200-kW Fuel Cell Test Facility at the National Transportation Research Center (NTRC)

Fuel Cell Power Plant

Commercially available UTC phosphoric acid fuel cell

- Consumes 2,050 cft/hr gas
- Generates 200 kW/235kVA electricity
- Generates 450,000 Btu/hr hot water @ 140 and 250°F
- Quiet — conversational level (66dBA @30 ft)

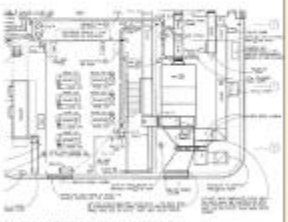
Heat Recovery

SEMCO desiccant wheel

- recovers enthalpy,
- controls humidity from exhaust air

Existing Building Systems will use Fuel Cell Thermal Energy

- 7 gas-fired boilers (2,070 MBtu/hr each)
- Hot water heats building in winter
- 525-ton chiller produces 55°F air
- 3,000-3,300 therms/mo reheat 55° air for summer temperature control



Retrofit installation at NTRC improves efficiency

- Combined heating cooling and power installation improves building operation
  - 59% efficiency in Summer by using 250°F water for temperature control (COP for low heating value of gas)
  - Expected to reduce utility bills
- SEMCO desiccant wheel recovers energy (heat or cooling) and controls humidity from exhaust air
- Real-time monitoring of system performance
  - Monitor via website

Efficiency Improvements Planned for 2002

Activity	Schedule
Purchase Fuel Cell	June-01
Site Engineering Design	April-02
Permitting–air permit not required	June-02
Delivery of FCPP to Site	September-01
Competive construction bid	Apr-02 - Aug-02
FCPP Installation	Sept-02 - Dec-02
System Start-up, Check out, conditioning	January-03
Operations/Maintenance Training	February-02
On-site Acceptance Test	March-02
First Year Operation	March-04
Summary Report on First Year Operation	May-04
Replace fuel stack	January-08

Fuel Cell Operates in Grid-independent Mode

- Fuel cell normally operates while connected to the electric grid.
- Fuel cell designed to automatically disconnect from the grid when grid fails or is out of tolerance by opening the fuel cell "grid enable circuit"
  - Fuel cell independently operates the grid-independent circuit
- Local utility (LCUB) required installation of reverse power relay to prevent power from feeding grid during grid outage.
- If the fuel cell fails to disconnect from the grid during a power outage, reverse power relay disconnects fuel cell from grid.
  - Local utility (LCUB) manually resets reverse power relay

Fuel Cell—opportunity for inter-connection research

- Proposed research project
  - Compares grid disconnect relays of LCUB substation and UTC fuel cell
  - Evaluates "load tracking" control loop interaction with reverse power relay
- Proposed project participants
  - ORNL's Engineering Science and Technology Division,
  - EPRI/PEAC
- Tennessee Valley Authority (partial funding allocated)
- CERL
- UTC Fuel Cells (?)
- IEEE (?)

Deploy CCHP Fuel Cell at NTRC

- NTRC Fuel Cell deployment team
- IC Thomasson designed building interfaces; managing construction
  - Fixed price construction contract
- Project working with local electric utility (Lenoir City Utility Board)
  - May provide switching from local substation, install reverse power relay and participate in experiments
- Project working with local gas utility (Knoxville Utility Board)
  - Providing new rate for gas-powered technologies
- Project draws on various funding sources:
  - DOE Office of Distributed Energy Office of Distributed Energy and Electric Reliability
  - utility bills (should decrease),
  - $200K NETU/DoD grant
- Showcase DOE Technology Deployment and Collaborative Grid Inter-connection Research Project