XII.5 Fuel Cell-Powered Lift Truck Sysco Houston Fleet Deployment

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Contract Number: DE-EE0000485

Subcontractors:
- Plug Power Inc., Latham, NY
- Air Products, Allentown, PA
- Big-D Construction, Salt Lake City, UT

Project Start Date: October 1, 2009
Project End Date: September 30, 2013

Objectives

The objectives of this project are to:

- Convert a fleet of 79 class-3 electric lift trucks to hydrogen fuel cells at the Sysco Houston facility (including seven temporary rental units and 25 sub-zero temperature units).
- Demonstrate the safe and reliable operation of hydrogen-fueled material handling equipment (MHE).
- Demonstrate the economic benefits of conversion to hydrogen fuel cell-powered MHE.
- Demonstrate operator acceptance of hydrogen fuel cell-powered MHE.
- Demonstrate the operation of hydrogen fuel cells in sub-zero temperatures.
- Provide a cost effective and reliable hydrogen fuel supply.
- Spur further lift truck fleet conversions to hydrogen fuel cells.
- Establish a proving ground for hydrogen fuel cell-powered MHE.

Relevance to the American Recovery and Reinvestment Act (ARRA) of 2009 Goals

This project advances the goals of the American Recovery and Reinvestment Act (ARRA) of 2009 to create new jobs, save existing jobs, and spur economic activity and investment in long-term economic growth by:

- Creating jobs at Plug Power to design, build and commission the fuel cell power units.
- Creating jobs at Air Products and Big-D Construction to design, install and commission hydrogen storage and fueling equipment.
- Creating jobs at Air Products to deliver hydrogen to the Sysco Houston facility.
- Training Sysco Houston lift truck operators in hydrogen safety, fueling procedures and fuel cell operation.
- Training Sysco Houston lift truck maintenance personnel to service fuel cells.
- Improving the overall economic efficiency of material handling operations.

This project advances the DOE Fuel Cell Technologies' ARRA project goals of accelerating the commercialization and deployment of fuel cells and fuel cell manufacturing, installation, maintenance, and support services by demonstrating:

- Safe and reliable operation of hydrogen storage and fueling equipment and fuel delivery.
- Reliable and efficient operation of hydrogen fuel cells.
- Economic and environmental advantages of fuel cells over batteries.
- Practical operation and maintenance of fuel cells.

Technical Barriers

This project addresses the following technical barriers to the use of fuel cell powered lift trucks:

- Safe and reliable hydrogen use in a high-throughput distribution center.
- Fuel cell use in sub-zero temperatures.
- Fuel cell lifetime and reliability.

Technical Targets and Milestones

The technical targets and milestones of this project include:

- Installing hydrogen storage and fueling equipment by December 2009.
- Developing a hydrogen safety plan by May 2010.

- Commissioning 79 class-3 power units by February 2010.
- Completing startup and training by February 2010.
- Starting operation and evaluation by March 2010.

Accomplishments

The accomplishments of this project include:

- Commissioning hydrogen storage and fueling equipment by December 2009.
- Commissioning 79 GenDrive class-3 power units by February 2010.
- Completing all fueling, operation and maintenance training by February 2010.
- Training over 100 Sysco personnel in the safe use and fueling of hydrogen fuel cells.
- Commissioning 26 GenDrive class-2 power units by April 2010 (these power units are not included in the scope of this project).
- Demonstrating the successful operation of 25 class-3 power units in sub-zero temperatures.
- Logging 25 months and over 647,000 hours of fuel cell operation by March 2012.
- Consuming 60,350 kilograms of hydrogen by June 2012.
- Monitoring operating costs and reliability of all GenDrive power units (ongoing).

Introduction

The purpose of this project is to demonstrate that hydrogen fuel cells are a safe and economical alternative to batteries for powering electric pallet jacks and lift trucks. The primary barriers to widespread use of hydrogen fuel cells for material handling equipment are concerns about the safety of hydrogen storage and fueling equipment, operating costs for fuel and maintenance, and the long-term reliability of fuel cells.

Approach

This project is evaluating the safety and economics of using hydrogen fuel cells to power a fleet of 26 class-2 and 79 class-3 electric lift trucks at the Sysco Houston facility. Sysco Houston will supply the lift trucks, Plug Power is supplying the GenDrive fuel cell power units, Air Products and Big-D Construction are supplying the hydrogen storage and fueling equipment, and Air Products is supplying the hydrogen fuel. The equipment will be maintained by Sysco Houston personnel with assistance from Plug Power and Air Products personnel when necessary. Plug Power and Air Products also assist Sysco Houston in developing a comprehensive hydrogen safety plan.

Sysco Houston and Plug Power monitor the operation and maintenance of the power units and the hydrogen storage and fueling equipment over the duration of the project. This information is reported to the DOE and the National Renewable Energy Laboratory quarterly and summarized annually.

Results

This project has successfully demonstrated the safe and economical operation of 26 class-2 and 72 class-3 power units and associated hydrogen storage and fueling equipment. The class-2 power units were not included in the funding for this project. Seven of the original 79 power units were rentals and have been returned to Plug Power. Twenty-five of the class-3 power units were modified to operate in sub-zero temperatures.

The current cost of hydrogen fuel is approximately the same as the cost of electricity to charge lead-acid batteries but Sysco is saving nearly $100,000 per year in fewer man-hours spent refueling fuel cells compared to swapping batteries. The lift truck operators also appreciate the improved performance of fuel cells compared to lead-acid batteries.

Sysco and Plug Power have been monitoring the type and frequency of fuel cell repairs. Figure 1 shows the mean time between repairs (MTBR) vs. run-time for each class of power unit. Figure 2 shows the MTBR distribution by class and Figure 3 show the repair time distribution by class. To date, no conclusions have been drawn to explain the differences in repair statistics between the class-2 and class-3 power units. However, Sysco has changed the way they maintain pallet jack and lift truck power sources from reactive maintenance

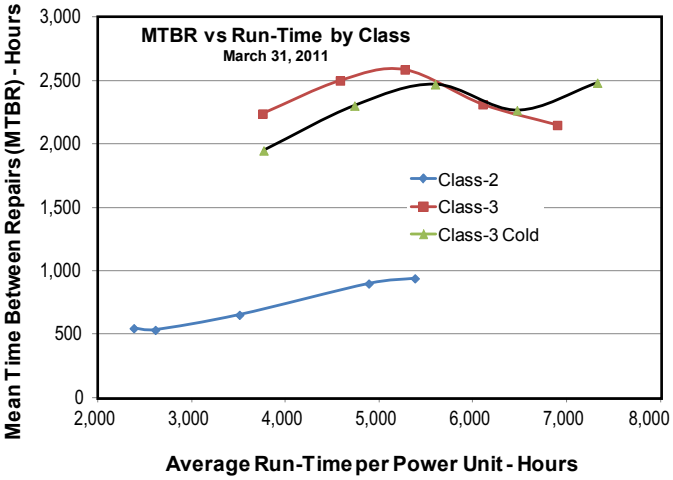

FIGURE 1. MTBR vs Run-Time by Class

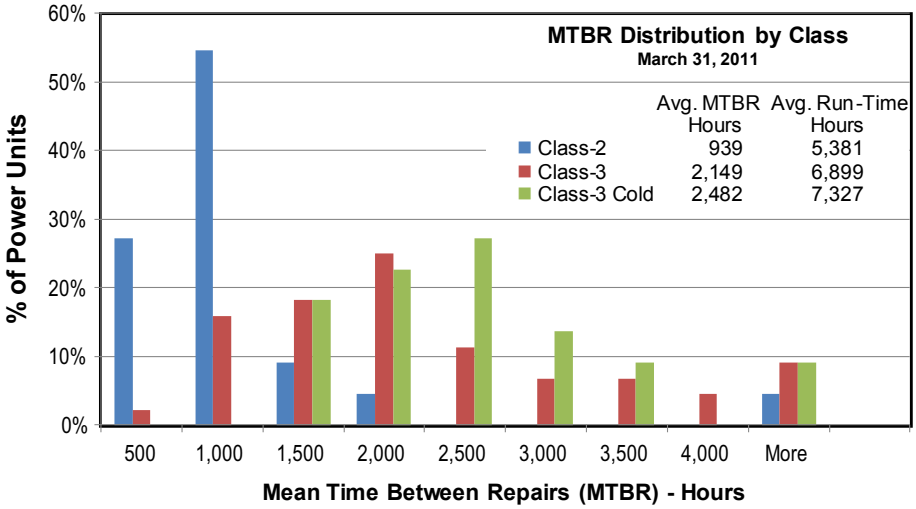

FIGURE 2. MTBR Distribution by Class

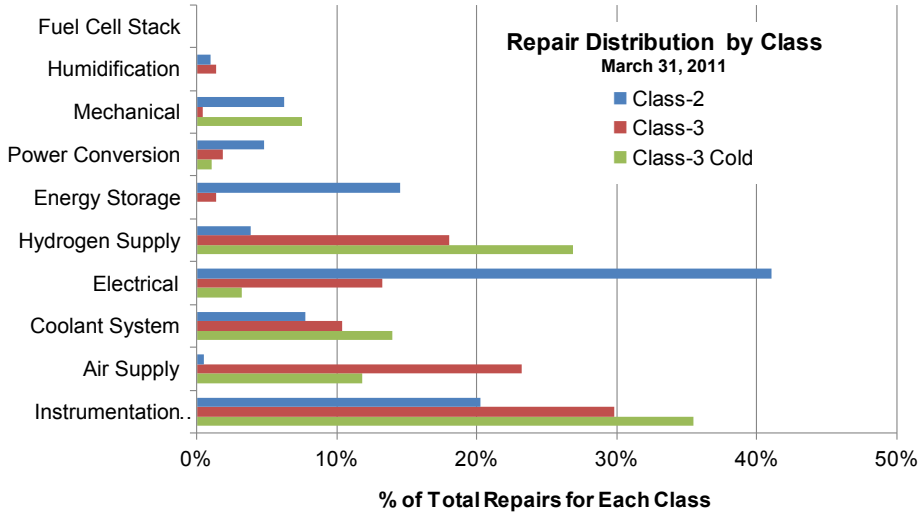

FIGURE 3. Repair Distribution by Class

with lead-acid batteries to preventative maintenance with the hydrogen fuel cells.

Since we have seen less unplanned disruptions in our operations of hydrogen fuel cells and with the ease that Sysco Houston was able to introduce them into our fleet of pallet jacks and forklifts, this helped Sysco to expand the use of hydrogen fuel cells at more of our 70+ operating companies across North America.

Conclusions and Future Directions

Based on the proven reliability and safety of current hydrogen fuel cell operations at Sysco Houston, Sysco's future directions include:

- Ongoing operational and maintenance support for power units and hydrogen storage and fueling equipment.
- Ongoing data collection from power units and hydrogen storage and fueling equipment.
- Finish implementing fuel cell fleet conversions at Philadelphia, San Antonio, Long Island and Northeast regional distribution center facilities by mid-2012; this is part of Sysco's overall capital investment project of replacing approximately 1,000 lead-acid batteries with 500+ fuel cells at seven additional sites over the next 24 months.
- Planning to add five new class-3 power units to the Houston lift truck fleet at a cost of approximately $65,000 over the next year.

- Committed to additional fuel cell fleet conversions at Boston, Riverside and Los Angeles facilities.
- Supporting the conversion to fuel cells to help reduce the overall costs of fuel cell power units and hydrogen fuel.
- Helping other Sysco facilities develop hydrogen safety plans.

FY 2012 Publications/Presentations

1. Scott Kliever participate**d** in the Update on Fuel Cell Technologies workshop session at the IFDA 2011 Distribution Solutions Conference in Fort Worth, TX on October 24, 2011.

2. Scott Kliever delivered an American Recovery and Reinvestment Act merit review presentation in Washington, D.C. in May 2012.