STATE OF CALIFORNIA
GRANT REQUEST FORM (GRF)
CEC-270 (Revised 12/2019) CALIFORNIA ENERGY COMMISSION

A) New Agreement # PIR-19-017 (to be completed by CGL office)

B) Division	Agreement Manager:	MS-	Phone
ERDD	Yahui Yang		916-327-2224

C) Recipient's Legal Name	Federal ID Number
Bakhtar Research and Engineering, LLC	82-1615627

D) Title of Project
FORCED RESONANCE IMAGING FOR BURIED PIPELINE DETECTION

E) Term and Amount

Start Date	End Date	Amount
6/30/2020	6/30/2023	$ 1,582,117

F) Business Meeting Information

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

Proposed Business Meeting Date 6/10/2020 ☐ Consent ☒ Discussion

Business Meeting Presenter Reta Ortiz Time Needed: 5 minutes

Please select one list serve. Research (Energy RDD / PIER program)

Agenda Item Subject and Description:
Bakhtar Research and Engineering, LLC
Proposed resolution approving agreement PIR-19-017 with Bakhtar Research and Engineering, LLC for a $1,582,117.00 grant to develop and demonstrate a natural gas pipeline detector using forced resonance imaging technology for near real-time detection, locating, depth estimation, and material differentiation (plastic or metallic) of underground natural gas pipelines. (PIER NG funding) Contact: Reta Ortiz.

G) California Environmental Quality Act (CEQA) Compliance

1. Is Agreement considered a "Project" under CEQA?
   ☒ Yes (skip to question 2)
   ☐ No (complete the following (PRC 21065 and 14 CCR 15378)):

   Explain why Agreement is not considered a "Project":

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

   Explain reason why Agreement is exempt under the above section: Categorical exemption section 15301 exempts projects consisting of the operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing structures, facilities, mechanical equipment, or topographical features involving

negligible or no expansion of existing or former use. This project is exempt under 15301: Existing Facilities, because it will demonstrate a natural gas pipeline detecting tool at existing pipeline facilities. Project activities involve operation of existing pipeline facilities with no expansion of existing or former use. This project is also exempt under categorical exemption section 15306: Information Collection, as the project will collect data of natural gas pipelines in real-time. This project will not result in a serious or major disturbance to an environmental resource.

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

Check all that apply

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

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

Legal Company Name:	**Budget**
Rohde & Schwarz	$ 36,000
	$
	$
	$
	$
	$
	$
	$
	$
	$

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

Legal Company Name:

STATE OF CALIFORNIA
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J) Budget Information

Funding Source	Funding Year of Appropriation	Budget List Number	Amount
NG Subaccount, PIERDD	20-21	501.001O	$1,582,117
			$
			$
			$
			$
			$

R&D Program Area: ESRO: ETSI TOTAL: $ 1,582,117

Explanation for "Other" selection

Reimbursement Contract #: Federal Agreement #:

K) Recipient's Contact Information

1. Recipient's Administrator/Officer

Name: Khosrow Bakhtar

Address: 2253 Martin # C-109

City, State, Zip: Irvine, CA 92612-1443

Phone: 949-500 - 1460

E-Mail: kbakhtar@bausa.org

2. Recipient's Project Manager

Name: Khosrow Bakhtar

Address: 2253 Martin # C-109

City, State, Zip: Irvine, CA 92612-1443

Phone: 949-500 - 1460

E-Mail: kbakhtar@bausa.org

L) Selection Process Used

☒ Competitive Solicitation Solicitation #: GFO-19-502p2

☐ First Come First Served Solicitation Solicitation #:

M) The following items should be attached to this GRF

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

_____ _____

Agreement Manager **Date**

_____ _____

Office Manager **Date**

_____ _____

Deputy Director **Date**

Exhibit A
Scope of Work
Bakhtar Research and Engineering, LLC

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2	X	Preliminary Field Testing & Evaluation Using "Make-Shift" Configuration BPD
3	X	*BakhtarRadar* Support and Motorized Platform Modification and Diagnostic Software Development
4		Design and Fabrication of Forced-Resonating Antennae
5	X	Integration and Synchronization of GPS and BPD
6	X	Software Modification for Data Collection and Analysis
7	X	BPD System Performance Validation and Demonstration
8		Evaluation of Project Benefits
9		Technology/Knowledge Transfer Activities
10		Production Readiness Plan

B. Acronym/Term List

Acronym/Term	Meaning
BPD	Bakhtar Pipe Detector
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
EM	Electromagnetic(s)
FR Antennae	Forced Resonating Dipole/Horn Adaptive Antennae
FRI	Forced Resonance Imaging
GPR	Ground Penetrating Radar
GPS	Global Positioning System
GUI	Graphical User Interface
ICR	Inductors, Capacitors, Resistors
RTK	Real-Time Kinematic (satellite navigation technique used to enhance the precision of position data derived from satellite-based positioning systems)
SNR	Signal-to-Noise Ratio
TAC	Technical Advisory Committee
TL	Transmission Line(s)
VNA	Vector Network Analyzer

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

A. Purpose of Agreement

The purpose of this Agreement is to fund the development and demonstration of a Bakhtar Pipe Detector (BPD) for near real-time detection, location, depth estimation, and determination of

[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.

material type (plastic or metallic) of underground natural gas pipes using Forced Resonance Imaging (FRI) technology.

B. Problem/ Solution Statement

Problem

Billions of dollars of damage have been and continue to be done by underground pipes, due to incorrect information regarding their location, or failure to detect their presence at all. Many underground pipes are reaching the end of their practical lives and need to be replaced or repaired. Hence, accurate information regarding these pipes is essential for utility owners, engineers, contractors, surveyors, and others, particularly for purposes of excavation. Ground penetrating radar (GPR) has been widely used in obtaining information about buried pipes for better maintenance and management. This widely used scanning technique is of limited usefulness for determining the precise position of buried pipes in geological areas with clay minerals and significant ground moisture content. Also, GPR's ability to detect buried pipes is restricted to pipes made of conductive materials (i.e., metals), as it cannot detect plastic pipes, which are non-conductive and widely used in buried gas pipelines. The difficulties associated with accurately locating buried pipes using GPR create the need for a more advanced non-invasive tool with the ability to detect both plastic and metallic pipes and determine their location with improved accuracy, regardless of the characteristics of the surrounding geology.

Solution

The proposed technology with FRI capability provides an innovative, rapid and cost-effective approach for accurately locating, estimating the depth of, and confirming the material type (metallic or plastic) of underground pipelines. The BPD with FRI can be used for screening areas suspected of having buried pipelines in near real-time. The BPD can detect buried pipes based on their material makeup, not on their electromagnetic conductivity. The BPD's threshold of detection can differentiate between plastic and metallic pipes. The return time for the radar trace representing the profile of the buried pipe is used to calculate and locate the depth of burial and diameter of the pipe. The horizontal location information, with high accuracy, is determined by detecting additional Radar profile(s) of the pipeline and using the BPD's Global Positioning System (GPS) footprint coordinates on the surface to calculate the horizontal location information. The BPD with FRI capability enables detection of buried pipes in any geologic setting regardless of mineral composition (clay) or moisture content. The proposed technology will reveal depths, diameters, and material types of the buried pipes, in near real-time, at suspected pipe locations and non-invasively provide a solution to the aforementioned problem.

Following completion of configuration and calibration of the BPD, the device will be demonstrated in the field to: (i) locate buried pipes in x and y (i.e., horizontal and vertical) directions with an accuracy of 0.39 in (1cm), which is at least 15% more accurate than existing location devices; (ii) determine pipe depth with an accuracy that is 70% better than current capability; (iii) determine pipe diameter with an accuracy of within a few inches under normal surface conditions; and (iv) distinguish between metallic and non-metallic pipes. These functions will be done in near real-time, regardless of what the ground cover consists of, because the small amount of power (less than 10 decibel-milliwatts [dBm]) is forced resonated rather than transmitted at the fundamental frequency of the antennae like a GPR device would.

C. Goals and Objectives of the Agreement

Exhibit A
Scope of Work
Bakhtar Research and Engineering, LLC

Agreement Goals

The goal of this agreement is to develop and demonstrate a non-invasive BPD for the detection of underground pipes, and the determination of their location and material type. The detector will operate in near real-time to determine the location, dimensions, material type, and depth of underground pipes, regardless of the geological surroundings.

Ratepayer Benefits: This Agreement will result in ratepayer benefits by reducing/eliminating potential excavation-caused damage to pipelines and enhancing operational safety in pipeline fields. This promotes reliable and safe operations for delivering natural gas to ratepayers via buried pipelines. Furthermore, it will benefit California natural gas ratepayers through research and development activities to create new science and technology, in an area not adequately addressed by competitive or regulated entities, thus benefiting California citizens.

Technological Advancement and Breakthroughs: This agreement will lead to technological advancements and breakthroughs that overcome barriers to the achievement of the State of California's statutory energy goals by providing an advanced technological tool capable of more accurately detecting and locating buried pipes, as well as distinguishing between metallic and non-metallic pipes. These technological advancements and breakthroughs are important for safe and reliable delivery and operation of underground pipelines, especially considering the increased use of such pipelines due to population growth.

Agreement Objectives

This agreement will focus on developing and demonstrating a system that can detect subsurface natural gas pipes, collect three-dimensional location information with increased accuracy, and provide additional information on pipe diameter and type (plastic or metallic). The specific objectives include:

- Assemble a makeshift configuration of the proposed BPD with FRI capability, using components used originally for the BakhtarRadar system, to prepare for the final design and configuration of the BPD.
- Test the assembled system at a utility site with underground pipelines by performing ground characterization at several locations to statistically determine the average site specific "electromagnetic wave speed" [electromagnetic (EM) impedance] of the test site.
- Use the test data to design and build the final configuration of the BPD and upgrade its software algorithms for near real-time detection of buried pipes; then continue the field testing to acquire data on pipe depth and location.
- Postprocess the data to reconstruct pipeline images with dimensional details and depth.
- Achieve almost real-time identification of pipeline location and use the location data for further study.
- Develop near real-time detection and pipe material distinguishing capabilities to determine the diameter and depth of buried pipes, and also differentiate between metallic and plastic pipes.
- Use the final configuration of the BPD with FRI capability for near real-time detection of buried pipes, including the reporting of their location, dimensional details, material type (plastic or metallic), and depth with more than a 70% improvement in accuracy over existing technology.
- Make the BPD user-friendly and set its input parameters by default for the examination of test sites with underground pipelines for near real-time detection in the field.
- Demonstrate the full capability of the BPD in the field (at least six months before the end of the agreement) at the gas company site(s) to show the BPD's results in determining,

in near real-time, the location, depth, diameter, and material type (plastic and or metallic) of buried pipes.

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.
- 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.

o **Software Application Development**

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

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

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

MEETINGS

Subtask 1.2 Kick-off Meeting

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

The Recipient shall:

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

  The administrative portion of the meeting will include discussion of the following:
  - o Terms and conditions of the Agreement
  - o Administrative products (subtask 1.1)

- CPR meetings (subtask 1.3)
- Match fund documentation (subtask 1.7)
- Permit documentation (subtask 1.8)
- Subcontracts (subtask 1.9); and
- Any other relevant topics.

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

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

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

The CAM shall:

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

Recipient Products:

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

CAM Product:

- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings

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

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

The Recipient shall:

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

The CAM shall:

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

Recipient Products:

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

CAM Products:

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

Subtask 1.4 Final Meeting

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

The Recipient shall:

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

  The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.
  - The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.

- The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
  - Disposition of any state-owned equipment.
  - Need to file a Uniform Commercial Code Financing Statement (Form UCC-1) regarding the Energy Commission's interest in patented technology.
  - The Energy Commission's request for specific "generated" data (not already provided in Agreement products).
  - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
  - "Surviving" Agreement provisions such as repayment provisions and confidential products.
  - Final invoicing and release of retention.

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

Products:

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

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices

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

The Recipient shall:

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

Products:

- Progress Reports
- Invoices

Subtask 1.6 Final Report

The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. The CAM will review the Final Report, which will be due at least **five months** before the Agreement

end date. When creating the Final Report Outline and the Final Report, the Recipient must use the Style Manual provided by the CAM.

Subtask 1.6.1 Final Report Outline

The Recipient shall:

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

Recipient Products:

- Final Report Outline (draft and final)

CAM Product:

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

Subtask 1.6.2 Final Report

The Recipient shall:

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

- Ensure that the document omits subjective comments and opinions. However, recommendations in the conclusion of the report are allowed.
- Include a brief description of the project results in the Abstract.

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

Products:

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

CAM Product:

- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds

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

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

The Recipient shall:

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

  If match funds were a part of the proposal that led to the Energy Commission awarding this Agreement, then provide in the letter:
  - A list of the match funds that identifies:
    - The amount of cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
    - The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the source (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient must identify its owner and provide a contact name, address, telephone number, and the address where

the property is located.
    - 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.

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

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

Products:
- Permit Status Letter
- Updated List of Permits *(if applicable)*

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

Subtask 1.9 Subcontracts

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

The Recipient shall:

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

Products:

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

TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)

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

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

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

- Researchers knowledgeable about the project subject matter
- Members of trades that will apply the results of the project (e.g., designers, engineers, architects, contractors, and trade representatives)
- Public interest market transformation implementers

- Product developers relevant to the project
- U.S. Department of Energy research managers, or experts from other federal or state agencies relevant to the project
- Public interest environmental groups
- Utility representatives
- Air district staff; and
- Members of relevant technical society committees.

The Recipient shall:

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

Products:

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

Subtask 1.11 TAC Meetings

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

The Recipient shall:

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

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

IV. TECHNICAL TASKS

TASK 2: PRELIMINARY FIELD TESTING AND EVALUATION USING "MAKE-SHIFT" CONFIGURATION OF BPD

The goals of this task are to (1) generate field data on the basic characteristics of underground pipelines (plastic and metallic) for final configuration of the BPD for near real-time detection; (2) generate field data to fine-tune the BPD software modification for signal processing and analysis for near real-time detection of the location, depth, dimensions, and material type (metallic or non-metallic) of buried pipes; (3) identify the general procedures for underground pipeline detection in the field.

The Recipient shall:
- Prepare a *Field Test Plan* detailing requirements regarding site preparedness, test procedures, and how testing will be performed.
- Perform examinations / tests on selected test beds and collect field data to:
  - Calculate the depth of underground pipelines at each site.
  - Calculate the diameters of underground pipelines at each site.
  - Differentiate between metallic and non-metallic buried pipes at each site.
  - Repeat the above steps until statistically reliable field data for analysis are obtained.
  - Compile all data obtained for further assessments and evaluations of the BPD's ability to perform near real-time analysis and display of results in the field.
  - Perform analysis by post-processing of data.
- Analyze all data from the above and compare the results with gas company records. The locations of all buried pipes detected will be confirmed by testing at least twice to make sure the utility company has sufficient and accurate records. Profiles of the detected pipes from the first set of testings will be used to establish their surface footprints, and their GPS coordinates will be marked (staked) on the ground. At least two more test passes will then be made over the marked GPS coordinates to confirm the accuracy of the BPD's results with respect to the depth and location of the detected pipes.
- Prepare a *Preliminary Field Test Results Report* outlining the results of the BPD's performance with respect to the detection of buried pipes and the accuracy of its determinations regarding their location, depth, diameter, and material type (metallic or non-metallic).
- Participate in CPR#1 meeting and prepare a *CPR#1 Report* as described in subtask 1.3.

Products:

- Field Test Plan (draft and final)
- Preliminary Field Test Results Report (draft and final)
- CPR #1 Report (draft and final)

TASK 3: BakhtarRadar SUPPORT AND MOTORIZED PLATFORM MODIFICATION AND DIAGNOSTIC SOFTWARE DEVELOPMENT

The goals of this task are (1) to design and fabricate a new support platform (skid) upon which the BPD FR antennae, as well as the GPS antenna, are erected; (2) to select a small motorized platform that pulls the skid and BPD-associated peripherals, including the battery (generator/inverter), at a constant low speed. Maintaining constant low speed of movements during examinations of the test bed will improve the signal-to-noise ratio (SNR), and thus the effectiveness of the BPD; (3) to determine the type of generator or inverter that can provide pure sine wave power for field operation of the BPD and its associated peripherals.

The Recipient shall:

- Design and construct a new support platform (skid) to reduce the interface friction between the test bed surface and the skid upon which the FR and GPS antennae are mounted during testing operations.
- Investigate and purchase the most suitable motorized platform for pulling the skid and carrying the BPD acquisition-control units, the GPS rover, power generator/inverter, and the Vector Network Analyzer (VNA) control and acquisition units.
- Make necessary modifications to the mobilized platform so as to accommodate all the required BPD hardware for field operations.
- Prepare a *Report on Support and Motorized Platforms* that details their field functionalities.
- Develop diagnostic software that quantifies pipeline location/geometry.
- Prepare a Diagnostic *Software Report* that describes the software interface and output used for near real-time detection and location of buried pipes.
- Participate in CPR#2 meeting and prepare a *CPR #2 Report* as described in subtask 1.3.

Products:

- Report on Support and Motorized Platforms (draft and final)
- Diagnostic Software Report (draft and final)
- CPR #2 Report (draft and final)

TASK 4: DESIGN AND FABRICATION OF FORCED-RESONATING ANTENNAE

Antennae constitute the most important components of the BPD. Their ability to transmit and receive back-scattered signal under reflection mode of EM transmission with a signal-to-noise ratio (SNR) well above the noise floor at low-power (10 decibel-milliwatts [dBm]) is critical for near real-time detection of buried pipes. Attention will be directed to maintain internal impedance of Forced Resonating Dipole/Horn Adaptive Antennae (FR antennae) at 50 Ohms (Ω) while maintaining EM compatibility between the load (antenna), the source (VNA) and the transmission line (TL). The goals of this task are (1) to establish design parameters, size and required specifications for linear ICR (Inductors, Capacitors, Resistors) components to be used for the design and fabrication of FR antennae; (2) to establish the most appropriate frequency band of operation for near real-time detection of underground pipelines; (3) to fabricate the antennae to meet operational requirements in the field under most adverse environmental conditions for near real-time underground pipeline detection and evaluation.

The Recipient shall:

- Use the results of Task 2 to determine the final design specifications for the FR antennae to best allow for near real-time detection of underground pipelines.
- Perform extensive field and laboratory testing and evaluation to arrive at the final design of the FR antennae (horn and dipole) prior to their construction.
- Design and construct two pairs of adaptive FR dipole and two pairs of adaptive FR horn antennae.
- Test and evaluate performance of these antennae in the field using the makeshift configuration of the BPD and compare and assess the performance of the dipole antennae with the horn antennae for frequency bands of interest to the project
- Prepare an *Antennae Design, Construction and Performance Assessment Report* describing the above activities and findings.

Products:

- Antennae Design, Construction and Performance Assessment Report (draft and final)

TASK 5: INTEGRATION AND SYNCHRONIZATION OF GPS AND BPD

The goal of this task is to conduct a search and evaluation for the most desirable real-time kinematic (RTK) GPS device with a precision of ±0.39 in (±1 cm) and associated software and a data logger. A surveying software package will be used for BPD location tracking in combination with the GPS device. The GPS device's frequency of 1 Hz will be synchronized so that each radar trace of made by the BPD corresponds to a set of coordinates (x; y; z), i.e., eastings, northings, and elevations.

The Recipient shall:

- Acquire a suitable RTK GPS device and its associated data logger capable of connecting to the laptop running the BPD's software, via either USB or serial ports.
- Include a provision with the data logger to enable simultaneous triggering of both the BPD's and the GPS device's data acquisition systems.
- Prepare a *GPS Operating Manual* with information on external triggering of the BPD using the GPS device's data logger.
- Participate in CPR #3 meeting and prepare a *CPR #3 Report* as described in subtask 1.3.

Product:

- GPS Operating Manual (draft and final)
- CPR #3 Report (draft and final)

Task 6: SOFTWARE MODIFICATION FOR DATA COLLECTION AND ANALYSIS

The goals of this task are to modify available ***BakhtarRadar*** software written in the C++ programming language by converting it to Windows-based code for near real-time execution of analysis and display of field results.

The Recipient shall:

- Use processed data from the BPD and the GPS device to establish the footprint of detected buried pipes on the surface, and to perform location tracking.
- Modify the graphical user interface (GUI) of the BPD to enable additional input for default test parameters.
- Set internal triggering of the BPD for cases where GPS cannot work (access to sufficient satellite connections blocked by tall trees, buildings, etc.).
- Convert the operating software to Windows-based code for faster execution in the field and faster display of results.
- Design and implement digital filters for clutter removal by considering the threshold of detection for buried plastic and metallic pipes.
- Modify the software package associated with the BPD field data sets that are automatically saved with file names having eight characters, with job extensions and corresponding converted GPS coordinates data sets saved with the same file names and xls extensions.
- Make necessary modifications in the software package associated with BPD field data sets and corresponding converted GPS coordinates data sets for near real-time display of results, which include the location, depth, diameter, and material type of buried pipes.
- Implement internal triggering provisions for BPD r operation without GPS.
- Implement digital filters to mask subsurface geologic features for unique identification and determination of the material type of buried pipes.
- Implement a GUI for adjusting test parameters in the SETUP Window of the BPD.
- Prepare a *Software Report* describing the modifications made and the inputs to the GUI for near real-time detection of buried pipes.
- Participate in CPR #4 meeting and prepare a *CPR #4 Report* as described in subtask 1.3.

Products:

- Software Report (draft and final)
- CPR #4 Report (draft and final)

TASK 7: BPD SYSTEM PERFORMANCE VALIDATATION AND DEMONSTRATION

The goal of this task is to: (1) use the findings and results of Tasks 2 to 6 to assemble a prototype configuration of the BPD for near real-time detection of buried pipes; (2) validate the functionality of the BPD; and (3) demonstrate the BPD at utility sites for at least six months.

The Recipient shall:

- Configure a complete system comprising of a VNA TL, an FR dipole/horn antennae (Load),a GPS device and data logger, a portable generator/inverter, a control and acquisition unit (laptop computer), and a motorized moving platform.
- Perform an extensive series of EM compatibility tests to ensure proper operation of the system and reduce standing wave formation in the transmission lines and minimize losses in connecting ports.
- Evaluate the functionality of the configured system for underground pipeline detection by field testing and near real-time realization of the depths, diameters, and material type of buried pipes in different geologic formations (coverings).
- Make final modifications, based on field testing and evaluations, to the BPD's hardware and software.

- Prepared a *Configuration and Validation Report* that details the above activities and the findings.
- Provide a *Field Demonstration Plan* that describes site preparedness, demonstration procedures, and planned activities.
- Demonstrate the capability of the prototype BPD to detect, locate, and distinguish the material type (metal or plastic) of buried pipes in the field for at least six months.
- Verify the locating and depth detection accuracy by randomly digging up few pipes and measuring their exact locations and depth, as well as by consultation with PG&E engineers.
- Prepare a *Field Demonstration Report* summarizing the results obtained and the findings.
- Participate in CPR #5 meeting and prepare a *CPR #5 Report* as described in subtask 1.3.

Products:

- Configuration and Validation Report (draft and final)
- Field Demonstration Plan (draft and final)
- Field Demonstration Report (draft and final)
- CPR #5 Report (draft and final)

TASK 8: EVALUATION OF PROJECT BENEFITS
The goal of this task is to report the benefits resulting from this project.

The Recipient shall:

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

    - <u>For Product Development Projects and Project Demonstrations:</u>
        - Published documents, including date, title, and periodical name.
        - Estimated or actual energy and cost savings, and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
        - Greenhouse gas and criteria emissions reductions.
        - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
        - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
        - A discussion of project product downloads from websites, and publications in technical journals.
        - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any

- Additional Information for Product Development Projects:
  - Outcome of product development efforts, such copyrights and license agreements.
  - Units sold or projected to be sold in California and outside of California.
  - Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
  - Investment dollars/follow-on private funding as a result of Energy Commission funding.
  - Patent numbers and applications, along with dates and brief descriptions.
- Additional Information for Product Demonstrations:
  - Outcome of demonstrations and status of technology.
  - Number of similar installations.
  - Jobs created/retained as a result of the Agreement.

o 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
- Mid-term Benefits Questionnaire
- Final Meeting Benefits Questionnaire

TASK 9: 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.

Exhibit A
Scope of Work
Bakhtar Research and Engineering, LLC

The Recipient shall:

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

Products:

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

TASK 10: PRODUCTION READINESS PLAN

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

The Recipient shall:

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

Products:

- Production Readiness Plan (draft and final)

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

RESOLUTION NO: 20-0610-15b

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: BAKHTAR RESEARCH AND ENGINEERING, LLC.

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

RESOLVED, that the CEC approves Agreement PIR-19-017 with Bakhtar Research and Engineering, LLC for a $1,582,117 grant to develop and demonstrate a natural gas pipeline detector using forced resonance imaging technology for near real-time detection, locating, depth estimation, and material differentiation (plastic or metallic) of underground natural gas pipelines; and

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

CERTIFICATION

The undersigned Secretariat to the Commission does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the CEC held on June 10, 2020.

AYE:
NAY:
ABSENT:

ABSTAIN:

_____
Cody Goldthrite
Secretariat