2017 Step 2 – LOI – Detailed Application

Project Overview

Project Title: Advanced Methane Measurements using Ground-based and UAV-based Sensors

Project Lead:

Ms. Brooke Coburn
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Project Lead Organization / Company Information:

Organization: Encana Corporation Department: Government Relations
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Is the requested funding amount different than Letter of Intent (LOI) form? NO

2017 AUPRF Funding Request: $50,000

Leveraged Funding:

Funding Source: General Electric (GE) Requested / Secured / In-kind $132,000
Funding Source: Encana Requested / Secured / In-kind $18,500
Funding Source: Emissions Reduction Alberta (ERA) Requested / Secured / In-kind $200,500

Total Leveraged Funding: $351,000

Total Project Budget: $401,000
Original LOI budget was $330,000. This is mainly due to the fact initial project costs were understated by not applying the exchange rate from USD to CAD to GE’s overall project costs as well as due to the realignment of funding opportunities and associated timelines. The LOI had originally included Natural Resources Canada as a requested funding source, however that is no longer the case and instead a request has been made to Emissions Reduction Alberta (ERA).

Category: Air Quality and Climate Change

Project Scope:

The proposed project, Advanced Methane Measurements using Ground-based and UAV-based Sensors, is a field demonstration of a methane detection and quantification system under development by GE for the selective continuous and unattended monitoring and localization of methane leaks. This project will
involve the use and application of GE’s monitoring technology, related analytics tools, and applications to address knowledge gaps and evaluate technologies. GE will partner with Encana to gain access to a range of facilities for implementation and testing. With proven field results, GE would be enabled to offer these alternative, advanced, and low-cost detection technologies to the oil and gas industry at large, enabling industry-wide reductions in methane emission footprints.

In 2011, Canadian GHG emissions for upstream oil and gas flaring, methane venting and fugitives were 34.4 million tonnes CO\textsubscript{2} equivalent, 65% of which were from Alberta sources\textsuperscript{1}. Direct methane emissions account for 89% of this amount and are primarily composed of:

- Fugitives (33%) which are primarily composed of 16% from surface casing vent flows (SCVF) which are leaks from wellbores; 11% from equipment leaks; and 6% from other sources;
- Reported venting (30%) which are the amounts reported to regulators from production accounting systems and are mostly composed of well casing vents in cold heavy oil;
- Unreported venting (26%) which are composed of a number of small releases from pneumatic equipment and other process sources.

Innovative technologies using advanced sensors deployed remotely, employing ground-based or aerial platforms such as described in this proposal are directly relevant and will be trialed for the detection and quantification of fugitive methane emission sources (11.3 million tonnes CO\textsubscript{2}e per year). In the future, the technology could be adapted and deployed for other methane emission sources.

It is being recognized that the statistical distribution of methane emission sources is not uniform but characterize by (1) a small number of emission sources contributing a disproportionate amount of emission volumes and (2) some emission sources emit relatively large volumes infrequently during relatively small time intervals. Massive resources will be required unless faster and scalable technologies are developed, demonstrated and deployed. A bottom-up approach whereby each facility and each instrument or device is manually measured and monitored using current available methods is impractical and extremely onerous in terms of financial and human resources.

To address these challenges, GE is currently developing two proprietary methane detection technologies, as described below:

**Technology 1: Area Methane Measurements using Ground-based Sensors**

GE’s ground-based fugitive methane emission sensor currently under development will be an ATEX-certified, small size wireless sensor node deployed on facilities such as well-pads and in gathering and boosting compressor stations to allow for remote, continuous detection and analytics of emissions including methane concentration, methane leak rate and methane leak location. This project will involve the use and application of GE’s monitoring technology, related analytics tools, and applications (collectively, the “GE Monitoring Technology”) at Encana’s facilities to determine whether the GE Monitoring Technology, when positioned strategically, is effective in detecting and locating methane leaks in a real time, unattended mode. GE envisions this effective monitoring will assist customers by reducing manual inspection requirements and expense by alerting personnel only to those circumstances where detected leakage is high enough to warrant a follow up visit or repair. The GE Monitoring Technology units can be remotely monitored using GE communication components providing valuable qualitative and quantitative information about equipment methane leakage from

\textsuperscript{1} Clearstone Engineering (2014), Overview of the GHG Emissions Inventory, prepared for Environment Canada
operator facilities. This new generation of gas sensors, known as multivariable sensors, utilize a fundamentally different measurement approach, eliminating numerous limitations of existing sensors. These multivariable sensors quantify total hydrocarbons, accurately detect vapors in the presence of numerous chemical interferences, have self-correction for temperature, and reject chemical interferences. The technology developed at GE represents a major differentiator compared to previous batch or discrete leak measurements and will lead to a more comprehensive understanding of leak source characteristics and their mitigation. From the hardware perspective, individual methane sensors with sensitivity 1 ppm have been developed which enable detection of methane at the background level with a low operation power and small form factor, while remaining cost effective.

Technology 2: Area Methane Measurements using Unmanned Aerial Vehicles (UAV)

GE is currently developing a proprietary Aerial Based Platform for selective detection of methane leaks. This project will involve the use and application of GE’s proprietary UAV mounted measurement and detection technology, sensors and related tools and applications (collectively, the “GE Aerial based Platform Methane Detection”) at Encana’s facilities to determine whether the GE Aerial Based Platform Technology, when used to strategically scan a facility, is effective in detecting, locating and measuring methane leaks in real time. This technology features an autonomous UAV with an integrated standoff laser-based methane sensor. This method of fugitive methane emission inspection provides the operator with a significant time-savings and real-time reporting. The collected data features a methane concentration heat map indicating high and low concentration points at the facility, allowing for leak localization in a timely manner. GE envisions that effective monitoring will assist customers by reducing manual inspection requirements and expense by alerting personnel only to those circumstances where detected leakage is high enough to warrant attention. The Aerial Based Platform Methane Detection includes remote monitoring system using a GE data acquisition application.

Project Schedule with Milestones:

Objectives

The objectives of this project are:
1. To demonstrate 2 clean energy technologies for the reliable, scalable, rapidly deployable and efficient (with respect to human and financial resources) detection and quantification of methane emissions in the Alberta oil and gas sector.
2. To broadly and collaboratively disseminate project achievements and learnings in order to accelerate industry’s trajectory to delivering on the Alberta policy goal of 45% reductions by 2025.

Schedule

The project will progress in 5 stages with key milestones noted as follows:
**Task 1. Preparation:** As a first step, the team will evaluate Encana’s wide range of facilities and select those that are suitable testing environments for GE’s technologies.

1.1 Meetings with Encana team to discuss scope of collaboration in this solicitation and desired testing to be conducted at Encana facilities.
1.2 Agreement on test sites that are conducive to testing of technologies and are varied in equipment types, age (a mix of comparatively older and newer facilities), and geographic region. This is to ensure that the sites are representative of the mix of facility types across the industry.

**Task 2. Field Measurement Campaign (Round 1):** Once test sites have been selected, the GE team will begin the first round of their measurement campaign and comparison of technologies with currently used approaches for benchmarking.

2.1 Survey of test sites with currently utilized inspection devices (FLIR camera, Hi Flow Sampler, RMLD, etc.) for benchmarking purposes.
2.2 Deployment of GE’s Ground-Based Monitoring System in varying configurations at each site for continuous monitoring for a predetermined period of time.
2.3 Conducting of several Aerial surveys of each site with GE’s Aerial Based Detection Technology. Flight altitude, speed, flightpath will be altered to understand the impact of those parameters on the measurement data.

**Task 3. Analysis of Collected Data:** The team will analyze the collected test data and compare with the data collected from the initial scans (from task 2.1 above). Additionally, the team will gather operational data from Encana in order to better understand any potential opportunities in the datasets (scheduled venting, maintenance operations, etc.).

3.1 Benchmarking of GE technologies (compared with data collected from Task 2.1).
3.2 Creation of heat maps indicating high concentration points on the sites.
3.3 Fusing of ground-based sensor data (bottom-up) with aerial data (top-down) for comprehensive analysis of emission footprint.
3.4 Development of summary charts/graphics localizing high concentration points at each site and potentially faulty equipment to enable more effective mitigation efforts.

**Task 4. Field Measurement Campaign (Round 2):** Once data collected has been analyzed (as part of Task 3 above), the GE team will begin the second round of testing, implementing learnings and adjusting testing procedures as needed for potentially enhanced measurement results.

4.1 Survey of test sites with currently utilized inspection devices (FLIR camera, Hi Flow Sampler, RMLD, etc.) for benchmarking purposes.
4.2 Deployment of GE’s Ground-Based Monitoring System in varying configurations at each site for continuous monitoring for a pre-determined period of time.

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### Project Schedule & Budget

<table>
<thead>
<tr>
<th>Activities</th>
<th>Year</th>
<th>Principal Milestones and Tasks</th>
<th>Completion Date</th>
<th>Total Costs</th>
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<tr>
<td>Task 1</td>
<td>2017</td>
<td>Preparation</td>
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<td>2017</td>
<td>Field Measurement Campaign (Round 1)</td>
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<td>2017-2019</td>
<td>Project Reporting/ Communication of Results</td>
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<tr>
<td>Total</td>
<td></td>
<td></td>
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</table>
4.3 Conducting of several Aerial surveys of each site with GE’s Aerial Based Detection Technology. Flight altitude, speed, flightpath will be altered to understand the impact of those parameters on the measurement data.

**Task 5. Project Reporting/ Communication of Results:** Assemble project findings and conclusions in a final report to be shared through the PTAC network.

**Relevant Expertise of Research Team:**

**Brooke Coburn**, Encana  
**Project Role:** Encana Project Management  
Brooke Coburn, P.Eng., is a senior development engineer with 10 years of experience in the oil and gas industry. She received her mechanical engineering degree from the University of Calgary and has progressed through a series of diverse and challenging technical development roles in a variety of Alberta resource plays, including heavy oil SAGD, CHOPS, light oil and natural gas.

**Dean Jenkins**, Encana  
**Project Role:** Encana Project Support  
Dean Jenkins, P.Eng. is an operations manager with 28 years of experience in the oil and gas and environmental industries. He holds a MSc in Environmental Engineering from Montana Tech of the University of Montana and a BSc in Chemical Engineering from the University of Calgary. He has worked in a variety of capacities from production and environmental engineering roles onto an operations manager in drilling and completions.

**Myalee Evans**, GE  
**Project Role:** GE Canada Project Management  
Myalee Evans, P.Eng. has 11 years of experience in operations, equipment design and project management. She holds a B.Sc. (Eng) in Mechanical Engineering from Queen’s University and is currently completing an M.Eng. in Environmental Engineering from the University of Calgary.

**Nasr Alkadi**, GE  
**Project Role:** GE OGTC Project Manager  
Nasr Alkadi, PhD has over 13 years of experience in energy and efficiency and is currently leading the oilfield energy efficiency and emissions team at GE OGTC. Dr. Alkadi received his PhD from West Virginia University and is an expert in advanced energy systems design and analysis with an extensive focus on energy efficiency and emissions reduction in the Oil & Gas sector.

**Partnering Organizations**

GE has operated in Canada for over 100 years and actively collaborates with the Government of Alberta on energy, environment and health care innovation. The GE Customer Innovation Centre located in Calgary, Alberta, brings together global experts and advanced analytical tools to explore, analyze and solve business challenges. GE is focused on developing scalable solutions that can be applied quickly and commercialized for maximum return on investment and believes that innovation is the primary lever for
a more competitive economy and the key to successful innovation is collaboration. GE and Encana will collaborate on a demonstration of new methane detection technologies. GE will test and demonstrate two technologies for methane detection in partnership with Encana.

Encana: Encana is a leading North American energy producer that is focused on growing its strong portfolio of diverse resource plays producing natural gas, oil and natural gas liquids. By partnering with employees, community organizations and other businesses, Encana contributes to the strength and sustainability of the communities where it operates. Encana will collaborate with GE and provide site locations for demonstrating methane detection technologies.

**Peer Review and Communication of Results:**

Upon approval of funding, this project will receive feedback and review from PTAC’s Air Research and Planning Committee. Project results and conclusions will be assembled in a final report to be shared through the PTAC network.

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