

## IX.5 Ground Support Equipment Demonstration

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Contract Number: DE-EE0006093

Subcontractor:  
 Nuvera Fuel Cells, Billerica, MA

Project Start Date: January 2013  
 Project End Date: December 2015

- Factory acceptance test to demo equivalent operation as battery/internal combustion engine
- Nuvera conducts site planning to install hydrogen at two locations

### Technical Barriers

- Upsizing GenDrive architecture from current 48-V product to 80 V
- Outdoor application – need for weatherproofing

### Technical Targets

See Table 1.

### FY 2013 Accomplishments

- Fuel cell testing
- Systems engineering - collection of requirements
- Data logging of CT5E in FedEx Express application (Ontario, CA)
- Sharing of information with baggage tow tractor manufacturer
- System modeling
- Coordination with FedEx Express sites for hydrogen prep/permits
- Kickoff meeting with DOE and Partners in Latham on March 27, 2013
- Receipt of Charlotte CT5E at Plug Power for weatherproofing and interconnect design
- Hydrogen supply agreement

### Overall Objectives

- To create a hydrogen fuel cell-based solution as a cost-competitive and more energy-efficient baggage tow tractors (airport vehicle) compared to the incumbent internal combustion engine-powered vehicles.
- To enable airport end users to accomplish their daily tasks with a hydrogen fuel cell solution while reducing consumption of gasoline and diesel fuels, reducing U.S. demand for petroleum.
- To demonstrate lower carbon emissions with the fuel cell solution.
- To demonstrate a value proposition that shows decreased energy expenditures when compared to diesel-powered airport vehicles.

See Table 1.

### Fiscal Year (FY) 2013 Objectives

- Plug Power develops the 80-V fuel cell product for baggage tow tractor
- Testing with Charlotte CT5E baggage tow tractor

**TABLE 1.** Specific Project Objectives and Expectations

DOE Project Objectives	Plug Power-FedEx Project Expectations
Reduce petroleum consumption	Each BTT uses ~2 gal/hr. Total BTT run time of 15 BTT's over 2 years will be upwards of <b>175,200 gallons of diesel fuel reduced.</b>
Reduce emissions at airports	At 9.8 kg CO2 per gal of diesel, there will be upwards of <b>1717 metric tonnes of CO2 eliminated at airports.</b>
Operate 10 hrs/day & 5,000+ hours	BTT operation occurs during two shifts: day (11 AM-3 PM) and night (10 PM-2 AM). The total clock day is 11AM-2PM (15 hours). <b>Actual BTT activity is 8 hours per day. Total run time of 15 BTT's over 2 years will be upwards of 87,600 fleet hours.</b>
Towing capability of 3,000 to 6,000 lbs.	The BTT will be able to tow 4 FedEx containers each weighing 40,000 lbs. The corresponding <b>drawbar capacity of the fuel cell-powered BTT is 5,000 lbs.</b>
Accelerated development of FC-powered GSE	<b>Fleet of 15 80V fuel cell systems in real world application in 2013 gaining significant field experience while allowing a premier BTT end user to evaluate for larger deployments.</b>

FC - fuel cell; GSE - ground support equipment; BTT - baggage tow tractor

- Site planning at Memphis



## INTRODUCTION

This project will deploy 15 fuel cell-powered units for two years at FedEx’s busiest airport. The project is planned for two phases. The first is a one-year development phase where Plug Power develops, builds and tests the 80-V (~20 kW) fuel cell system for the baggage tow tractor application. The second is a two-year demonstration where a fleet of baggage tow tractors are integrated into Charlotte CT5E electric tow tractors and deployed at the FedEx locations under real-world conditions. The two fuel cell fleets will be fueled by a Nuvera PowerTap steam methane reformer and compression, storage, and dispensing solution at each site.

## APPROACH

Plug Power will design an 80-V battery as a drop in place replacement of an electric Charlotte tug (see Figure 1).

Hydrogen will be supplied to the tugs via Nuvera PowerTap hydrogen generators, which will provide onsite hydrogen at 350 bar to be dispensed directly to the fuel cell in the tug (see Figure 2).

- Definition of requirements – already in process
- Alpha prototype – second quarter testing/third quarter design improvements
- Baggage tow tractor beta builds – fourth quarter demo builds
- Baggage tow tractor testing and certification – by end of year
- Site preparation
- Commissioning
- Demonstration
- Assessment after Year 1
- Demonstration
- Assessment after Year 2

## RESULTS

The kickoff of the project occurred on March 27, 2013. Results will be communicated in quarterly reports later this year.

## CONCLUSIONS AND FUTURE DIRECTIONS

The demonstration of 15 baggage tow tractor units at Memphis will begin early in 2014.

### Direct Replacement Of 80V Battery

*Designed to meet the same form, fit, and function as the battery*

- Stack – power (~20 kW)
- Ballast - weight (counterbalance)
- H2 Tank - run time for BTT app

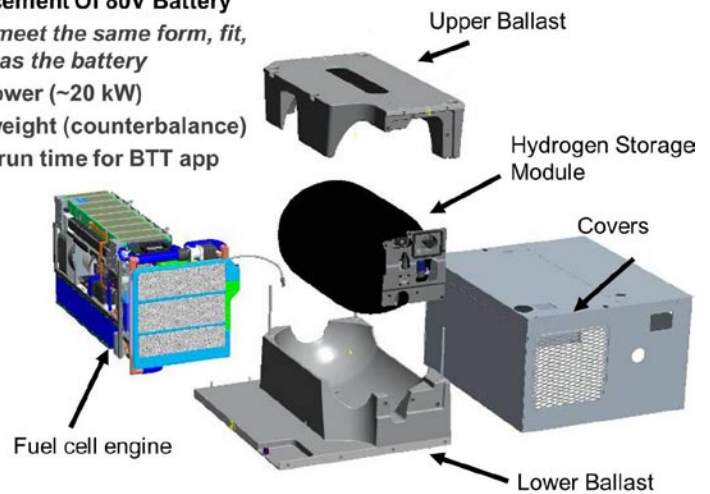


FIGURE 1. Direct Replacement of 80-V Battery

### Nuvera H2 Production and Dispensing

- Fueling Pressure: 350 bar
- Refueling time: ~1 kg/min
- H2 Capacity: 50 kg/day
- H2 Storage: 60 kg
- H2 Purity: 99.995%
- Safety: breakaway hose includes hydrogen safety shutoff valve

**POWERTAP™**  
a complete hydrogen generation and refueling solution for vehicle fleets



FIGURE 2. Hydrogen Solution