DOT PHMSA Internal Quarterly Report

Date of Report: 5th 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
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For quarterly period ending: December 31, 2023

1: Items Completed During this Quarterly Period:

Table 1. Payable Milestones Completed This Quarter

Technical and Deliverable Milestone Schedule						
Item #	Task #	Activity/Deliverable	Title	Federal Cost	Cost Share	Total
8	8	5th Quarterly Status Report	Submit 5th Quarterly Report	69,748.00	30,801.00	100,549.00
		Fifth Payable Milestone	**SUBTOTAL**	69,748.00	30,801.00	100,549.00

The 5th Quarterly Status Report was completed this quarter and drawn from Attachment #3. This item was completed during this reporting period and will align with 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: TEST SET UP

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

The project team has been working on the test set up over the previous 3 months.

As discussed in the Evaluation Framework, laboratory testing is going to 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. There are multiple aspects to the test set up including an array of flow controllers extending out from the gas sources and pressure regulators.

Water can be introduced into the test stream by way of a flow mixer after gas flows through the mass flow controllers to determine if humidity has an outsized influence on the accuracy or dynamics of the sensor behavior, especially as it relates to hydrogen detection or cross sensitivity. Additionally, there is work in progress to create a variable temperature stage to investigate sensor response at higher and lower temperatures.

GTI Energy will conduct laboratory testing of devices at the Des Plaines facility. Devices like multi-gas monitors/CGIs, leak survey detection instruments, and FIDs are among those that will be tested. Instruments to be tested include the SENST Technologies G2, G3, PMD, PMD-2, LZ-30, and LZ-50; Bascom Turner Rover II, Gas Explorer; the Gazomat Inspectra Laser and Gazoscan; the Heath DP-IR, Detecto-Pak 4, RMLD-CS; the Inficon IRwin; the Teledyne/GMI GS700, GS-700-H2, GS500; and the Thermo Fisher TVA2020. Some of these instruments have been received while we are waiting to receive others.

In this setup, a demand regulator is attached to a gas cylinder which extends to an electronic valve that is situated upright to allow venting to the atmosphere when the device is not undergoing tests.

Gas mixtures have been acquired from various distributors able to provide us with the proper mixing bottles. In total, we will have 16 mixtures for testing at 0, 5, 10, and 20% hydrogen blends. These 4 different hydrogen blends will be repeated for trials with 10, 1000, 5000, and 25000 PPM of methane. In addition, to these trials with a mixture of just hydrogen and methane, 16 more trials will be conducted; 8 with blends of 100 and 1000 PPM of CO, then 8 with blends of 5 and 50 PPM of H2S. This will help us further investigate impacts on methane detection and quantification devices.

GTI Energy originally proposed that 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 for the laser methane detectors. However, during the December 2023 Technical

Advisory Panel meeting it was suggested that the Tedlar bags would introduce too much variation. Moving forward, GTI Energy is exploring the use of gas filled glass cells for this testing. A cardboard background will be 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 accordingly in advance of any data analysis. One method that the project team plans to employ will be to randomize the instruments that different testers use so that any bias in measurements is minimized. 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.

The project team held a meeting with TAP members on December 15th to welcome any questions or comments in advance of the laboratory testing. The slides from that update meeting can be found below. The TAP members provided the project team with many helpful comments that will be taken under consideration including but not limited to: advisement on the construction of the remote methane detector testing, a discussion on the role ambient light might play on measurements, and using cells as opposed to Tedlar bags.

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 now approaching their final stages, with one company secured for field trials after Q3 of 2024. Material procurement has begun and more conversations with the participating utility will be conducted in the coming months as the test matrices are constructed and finalized.

ACTIVITY: FIFTH QUARTERLY STATUS REPORT

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

The fifth quarterly status report (this report) will be completed and submitted on schedule (on or before December 31st, 2023)

ACTIVITY: PROJECT MANAGEMENT

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

During this quarter, GTI conducted 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 2 with the submittal time of this quarterly report outlined in red.

Table 2. 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												