, and Liquefaction Hazards for California natural gas infrastructure.

Products:

- Probabilistic Landslide Hazard Report
- Probabilistic Liquefaction Hazard Report

TASK 6 SEISMIC RESISTANCE DEVELOPMENT INCLUDING SOIL- STRUCTURE- INTERACTION

The goal of this task is to create two models that will predict the resistance of gas infrastructure to loading from permanent ground displacement and dynamic strains. The first model will focus on gas pipeline response to loading and the second model will focus on underground gas storage infrastructure. The models will consider two key features: pipe to soil interactions and resistance

EXHIBIT A

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to loading and strain.

The Recipient shall:

- **Subtask 6.1 Creation and Validation of Resistance Model for Gas Pipeline**
 - Meet with gas utility partner in order to define set of pipeline input parameters
 - Run FEA analysis of to cover pipeline parameters and envelope ground displacement hazards
 - Develop a Resistance Model for Gas Pipeline
 - Meet with gas utility partner to choose a set of case histories and evaluation criteria
 - Validate the model using testing conditions
 - Prepare a *Resistance Model for Gas Pipeline Report* that explains how the models work, model's inputs, outputs, assumptions, and validation of resistance models for gas pipeline.
- **Subtask 6.2 Creation and Validation of Resistance Model for Gas Storage System**
 - Meet with gas utility partners in order to define relevant components upon which to develop response to ground shaking
 - Develop ground shaking fragility relationships for aboveground systems
 - Develop a *Resistance Model for Gas Storage System Report* detailing of the creation and validation of resistance models for gas storage system.
 - Meet with gas utility partner to identify a case history location
 - Identify oil and gas production facilities that can provide additional case history information
 - Validate the model using a set of case histories

Products:

- Resistance Model for Gas Pipeline Report
- Resistance Model for Gas Storage System Report

TASK 7 QUANTIFICATION OF RISKS

The goals of this task are to

1. Link the hazards database created in TASK 3 (ground motion) TASK 4 (fault displacement) and 5 (landslide hazard and liquefaction) with the risk models developed in TASK 6 (pipeline resistance and gas storage wells resistance) in order to predict probability of failure
2. Incorporate threats that have already been quantified in previous Energy Commission funded projects. These threats are known to have an impact on the resistance of pipelines and gas storage systems from seismic events.
3. Define simplified consequence models for use in quantitative risk calculations.

The Recipient shall:

- Integrate the Hazard Databases (Task 3,4,5) with resistance models (Task 6)
- Integrate hazard already quantified in previous Energy Commission funded projects (PIR-15-016 and PIR-16-028), and validate the two improved models using utility partners data.
- Add gas release consequence model by:
 - defining consequence models for gas release volume and thermal radiation exposure
 - adding consequence model to both resistance models

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- Prepare and provide a Risk Quantification Report detailing the Integration of External Hazard Model and Validation, and Gas Pipeline and Gas Storage Field Consequence Model.
- Prepare and provide *CPR Report #2* and participate in CPR Meeting as described in subtask 1.3

Products:

- Risk Quantification Report
- CPR Report #2

TASK 8 – MITIGATION STRATEGIES

The goal of this task is to develop a decision making strategy to reduce seismic risks. Costs and effectiveness of risk mitigation measures will be considered to select the most appropriate actions before an earthquake (by affecting probability of failure) and after an earthquake (by limiting the consequences of failure). This is also true for landslides.

The Recipient shall:

- Identify mitigation measures and strategies to natural gas pipeline and storage risks
- Define costs and benefits of mitigation strategies by:
 - meeting with utility partners to develop a list of potential mitigation measures, and
 - quantifying the ability of mitigation measures to decrease hazard (e.g., slope stabilization), increase resistance (e.g., thicker pipe), and decrease consequences (e.g., sensors with automatic shutdown valve).
- Use models developed in previous tasks, especially Task 7, to identify risk leading indicators and develop mitigation strategy.
- Prepare a *Mitigation Strategy Report* summarizing the mitigation measures and strategies, cost and benefit, and input to the mitigation measures cost and benefit of natural gas infrastructure in California.

Products:

- Mitigation Strategy Report

TASK 9 EVALUATION OF PROJECT BENEFITS

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

The Recipient shall:

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

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- in the estimates.
- Greenhouse gas and criteria emissions reductions.
 - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
 - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
 - A discussion of project product downloads from websites, and publications in technical journals.
 - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
 - Additional Information for Product Development Projects:
 - Outcome of product development efforts, such copyrights and license agreements.
 - Units sold or projected to be sold in California and outside of California.
 - Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
 - Investment dollars/follow-on private funding as a result of Energy Commission funding.
 - Patent numbers and applications, along with dates and brief descriptions.
 - Additional Information for Product Demonstrations:
 - Outcome of demonstrations and status of technology.
 - Number of similar installations.
 - Jobs created/retained as a result of the Agreement.
 - For Information/Tools and Other Research Studies:
 - Outcome of project.
 - Published documents, including date, title, and periodical name.
 - A discussion of policy development. State if the project has been cited in government policy publications or technical journals, or has been used to inform regulatory bodies.
 - The number of website downloads.
 - An estimate of how the project information has affected energy use and cost, or have resulted in other non-energy benefits.
 - An estimate of energy and non-energy benefits.
 - Data on potential job creation, market potential, economic development, and increased state revenue as a result of project.
 - A discussion of project product downloads from websites, and publications in technical journals.
 - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
 - Respond to CAM questions regarding responses to the questionnaires.

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

Products:

- Kick-off Meeting Benefits Questionnaire

EXHIBIT A

Scope of Work

- Mid-term Benefits Questionnaire
- Final Meeting Benefits Questionnaire

TASK 10 TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

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

The Recipient shall:

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

Products:

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

V. PROJECT SCHEDULE

Project schedule is attached in excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: THE REGENTS OF THE UNIVERSITY OF
CALIFORNIA, ON BEHALF OF THE LOS ANGELES CAMPUS

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 PIR-18-002 from GFO-18-502 with The Regents of the University of California, on behalf of the Los Angeles campus, for a \$3,485,255 grant to develop a seismic risk quantification methodology and tool for natural gas storage and pipeline infrastructure, and adopting staff's determination that this action is exempt from CEQA. The tool will be able to identify, prioritize, and mitigate seismic risks; 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 May 15, 2019.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

Cody Goldthrite,
Secretariat