7B: Fuel Cell-Powered Lift Truck FedEx Freight Fleet Deployment

Project ID: ARRAH2009
Jonathan King, Program Manager
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Project Overview

- **Timeline**
  - Start: October 1, 2009
  - Finish: September 30, 2013
  - 17% complete
- **Budget**
  - DOE: $1,290,464
  - Cost-share: $1,549,540
  - FY 2009 funding: $586,680
  - FY 2010 funding: $180,940
- **Barriers**
  - Interim forklifts at new facility until fuel cells come on-line
  - Permits for indoor dispensing
  - Introducing hydrogen into the everyday world of FedEx Freight
- **Partners**
  - Plug Power – GenDrive system and service provider
  - Air Products – Hydrogen supplier

Relevance

- Safe and reliable operations of hydrogen material handling equipment (MHE)
- Convert an entire MHE fleet at FedEx Springfield, MO facility with fuel cell powered forklifts (class-1)
- Demonstrate economic benefits of conversion
- Provide cost effective and reliable hydrogen
- Spur further lift truck fleet conversions
- Establish proving ground for hydrogen MHE

Plan and Approach

- Install hydrogen fueling equipment
- Retrofit 35 electric forklifts to operate using fuel cells
  - Train forklift operators to fuel hydrogen fuel cells
  - Train maintenance techs to perform simple repairs and preventive maintenance (PM) on fuel cells
- Fuel cell forklift operation and evaluation
  - Fuel economy
  - Reliability
  - Cost
  - Operator acceptance
- Annual assessments

Milestones

Milestones	Progress	% Complete
Fueling Station Installation	Air Products' completed construction and installation of the fueling equipment FedEx to finish system integration	90%
Hydrogen Safety Plan	Working with Air Products and Plug Power to complete the hydrogen safety plan	90%
►Go/No Go	Fueling station to be tested and operational	0%
GenDrive Power Unit Build	Plug Power completed build of 35 class-1 units in December 2009	100%
Start-up and Training	Start-up and training will begin after fueling station installation finalized	0%
Lift Truck Operation and Evaluation	Operation and evaluation will begin after commissioning	0%

Technical Accomplishments and Progress – Fuel Cells

- Plug Power built and delivered 35 GenDrive class-1 power units two months ahead of schedule
  - Voltage 36 Vdc
  - Power output 10-12 kW
  - Hydrogen storage 2.2 kg
  - Storage pressure 350 bar

Technical Accomplishments and Progress – H_2

- Air Products installed the liquid hydrogen handling and gaseous compression, storage and dispensing equipment
- This includes all interconnecting piping, civil, electrical and mechanical connections, and safety systems
  - 2 indoor dispensers
  - 6,000 USG liquid hydrogen horizontal tank
  - Refuel time 3-6 minutes
  - ~91 kg/day usage
- When refueling, FedEx will incorporate a dummy connection to the forklift's electrical connector to prevent drive-offs that will damage the hydrogen hose

Collaborations

- **Partners**
  - Plug Power (Industry) – GenDrive system and service provider
  - Air Products (Industry) – Hydrogen supplier

- **Technology Transfer**
  - Collaboration with Plug Power for commissioning of GenDrive fuel cell system and service
  - Collaboration with Air Products on the installation of the hydrogen fueling system

Proposed Future Work

STARTUP AND TRAINING

- Commission and start up the fueling station and power units and train FedEx Freight personnel in their use and maintenance, including:
  - Provide hydrogen fueling station training, including operation, hydrogen safety and emergency response in a “train the trainer” arrangement
  - Provide power unit training, including operation, planned maintenance, service, hydrogen safety and emergency response in a “train the trainer” arrangement

OPERATION AND EVALUATION

- Provide operational and maintenance support for the GenDrive power units and the hydrogen handling and dispensing equipment and evaluate their performance over the duration of the project, including:
  - Collect data from the power units and evaluate performance, operability and safety
  - Collect data from the liquid and gaseous hydrogen fueling equipment and evaluate performance, operability and safety

Summary

Relevance: Develop safe hydrogen MHE operations to spur future conversions and demonstrate economic benefits

Approach: Install Air Products hydrogen fueling station, build 35 Plug Power GenDrive power units, and commission and evaluate for a successful operation

Technical Accomplishments: Plug Power built and delivered 35 GenDrive units and Air Products installed the hydrogen fueling system

Technology Transfer/Collaborations: Plug Power and Air Products

Future Work: Startup and training & operation and evaluation