

X.8 Dedicated To The Continued Education, Training and Demonstration of PEM Fuel Cell Powered Lift Trucks In Real-World Applications

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Subcontractor:

Hydrogenics, Mississauga, Ontario, Canada

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Objectives

Through both the education and deployment segments of the project, the objective has been to build further upon LiftOne's successful 2007 fuel cell lift truck deployment in South Carolina by:

- Educating a broad and key group of stakeholders to the benefits of fuel cell and hydrogen technology including, facilities management, operators, maintenance personnel, health and safety groups, first responders, authorities having jurisdiction, technical and community colleges and the general public.
- Demonstrate fuel cell and hydrogen technology through one-month long and geographically diverse deployments of two hydrogen fuel cell-powered lift trucks in real-world applications involving large, prominent companies.
- Demonstrate further this technology by bringing the fuel cell-powered lift trucks to additional high profile public sites.
- To further assist in the commercialization of fuel cell and hydrogen technology through the successful deployments and presentation of cost value propositions.

Technical Barriers

This project addresses the following technical barriers from the Education section (3.9.5) of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

- (B) Mixed Messages
- (E) Regional Differences

Contribution to Achievement of DOE Education Milestones

This project will contribute to achievement of the following DOE milestones from the Education section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

- **Milestone 14:** Hold Community Seminars to introduce local residents to hydrogen (4Q, 2009). This has been done through the H2 -101 Education Sessions held during the first eight months, by engaging with first responders, engineering groups, companies and individuals at shows and public demonstrations, including the 2009 National Hydrogen Association (NHA) Conference.
- **Milestone 18:** Develop end-user workshop materials for use at events (4Q, 2009). LiftOne has shown the hydrogen fuel cell-powered lift trucks at all education sessions conducted at the LiftOne branch locations and handed out versions of the lesson plan to the attendees, comprised of lift truck fleet users. Additionally, through the actual site deployments, end-users at companies such as Stanley Tools, Lowe's, Bausch & Lomb, Michelin Tire, Electrolux and UTi have and will continue to be introduced to hydrogen fuel cell-powered lift trucks.
- **Milestone 19:** Develop short courses for end-users at technical colleges (4Q, 2011). LiftOne has engaged with several regional community colleges during the past year and made arrangements to make H2-101 presentations. LiftOne did conduct two hydrogen seminars at the North American Council of Automotive Teachers - 2009 Conference held at Central Piedmont Community College – North Campus, on July 22–23.
- **Milestone 23:** Hold teacher workshops (2Q, 2007 through 4Q, 2010). Through the above-mentioned North American Council of Automotive Teachers Conference, LiftOne was able to connect with several Charlotte, NC area high school technical

instructors to make arrangements for future on site hydrogen workshops.

- **Milestone 29:** Evaluate knowledge and opinion of hydrogen technology of key target audiences toward meeting objectives (4Q, 2009). Each Hydrogen Education Session held has included initial assessments of hydrogen awareness among the attendees.

Accomplishments

- Designed and presented a comprehensive Hydrogen “101” seminar, which has increased overall hydrogen awareness in LiftOne’s NC-SC-VA region. Focusing on proton exchange membrane (PEM) fuel cells for the material handling industry, the one-day sessions have been held among a wide variety of lift truck fleet users at the LiftOne seven branch locations.
- Demonstrated fuel cell-powered trucks at high profile events such as the ribbon cutting ceremony for the Columbia, South Carolina Hydrogen Fueling Station; the NHA Conference and at Michelin Tire’s Corporate “Earth Day.” These events provided prime opportunities to evidence the immediate commercial availability of hydrogen fuel cell power for sit-down rider (Class I) electric lift trucks (Figure 1).
- Successful launching of the six-site deployment schedule in May, with the first site at Stanley Tools, where the two fuel cell-powered lift trucks were put into full service. End users are introduced to the benefits of hydrogen fuel cell power, with hands-on experience in both operation and refueling.
- Compiled data from the Hydrogenics HyPX Fuel Cell Power Packs, along with the Air Products HF-150 mobile fueler, and submitted the data to the National Renewable Energy Laboratory for analysis.



FIGURE 1. LiftOne Truck Fueling at the Columbia, SC, Hydrogen Station



Introduction

The materials handling industry, a \$12 billion global market representing approximately 750,000 lift trucks sold each year, has proven to be a significant near-term market for PEM fuel cell adoption in a mobility application. This is due to the lack of emissions and the increased productivity the technology provides vs. that of using lead-acid batteries or fossil fuels (propane, gasoline, diesel) for lift trucks and other material-handling units. As a leading dealership in the Carolinas and Virginia, LiftOne first demonstrated PEM fuel cells in 2007, and was able to gain early field trial experience, while recognizing the acute overall need for hydrogen education. To help facilitate the integration of hydrogen fuel cells into real-world applications in the material handling industry, LiftOne first developed a comprehensive hydrogen education and awareness presentation. The seminar is conducted for lift truck users at LiftOne branches, and other sessions are held for selected technical colleges and professional industrial organizations. The sessions began in late March and have made a positive impact on increasing hydrogen awareness. The deployment segment of the project commenced in mid-May with the two fuel cell-powered lift trucks put into full service for one-month long periods at strategically selected high profile companies. The exposure gained by the deployments has and will continue to be a tremendous method of demonstrating the viability of hydrogen fuel cell power. LiftOne also participated by displaying the fuel cell lift trucks at the NHA Conference held in Columbia, SC, from March 30th through April 3rd, which had over 2,500 people in attendance.

Approach

Recognizing the need to help increase hydrogen awareness among material handling users, LiftOne’s approach for hydrogen education has been focused primarily on the identification of key target audiences. This has been the strategy for both the education and deployment segments of the project. On the education side, the seminar content was designed for the layman’s introduction to hydrogen; its history and use over time, and its associated properties/safety items. Fuel cell design and applications, with a strong focus on material handling applications for fuel cells are the key components of the free seminar’s content. A live demonstration of a working fuel cell in an electric forklift ends each 4-5 hour session. The target audience includes representatives from companies operating medium to large electric material handling fleets, with a secondary audience from fossil fuel powered fleets. Individuals and technical colleges are a third audience, with the

entire effort geared toward providing overall hydrogen education awareness, while at the same time providing substantial evidence to allow companies to further progress in the investigation of this alternative fuel.

For the LiftOne deployment segment, a selection criterion was established to determine six optimum trial sites for the two fuel cell-powered CAT® lift trucks for one-month long periods each. These included larger, high profile companies with sizable electric fleets, running multiple shifts and providing high hour usage. For each site, a complete presentation was made and a proposal made for the trial scenario. Upon selection, a survey was made for the correct siting of the mobile fueler. Full orientation classes are conducted with the operators and other deployment site personnel, with hydrogen safety training, fuel cell operation training and hands-on training for the mobile fueler. Once underway, LiftOne monitors fuel cell performance, interacts with site personnel and downloads data. After the conclusion of the trial, the data is compiled, analyzed and then presented at the review meeting with the company participating in the deployment. A critical item at the meeting is the value proposal, which highlights the cost of fuel cell operation vs. that of lead-acid batteries. All the cost components for fuel cell integration into fleets are reviewed, as well as the budget information previously furnished by that site’s management. From this point, the recommendations can be made and when justified, the ultimate steps taken toward a more involved “pilot” program.

Results

Positive progress has been seen for both the segments of the LiftOne project. To assist in increasing the overall hydrogen awareness level in the material handling industry, nine hydrogen education seminars were conducted at LiftOne branch locations. Over 90 key end-users have participated in these sessions thus far (Figure 2). The demonstration of the working fuel cell in a lift truck at the sessions provided the attendees an opportunity to see what had previously only been read about. Additional awareness and exposure for the fuel cell powered lift trucks was gained through demonstrations at strategic events. Most notably, the trucks were exhibited at the NHA’s 2009 Conference in Columbia, SC, in April, where over 2,500 attendees were able to view the functioning units. During this event, the fuel cell-powered lift trucks appeared on a local television station’s morning show, participated in the conference “live demo” area, and were actually utilized for moving materials prior to the start by the set-up company. LiftOne was also able to participate in the ribbon cutting ceremony at the newly commissioned Columbia, SC, hydrogen fueling station on March 31st. The project’s three fuel cells were all fueled at this station.

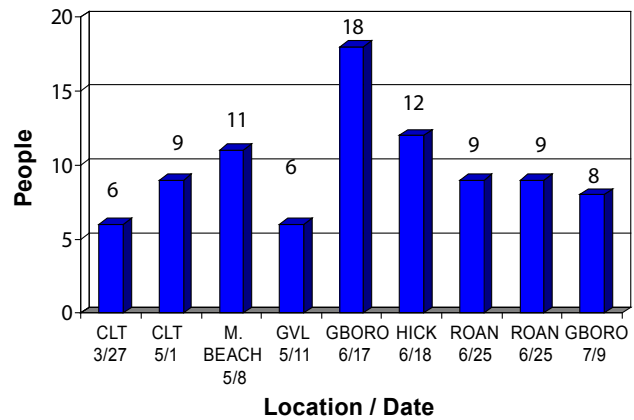


FIGURE 2. LiftOne H2 – Education Session Attendees

Progress was also seen through the positive engagement with several local community and technical colleges. Specifically the interaction with Central Piedmont Community College - North Campus in Huntersville, NC, led to LiftOne’s participation in the North American Council of Automotive Teachers - 2009 Conference. At the conference attended by 250 college instructors, two presentations and a demonstration of a working fuel cell were given. LiftOne has been able to supplement its hydrogen awareness campaign, by reaching out to this important technical sector of the education community.

With regard to the deployment segment of the project, significant progress was made through the engagement and subsequent approvals to schedule the actual deployments at six large, high profile electric lift truck fleet users. These companies are: Stanley Tool, Lowe’s, Michelin Tire, Bausch & Lomb, Electrolux and UTi. A critical result involved the successful interaction with all of these major companies, most with multiple locations across the United States. These opportunities allowed LiftOne to make full presentations providing the necessary initial educational information covering hydrogen, PEM fuel cells and the justification for real-world applications in the material handling industry.

As of this report, we have completed the successful deployment at Stanley Tools at their one million+ sq. ft. distribution center. The units were put into regular service among the facility’s 100+ lift truck fleet, with over 10 operators and additional management personnel participating in the trial. The review meeting is pending as of the date of this annual report, and will be held the week of August 17th. Positive results were experienced as the fuel cell powered trucks performed well and were able to handle all tasks efficiently and effectively with virtually no issues. Operators easily adapted to the mobile fueler and were able to handle the procedure with no difficulties at all. Most weeks evidenced between four and 11 fills each per fuel cell,

accomplished during Stanley Tool’s five-day/two-shift work schedule (Figure 3, Figure 4).

Conclusions and Future Directions

A critical realization has been made during our efforts over the first year. Specifically, regarding the high level of intrigue that exists surrounding the practical use of hydrogen fuel cells for powering lift trucks. This has been seen to be true among companies operating all sizes and styles of fleets. LiftOne has been able to address much of the intrigue through both the project’s education segment and with the start of the deployment segment. Increased awareness and comprehension of hydrogen use as a fuel has resulted, while many of these companies have evidenced a willingness to further investigate this clean energy alternative to battery power. In this respect, LiftOne was able to positively engage with several major companies where historically there

was no such engagement, exclusively through the topic of hydrogen fuel cells.

The following conclusions have been derived through the LiftOne Hydrogen Project’s first year:

- There is an unquestionable, acute willingness to investigate and learn more about fuel cell power among the majority of companies that operate material handling fleets.
- LiftOne’s ability as a lift truck dealership to provide hydrogen education to companies at the local level has been positive, by increasing awareness of this technology to a variety of end users. Showing the actual working fuel cell-powered unit has been a huge benefit.
- A strong desire definitely exists at this time, for correct sized companies to consider the practicality and economical viability of using hydrogen fuel cells for their lift trucks.
- Actual deployments are an absolute necessity for “next step” fuel cell consideration.

As far as future direction for the LiftOne hydrogen project, these steps will be undertaken:

- Continue to revise the education session’s content as deemed necessary, incorporating fuel cell technology developments and cost model improvements.
- Expand the education portion further through increased engagement with more local community and technical colleges.
- Continuation of engagement with first responders through their inclusion at all deployment orientation sessions.
- Maximize local and national publicity of the lift truck deployments through newspapers, television and trade publications.

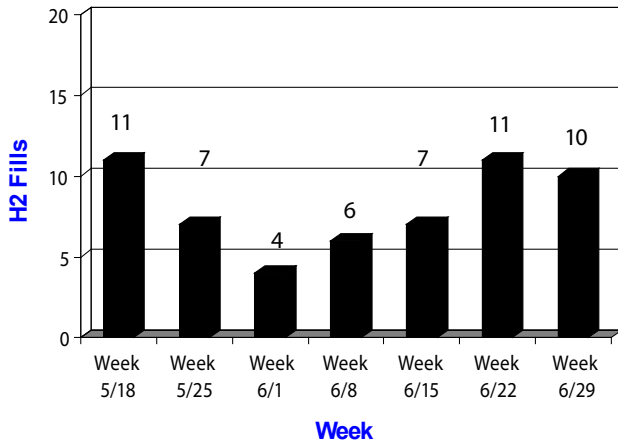


FIGURE 3. Fuelings For Fuel Cell # 11 in Truck # 0264 LiftOne – Site # 1

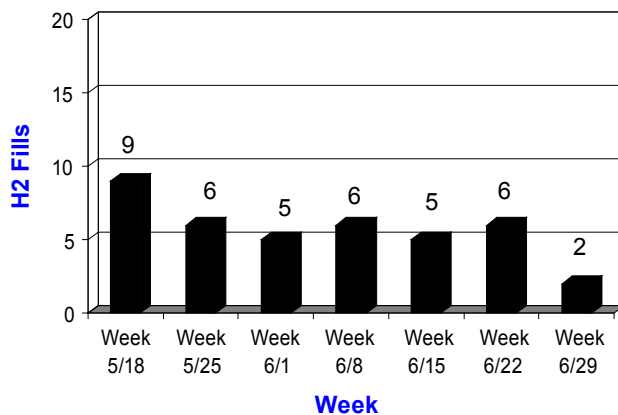


FIGURE 4. Fuelings For Fuel Cell # 18 in Truck # 0265 LiftOne – Site # 1

FY 2009 Presentations

1. Bill Ryan, General Manager / VP - LiftOne, “Emerging Markets”, Keynote Session 4, National Hydrogen Association Conference and Hydrogen Expo, Columbia, South Carolina on April 1, 2009.
2. Tom Dever, Hydrogen Education Program Director - LiftOne, “Dedicated to the Continued Education, Training and Demonstration of PEM Fuel Cell Powered Lift Trucks in Real-World Applications”, US Fuel Cell Council Spring Meeting, Arlington, Virginia on May 20, 2009.
3. Tom Dever, Hydrogen Education Program Director and Chris File, Technical Trainer - LiftOne, “Hydrogen PEM Fuel Cells In The Material Handling Industry”, North American Council of Automotive Teachers – 2009 Conference, Central Piedmont Community College - North Campus, Huntersville, North Carolina, July 22-23, 2009.