

**Texas Commission on Environmental Quality
New Technology Research & Development (NTRD) Program
Monthly Project Status Report**

Contract Number: 582-11-11145-3264
Grantee: The University of Texas at Austin (UT-CEM)
Report for the Monthly period: July 2012 **Date Submitted:** August 8, 2012

Section I. Accomplishments

Provide a bulleted list of project accomplishments as well as a description of their importance to the project.

- Completed task deliverable reports for Tasks 2.1 and 2.2, which included preparing the hydrogen station and training personnel for the demonstration.
- Ran the hydrogen station and produced approximately 12 kilograms of hydrogen. Carbon monoxide (CO), methane (CH₄), and carbon dioxide (CO₂) impurities measured in the produced hydrogen were below J2719 limits.
- Over 30 kilograms of hydrogen was dispensed to the bus, which supported operation of the bus during July 2012.
- The bus continued to experience problems that prevented it from beginning passenger service. Early fuel cell problems from June 2012 were traced to low coolant flow rate in Fuel Cell #1. This was corrected and service was expected to begin in mid-July 2012; however, a second problem arose with the air blower on Fuel Cell #2 shortly afterwards. Hydrogenics and Proterra are currently trying to resolve this latest issue. These issues are discussed in *Section II: Problems/Solutions*.

Indicate which part of the Grant Activities as defined in the grant agreement, the above accomplishments are related to:

- Task 2.1: The PERFORMING PARTY will contract with the Gas Technology Institute (GTI) to prepare the hydrogen fueling station and increase its hydrogen fuel capacity for use with the demonstration Proterra bus. *(This task has been completed, and report was issued in July.)*
- Task 2.2: Task Statement: The PERFORMING PARTY will prepare the station operations and maintenance manual, train staff in operation of the station, and arrange for station maintenance during the demonstration. *(This task has been completed, and report was issued in July.)*
- Task 2.5: The PERFORMING PARTY will operate the hydrogen fuel cell hybrid-electric bus in a realistic working environment over a twelve month period, including using the hydrogen generation and fueling station as the bus's primary fuel source.

Section II: Problems/Solutions

Problem(s) Identified: Report anticipated or unanticipated problem(s) encountered and its effect on the progress of the project

- a) During a production run on July, 16, 2012, the hydrogen compressor did not cycle on after it had turned off due to low pressure in the hydrogen buffer storage tank. Under normal operation, the buffer tank is filled with hydrogen to feed the compressor. The compressor will cycle on and off as the buffer tank is depleted. On this day, the compressor skipped a cycle.
- b) The natural gas boost compressor, which feeds fuel to the reformer burners, experienced a loss of performance and possible air infiltration. The compressor was unable to achieve full pressure and the burner temperature was low.
- c) The outstanding fuel cell problems from June 2012 for the Proterra bus were diagnosed to be a low coolant flow rate in Fuel Cell #1.
- d) Upon correcting coolant flow rate problems and operating the bus for a day, the second fuel cell began to no longer respond.

Proposed Solution(s): Report any possible solution(s) to the problem(s) that were considered/encountered

- a) The problem is unclear at this time; however, GTI and UT-CEM reset the compressor and continued to use it with no further issues.
- b) The compressor has a leak and is introducing air diluted methane to the burners.
- c) Possible solutions include replacing malfunctioning pumps or rerouting plumbing.
- d) Diagnosis of data streams from the bus by Proterra and Hydrogenics point to a failed air blower.

Action(s) Conducted and Results: Describe the action(s) taken to resolve the problem(s) and its effect

- a) The compressor's ability to turn on during cycling, which occurs during reformer operation will continue to be monitored closely.
- b) Visual inspections carried out by GTI personnel concluded that there was a crack in the transfer tubing between the first and second stages of the booster compressor. Replacement tubing was ordered and installed by UT-CEM personnel. Only a small increase in performance was observed after the tubing was replaced. Since this did not completely solve the problem, GTI has ordered first and second stage rebuild kits that will be installed the week of August 13, 2012. Results to be determined.
- c) Proterra installed more robust external pumps, replacing the internal pumps within the Hydrogenics fuel cells. The new coolant pumps helped but did not solve the problem. They then modified the coolant line plumbing, which resolved the issue entirely. The fuel cells operated without any low coolant flow rate issues afterwards.
- d) Proterra and Hydrogenics are scheduling a site visit in August 2012 to replace the air blower. Results to be determined.

Section III. Goals and Issues for Succeeding Period:

Provide a brief description of the goal(s) you hope to realize in the coming period and identify any notable challenges that can be foreseen

- Replace Proterra bus fuel cell air blower.
- Begin passenger service with the bus if the fuel cell is operational prior to mid-August 2012. After this date, beginning passenger service is complicated by the change in semesters for the UT Shuttle schedule. Additional drivers may need to be trained for the Fall semester routes.
- Continue producing hydrogen for use by the Proterra bus. Modifications to the PLC code will be implemented as confidence is gained to increase the level of automation and unattended operation time.
- GTI has scheduled a trip to Austin for August 14, 2012, through August 17, 2012, to repair the natural gas booster compressor. Additional maintenance activities to be performed include:
 - Removing spent desulfurizer adsorbent and replacing with fresh material (UT-CEM) will dispose of hazardous material through EHS office;
 - Replace check valve on priority panel;
 - Calibrate station and dispenser hydrogen sensors;
 - Check site flame detector;
 - Replace air actuator on priority panel that has developed an intermittent leak;
 - Install a vortex cooler in remote input/output electrical enclosure; and
 - Take hydrogen gas sample and analyze at GTI's facilities in DesPlaines, Illinois.

Date: 8/8/2012

Authorized Project Representative's Signature

NOTE: *Please attach any additional information that you feel should be a part of your report or that may be required to meet the deliverable requirements for tasks completed during this reporting period.*