

GRANT REQUEST FORM (GRF)New Agreement PIR-14-014 (To be completed by CGL Office)

Division	Agreement Manager:	MS-	Phone
ERDD	Avtar Bining	43	916-327-1411

Recipient's Legal Name	Federal ID Number
Institute of Gas Technology dba Gas Technology Institute	36-2170137

Title of Project
Pipeline Right of Way Monitoring and Notification System

Term and Amount	Start Date	End Date	Amount
	6/30/2015	3/30/2018	\$ 1,049,978

Business Meeting Information
 ARFVTP agreements under \$75K delegated to Executive Director.

Proposed Business Meeting Date	5/13/2015	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
Business Meeting Presenter	Avtar Bining	Time Needed:	5 minutes

Please select one list serve. Select

Agenda Item Subject and Description

INSTITUTE OF GAS TECHNOLOGY dba GAS TECHNOLOGY INSTITUTE: Proposed resolution approving Agreement PIR-14-014 with Institute of Gas Technology dba Gas Technology Institute (GTI) for a \$1,049,978 grant to demonstrate a "Pipeline Right of Way (ROW) Monitoring and Notification System" that can provide leading indicators of threats to buried natural gas pipelines using both mobile sensors mounted on excavation devices and stationary sensors mounted directly on the pipe at a site to be provided by a California natural gas utility. (PIERDD Funding) Contact: Avtar Bining (Staff Presentation: 5 minutes)

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":
Agreement will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because it involves a system of small sensors on a permitted portion of natural gas pipeline and on some excavation machinery. The system will be comprised of sensors, analytics, and an alert mechanism interconnected using wireless links. The objectives are to demonstrate effective risk reduction through the use of the following technologies: 1) stationary sensors on pipelines, 2) mobile sensors on excavating machinery, 3) analytics using semantic web technology in conjunction with Bayesian networks, and 4) a high degree of wireless connectivity with the sensors and the end users.
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: _____
- Common Sense Exemption. 14 CCR 15061 (b) (3)
- Explain reason why Agreement is exempt under the above section:
- 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

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

GRANT REQUEST FORM (GRF)



Legal Company Name:	Budget
Leidos Engineering	\$ 506,500
	\$
	\$
	\$
	\$
	\$
	\$
	\$
	\$
	\$

EXHIBIT A Scope of Work

A. Task List

Task #	CPR ¹	Task Name
1		General Project Tasks
2		Right of Way Monitor Hardware Design
3		Data Communication Design
4	X	Data Analytics
5		Stationary Monitor Prototype Construction
6		Mobile Monitor Prototype Construction
7	X	Pre-Deployment Testing
8		Deployment of Monitor Hardware
9		Field Testing of Hardware and Analytics
10		Evaluation of Project Benefits
11		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
HCA	High Consequence Area
IOU	Investor Owned Utility
NG	Natural Gas
ORW	OnRamp Wireless
RF	Radio Frequency
ROW	Right of Way
RPMA	Random Phase Multiple Access
TAC	Technical Advisory Committee

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

A. Purpose of Agreement

The purpose of this Agreement is to fund the deployment and demonstration of a system that alerts operators to the presence of threats in the pipeline Right-of-Way (ROW). This system wirelessly monitors vibration and electrical potentials on a pipeline at regular intervals; it will also monitor the status of several pieces of excavation machinery. The system will process the data generated by these devices and infer when digging equipment or other threats to the pipeline are present in the ROW prior to damage occurring.

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

B. Problem/ Solution Statement

Problem

The greatest threat to buried pipelines is the operation of third party digging equipment within the pipeline right-of-way. Current methods to continuously monitor the ROW, such as distributed fiber optic sensors, are difficult to retro-fit to existing pipelines in populous areas. It is these high consequence areas (HCA) that require a cost-effective retrofit method for ROW monitoring and notification; there are none at this time.

Solution

The Recipient will develop a pipeline monitoring system that continuously monitors pipeline structures and wirelessly provides alerts to the investor owned utility (IOU). The system will consist of existing low-cost, low power radio systems and off-the-shelf sensors. These technologies will lower the deployment costs to the extent that multiple sensors can be installed at discrete points in a given mile of pipeline. Sensors will also be installed on select pieces of excavation equipment such that their location and status can be monitored. The overlapping coverage of multiple stationary sensors along with mobile sensors on pipelines will provide the same functionality as continuous fiber optic sensors in a form that can be retrofit to existing pipelines.

The data generated by the mobile and stationary sensors will be wirelessly transferred to a cloud hosted repository. A variety of analytics will be applied to this data to determine when actionable threats are present on the ROW. Some pre-processing analytics will reside with the distributed sensors to discriminate what raw data needs to be transferred to the host. The data transferred to the host repository will be examined in terms of locale and time stamp to generate the notification and location for actionable threats.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- To deploy a sensor based system to detect threats entering the ROW
- To demonstrate the wireless collection of threat data to a hosted repository
- To demonstrate analytics that can identify actionable threats from the data
- Provide wireless notification of the identified threats to appropriate parties

Ratepayer Benefits: This Agreement will result in the ratepayer benefits of increased safety and greater reliability. This will be achieved by identifying the presence of excavation machinery or other threats in the ROW utilizing a sensor based system. The system will consist of sensors deployed along the ROW as well as sensors mounted on excavators that wirelessly connect with analytics that can merge the data from these multiple sources.

Technological Advancement and Breakthroughs:² 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 preventing excavation damage to gas pipelines. A

² California Public Resources Code, Section 25711.5(a) also requires EPIC-funded projects to lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory and energy goals.

EXHIBIT A Scope of Work

breakthrough in the cost of deploying damage prevention systems is the anticipated outcome of this agreement.

Agreement Objectives

The objective of this Agreement is to deploy and demonstrate a system that provides early indications of threats within the pipeline ROW.

II. 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

- 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.
- Submit the final product to the CAM once agreement has been reached on the draft. The CAM will provide written approval of the final product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- If the CAM determines that the final product does not sufficiently incorporate his/her comments, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

For products that require a final version only

- Submit the product to the CAM for approval.
- If the CAM determines that the product requires revision, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

For all products

- Submit all data and documents required as products in accordance with the following Instructions for Submitting Electronic Files and Developing Software:

EXHIBIT A

Scope of Work

- **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).

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.

EXHIBIT A

Scope of Work

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
 - 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

EXHIBIT A

Scope of Work

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

EXHIBIT A

Scope of Work

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.

EXHIBIT A

Scope of Work

The Recipient shall:

- Submit a monthly *Progress Report* to the CAM. Each progress report must:
 - Summarize all Agreement activities conducted by the Recipient for the preceding month, including 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.
 - Provide a synopsis of the project progress, including accomplishments, problems, milestones, products, schedule, fiscal status, and any evidence of progress such as photographs.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the “Payment of Funds” section of the terms and conditions. In addition, each invoice must document and verify:
 - Energy Commission funds received by California-based entities;
 - Energy Commission funds spent in California (*if applicable*); and
 - Match fund 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 and approve 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 a 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.
- Submit a draft of the outline to the CAM for review and comment.
- Once agreement has been reached on the draft, submit the final outline to the CAM. The CAM will provide written approval of the final outline within 10 days of receipt.

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 and the Style Manual provided by the CAM.

EXHIBIT A Scope of Work

- Submit a draft of the report to the CAM for review and comment. Once agreement on the draft report has been reached, the CAM will forward the electronic version for Energy Commission internal approval. Once the CAM receives approval, he/she will provide written approval to the Recipient.
- Submit one bound copy of the Final Report to the CAM.

Products:

- Final Report (draft and final)

CAM Product:

- Comments on Draft Final Report Outline

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.
- A copy of a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.
- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.

EXHIBIT A Scope of Work

- 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.

EXHIBIT A

Scope of Work

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;

EXHIBIT A

Scope of Work

- 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.

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

III. TECHNICAL TASKS

TASK 2 – Right of Way Monitor Hardware Design

The goals of this task are to: 1) Prepare a detailed design of the hardware for stationary deployment, 2) Prepare a detailed design for mobile hardware to be placed on excavating machinery, and 3) to present this design to the various project stakeholders.

The Recipient shall:

- Gather input on typical installation scenarios from the IOU(s) providing stationary sensor test sites for the demonstration.
- Gather input on the types of excavating machinery available for the demonstration.
- Capture end user data requirements such as the recipients of the threat alerts and the format/content expected within the alerts.
- Define the set of sensors mounted directly on the pipeline to fulfill the base requirements.
- Determine additional sensors on the pipe to provide added value to the IOU(s) hosting the demonstration.
- Estimate the spacing needed between stationary sensors to achieve pre-emptive detection of threats on the ROW.
- Prepare a Draft Hardware Design Report including documents describing the stationary sensor installations and the mobile devices for excavators.
- Present these materials to the various stakeholders for review.
- Prepare and circulate a Hardware Design Report capturing feedback or amendments to the formal design documents.

Products:

- Hardware Design Report (Draft and Final)

TASK 3 – Data Communication Design

The goals of this task are to prepare a detailed design of the wireless hardware and network provisioning required to support the IOU(s) test sites.

The Recipient shall:

- Gather input on suitable IOU test sites to include location, access restrictions, availability of network infrastructure installation locations, availability of alternating current power for infrastructure (solar power infrastructure is available if needed), availability of cellular service for backhaul connectivity of network infrastructure, potential locations for stationary sensors, installation options for stationary sensors, and guidance on labor restrictions related to installation of telecommunications/infrastructure equipment and stationary sensors.
- Prepare a Radio Frequency (RF) network coverage map based on infrastructure and stationary sensor locations. RF network infrastructure shall be 2 On-Ramp Wireless Random Phase Multiple Access (RPMA) Points per test site which shall provide coverage for at least one linear mile of pipeline. At least ten stationary sensor locations shall be identified.
- Prepare and provide Data Communication Design Report including infrastructure site installation documents such as appropriate drawings and analysis.

EXHIBIT A

Scope of Work

Products:

- Data Communication Design Report

TASK 4 – Data Analytics

The goals of this task are to: 1) Capture the current IOU(s) means and practice for generating encroachment alerts, 2) Extract the business logic flow governing the alert process, 3) Construct the analytics to extract threat events from sensor data in the presence of background noise, and 4) Provide threat alerts in accordance with the established business logic.

The Recipient shall:

- Work with the IOU(s) and the TAC members to establish the current practices for generating and handling threat alert notifications.
- Generate formal business rules for the generation, distribution, and execution of threat alerts.
- Implement the analytics by expressing the business rules and other criteria in the form of causal Bayesian Networks.
- Using synthetic or historical alert data, construct a set of cloud level analytics to recognize a valid threat situation, generate alerts, and deliver them to the appropriate parties.
- Construct a Web Hosted Mockup of the user data interface to demonstrate the functionality of the alerting system.
- Develop a Web Hosted Mockup Test Plan to share with stakeholders prior to demonstration.
- Demonstrate the Web Hosted Mockup of the user interface to the participating IOU(s), CAM, and TAC and capture feedback.
- Develop device level analytics for the stationary sensors using data generated during the execution of Task 5.
- Develop device level analytics for the mobile sensors using data generated during the execution of Task 6.
- Scale the output of the device level analytics to minimize the amount of data that must be wirelessly transmitted.
- Perform additional tests of the Web Hosted Mockup of the user interface to verify its performance.
- Make adjustments to the data analytics based on this testing.
- Prepare and provide a Web Hosted Mockup Report describing performance relative to the stored sensor data.
- Prepare a CPR Report and participate in a CPR meeting per Task 1.3.

Products:

- Web Hosted Mockup Test Plan
- Web Hosted Mockup Report
- CPR Report

TASK 5 – Stationary Monitor Prototype Construction

The goals of this task are to: 1) Construct basic functional prototypes of the stationary pipeline sensor packages and radios, 2) Perform bench testing of these packages, and 3) Record sensor data to be used in the Task 4 development of cloud level analytics.

EXHIBIT A

Scope of Work

The Recipient shall:

- Specify the hardware required for the construction of the stationary monitor prototypes.
- Procure the materials for the construction of the prototypes.
- Construct test bench versions of the stationary monitor prototypes.
- Verify the performance of the sensors, radios, and other sub-systems.
- Electronically record sensor data for the development of device level analytics.
- Test draft device level analytics on the prototypes to verify functionality.
- Develop Stationary Monitor Design Report including documents for the construction of stationary monitors.
- Construct hardened prototypes suitable for outdoor testing.
- Verify functionality of hardened prototypes.

Products:

- Stationary Monitor Design Report

TASK 6 – Mobile Monitor Prototype Construction

The goals of this task are to: 1) Construct basic functional prototypes of the mobile sensor packages for deployment on excavation machinery, 2) Perform bench testing of these packages, and 3) Record sensor data to be used in the Task 4 development of cloud level analytics.

The Recipient shall:

- Specify the hardware required for the construction of the mobile monitor prototypes.
- Procure the smartphone devices and other hardware for the construction.
- Construct test bench versions of the mobile monitor prototypes.
- Set up mobile app on devices and verify connectivity.
- Electronically record sensor data for the development of device level analytics.
- Test draft device level analytics on the mobile prototypes to verify functionality.
- Develop Mobile Monitor Design Report including design documents and provide them to the IOU(s), the TAC, and the CAM.
- Construct hardened prototypes suitable for outdoor testing.
- Verify functionality of hardened prototypes.
- Update system software code as needed to accommodate testing results and to support defined project requirements.

Products:

- Mobile Monitor Design Report

TASK 7 – Pre-Deployment Testing

The goals of this task are to: 1) Construct two each of hardened stationary and mobile sensor packages and 2) Perform limited outdoor testing on these as qualification for more extensive deployment and field testing.

The Recipient shall:

- Develop a Test Plan to verify that the system is ready to move to deployment.
- Install hardened stationary prototypes on a readily available section of pipe.
- Install hardened mobile prototypes on IOU provided excavation equipment.

EXHIBIT A

Scope of Work

- Perform testing with actual infrastructure hardware (ORW Access Points with cellular backhaul) to be used in the IOU pilot tests.
- Test entire system set-up end-to-end with all hosting infrastructure.
- Perform basic functional testing of prototype hardware.
- Verify connectivity to analytics via a Web Hosted User Interface Demo.
- Perform cross-testing by running excavator with mobile sensor package in vicinity of stationary sensors.
- Demonstrate the Web Hosted User Interface to the participating IOU(s), CAM, and TAC and capture feedback.
- Prepare a Pre-Deployment Test Report that includes results and provides data verifying the proposed functionality has been achieved.
- Prepare a CPR Report and participate in a CPR meeting per Task 1.3.

Products:

- Test Plan
- Web Hosted User Interface Demo
- Pre-Deployment Test Report
- CPR Report

TASK 8 – Deployment of Monitor Hardware

The goals of this task are to: 1) Construct a sufficient number of stationary and mobile sensor devices to provision test sites, and 2) Work with the IOU(s) to deploy the devices to the site(s)

The Recipient shall:

- Work with the IOU(s) to construct a reasonable Deployment Schedule.
- Provide Deployment Schedule to the participating IOU(s), TAC, and CAM.
- Prepare Deployment Procedures plan and associated bill of materials.
- Install wireless network infrastructure with appropriate labor resources as per guidance from the IOU.
- Perform wireless network installation verification including “RF site survey” to validate RF network coverage.
- Install stationary sensors with appropriate labor resources as per guidance from the IOU.
- Install mobile sensors on utility selected pieces of excavation equipment.
- Perform stationary sensor connectivity and functional testing.
- Perform end-to-end functional testing through all installed and hosted system components.
- Prepare and distribute an Installation Report with updated RF network coverage analysis based on installation verification data and end-2-end functional test results.

Products:

- Deployment Schedule
- Installation Report

TASK 9 – Field Testing of Hardware and Analytics

The goals of this task are to: 1) Perform a full four seasons field test of the system at the participating IOU(s) unless a shorter time is approved in writing by the CAM, and 2) Perform cross-testing of the mobile and stationary sensors to refine the calibration of both systems.

EXHIBIT A Scope of Work

The Recipient shall:

- Prepare an Operator's User Manual to allow the participating IOU(s) to facilitate the day-to-day operation of the field test system.
- Facilitate a presentation of the Operator's User Manual to the participating IOU(s), TAC, and CAM at the beginning of the field test.
- Set up structured tests of excavation machinery fitted with mobile sensors in proximity to pipeline ROW with stationary sensors installed to provide additional training data for both systems.
- Perform structured tests of the mobile and stationary sensors in isolation to one another.
- Capture data on random events that exercise the system capabilities.
- Identify primary and secondary representative pipe sections for sensor packages locations for field testing.
- Identify alternate sites for field testing representative of possible interferences that may be encountered.
- Prepare a Draft Field Test Report on the experience of operating the ROW monitor system.
- Prepare a Field Test Report after receiving comments from end users and sponsor.

Products:

- Operator's User Manual
- Field Test Report (Draft and Final)

TASK 10 - 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 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.

EXHIBIT A

Scope of Work

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

EXHIBIT A

Scope of Work

TASK 11 - Technology/Knowledge Transfer Activities (*Mandatory task*)

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 on the results of the project.
- 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)
- Technology/Knowledge Transfer Plan (draft and final)
- Technology/Knowledge Transfer Report (draft and final)

IV. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: GAS TECHNOLOGY INSTITUTE

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

RESOLVED, that the Energy Commission approves Agreement PIR-14-014 from PON-14-503 with **Institute of Gas Technology dba Gas Technology Institute** for a **\$1,049,978** grant to demonstrate a "Pipeline Right of Way Monitoring and Notification System" that can provide leading indicators of threats to buried natural gas pipelines using both mobile sensors mounted on excavation devices and stationary sensors mounted directly on the pipe at a site to be provided by a California natural gas utility; 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 13, 2015.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

Harriet Kallemeyn,
Secretariat