

“Dedicated to The Continued Education, Training and Demonstration of PEM Fuel Cell Powered Lift Trucks In Real-World Applications”

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May 10, 2011



Project ID# : ED008

“This presentation does not contain any proprietary, confidential, or otherwise restricted information.”

Overview

Timeline

- Start - 9/1/2008
- Finish - 8/31/2011
- Complete as of May 2011:
Deployment 100% / **Education** 82%
Overall: 88% Complete

Budget

- Total project funding
 - DOE share: \$ 820,272
 - Contractor share:
\$ 385,273
- Funding Received:
FY2008: \$ 386,000
FY2009: \$ 434,272
FY2010 /FY2011: \$ 0

Barriers

- Barriers addressed
 - A. Mixed Messages for Education
 - B. Infrastructure cost / justification
 - C. Difficulty in measuring success

Partners

- Hydrogenics:
“HyPx™ Fuel” Cell Power Pack
Manufacturer, originally served as
subcontractor for FCPP and providing
technical support during the deployments.



Hydrogen Education / Deployment of Fuel Cell Powered Lift Trucks: *The LiftOne Program Objectives /Relevance*

- *To educate a broad group of stakeholders to the benefits of fuel cell and hydrogen technology* by conducting “H2 – Education Seminars”, which have taken place over the past year at: a) All LiftOne branch locations; b) Selected lift truck user sites; c) Professional organizations’ meetings; d) Local community colleges; e) Two participating 1st responders’ facilities.
- The demonstration of “*clean energy*” through the execution of a series of six (6), one-month long deployments of 2 each hydrogen fuel cell powered lift trucks at strategically selected, large electric fleet user locations across the LiftOne territory. All 6 scheduled deployments were completed as of August -2010. One additional site to be added.
- *To further assist in the commercialization of fuel cell and hydrogen technology* through the longer and geographically diverse deployments in *real-world* applications. Ongoing!

Project Approach

- The ***Education Segment*** has involved the H2 seminars, conducted at the various LiftOne Branches. 2 sessions are held per month, with an average of 15 attendees from companies with varying material handling fleet sizes.
- Additional “on the road” sessions have been conducted over the past year with selected “end users” at their facilities. This outreach has positively increased H2 Awareness among the material handling / fleet owners in the business community.
- All sessions included the working fuel cell powered lift truck demo on site, again the critical component for attendees.
- The Program’s reach has expanded and increased H2 Awareness /Visibility over the past year at these events:
 - Spartanburg, SC: “Upstate - Green Conference”**
 - Columbia, SC: “Green is Good For Business” Expo**
 - Charlotte, NC / Columbia, SC: “Odyssey Week” Events**

Project Approach - Continued

- The content for the Education Sessions was condensed to fit into the time slots available at those participating companies. This allowed for more opportunities to introduce Hydrogen as a viable alternative power source, provide information and conduct the live demonstrations.
- The ***Deployment Segment*** again included the program's 2 CAT[®] lift trucks powered by the Hydrogenics "HyPX" series Fuel Cell Power Packs, with on-site H₂ refueling by the Air Products model HF-150 mobile fueler.
- The last scheduled deployment at AGI – In Store involved the orientation sessions for all facility personnel. H₂ safety and hands on fueling instructions were covered by LiftOne and Air Products. Sessions were conducted for two shifts.
- The local Forest City, NC Fire Department was invited and readily participated at the AGI Orientation sessions.

Education / Deployment Milestones

| Month / Year | Milestone or Go/ No-Go Decision |
|--------------------|---|
| May / 2010 | Milestone: Using the experiences, feedback and real world data from the LiftOne - H2 Education Program's deployments, Tom Dever participated as a featured panelist at the National Hydrogen Association sponsored "Hydrogen Business Solutions Forum" at the NHA Annual Conference at Long Beach, California. |
| July- Aug. / 2010 | Milestone: The 6th and final site of the original Deployment Schedule was executed at AGI - In Store (Forest City, NC). All site observations, data gathering / analysis were performed, with the Formal Review Meeting held on September 10, 2010. A successful trial with a fair chance of someday adoption at one of their larger Distribution Centers. |
| September / 2010 | Go / No-Go Decision: Decision made to bring the Hydrogen Education / Awareness sessions to selected companies for on site presentation / with live fuel cell powered lift truck demonstrations. |
| Sept - Oct / 2010 | Milestone: Participation in strategic regional "Green Business" Expos (Spartanburg, Columbia, SC; Charlotte, NC). These high profile events prove to be an excellent method of demonstrating the working H2 fuel cell powered lift truck. |
| Feb - March / 2011 | Go / No-Go Decision: Decision made to pursue continuation of deployment(s) with another OEM's fuel cell power pack. To use the expertise of both LiftOne and a more proven manufacturer to assist in further commercialization of hydrogen fuel cell power for the material handling industry. |

Deployment Program

- During the past year, the program's 6th and last scheduled deployment was completed at AGI – In Store. A good trial with these results:

Site # 6 - AGI - In Store: 25 days ran

* **Truck 0264 / Cell # 17 ran 190 hrs**

* **Truck 0265 / Cell # 18 ran 229 hrs**

* **86 kg of H2 used / 62 fills / 53.75 tanks**

* **4.7 minutes average fuel time**

* **7.8 hrs avg run time per tank (1.6kg)**

Notes: water pump, purge valve

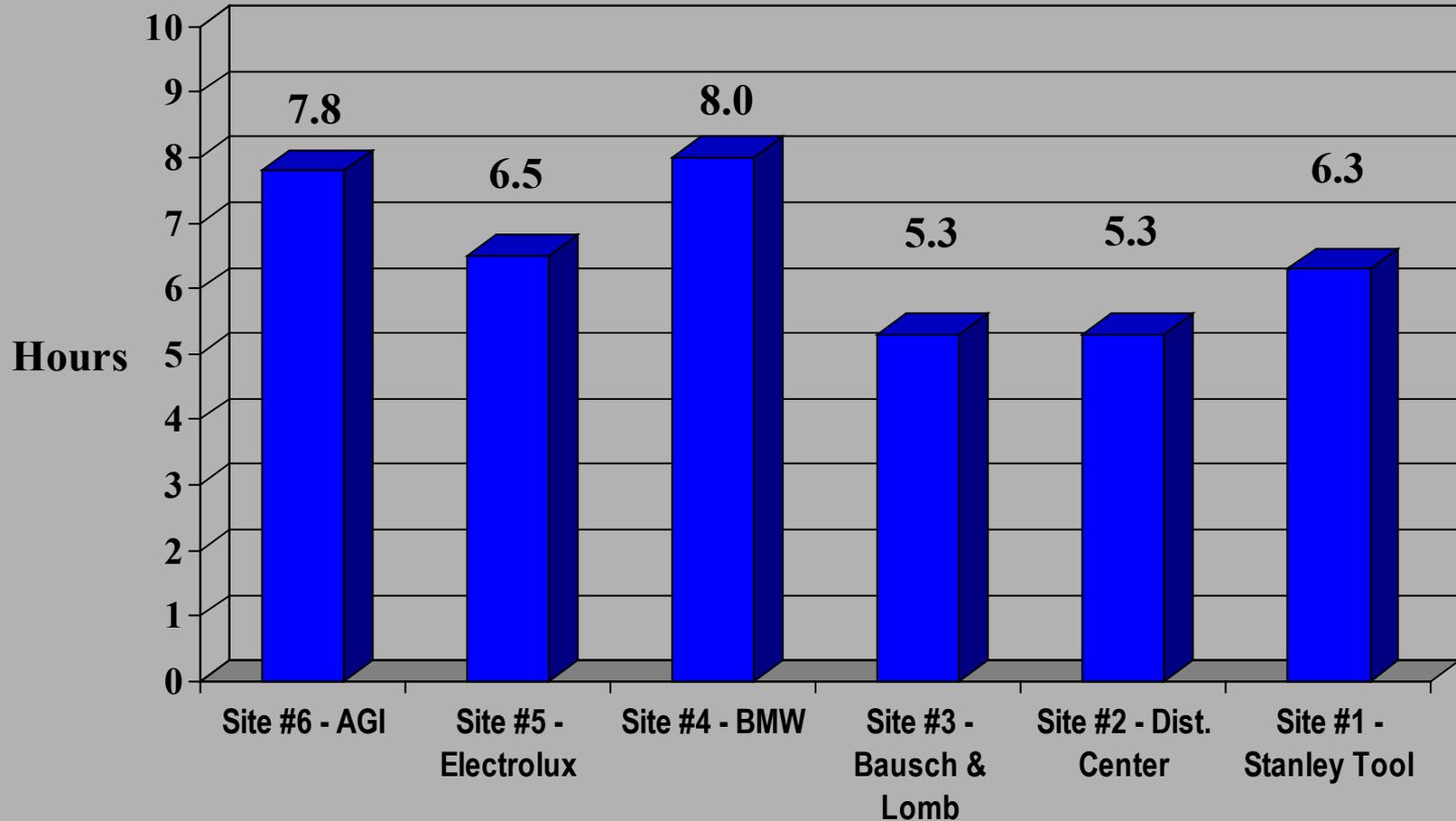
Straight forks - sideshifter application

Good trial - 2 technical issues fixed.

Decent hours run. Good time per tank.

- Site #6 issues were: A) Cell #18: coolant low flow (water pump replaced on site); B) Cell # 17: purge valve irregularity.
- *Trial graded as an "A", fuel cells handled steep ramps well during trial.*

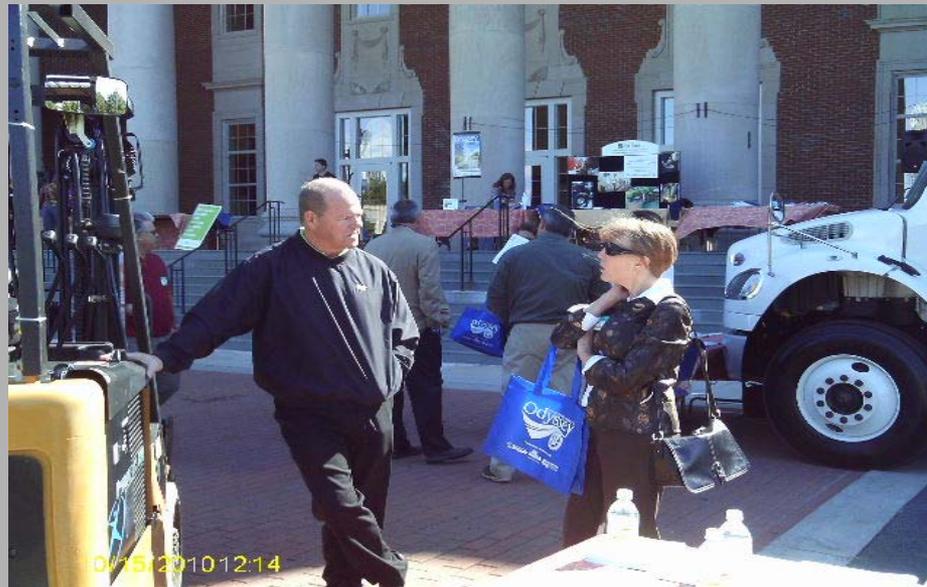
Program Deployment Sites Hours Run - Per 1.6 KG Tank



Technical Accomplishments / Progress continued

Education Program: Hydrogen "101" Outline

- History of Hydrogen /Properties; Applications in industry
- Fuel Cell design / applications; PEM fuel cells for material handling
- Performance review from LiftOne Deployments
- Infrastructure outline and discussion
- Cost comparisons and scenarios
- Tax incentive discussion





CAT Model E5000
Class I - 48v lift truck



Hydrogenics Model
HyPx1-33, Fuel Cell
Power Pack



Air Products Model
HF-150 Mobile Fueler

Activities For Next Fiscal Year

1. Continue with Hydrogen Education Seminars
 - Focus on conducting the sessions on the road at customer sites.
2. Continue with Exhibits and Demonstrations at regional business Expos and industrial shows.
3. Engage with Lift Truck Dealers and associations to conduct workshops.
4. Add an additional Deployment Site – (2 month duration) by solidifying an agreement with an additional fuel cell OEM.
5. Continue to use the local media and trade publications to increase awareness of hydrogen fuel cell power for the material handling industry.

Summary

- The LiftOne Hydrogen Education Program has continued to be effective towards increasing hydrogen awareness among the commercial communities in North Carolina, South Carolina and Virginia.
- Reaching out to users through a variety of avenues such as at the LiftOne branches, company locations and the regional expos, has remained a solid strategy and will continue for the final 5 months of the program.
- It has been important to gear the H2 information and materials to fit the respective audiences (end users, municipalities, academia, general public, etc.).
- As has been the case since Day 1, the cost equation to convert from batteries to fuel cells remains a major obstacle that has to be overcome.
- The LiftOne Deployments have provided excellent opportunities for the participating companies to try the fuel cell alternative. In each case, while not making the conversion immediately, these companies and others are staying tuned for developments in the industry.

Working closely with us:



- Partnering with LiftOne for this project as a subcontractor, Hydrogenics as manufacturer of the HyPX series Fuel Cell Power Packs used for the Deployments.
- Also, for interpreting the data from the Deployment Schedule, and specifically for the 6th and final site at AGI – In Store.
- Representing Hydrogenics again were Michael Xu (Product Development Manager) and Frank Hailah (Systems Integration Technologist).
- While Hydrogenics has fulfilled their obligation as subcontractors for the project, LiftOne has taken steps to begin demonstrating other OEM's fuel cell power packs for optimum performance and cost efficiencies.