

# FC Tec

Fuel Cell Test and Evaluation Center

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Engineer Research and Development Center



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# Fuel Cell Test and Evaluation Center



Accelerating the Development  
and Commercialization  
of Fuel Cell Systems

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## Background

The U.S. Department of Defense (DoD) Fuel Cell Test and Evaluation Center (FC Tec) is a National Resource facility for the independent, unbiased testing and validation of fuel cell power systems for both military and commercial applications. Located at Concurrent Technologies Corporation's (CTC's) Environmental Technology Facility, in Johnstown, Pennsylvania, the FC Tec was established through a collaborative effort between the U.S. Army Construction Engineering Research Laboratory (CERL), an element of the U.S. Army Engineer Research and Development Center (ERDC); the U.S. Army Corps of Engineers; and CTC.

The FC Tec's primary goal is to significantly accelerate the development and commercialization of fuel cell power systems.

## Objectives

- Enhance the performance of fuel cell technologies
- Validate prototype, pre-production systems and components
- Evaluate design and off-design characteristics of fuel cells
- Identify alternative operating modes
- Support the development of standards for military and commercial applications
- Reduce life-cycle costs for commercial fuel cell technologies

## FC Tec Capabilities/Services

- Grid connected or grid-independent testing of complete fuel cell power plants
- Developing plans and protocols required to conduct tests on fuel cell systems
- Operating fuel cells on alternative fuel sources, including fuel blending
- Simulating electrical loads using various inductive and resistive load banks
- Evaluating heat-recovery capabilities of fuel cells by measuring system performance under various thermal load scenarios
- Performing chemical analyses of gas emissions and wastewater discharges
- Conducting tests under variable environmental conditions
- Evaluating shock and vibration effects
- Testing fuel cells continuously, 24-hours-a-day/7 days-a-week
- Providing computerized process control and data acquisition capability including protected, Internet data access
- Providing baseline studies of safety and reliability issues

## FC Tec Systems

**High Power Resistive Load Bank** – used for short- and long-term electrical load testing in grid connect mode of operation.

- Simulates resistive loads ranging from 5 kW to 255 kW, in 5 kW increments
- Integrates with the FC Tec's Computer-Based Data Acquisition System
- Simulates a wide range of electrical loads in conjunction with the Motor Load Bank
- Equipped with in-line voltage and current sensors



High Power Resistive Load Bank



Low Power Resistive Load Bank

**Low Power Resistive Load Bank** – used for short- and long-term electrical load testing in grid connect mode of operation.

- Load range up to 4 kW
- Integrates with the FC Tec's Computer-Based Data Acquisition System
- Simulates typical residential power requirements
- Equipped with in-line voltage and current sensors



High Power Thermal Load Bank

**High Power Thermal Load Bank (TLB)** – used to conduct thermal testing of fuel cell heat-recovery systems.

- Interfaces with two fuel cell heat exchangers, simultaneously or independently
- Handles variable flow rates up to 100 gpm
- Provides fluid temperatures up to 300°F
- Integrates with the FC Tec's Computer-Based Data Acquisition System
- Applies variable heat loads for thermal response mapping of fuel cell heat recovery systems
- Provides direct integration capability to fuel cell stacks because of its stainless steel construction
- Equipped with flow, temperature and pressure sensors



Temperature/Humidity Environmental Test Center

**Temperature/Humidity Environmental Test Center** – used to conduct environmental testing of low-power fuel cell systems

- -10°F to +140°F temperature range
- 48-inch access door
- 35% to 95% humidity range
- 72-inches wide x 72-inches deep x 90-inches high

“Government and private industry are encouraged to take advantage of the resources available at the FC Tec.”

- Dr. Michael J. Binder, U.S. Army ERDC/CERL Fuel Cell Program Manager

# Accelerating the Development of Fuel Cell Power Systems

## ...For a clean, alternative power source for a safer environment

**Motor Load Bank (MLB)** – consists of three motor skids that are used for short- and long-term electrical load testing in grid-independent mode of operation.

- Simulates a number of fan, pump and industrial motor loads from 5 hp to 85 hp in various configurations, including soft start and variable speed applications
- Equipped with voltage, current and kilowatt sensors
- Integrates with the FC Tec's Computer-Based Data Acquisition System
- Simulates a wide range of practical electrical loads in conjunction with the High Power Resistive Load Bank

**Computer-Based Data Acquisition System (CDAQ)** – provides an automated means to monitor and collect data on critical fuel cell operating parameters.

- Acquires data from sensors installed in the Motor, Resistive and Thermal Load Banks, fuel cell and various other sensors installed in the FC Tec
- Provides long-term database storage for collected data
- Provides a means for electronically disseminating data to FC Tec engineers, commercial clients and government clients for analysis and publication
- Allows for adjustable data acquisition rates to accommodate specific test needs
- Collects and stores data automatically in a Microsoft Access® database for further analysis
- Allows FC Tec engineers and clients to access password-protected data via the Internet

**FC Tec Process Control System** – an integral part of the FC Tec's Computer-Based Data Acquisition System.

- Controls all load bank equipment in automatic or manual modes of operation
- Interfaces with multiple operator screens to create fuel cell test plans
- Executes fuel cell test plans automatically
- Allows plans to be saved and executed at any time by FC Tec engineers
- Improves reliability of test operations and displays results automatically
- Allows FC Tec technicians to configure and operate the fuel cell load banks manually or automatically using PC-operator interface screens
- Allows FC Tec technicians to monitor operating conditions and to collect data from various installed sensors

Computer-Based Data Acquisition System



Pump Skid



Fan Skid



Motor Load Bank Skids



Dynamometer Skid



Vibration Test System



Continuous Emissions Monitoring Trailer



180-kW Resistive/Inductive/VAC/VDC Load Bank



Power Processing System

**Vibration Test System** – used to simulate shock and vibration effects on low-power fuel cell systems.

- Meets the requirements of ASTM, ISTA and other industry-standard product test specifications
- 13,000-lb force
- 70 in/second velocity
- Performs sine, random and shock profiles
- 5 to 2000 hz frequency

**Continuous Emissions Monitoring (CEM) Trailer** – a fully integrated system that is used to monitor fuel cell system stack emissions. The mobile system is equipped with instrumentation used to monitor:

- Carbon Dioxide – using an infrared light absorption system
- Carbon Monoxide – using an infrared light absorption system
- Oxides of Nitrogen – using a chemiluminescence detector
- Total Hydrocarbon – using a flame ionization detector
- Oxides of Sulfur – using an ultraviolet fluorescence detector

Coupled with CTC's capabilities to measure stack velocity and collect gas sample streams, a full range of air emission monitoring is available.

**180-kW Resistive/Inductive/VAC/VDC Load Bank** – used for simulating various load conditions encountered by fuel cells.

- AC and DC capabilities
- 120/220/480 VAC settings
- DC and AC tests conducted simultaneously
- Entirely self-contained, mobile unit

**Power Processing System** – a bi-directional device to allow for usage of the grid as a load, so power being generated is not wasted. Also capable of being a high-power power supply.

- Remote voltage sensing
- Analog control signal
- Independent mode control for each output channel
- Reverse voltage protection
- Independent hardware channel enable
- Independent channel shutdown

### Future FC Tec Systems

**Grid Simulator** – designed to simulate electrical grid disturbance including voltage sags and surges, frequency distortions, and transient generation for residential-sized fuel cell power plants.

**Low Power Thermal Load Bank** – designed to conduct thermal testing of fuel cell heat recovery systems for residential-sized fuel cell power plants.

**Dynamic AC Load Simulator** – 15KVA, 120/240VAC, single phase load bank system designed for short- and long-term electrical load testing in grid-independent mode of operation for residential-sized fuel cell power plants.

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Providing a clean alternative for electric power generation