VII.B.1 Innovative Advanced Hydrogen Mobile Fueler

Sara Odom (Primary Contact), Spencer Quong
Electricore, Inc.
27943 Smyth Drive, Suite 108
Valencia, CA 91355
Phone: (661) 607-0260
Email: sara@electricore.org

DOE Manager: James Alkire
Phone: (720) 356-1426
Email: James.Alkire@ee.doe.gov

Contract Number: DE-EE0007275

Subcontractors:
- Air Liquide, Houston, TX
- Hydrogen Technology & Energy Corporation, Vancouver, BC, Canada
- Quong & Associates, Inc., San Francisco, CA
- Manta Consulting, Carmel, CA

Project Start Date: July 1, 2016
Project End Date: December 31, 2019

Overall Objectives

- Design and build an Advanced Hydrogen Mobile Fueler (AHMF).
- Deploy AHMF to support a network of hydrogen stations and vehicles in the United States.
- Gather and analyze fueling data for the National Renewable Energy Laboratory Technology Validation Team.

Fiscal Year (FY) 2017 Objectives

- Completion of the final design of the AHMF including the selection of applicable components and key vehicle parameters.

Technical Barriers

This project addresses the following technical barriers from the Technology Validation section of the Fuel Cell Technologies Office Multi-Year Research, Development, and Demonstration Plan.

(C) Hydrogen Storage

(D) Lack of Hydrogen Refueling Infrastructure Performance and Availability Data

(E) Codes and Standards

Contribution to Achievement of DOE Technology Validation, Safety, Codes & Standards, and Hydrogen Delivery Milestones

This project will contribute to achievement of the following DOE milestones from the Technology Validation, Hydrogen Delivery, and Hydrogen Safety, Codes and Standards sections of the Fuel Cell Technologies Office Multi-Year Research, Development, and Demonstration Plan.

Technology Validation

- Milestone 2.3: Validate fuel cell electric vehicles achieving 5,000-hour durability (service life of vehicle) and a driving range of 300 miles between fuelings. (4Q, 2019)
- Milestone 3.4: Validate station compression technology provided by delivery team. (4Q, 2018)
- Milestone 3.8: Validate reduction of cost of transporting hydrogen from central production to refueling sites to <$0.90/gge. (4Q, 2019)

Hydrogen Delivery

- Milestone 2.1 and 6.2: By 2015, reduce the cost of hydrogen delivery from the point of production to the point of use for emerging regional consumer and fleet vehicle markets to <$4/gge. (4Q, 2015)
- Milestone 2.4 and 6.3: By 2020, reduce the cost of hydrogen delivery from the point of production to the point of use in consumer vehicles to <$2/gge. (4Q, 2020)

Hydrogen Safety, Codes and Standards

- Milestone 2.19: Validate inherently safe design for hydrogen fueling infrastructure. (4Q, 2019)
- Milestone 3.4: Develop hydrogen material qualification guidelines including composite materials. (4Q, 2017)

FY 2017 Accomplishments

- Determined crucial design specifications (Table 1) and parameters for the AHMF and its components. The final design reflects target specifications identified for storage, fueling, performance, usage, etc.
- Selected and approved major components and subsystems for the AHMF design, such as the dispenser, storage, compressor, and cooling system, as well as initiated purchases of long lead items.
- Completed the final design package of the AHMF, including the following design documents: piping and

TABLE 1. AHMF Specifications

Specification	Description
Pressure Class	H70 (70 MPa) after compressing high bank storage
Pre-cooling	T30 (-30°C) or T40 (-40°C)
Performance	Up to 15 kg/h, 100-120 kg in 8-10 hours
Fueling Protocol	SAE J2601-2014 table based for 2-7 kg tanks SAE J2799-2014
Setup	One hour for limited performance, 8 hours for full performance
Storage	Up to 170 kg H_2 at 45 MPa with ability to connect to external storage
Power	On-board 480 VAC, low noise, low emissions diesel generator with option of using external power
Usage	Dispenser human machine interface allows fueling by minimally trained users

instrumentation diagrams; process flow diagrams; component layouts; three-dimensional conceptual modeling (Figure 1); and bill of materials. A final design report was provided to DOE on February 27, 2017.

- Conducted a design and safety review session with selected members of the DOE program office and Hydrogen Safety Panel. Initial hazard analysis completed.

✧ ✧ ✧ ✧ ✧

INTRODUCTION

This project will design, develop, deploy, and analyze the economic viability of a mobile fueling system for hydrogen. The project team proposed use of the AHMF to support a network of stations in the United States. As part of the design activity the project team was to define, in collaboration with an automaker, the preferred network of stations. The team has selected a northeast United States network. Automaker(s) will support the project by providing specifications based upon vehicle requirements, and support the evaluation of the AHMF with respect to compliance with specific fueling performance criteria. The AHMF will have the capacity to fuel approximately 10–20 fuel cell vehicles per day consistent with the requirements of the H70 fueling category. The AHMF will operate without remote power connections, be modular for easy transport and deployment, and have the ability to provide expanded daily capacity and multi-day operations through the use of delivered gaseous hydrogen.

APPROACH

The project consists of two primary phases each consisting of several key tasks and milestones.

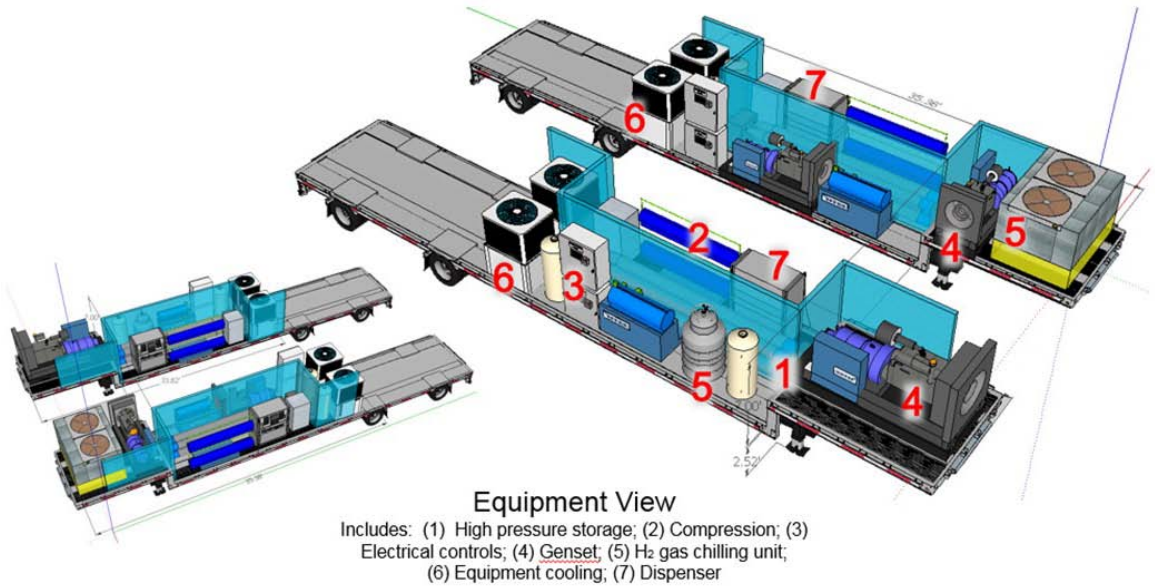

FIGURE 1. AHMF equipment view

The first phase will involve the design, development, and construction of the AHMF, moving from the conceptual design through to completion of assembly and testing so the AHMF is ready to deploy. The first phase will contain two key decision points: the final design review and construction and testing of the AHMF.

The second phase will demonstrate the AHMF over 18 months at multiple site locations and gather key data in collaboration with participating automotive companies. Fueling data will be provided to the National Renewable Energy Laboratory quarterly for review and analysis; economic data will be included in the project's final report.

RESULTS

The AHMF project has completed the design stage and is ready to begin construction. The team solicited input from selected automotive companies (potential users of the AHMF) and DOE to determine crucial design specifications and parameters for the AHMF and its components. The team decided to use Air Liquide's C100 station design as the base design for this project. The design utilizes several components from the C100, with appropriate modifications to accommodate the AHMF specifications and mobile approach. The AHMF will be a self-contained, full performance mobile hydrogen station.

In addition to the design specification, the team developed a project safety plan that addresses potential threats and impacts to personnel, equipment, and the environment. By utilizing the Air Liquide C100 station design, the team has efficiently reduced project risks and saved time by using components that have already been tested and approved by Air Liquide.

The team has started to acquire major and long lead components including the purchase of two Hydrogen Technology & Energy Corporation Power Cubes, compressor, and heat exchanger. In addition, the team is actively pursuing vendor quotes and purchase order agreements for the remaining equipment items.

During the design process the team identified barriers and challenges associated with the operation and site selection of the AHMF including high pressure storage, retail sale of hydrogen, and unattended fueling. The team has developed a plan with DOE and other stakeholders to reduce risk and address the barriers identified.

The Final Design Report submitted to DOE specifically addresses the selected components to be installed, and a comparison with DOE's cost targets for compression, storage, and dispensing.

CONCLUSIONS AND UPCOMING ACTIVITIES

Upon approval of Budget Period 2 funding the team will begin construction on the AHMF. Planned activities include assembly, testing of sub-systems and full system, and site selection.

FY 2017 PUBLICATIONS/PRESENTATIONS

1. 2017 DOE Annual Merit Review Presentation.