

Hawaii Fuel Cell Test Facility

presented to

DOE Hydrogen Codes and Standards

Coordinating Committee

Fuel Purity Specifications Workshop

Renaissance Hollywood Hotel

by

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Hawaii Natural Energy Institute

- **Established by the Hawaii Legislature in 1974 to assist the state in developing Hawaii's renewable energy resources**
- **Research unit in the University of Hawaii's School of Ocean and Earth Science and Technology (SOEST)**
- **Staff includes nine tenure (track) faculty, scientific staff, post-doctoral fellows, graduate students, administrative support**
- **Current research includes hydrogen and fuel cells, sea-bed methane hydrates, high value products from biomass, photovoltaics, and biotechnology**
- **HNEI also manages several multimillion dollar public/private partnerships for deployment and demonstration of fuel cell and renewable energy technologies**



20 Years of Hydrogen Research in Hawaii

- 1986 – DOE funded Hydrogen from Renewable Resources Program initiated at HNEI**
- 1996 – HNEI named U.S. DOE Center of Excellence for Hydrogen Research and Education**
- 2000 – H₂ Feasibility Study under Hawaii House-Senate Resolution**
- 2001 – Hawaii Act 283: Funding for development of H₂ partnerships**
- 2001 – Hawaii Energy and Environmental Technology Initiative**
- 2002 – Hydrogen Power Park – DOE funded public/private partnership to develop hydrogen infrastructure**
- 2003 – Hawaii Fuel Cell Test Facility opened**
- 2004 – Hawaii Hydrogen Center for Development and Deployment of Distributed Energy Systems**



Hawaii Energy and Environmental Technology Initiative

Partnership between HNEI and Naval Research Laboratory funded through ONR. Initiated in 2000 with total funding to date over \$10 million.

- **Development and testing of fuel cells for commercial and military applications**
 - **Established Hawaii Fuel Cell Test Facility**
 - **Established industrial partnerships**
- **Exploration and characterization of seabed methane hydrates**
 - **Established international partnerships and hosted three international workshops**
 - **Developed synthesis/characterization laboratory at UH**



Hawaii Fuel Cell Test Facility



Front view of test stand

- Developed by HNEI in partnership with UTC Fuel Cells, Office of Naval Research & Hawaiian Electric Company
- 4000 sqft facility opened in April 2003 with three state-of-the-art single cell test stands for full size PEM cells (up to 600 cm²)
- Operating 24/7 with focus on characterizing performance and durability of advanced technology fuel cells



HFCTF – Features



Test stands



Electrolyzer

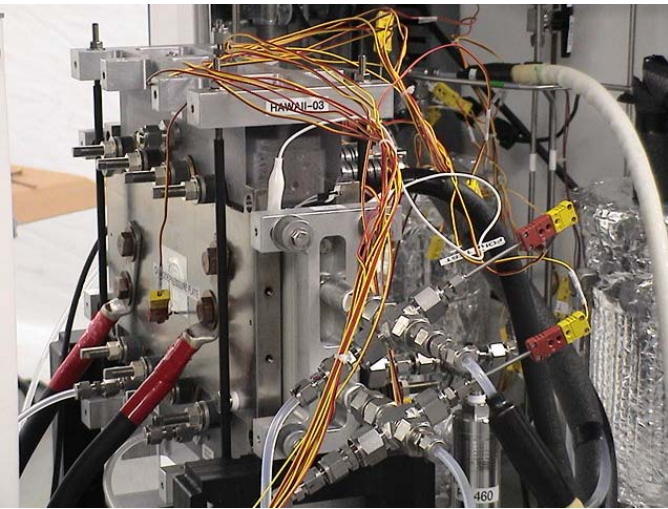


Gas storage

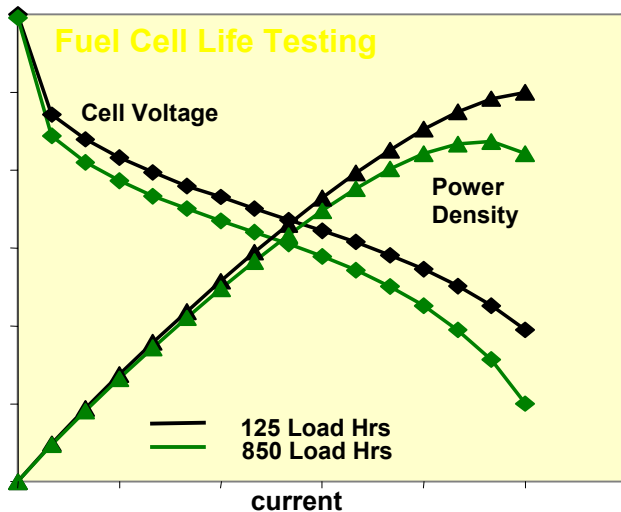
- Extensive safety systems
- Computerized process control and data acquisition
- Secure lines for external monitoring and data exchange
- Full time engineering support
- On-site hydrogen generation and storage
- Hydrogen and reformat fueling
- Air or oxygen at cathode
- *On-line high resolution gas analysis*



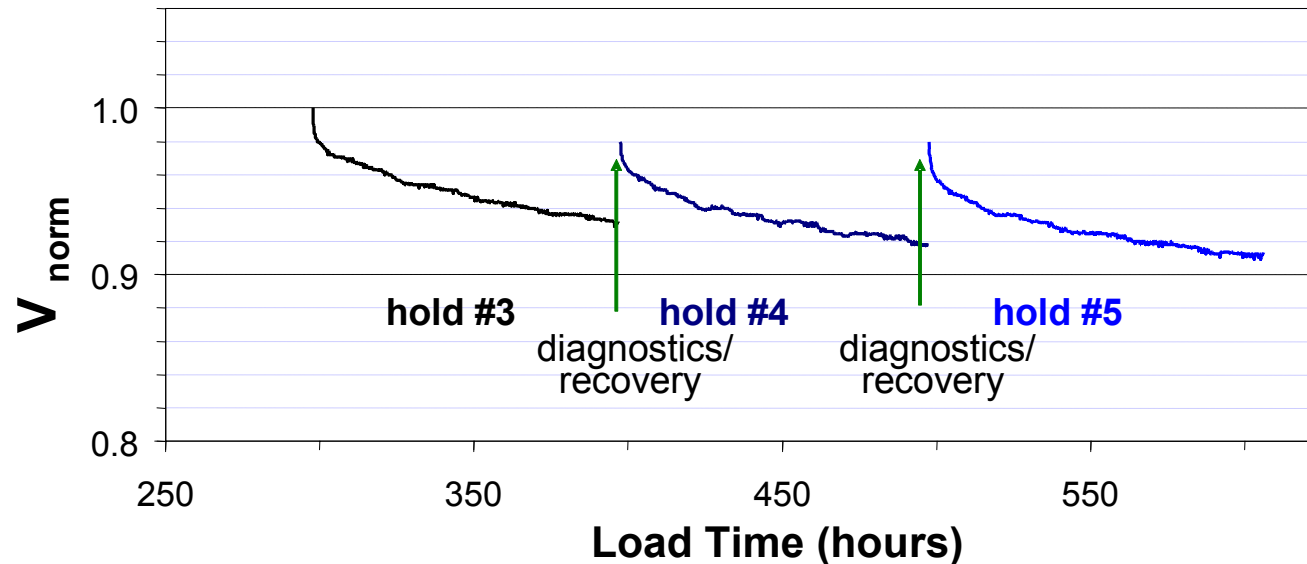
HFCTF – Test Activities



- **Wide variety of test protocols**
 - Cell performance and durability (24/7)
 - MEA and component characterization
 - Fuel purity characterization
- **Proposed activities (FY04)**
 - Two new cell and one new stack test stands
 - Stack durability testing
 - Dynamic testing of cells and stacks
 - Fuel purity studies
- **MEA fabrication and cell assembly**



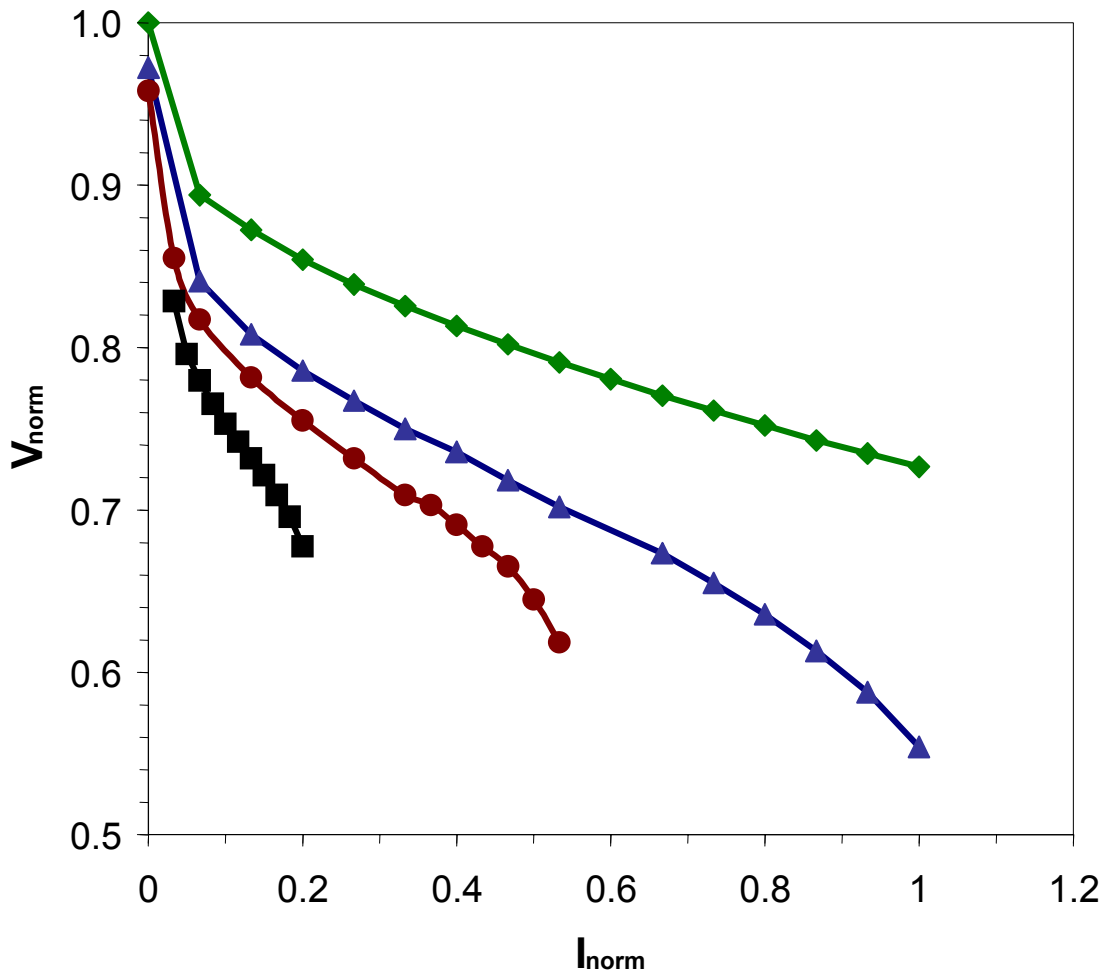
Endurance Testing



- **Sample of plots from lifetime testing**
- **Steady-state operation with in-depth diagnostics at fixed intervals**
- **Identify degradation mechanisms**



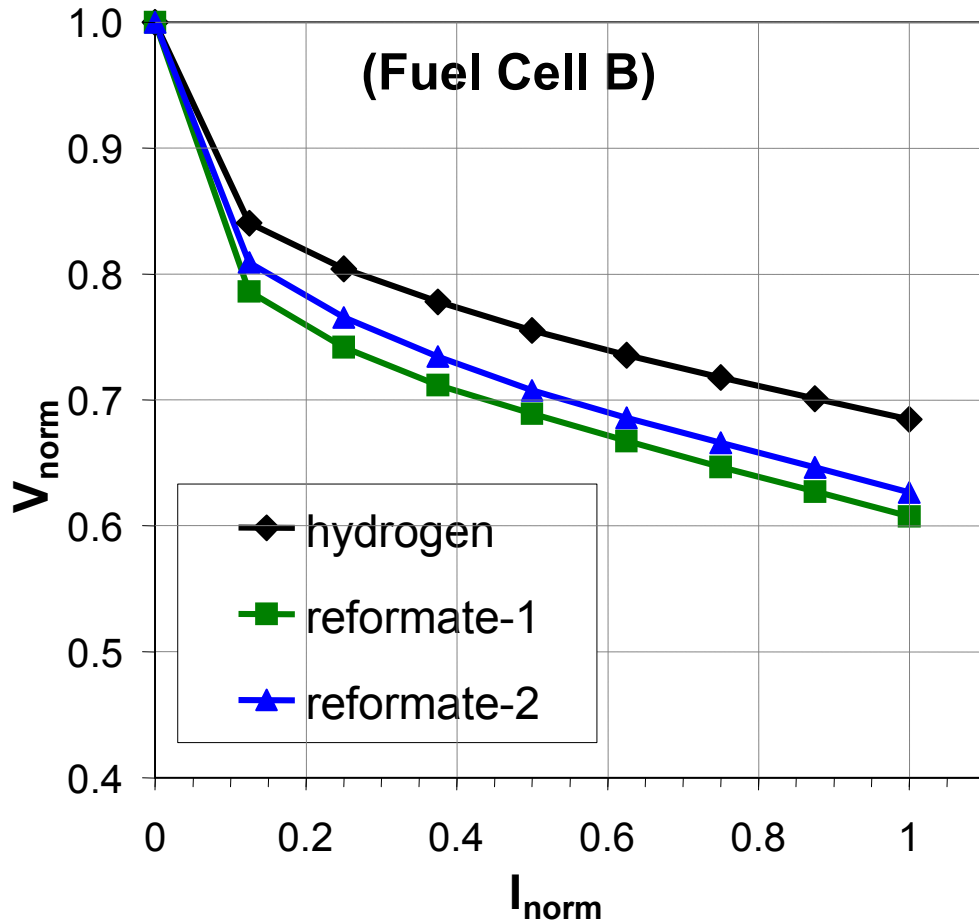
Oxygen Dilution Effects



- Provide complete sets of experimental polarization curves for fuel cell component model calibration
- Analyze losses in the cathode gas diffusion and catalyst layers



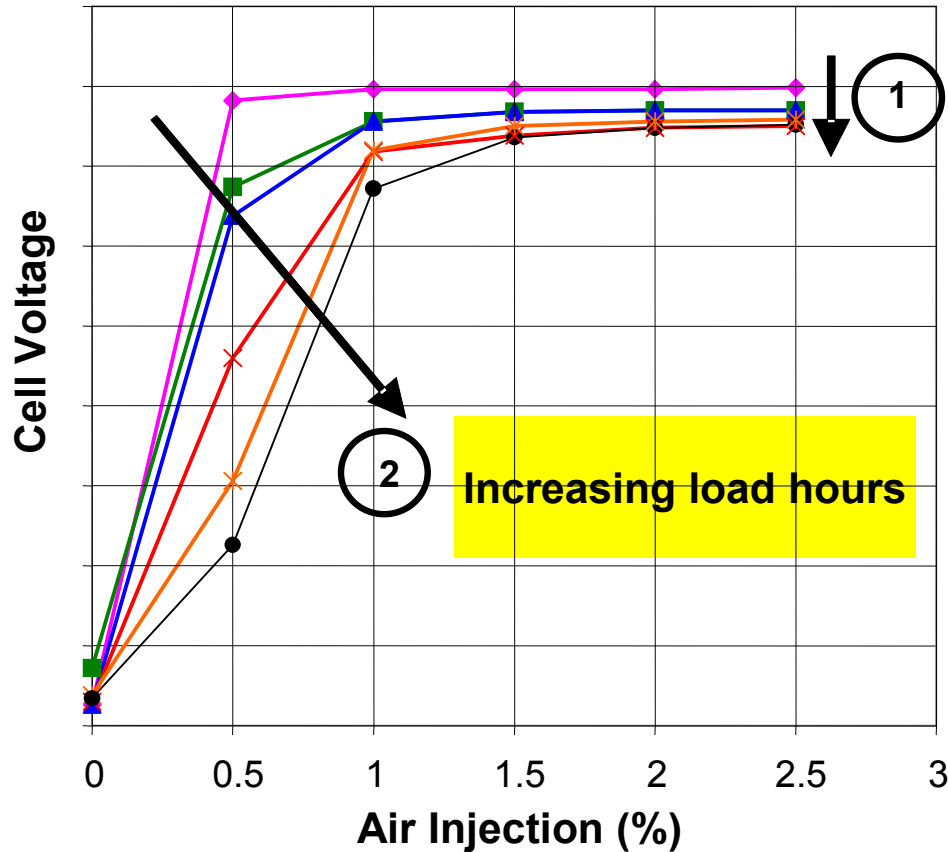
Fuel Evaluation



- Sample plots of cell performance fueled by hydrogen and different reformat formulations



CO Tolerance



- Curves show recovery with air injection on anode side following intentional poisoning with carbon monoxide
- Performance in final 'poisoned' state was up to 50% lower than original



Summary

- **The Hawaii Fuel Cell Test Facility is fully operational with trained staff, broad range of gas capability, and 24/7 operation.**
- **Performance and life testing protocols made available by UTC Fuel Cells have been implemented on full size single cells.**
- **On-line high resolution gas analysis for impurity analysis installed and becoming operational.**
- **HNEI ready to commit significant funds to fuel purity study (FY04 DOE plus-up).**
- **DOE investment highly leveraged by DOD interest and funding.**

