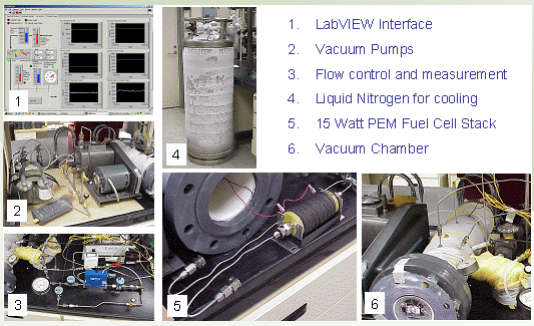
HYBRID FUEL CELL / GAS TURBINE SYSTEMS

PROTON EXCHANGE MEMBRANE FUEL CELL (PEMFC)

OVERVIEW

The experiment observed the results of subjecting a hydrogen-anode, air-breathing cathode Proton Exchange Membrane (PEM) fuel cell stack to the pressures and temperatures encountered at atmospheric conditions existing at altitudes up to 55,000 feet.

Experimental results were used to develop a computer model that can accurately simulate fuel cell performance at these extreme low pressure and low temperature conditions.



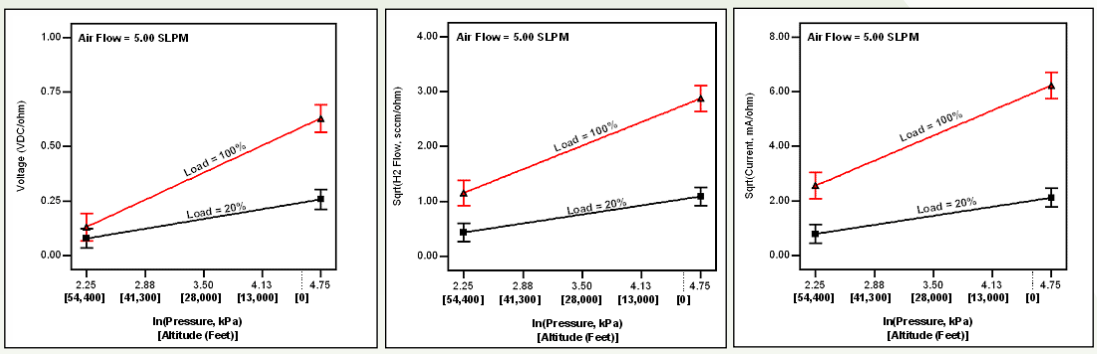
GOALS

- Fuel cells are getting increased attention from the aerospace industry.
- There is very little published data on the operation of a fuel cell at the extreme low pressures and temperatures of typical aerospace applications.
- The decision to pressurize a high altitude fuel cell system, and to what extent, needs to be based on relevant data.
- A computer model that can accurately predict fuel cell performance at high altitudes would be a valuable tool to high altitude fuel cell system designers.

RESULTS

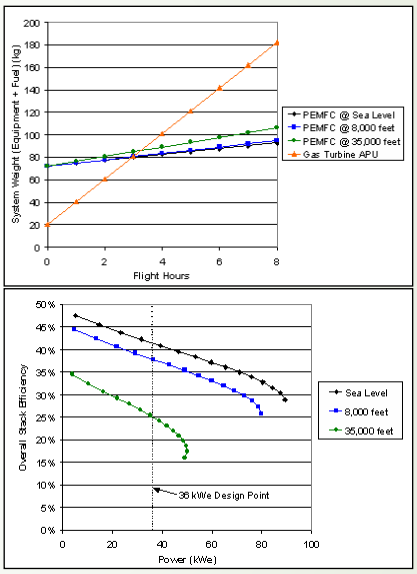
- PEM fuel cell performance at conditions existing at high altitudes can be measured experimentally.
- Voltage, current, and hydrogen consumption decrease with a decrease in pressure. This effect depends on the load applied to the stack.

Fuel cell voltage, current, and hydrogen consumption all decrease with decreasing pressure.



- The exchange current density (io) term used in the Tafel equation has a high dependence on the ambient air pressure for an air-breathing PEMFC stack.
- Using a pressure and temperature dependent io, a computer model can predict actual fuel cell stack performance at high altitudes reasonably well.

The computer model is used to predict fuel cell performance used to provide 36 kW of auxiliary power on a large passenger jet.



RECENT PUBLICATIONS

Pratt, J. (2004). "Experimental Evaluation and Computer Simulation of a Proton Exchange Membrane Fuel Cell at High-Altitude Conditions," M.S. Thesis, University of California Irvine, Irvine, CA, 2004.

Pratt, J., Brouwer, J., and Samuelsen, G. S. (2003). "Experimental Evaluation and Computer Simulation of an Air-Breathing PEM Fuel Cell at Aircraft Flight Altitudes," 2003 Fuel Cell Seminar, Nov. 3-6, Miami Beach, FL.

PERSONNEL

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Project Sponsors:

- NASA Glenn Research Center
- California Energy Commission
- U.S. Department of Defense, Fuel Cell Research Center