

Public Quarterly Report

Date of Report: 1st Quarterly Report- February 18, 2019

Contract Number: #693JK31910016POTA

Prepared for: DOT

Project Title: Develop Remote Sensing and Leak Detection Platform that can Deploy Multiple Sensor Types

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For quarterly period ending: December 31, 2019

1: Items Completed During this Quarterly Period:

Team Project Activities completed during this quarter – none.

<i>Item #</i>	<i>Task #</i>	<i>Activity/Deliverable</i>	<i>Title</i>	<i>Federal Cost</i>	<i>Cost Share</i>
5	7	1 st Quarterly Status Report	Submit 1 st Quarterly Status Report	8,884.75	8,884.75

2: Items Not-Completed During this Quarterly Period:

Team Project Activities not completed this quarter

<i>Item #</i>	<i>Task #</i>	<i>Activity/Deliverable</i>	<i>Title</i>	<i>Federal Cost</i>	<i>Cost Share</i>
1	1	Project Kick-Off, Protocol	Project Plan	34,964.50	34,964.50
2	3	Test Range Review	Test Range & Staging Protocols	2,000.00	2,000.00
3	4	Aviation Safety Case – Initial Release	Airspace Development	2,000.00	2,000.00
4	6	Data Analysis & Benchmarking Plan – initial release	Data Analysis & Benchmarking	1,250.00	1,250.00
6	2	Integration Report – for 1 st Campaign	Data Curation & Analysis	20,000.00	20,000.00
7	3	Test Range & Protocol Update	Test Range & Staging Protocols	1,000.00	1,000.00
8	4	Aviation Safety Case – update	Airspace Development	3,000.00	3,000.00
9	6	Data Analysis & Benchmarking Plan - update	Data Analysis and Benchmarking		
10	7	2nd Quarterly Status Report	Submit 2nd quarterly report	8,884.75	8,884.75

3: Project Financial Tracking During this Quarterly Period:

No invoices have been submitted to date, however the first invoice is being prepared for submission.

4: Project Technical Status –

Item #5 / Task 7 / 1st Quarterly Report / Submit 1st Quarterly Report

Status: this document presents the 1st Quarterly Report

Item #1 / Task 1 / Project Kick-Off, Protocol / Project Plan

Description: The Project Kick-Off meeting will organize and coordinate the project team (PHMSA and PRCI), review the project scope and schedule, introduce all stakeholders, establish key points of contact, and methods and frequency of communication for the project. This meeting will also be used to assess alignment and coordination with other related PHMSA (and possibly external) projects. After the project kick-off, the project team will formalize the Project Plan in advance of a stakeholder meeting at which the plan and schedule will be approved.

Status: The Kick-Off Meeting is scheduled for March 6th in San Diego and preparations are underway.

Item #2 / Task 3 / Test Range Review / Test Range & Staging Protocols

Description: Multiple PRCI members have expressed intention of making their ROW corridors available for this program. Multiple factors will be considered in the selecting the location(s) for conducting these tests including, for example, population density, proximity to transportation corridors, towered airports, traffic patterns of ongoing aviation operations (helicopters, crop dusters, parachutists, balloonists and gliders, commercial & military aircraft, etc.). Site selection will be based on risk-based approach identifying why the areas to be flown are in consideration from others.

Status: Significant effort has gone into evaluating parameters and finalizing the recommendation for the primary site of the flight tests. Two locations have been identified as prime candidates. Detailed assessments of the airspace overlying candidate locations of pipeline assets are underway, as are discussions with operators to confirm commitments, as is an assessment of alignment with other programs. At the Kick-Off Meeting on March 6th, final location recommendation(s) will be presented, as well as considerations behind the planned site.

Item #3 / Task 4 / Aviation Safety Case – Initial Release / Airspace Development

Description: The current state-of-the-art in BVLOS UAS operations requires the use of manned aircraft to follow the UAS to detect-and-avoid other air traffic – i.e., chase aircraft. Using chase plane operations as the approved baseline sense-and-avoid methodology, data sets will be developed to support the combined use of the FAA’s Air Traffic Management (ATM) system, Unmanned Aircraft Traffic Management (UTM), Automatic Dependent Surveillance - Broadcast (ADS-B) surveillance technology, ground-based radar (GBR) surveillance technology and/or airborne radar for this purpose. This project plans to provide valuable data to assist the FAA, PHMSA and PRCI members to advance the safety case for BVLOS UAS operations on pipeline corridors.

Status: Safety Case Development for elimination of chase aircraft is underway under an aligned program. A Concept of Operations Document has been drafted as has an Operational Risk Assessment. AATI is currently assessing alignment with this and other programs. At the Kick-Off Meeting on March 6th, the status of the safety case and alignments will be presented.

Item #4 / Task 6 / Data Analysis & Benchmarking Plan – initial release / Data Analysis & Benchmarking

Description: Automatic threat detects will be compared to independently collected ground truth data and reports from aerial patrol pilots. Independent human review of all imagery acquired will be performed and performance of threat detection will be measured against this baseline. The specific benchmarks will include:

- 1) Measure True Positives (tp).
- 2) Measure False Positives (fp) and False Negatives (fn).

3) The evaluation metrics generated will included:

- a. Number of threats correctly identified
- b. Number of threats missed
- c. Number of threats incorrectly identified
- d. Time for prediction to run (latency)

Status: Through the PRCI ROW-3-1 program and other current and past work performed by AATI (e.g., ROW-3, AATI in-house development and direct contracts with PRCI members), methods for training, tuning and benchmarking the performance of automatic machinery and fire threat algorithms have been developed to a significant degree. Training involves developing standard methods of creating images to train threat detection algorithms. Benchmarking deals with independently validating algorithm performance. Tuning involves the iterative process required to optimize True Positives, minimize/eliminate False Negatives, and eliminating False Positives. Some work has been completed to define methodologies for other imminent threats including liquid and gas leak, as well as active farming/logging, flooding and geotechnical threat (See ROW-3-1 document “PRCI ROW-3-1 M02-T01 Phase 1 Sensor Selection and Test Doc 2019-059).



Calibrated Target Development (388)

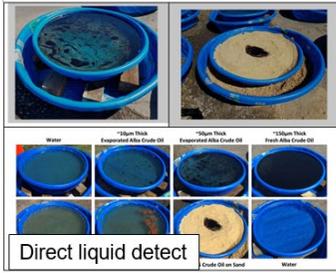
Threat	Status
Machinery Threat	Developed
Fire	Developed
Liquid Leak	Partially Developed
Gas Leak	Partially Developed
Active Farming/ Logging	In Development
Flooding	In Development



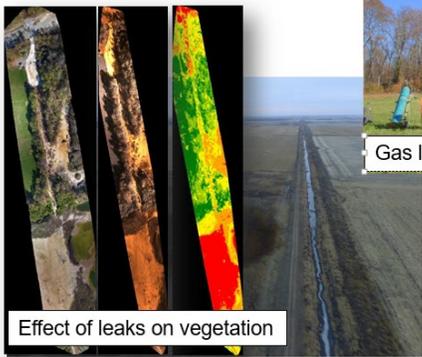
Machinery Threat Staging



Fire Threat Staging



Direct liquid detect



Effect of leaks on vegetation



Gas leak staging

Next steps include:

- a) Independent 3rd party contractor Geosyntec to review work to date and make recommendations for formalizing and standardizing these processes,
- b) Team agreement on a taxonomy for threats (goal is to gain consensus at the kick-off meeting).
- c) Assess alignment with other programs so data of value is more efficiently obtained and has higher value.

Item #6 / Task 2 / Integration Report – for 1st Campaign / Data Curation & Analysis

Description: The current ROW-3-1 ATDS payload is being designed to operate on conventional patrol aircraft only. Under this scope, Task 2 will focus on reducing the size, weight and power of the ATDS payload and integrating it into a LEHP UAS. The team will follow a similar

systems engineering approach as was used under the ROW-3 program that reduced the payload size from 165 pounds to less than 15 pounds for deployment on the LEHP UAS for equipment detection.

Status: The payload for the 1st campaign is currently in integration at AATI. Engine-on ground tests have been completed. A check flight on the RS-20 UAS is scheduled in March 9th. This system will automatically detect machinery threat and fire. Future versions will include additional, automatic, simultaneous threat detects.



InstiMaps Gen-2-AI-U (AATI Confidential)

Item #7 / Task 3 / Test Range & Protocol Update / Test Range & Staging Protocols

Description:

Test Range Selection. Multiple PRCI members have expressed intention of making their ROW corridors available for this program (see for example Colonial Letter of Support). Base on the final testing requirements, one or more test ranges may be selected. Multiple factors will be considered in the selecting the location(s) for conducting these tests including, for example, population density, proximity to transportation corridors, towered airports, traffic patterns of ongoing aviation operations (helicopters, crop dusters, parachutists, balloonists and gliders, commercial & military aircraft, etc.). Site selection will be based on risk-based approach identifying why the areas to be flown are in consideration from others.

AATI will prepare and submit the COA application to the FAA through a Public Operator. Discussions with local air traffic controllers are held. This must be done in the context of the customer's asset footprint, the project plan and safety and risk assessment and mitigation plans. COA approvals typically require up to six months to obtain, but once approved, have a term of two years. The application will include the extent and ceiling of the airspace, airworthiness and risk management, procedures for launch and recovery, communications, procedures for standard flight operations, emergency procedures and procedures for operations Beyond Visual Line of Sight (BVLOS).

Threat Staging. Simulated threats will be staged during the project to enable benchmarking threat detection capabilities. Current threats of interest for finalization under the protocol development task (Task 1) are described in the following table:

No.	Imminent Threat	Target Class	Target Type	Protocol	Approach
A1	Leak - Liquid	Staged	Induced vegetation stress	To be Developed	Review operator objectives; Review literature
A1	Leak - Liquid	Staged	Doubly-contained pools	Developed	Under ROW-1 and elsewhere
A1	Leak - Liquid	Staged	Liquid Leak Test facility	Under Development	In-situ controlled releases with secondary containment; multiple scenarios
A2	Leak - Gas	Staged	Induced vegetation stress	To be Developed	Review operator objectives; Review literature
A2	Leak - Gas	Staged	Calibrated Leak	Developed	AATI developed on Princeton project. Review operator objectives; Review literature
B	Active Machinery	Staged	Machinery	Developed	Developed under ROW-1 and elsewhere
B	Active Machinery	Known Construction Projects	Machinery	Developed	Under ROW-1 and elsewhere
C	Fire	Staged	"Fire Pots"	Partially Developed	AATI has utilized on other projects. Review operator objectives; Review literature
C	Fire	Emergency	Post-Wildfire	To be Discussed & Developed	Review operator objectives; Review literature
D	Storm Damage	Emergency	Post-Flood	To be Discussed & Developed	Pre-flood collect Phase 1. Rapid deployment after flooding
E	Active Logging	Opportunistic	Changes in vegetative stress signature	To be Discussed & Developed	Baseline collect Phase 1. Repeat collects during Phase 2
E	Active Logging	Opportunistic	Changes in vegetative stress signature	To be Discussed & Developed	Baseline collect Phase 1. Repeat collects during Phase 2

Threat staging will be refined as needed based on knowledge gained from the first task. The threat staging protocols will be designed based on operator objectives, prior PRCI and AATI experiences staging threats, and a review of peer reviewed (e.g., Golston, Yoel 2017) and grey literature (i.e. whitepapers / commercial publications) regarding detecting target threats and remote sensing hardware to be deployed by AATI. An example of prior experiences being used to support protocol development include the PRCI ROW-3 program protocol where machinery threats were staged in blind tests. Geosyntec will provide an independent third-party review of the testing protocol on the following aspects of the protocol:

- Test objectives relative to operator objectives
- Test design relative to ability to achieve objectives
- Test design considerations (logistical, technical, environmental safety)
- Test performance metrics

A PRCI member company that operates a transportation pipeline is designing a leak detection test bed that will be made available to the proposed project. The test facility will be at a field location that will allow for real-world testing of multiple remote sensing systems to the extent practical and will be engineered to promote repeated deployments to support testing and development of this and other projects. The test site will include capabilities to test petroleum releases on the ground and in the subsurface.

Status: Test Range Selection: See Item 2 – Task 3 above

Threat Staging: See Item 4 – Task 6.

Item #8 / Task 4 / Aviation Safety Case - Update / Airspace Development

Description: See Item 3 – Task 4

Status: Status will be presented at the kick-off meeting. Airspace has been approved for first flight test campaign (targeted in May).

Item #9 / Task 6 / Data Analysis & Benchmarking Plan - update / Data Analysis & Benchmarking

Description: See Item 8 – Task 6

Status: Status will be presented at kick-off meeting on March 6th.

Item #10 / Task 7 / 2nd Quarterly Status Report / Submit 2nd Quarterly Report

Status: 2nd quarterly report will be completed at the end of March

5: Project Schedule –

Long lead items have been the top priority to date – including site selection, confirming member commitments, sensor integration and aircraft systems readiness. With the kick-off meeting scheduled on March 6th, we believe that we are on track to performing the first flight test campaign in May.