DOT PHMSA Public Quarterly Report

Date of Report: 4th Quarterly Report Ending September 30, 2023
Contract Number: 693JK32210004POTA
Prepared for: USDOT PHMSA
Project Title: Advancing Hydrogen Leak Detection and Quantification Technologies Compatible with Hydrogen Blends
Prepared by: GTI Energy
Contact Information: Chris Moore, 847-768-0688, cmoore@gti.energy
For quarterly period ending: September 30, 2023

1: Items Completed During this Quarterly Period:

The laboratory set up and the 4th Quarterly Status Report were both completed this quarter and drawn from Attachment #3, Technical and Deliverable Payable Milestone Schedule (in the contract) from the fourth payable milestone. These items were completed during this reporting period and are the corresponding items included on our next invoice.

2: Items Not-Completed During this Quarterly Period:
This project is currently on schedule.

3: Project Technical Status:

ACTIVITY: FIELD EVALUATION

Item Title: Develop and establish laboratory and field evaluation methodologies
Item Number: 5
Task Number: 3

The project team finalized the Evaluation Framework which will be used to evaluate the extensive field and laboratory testing that will be set up and accomplished over the coming quarters.

All comments were brought under consideration by the project team, with some being adapted into the final Evaluation Framework to inform future testing. The full document has been submitted to the project page in PHMSA's PRIMIS server under "Technical Reports and Documents". The purpose of the report was to provide information on how individual sensors and full instruments will be evaluated on different performance parameters for hydrogen/natural gas blends. The testing will focus on two areas: 1) laboratory testing under controlled conditions, and 2) field testing with controlled leaks at

a local distribution company training facility with both underground and above ground leak sources. The following activity delves into more detail about how the laboratory tests will be set up and conducted over the next few quarters of scheduled work.

ACTIVITY: TEST SET UP

Item Title: Assemble laboratory test set up
Item Number: 7
Task Number: 3

As discussed in the Evaluation Framework, the previous quarterly's deliverable, laboratory testing would be accomplished in tandem at both Sensit and GTI Energy's facilities.

The individual sensor testing will be conducted by Sensit on four types of detectors:

1. Current state-of-the-art flammable gas detection sensors
2. Air toxic H2S and CO detection sensors
3. Oxygen detection sensors (both galvanic and electrochemical)
4. Hydrogen specific gas detection sensors

The laboratory setup includes a range of mass flow controllers that will be used to precisely apply specific concentrations of analyte and diluent gas to a device under test. The range of mass flow controllers is from 10sccm – 500sccm, a broad enough range to allow for the optimal mass flow controller to be used depending on the target gas concentration desired.

Given the wide range of sensors to be tested, a custom test fixture will be developed to assist with the collection of sensor data. The test fixture will consist of two parts: (1) mechanical containment of sensors to control exposure to the test gas mixture and (2) electronics to simultaneously measure multiple sensors as a function of time during gas exposure.

GTI Energy will conduct laboratory testing of devices at the Des Plaines facility. Devices include multi-gas monitors/CGIs, leak survey detection instruments, and FIDs. In the setup, a demand regulator is attached to a gas cylinder which extends to a valve that will be situated upright to allow venting to the atmosphere when the device is not undergoing tests. From there, tubing routes to a push-in connector. This connector allows a simple substitute between devices connected to an additional length of tubing securely fitted to each device inlet. After the connection to the instrument is secured, gas can be introduced, and measurements can be taken. All testing will be conducted within a fume hood with gas alarms nearby to reduce the risk of gas leakage or combustibility.

Laser methane detectors will be tested using Tedlar bags filled to specified gas concentrations measured from 40 feet with the bag at a 30-degree angle to reduce backscatter from the bag. A cardboard background is used to reduce any incident reflections that would impact path-integrated concentration readings. The project team

plans to test up to three different types of laser methane detectors to allow for a more varied database of results across different manufacturing companies.

The project team has also designed the testing so that external factors that might influence results can be controlled and planned accordingly in advance of any data analysis stage. Some of the other factors that the project team is considering include uncontrolled changes in flow due to overpressure or the pump being overloaded and changes to the lab humidity.

ACTIVITY: FIELD TESTING

Item Title: Determine field testing locations
Item Number: 14
Task Number: 6

The project team has begun to draft plans for field testing that would limit the number of confounding variables and ameliorate the data retrieval and analysis task for this project. Field testing agreements are still in progress as talks continue to develop with multiple sponsor companies that have shown interest in hosting field tests using their hydrogen-blending capable facilities. The team does not plan to conduct field visits within the next quarter, but material procurement will begin in the next few quarters as the test matrices are constructed and finalized.

ACTIVITY: FOURTH QUARTERLY STATUS REPORT

Item Title: Submit Third Quarterly Status Report
Item Number: 6
Task Number: 8

The fourth quarterly status report (this report) will be completed and submitted on schedule (on or before September 30th, 2023)

ACTIVITY: PROJECT MANAGEMENT

Item Title: N/A
Item Number: N/A
Task Number: 9

During this quarter, GTI conducted contracting, project scheduling, budgeting, establishment of data management strategies, preparation of reports, and organization of required meetings.

5: Project Schedule:

The project schedule is shown below in Table 1 with the submittal time of this quarterly report outlined in red.

Table 1. Project Schedule

Task	Description	1 - Q4 2022	2 - Q1 2023	3 - Q2 2023	4 - Q3 2023	5 - Q4 2023	6 - Q1 2024	7 - Q2 2024	8 - Q3 2024	9 - Q4 2024	10 - Q1 2025	11 - Q2 2025	12 - Q3 2025
1	Project Scoping and TAP												
2	Literature Review												
3	Develop Evaluation Framework												
4	Laboratory Tests												
5	Develop New Hydrogen Sensing Schemes												
6	Field Tests												
7	Statistical Analysis and Final Report												
8	Project Management												