
Innovative Advanced Hydrogen Mobile Fueler

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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, 2020

Overall Objectives

- Design and build an advanced hydrogen mobile fueler (AHMF).
- Deploy the 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 (NREL) technology validation team.

Fiscal Year (FY) 2018 Objectives

- Procure key components and long-lead items for the AHMF.
- Complete the procurement of components, build subsystems, and begin assembly of the AHMF.

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 Plan¹:

(C) Hydrogen Storage

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

(E) Codes and Standards.

Contribution to Achievement of DOE Technology Acceleration 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.
- Milestone 3.4: Validate station compression technology provided by delivery team.
- Milestone 3.8: Validate reduction of cost of transporting hydrogen from central production to refueling sites to <\$0.90/gallon gas equivalent.

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/gallon gas equivalent.
- 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/gallon gas equivalent.

Hydrogen Safety, Codes and Standards

- Milestone 2.19: Validate inherently safe design for hydrogen fueling infrastructure.

¹ <https://www.energy.gov/eere/fuelcells/downloads/fuel-cell-technologies-office-multi-year-research-development-and-22>

- Milestone 3.4: Develop hydrogen material qualification guidelines, including composite materials.

FY 2018 Accomplishments

- Completed design specifications and parameters for the AHMF and its components. The final design reflects target specifications identified for storage, fueling, performance, and usage.
- Purchased and received major components and subsystems for the AHMF including the 45-ft custom trailer, diesel generator, heat exchanger, dispenser, and compressor.
- Created detailed manufacturing and testing plans for AHMF.
- Received special permit approval from the U.S. Department of Transportation for 95-MPa transport high-pressure storage.

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, specifically that resulting from a collaboration between Air Liquide and Toyota. The 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 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 multiday operations through the use of delivered gaseous hydrogen.

APPROACH

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

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 NREL 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 currently in construction at the Hydrogen Technology & Energy Corporation's (HTEC's) Vancouver manufacturing facility. 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 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.

Based upon the final design, the team continues to procure necessary components and equipment for construction including:

- Custom 45-ft dual axle trailer
- Diesel generator
- HTEC Powercubes (2)
- Compressor
- Liquid nitrogen Blueeze system
- Liquid nitrogen cooling system components
- Heat exchanger
- Hydrogen flow meter
- Nozzle assembly

- Dispenser and point-of-sale hardware.

Air Liquide and a vendor (Hexagon Lincoln) have completed all of the required testing and received approval for the U.S. Department of Transportation Special Permit for 95-MPa transport. The tanks have already been manufactured and set aside for this project. The team has done preliminary work on the frame and fire protection for the high-pressure storage and is ready to issue the purchase order.

The team has been in discussions with automotive companies about possible site locations of the AHMF demonstration, but decisions are delayed until plans for the introduction of the fuel cell vehicles in the northeast United States are finalized.

Table 1. AHMF Specifications

Specification	Description
Pressure Class	H70 (70 MPa) after compressing high bank storage
Precooling	T30 (-30 °C) or T40 (-40 °C)
Performance	Up to 15 kg per hour, 100–120 kg in 8–10 hours
Fueling Protocol	SAE J2601-2014 table based for 2–7 kg tanks SAE J2799-2014
Setup	1 hour for limited performance, 8 hours for full performance
Storage	Up to 170 kg hydrogen at 45 MPa with ability to connect to external storage
Power	Onboard 480-V AC, low-noise, low-emissions diesel generator with option of using external power
Usage	Dispenser human-machine interface allows fueling by minimally trained users

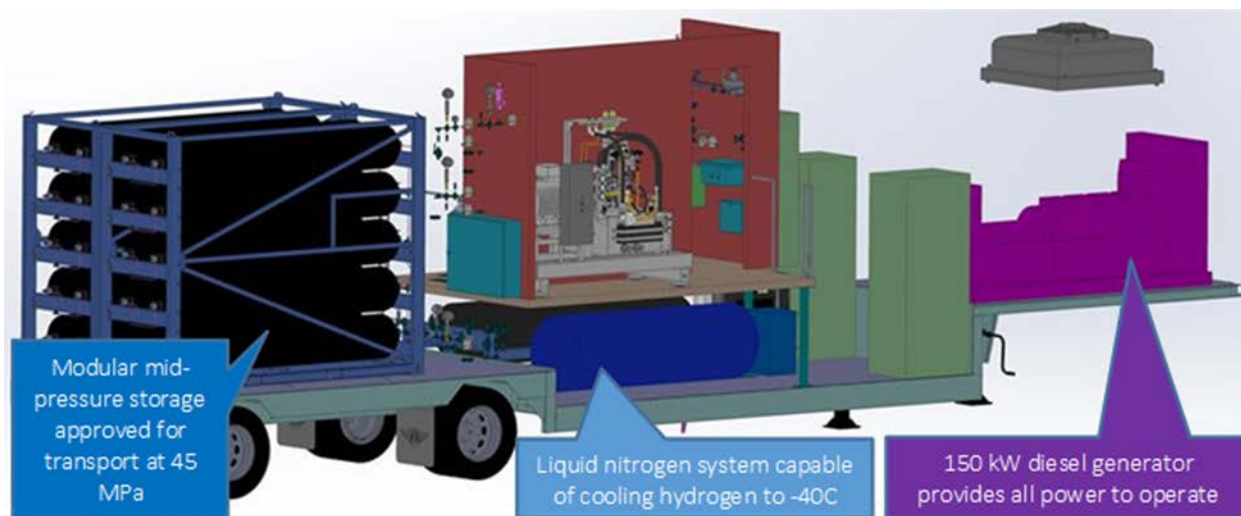


Figure 1. AHMF—passenger’s side view without trailer walls

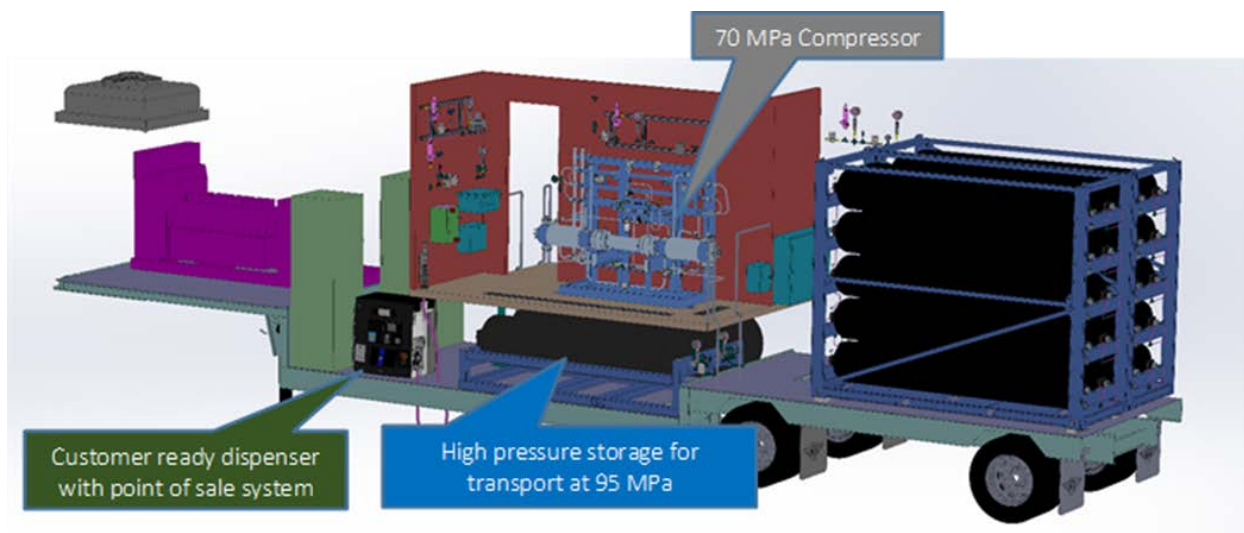


Figure 2. AHMF—driver's side view without trailer walls

CONCLUSIONS AND UPCOMING ACTIVITIES

The team is currently preparing for subsystem assembly and integration into the AHMF. Planned activities include assembly, testing of subsystems and full system, and site selection.

FY 2018 PUBLICATIONS/PRESENTATIONS

1. Sara Odom, "Innovative Advanced Hydrogen Mobile Fueler," Presentation at the 2018 DOE Hydrogen and Fuel Cells Program Annual Merit Review and Peer Evaluation Meeting, Washington, D.C., June 2018.