Fuel Cell-Powered Lift Truck
Sysco Houston Fleet Deployment

Project ID: ARRAH2010

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Project Overview

- **Timeline**
  - Start: October 1, 2009
  - Finish: September 30, 2013
  - 17% complete

- **Budget**

  Total Project Funding
  - DOE: $1,201,918
  - Cost-share: $2,046,710

- **Barriers**
  - Safe hydrogen use in high throughput distribution center
  - Full fleet conversion to Greenfield center
  - Operator productivity improvements
  - Fuel cell use in freezer setting
  - GenDrive fuel cell lifetime and reliability

- **Partners**
  - Plug Power – GenDrive system and service provider
  - Air Products – Hydrogen and hydrogen infrastructure provider
  - Big-D Construction – Site preparation provider for hydrogen infrastructure

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Relevance

OBJECTIVES

- Support American Recovery and Reinvestment Act goals of long-term economic growth by successfully demonstrating a new technology
- Establish a proving ground for expanded use of hydrogen fueling technology at Sysco, thereby promoting future adoption of fuel cells in other applications to help drive their use in the U.S.
- Promote the economic and environmental benefits of hydrogen fuel cell technology

TACTICS

- Convert the entire class-2 and class-3 lift truck fleet at Sysco Houston's greenfield distribution center to fuel cell use
- Demonstrate the economic benefits of large fleet conversions of lift trucks from lead-acid batteries to fuel cell power units by measuring, analyzing and reporting on the performance, operability and safety of the systems
- Demonstrate freezer operation
- Obtain affordable and reliable hydrogen

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Plan and Approach

- **Fueling Station Installation**
  - Install hydrogen handling and dispensing equipment consistent with merchant liquid hydrogen supply
- **GenDrive Power Unit Construction**
  - Complete build of 26 class-2 and 79 class-3 GenDrive power units
- **Startup, Training and Safety**
  - Commission and start up of the fueling station and power units and train Sysco Houston personnel in their use and maintenance
  - Complete NEPA environmental forms
- **Lift Truck Operation and Evaluation**
  - Receive operational and maintenance support for the power units and the hydrogen handling and dispensing equipment and evaluate their performance over the duration of the project
- **Program Management and Reporting**
  - Provide overall project management and reporting to the DOE over the course of the project, including quarterly reports, annual assessments and the submission of data to NREL

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Milestones

Milestones	Progress	% Complete
Fueling Station Installation	Big-D completed preparatory work for hydrogen infrastructure installation Air Products completed installation of hydrogen fueling system	**100%**
GenDrive Build	Plug Power completed build of 26 class-2 and 79 class-3 power units	**100%**
►**Go/No Go**	1. Fuel station was fully tested and deemed operational 2. Fuel cells passed factory acceptance testing	**100%**
Annual Assessments Month 18, 30 and 48	Assess reliability of the fuel cells by measuring the time between failures and examining the cause of failure Assess cost to maintain and operate the fuel cells, as well as overall operator experience	**0%**

Progress and Technical Accomplishments

PROGRESS

- Sysco Houston is successfully using hydrogen fuel cell technology for the first time in a total fleet environment
- Facility has proper safety, backup and operational procedures in place
- Close monitoring and return on investment calculations have increased Sysco's involvement in fuel cell powered lift truck operations
- Fully implemented hydrogen safety plan

ACCOMPLISHMENTS

- Converted the entire class-2 and class-3 lift truck fleet in a greenfield distribution center to fuel cell use
- Built permanent hydrogen fueling infrastructure
- Trained over 100 employees on operation and safety of hydrogen use
- Improved operator productivity due to elimination of battery degradation and charging time
- Completed 2,664 fills in first quarter 2010
- Through life of project 5.5 jobs have been created

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Technical Accomplishments and Progress: Fuel Cells

- In February 2010 Plug Power modified 25 class-3 power units for sub-zero temperature operation and delivered ahead of schedule
- Plug Power commissioned all 79 power units

GenDrive Class-2

Nominal voltage
36 Vdc
Max. Continuous Power
10.5 kW
Weight
2,600 lbs
Operating Temperature
-22 F – 104 F
Fill Time
70 seconds

GenDrive Class-3

Nominal voltage
24 Vdc
Max. Continuous Power
2.6 kW
Weight
590 lbs
Operating Temperature
-22 F – 104 F
Fill Time
60 seconds

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Technical Accomplishments and Progress: H2

- Air Products completed commissioning of fueling station December 2009
- Final fire marshal approval received February 2010, 3.5 months ahead of schedule
- First test fueling occurred January 2010
- Liquid tank operates with a MAWP of 150 psig, bulk high pressure storage tanks operate at 6,000 psig
- Indoor dispensers are 250 bar and capable of 700kg/day +
- Operator dispenser recognition requires pin code and badge scan
- Hydrogen gas detectors alarm at 25% of LEL and will shut down system

Collaborations

- **Partners:**
  - Plug Power – GenDrive system and service provider
  - Air Products – Hydrogen and hydrogen infrastructure provider
  - Big-D Construction – Site preparation provider for hydrogen infrastructure

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Proposed Future Work

OPERATION AND EVALUATION

- Monitor GenDrive power units project performance, operability and safety
- Monitor liquid and gaseous hydrogen fueling equipment project performance, operability and safety
- Monitor and provide project performance, operability and safety reports to the DOE, including any safety and performance data and issues identified during operation of the power units
- Support DOE communication efforts
- Hold kickoff event showcasing Sysco's new facility and hydrogen fuel cell initiative

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Summary

Relevance: Demonstrate the economic benefits of large fleet conversions of lift trucks from lead-acid batteries to fuel cell power units

Approach: Install an Air Products hydrogen fueling station, build Plug Power GenDrive power units and evaluate program to ensure success

Technical Accomplishments: Plug Power built and commissioned GenDrive units and Air Products installed the hydrogen fueling system

Technology Transfer/Collaborations: Plug Power, Air Products and Big-D Construction

Future Work: Operation and evaluation, DOE kickoff event