

Technology Acceleration Accomplishments

Poster Presentation #TA02

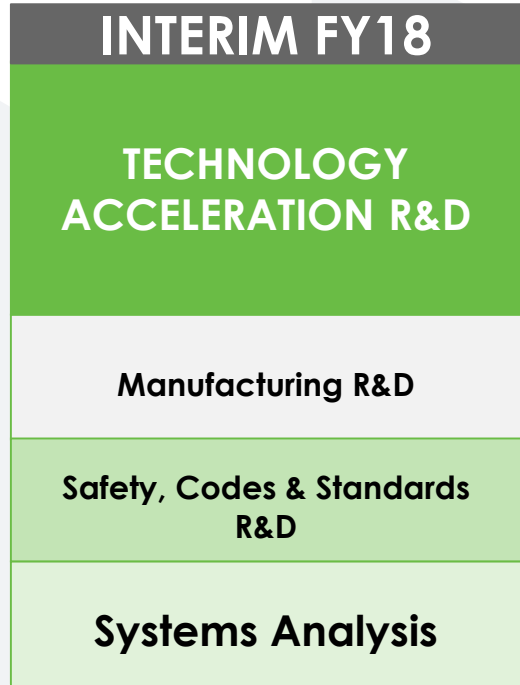
Annual Merit Review & Peer Evaluation

June 13, 2018



New Structure

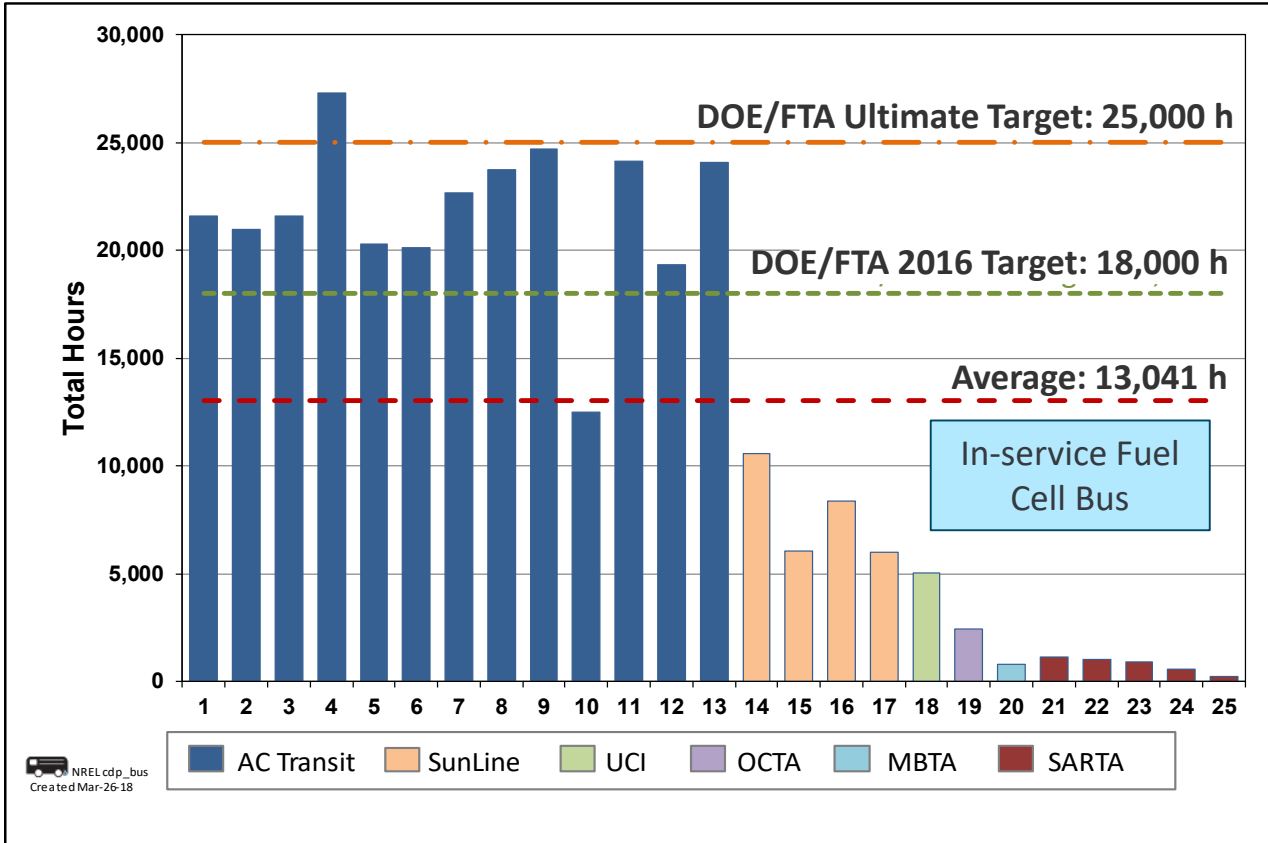
Transformation of Technology Acceleration Associated R&D to H₂ Infrastructure R&D from FY17 to FY19



Exceeded DOE-DOT Fuel Cell Bus Durability Target

Top fuel cell bus runs **>27,330 hours**, surpassing DOE/DOT ultimate target

Total Hours Accumulated On Each Fuel Cell Bus as of 2/28/18



12 fuel cell buses have more than **19,000 hours**



FCEV Delivery Vans Contribute to H2@Scale Vision



Objective

Develop fuel cell hybrid electric walk-in delivery vans, to **double battery-electric vehicle range** and validate through real-world operation

Accomplishments

FedEx

- First prototype truck complete, FC system Factory Acceptance
- Trucks are now on road in Albany, NY with 3,000 hours of operation

UPS

- Electric Vehicle complete, FC system installed and commissioned

Plans

FedEx

- Demonstrate trucks in commercial operation and collect data

UPS

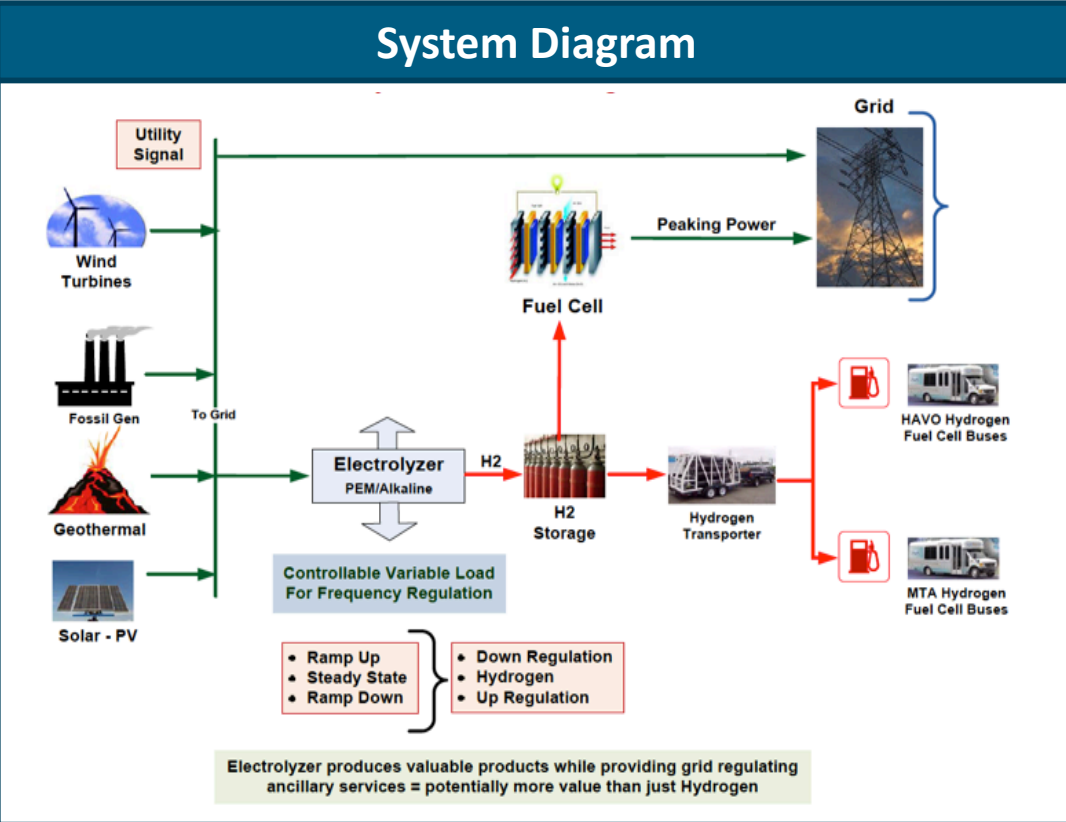
- Complete DC/DC converter testing. Build 15 more vans and deploy in two or more UPS distribution facilities in CA.

230,000 delivery vans nationwide & >450 million kg/H₂ potential demand per year

Hydrogen Energy Systems as a Grid Management Tool Project

Objective

Assess use of electrolyzer as a variable controllable load that can be reduced/increased to maintain the total load balance and frequency stability



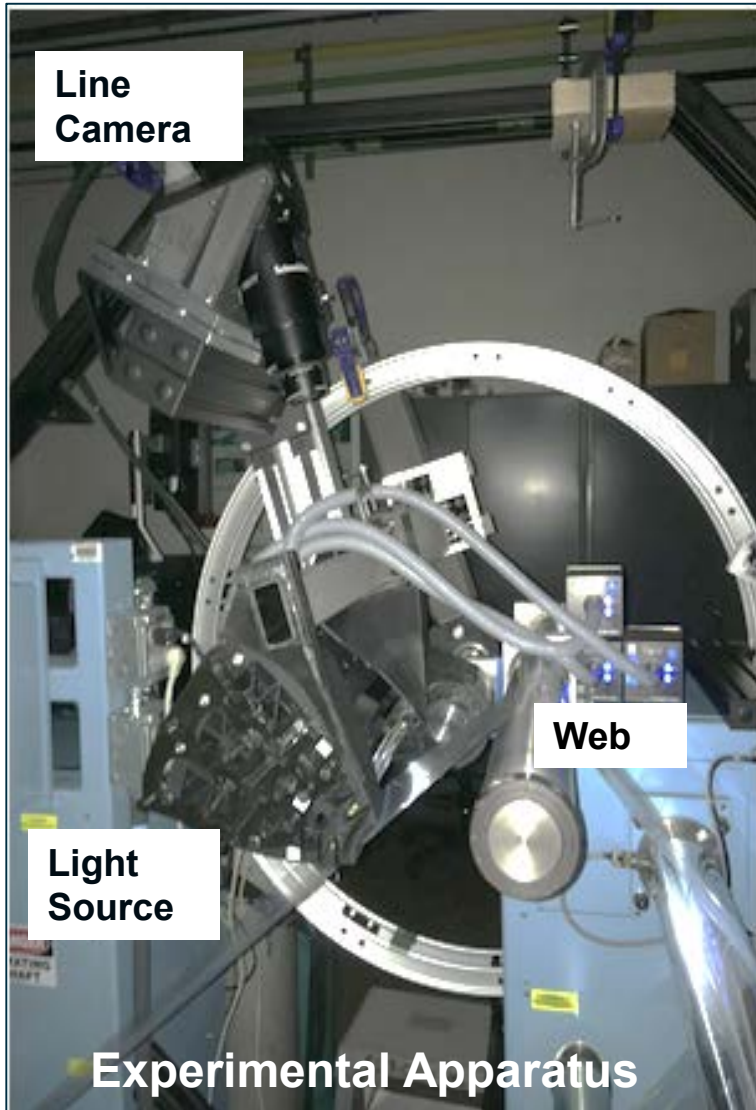
Accomplishment

- ✓ Completed Natural Energy Lab Hawaii Authority site infrastructure installation
- ✓ Reduced H₂ transport cost from centralized production to dispensing for buses (350 bar) by ~50%
- ✓ Utilized electrolysis in grid management applications



Project Partners

Advances in QC Techniques for MEA Manufacturing of Rolled Goods



Objective:

- High resolution characterization of Gore-Select membrane roll quality

Accomplishment:

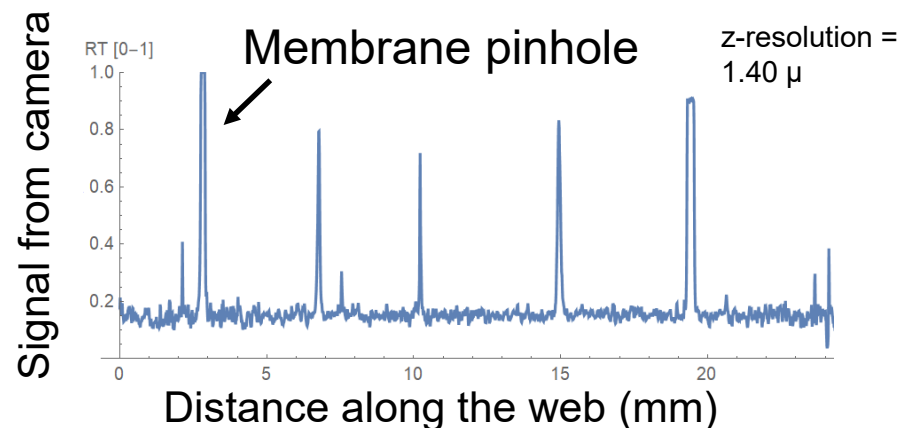
- Developed optical inspection (transmission/reflection) apparatus and classification algorithms for automated defect detection
- Optically scanned full-width, full-length production rolls at high resolution and provided full-roll metrics

Plans:

- Scan additional production rolls

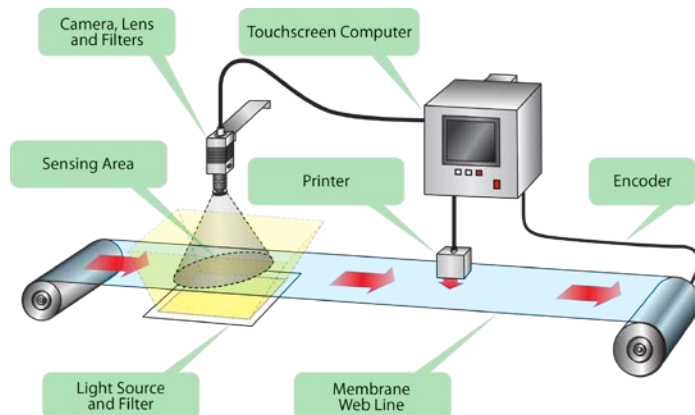


Experimental Data from Optical Scan



Objective:

- Build and demonstrate a prototype system that simultaneously measures:
 - Defects in a moving membrane web
 - Membrane thickness over the full web width



Cross-polarized near-UV-Vis optical arrangement

Accomplishments:

- Scaled up NREL technique to detect pinholes in membrane material
- Defects detected down to 10 μm at 100 ft/min

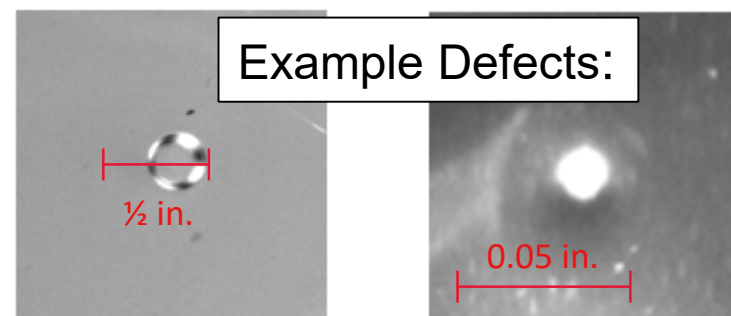
Plans:

- Scale system to real-time measurements of thickness over 24-inch web
- Demonstrate reliability of packaged system for defect detection on two industrial weblines

The MantisEye film inspection station



R2R film inspection station with Automated Dynamics machine vision system commissioned February 28



Bubble

Pinhole – white hole

Maritime Fuel Cell Generator Project (U.S. MARAD Collaboration)

Objective

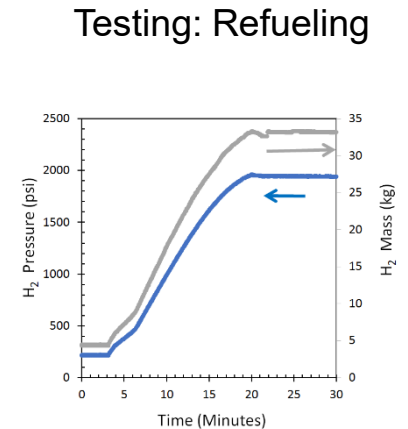
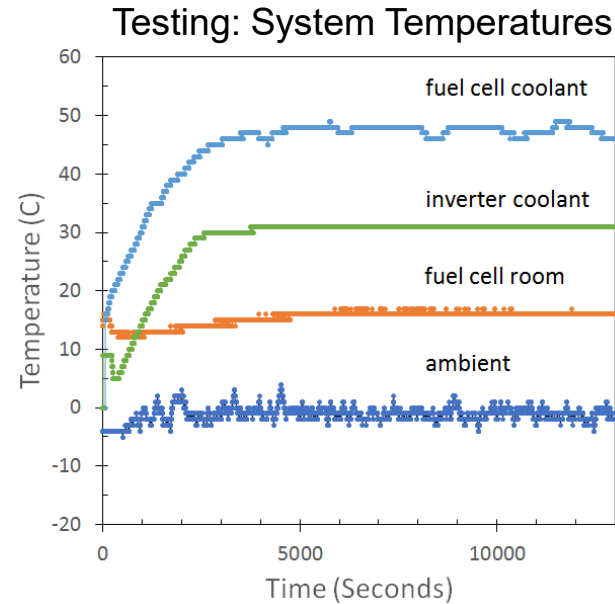
- To develop a power system for maritime applications

Activities and Accomplishments

- Lowered the technology risk of future port fuel cell deployments by providing:
 - Easier permitting and acceptance of H₂-FC technology in maritime applications by assisting USCG and American Bureau of Shipping develop H₂+FC codes and standards
 - A completed enhanced inverter system integration and testing in cold weather (-25°C)



Outdoor Testing at Hydrogenics



Further testing is needed to verify durability assumptions under various operating conditions.

FC Auxiliary Power Unit powering Truck Refrigeration Units

Objective:

- Develop and test fuel cell-based Transport Refrigeration Units (TRUs) for refrigerated Class 8 trucks that are more energy efficient than diesel engine power

Approach:

- Team I (multi-temperature): Nuvera, ThermoKing
- Team II (single-temperature): Ballard, Carrier, Walmart



Accomplishments:

- Phase I (completed): Assembled and tested 1st prototype unit
- Successfully integrated inverter and TRU into system and completed lab demonstration

Next steps/Plans:

- Complete and publish comprehensive project report (PNNL)