

HEB Grocery Total Power Solution™ for Fuel Cell Powered Material Handling Equipment

Fuel Cell Hybrid Power Packs and Hydrogen Refueling

William L. Mitchell

Nuvera Fuel Cells, Inc.

06/10/2010

**Project ID #
ARRAH2008**



Overview

Timeline

- Project Start – 09/01/09
- Project End – 08/31/11
- Percent Complete: 37%
(based on calendar time)

Barriers and Risks

- Fuel Cell Operation and Maintenance
- Hydrogen Station Operation and Maintenance

Budget

- Total Project Funding:
 - Overall: \$3,137K
 - DOE: \$1,139K
 - Cost share: \$2,178K

Partners

- HEB Grocery – Host Site
- DOE

Project Summary

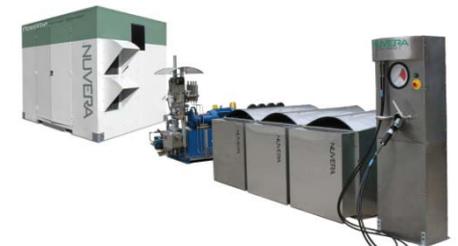
- Objectives:

- Install [1] PowerTap hydrogen generation system with indoor refueling, and [14] PowerEdge fuel cell systems at the H-E-B facility in San Antonio, TX



- Expected Outcomes:

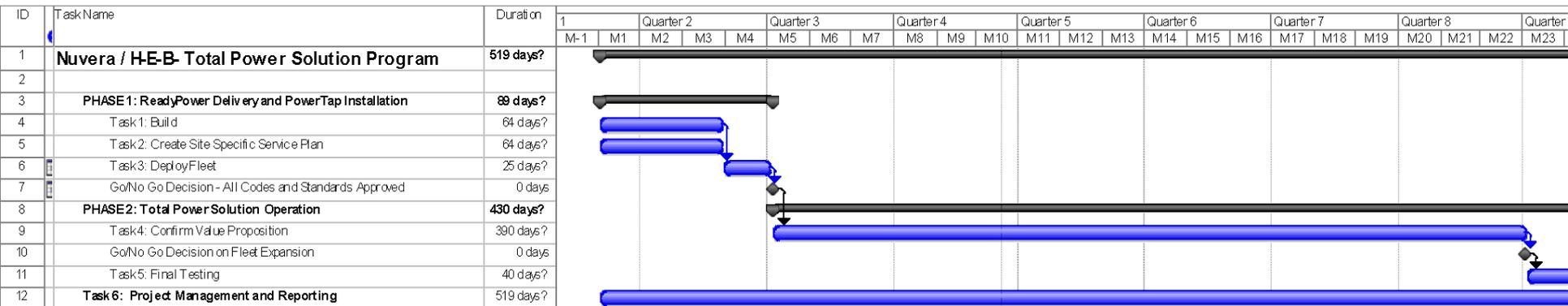
- Periodic reports documenting system performance and any issues
- Enable widespread adoption of hydrogen and fuel cell technology by employing this across the H-E-B fleet of 1,000 forklifts upon verification of economic/operational advantages
- Validation of the DOE market transformation activities:
 - Demonstrate forklift operation in highly transient environments
 - Demonstrate a distributed natural gas based hydrogen refueling system as a precursor to automotive stations



Task Description

- Task 1: Build
- Task 2: Site-specific service plan
- Task 3: Deploy fleet
- “Go/No Go” - To include quantitative metric of customer satisfaction
- Task 4: Confirm value proposition
- Task 5: Final testing
- Task 6: Project management/ reporting

Project Schedule and Status



Task #	Project Milestones	Milestone Completion Date			
		Original Planned	Revised Planned	Actual	Percent Complete
1	Build	10/30/09		10/30/09	100%
2	Site Plan	10/30/09		10/30/09	100%
3	Deployment	11/30/09	2/28/10	2/28/10	100%
	GO/NO GO: 2 PowerEdges Productivity Trial; certify passing of FAT; permitting and approvals	11/30/09	12/30/09	12/30/09	100%
4	Confirm Value Proposition	5/31/11	5/31/11		0%
5	Final Testing	7/31/11	7/31/11		0%
6	Project Management & Reporting	7/31/11	7/31/11		25%

Build

- Build RL-25's and PT-50
 - ✓ Fabricate and complete factory acceptance tests (FAT)
 - ✓ Build complete as of 10/30/09
 - ✓ FAT certification as of 12/30/09



PowerEdge Fuel cell Overview

Product Specifications

RL25

Rated Power (30 sec)	25 kW
Voltage	36 VDC
Operating Current Range ¹	-400A to 1150A
Energy Storage Capacity ²	35.7 kWh
Size - in. (mm)	38.2 in. x 20.1 in. x 30.8 in. (970 mm x 510 mm x 781 mm)
Target Weight - lbs (kg)	2600 lbs (1155 kg)
Refueling Time	120 sec
Hydrogen Storage	1.0 kg
Hydrogen Pressure	5075 psig (350 bar)
Hydrogen Port	SAE J-2600 H35, CE 0036
Ambient Operating Temperature ³	25 to 95°F (-4 to 35°C)
Environment	Indoor Use Only
Emissions	Water Vapor

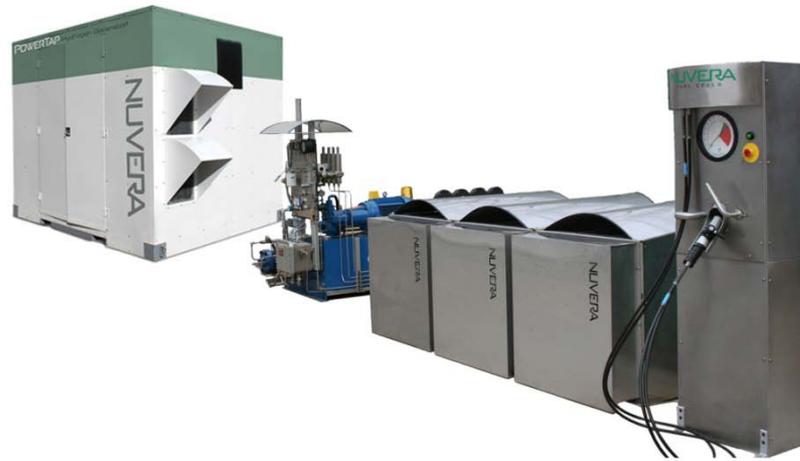
Notes 1: Actual lower limit is dependent on truck upper voltage threshold (value shown based on 44V)

2: Based on LHV of H₂ at 5075 psi (350 bar), 15°C and 1 hr battery discharge rate

3: System must be stored and started above freezing conditions (4°C, 39°F minimum)



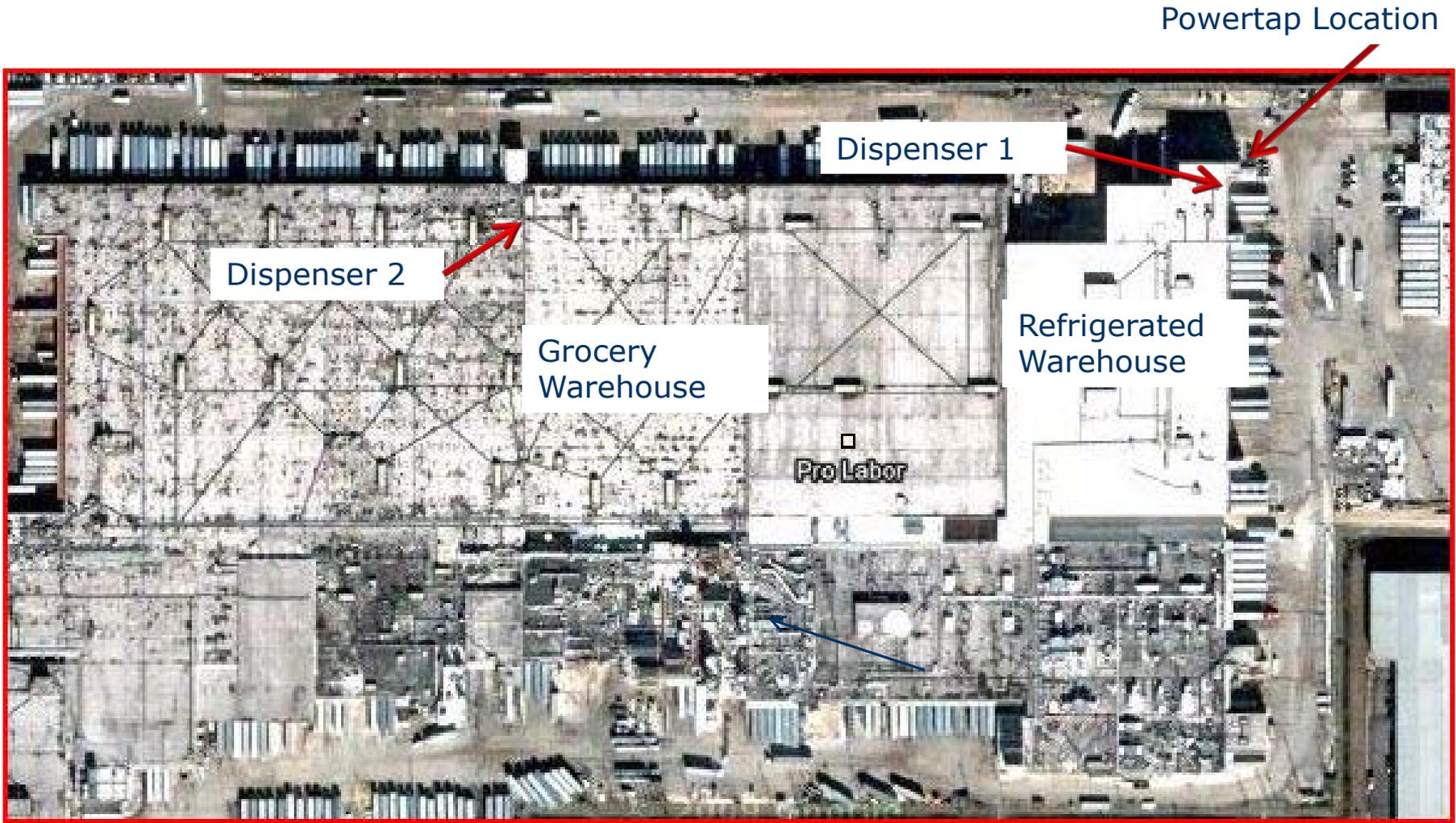
PowerTap Hydrogen Infrastructure



PowerTap Hydrogen Generator	Specifications
Rated Hydrogen Production	50 kg/day
Hydrogen Purity	99.995%
Natural Gas Consumption	7.5 MBTU/day 222 Nm ³ /day
Water Consumption	2400 l/day
Electrical Consumption	9 kW average
Size	12 ft x 4 ft x 9 ft 3.66 m x 1.22 m x 2.74 m
Operating Temperature	-4°F to 104°F (-20°C to 40°C)
Standards Compliance	Designed for CSA, CE
Environment	Outdoor
Emissions ¹	NOx: <15 ppm CO: <50 ppm SOx: undetectable

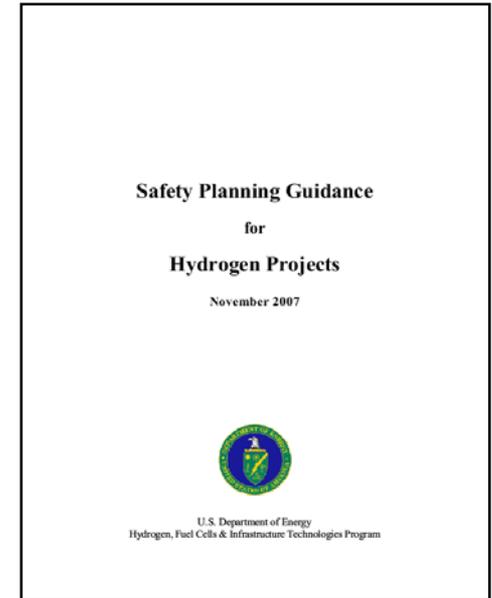
PowerTap Hydrogen Station	Specifications
Gaseous Hydrogen Source	Steam reformer, electrolyzer or delivered via tube trailer or liquid hydrogen
Dispensing Rate	500 – 1000 gram/minute
Dispensing Pressure	5000 psig (350 bar)
Storage Capacity	Configurable from 12 – 128 kg
Compressor	Hydraulically driven intensifier
Electrical Consumption	12 kW average
Operating Temperature	-4°F to 104°F (-20°C to 40°C)
Standards Compliance	System Designed to: CSA HG4 & NFPA 52 Dispenser Nozzle: SAE J2600-H35 Type A Compliant
Environment	Compression and Storage: Outdoor Dispenser: Indoor or Outdoor

Site Planning



Safety Plan

- Nuvera to comply with the DOE Safety Planning Guidance for Hydrogen Projects
 - Appendix IV Safety plan Checklist
 - Consistent with commercial requirements of applicable codes and standards
 - Product Electrical zone classification
 - Product FMEA
 - Site HAZOP
 - 3rd party PE review
 - Permits and AHJ reviews
 - Operating manuals
 - Service manuals
 - Hydrogen Safety training



Deploy Fuel Cell Truck Fleet

- Deploy Fleet
 - Site Planning
 - Hazards & Operability Analysis (HAZOP)
 - Site layout
 - Permitting & Approvals
 - Site Construction
 - Wireless Data Collection Infrastructure
 - Installation, Commissioning & Training
- Result: safe, code compliant, and cost-effective installation



Deploy Hydrogen Infrastructure

- Installed according to NFPA 52
 - Indoor Dispenser in Produce Distribution Warehouse
 - Indoor Dispenser in Grocery Warehouse
 - Outdoor PowerTap generation, compression, and storage system
- All permits and insurance in place
- All systems operational



Site Specific Service Plan

- Service Plan
 - Nuvera Customer Care will provide safety & service training, spare parts, data analysis, warranty, and factory service support

- H-E-B to be the local Service Providers for PowerEdge
 - 1st Responder Role: minimize customer downtime
 - Tier-1 Service training
 - Operator training
 - Schedule maintenance
 - Basic diagnostics and repairs
 - Tier-2 Service qualification
 - Advanced qualification for safety critical repairs (high pressure/voltage)

- Airgas to be the local service provider for the PowerTap

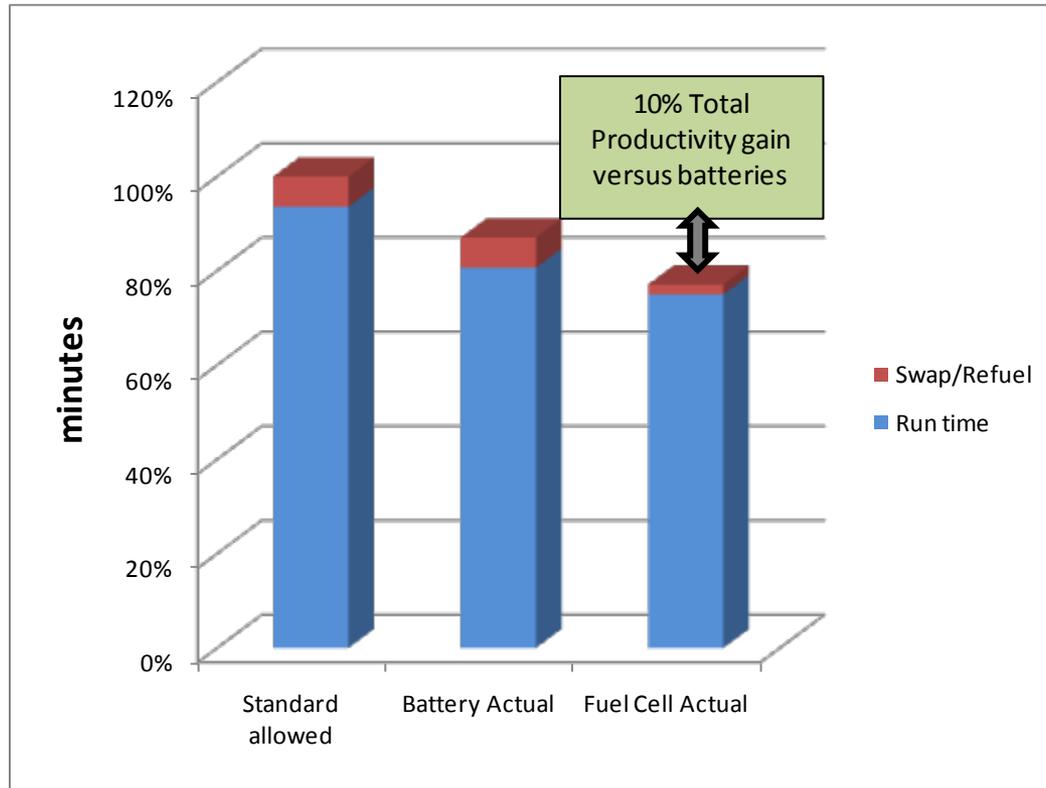
Confirm Value Proposition

- Confirm Value Proposition
 - Compile performance data of PowerEdge and PowerTap
 - Analysis by NREL
 - ✓ Assess productivity gains and operating costs
 - ✓ Validate the value proposition model
 - Update assumptions based on data generated

- H-E-B to assess whether to expand the fleet
 - Nuvera to develop PowerEdge models for use in additional forklifts types and applications

Initial Productivity Testing

- 3 month average – January - March 2010



- Reduced truck maintenance also expected – to be confirmed during operation

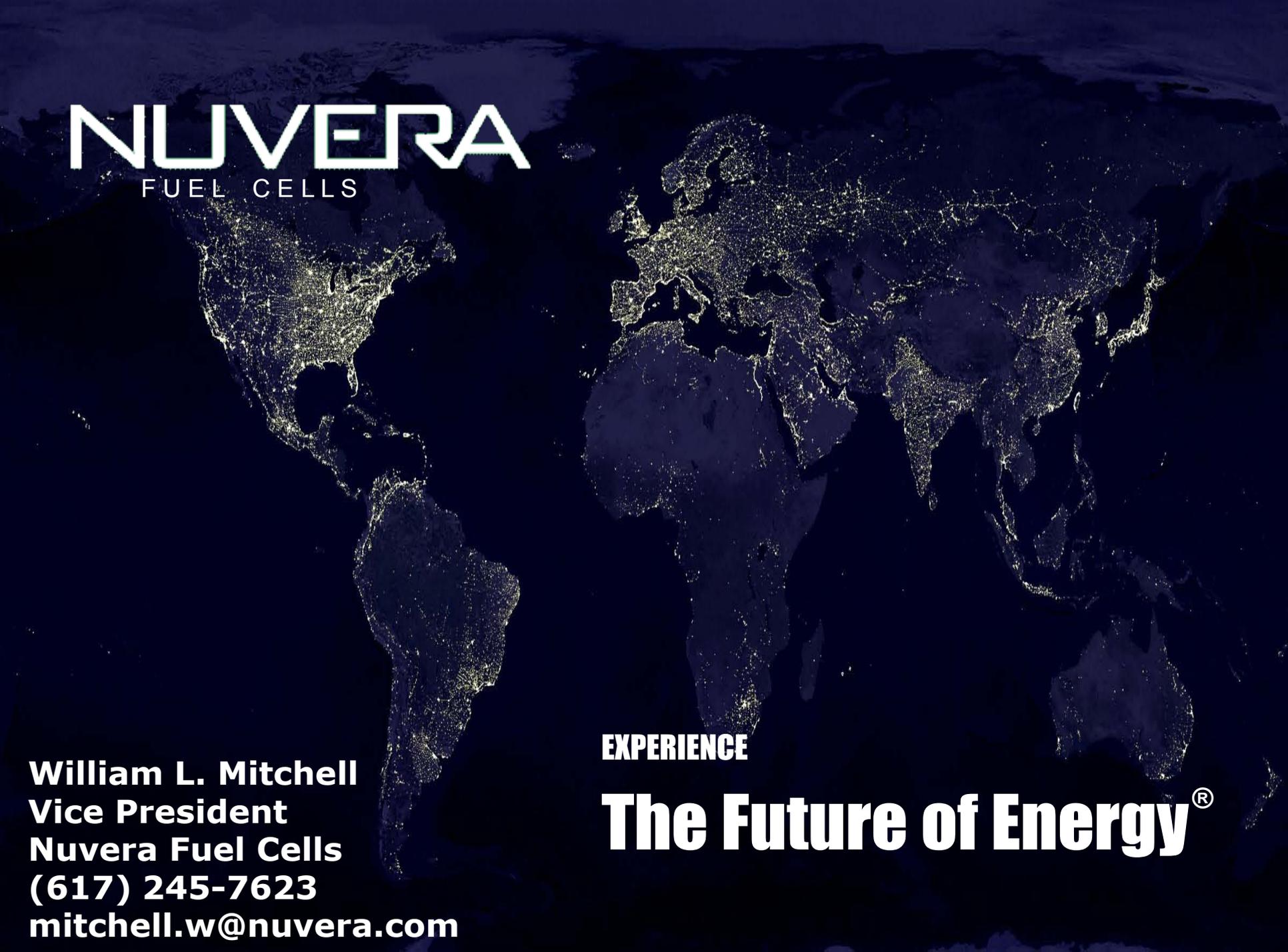
Future Work

- Continue to operate fleet in normal operations to gain durability and life cycle cost information on the fuel cell systems
- Monitor and record the long term operation cost of on-sight hydrogen generation
- Compile performance data of PowerEdge and PowerTap systems and send to NREL for analysis

Summary

- Completed installation of PowerTap hydrogen infrastructure
- Completed Installation of 14 PowerEdge fuel cells in forklift trucks
- Verified initial productivity
- Expansion opportunities identified
- Continued operation will verify long term durability and life cycle costs





NUVERA

FUEL CELLS

William L. Mitchell
Vice President
Nuvera Fuel Cells
(617) 245-7623
mitchell.w@nuvera.com

EXPERIENCE

The Future of Energy[®]