



Commercialization of Fuel Cells & Arbin Fuel Cell Testing System

The growing global demand for cleaner and more efficient use of fuel has drawn interest to the development and commercialization of fuel cells. Fuel cells have been developed and used for many years in spacecraft application, and efforts are underway to provide them for more widespread commercial use. Fuel cells can be used in a wide area of applications — from generating electricity for a utility power plant to running a car to powering a cell phone.

What is a Fuel Cell?

(This section of information is obtained from Fuel Cell 2000 Online Information Center, www.fuelcells.org.)

In principle, a fuel cell operates like a battery. Unlike a battery, a fuel cell does not run down or require recharging. It will produce energy in the form of electricity and heat as long as fuel is supplied.

A fuel cell consists of two electrodes sandwiched around an electrolyte. Oxygen passes over one electrode and hydrogen over the other, generating

electricity, water and heat.

Hydrogen fuel is fed into the anode (negative electrode) of the fuel cell. Oxygen (or air) enters the fuel cell through the cathode (positive electrode). Encouraged by a catalyst, the hydrogen atom splits into a proton and an electron, which take different paths to the cathode. The proton passes through the electrolyte. The electrons create a separate current that can be utilized before they return to the cathode, to be reunited with the hydrogen and oxygen in a molecule of water.

A fuel cell system which includes a "fuel reformer" can utilize the hydrogen from any hydrocarbon fuel - from natural gas to methanol, and even gasoline. Since the fuel cell relies on chemistry and not combustion, emissions from this type of a system would still be much smaller than emissions from the cleanest fuel combustion processes.

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Pierre-Jean, Arbin sales engineer, stands next to a linear, high power, one channel fuel cell testing system. Voltage range from 0-30V, 100A current, and maximum power of 500W.

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Arbin Fuel Cell Testing System

In the wake of the great demand for fuel cells, Arbin has developed and manufactured its first, integrated fuel cell testing system (FCTS). This system is developed for testing PEM (Proton Exchange Membrane) fuel cells using H₂-O₂ or H₂-air fuels. The hardware components of FCTS consist of:

1. Gas handling and flow rate control unit for both the fuel and oxidant — This unit can handle a wide range of flow rate. Combustible gas monitor, purge gas inlets and valves are

- included.
2. Reactant gas humidifiers — Designed with Arbin’s proprietary technology, the humidifiers control the gas humidity precisely and reliably. They are compact in size and are energy-efficient. There is no need to supply extra heat exchange and chiller units to maintain the reactants’ temperatures.
 3. Optional auxiliary input modules, which include auxiliary voltage, pressure and temperature inputs — Pressure and temperature sensors with cables, as well as voltage measurement cables are supplied.
 4. Electronic load — A typical high current, linear, e-Load module with maximum current of 200A,

maximum voltage of 100V, maximum power of 2000W. With paralleling technology, e-Loads up to a few thousands Ampere capability are available.

5. PC and peripherals.

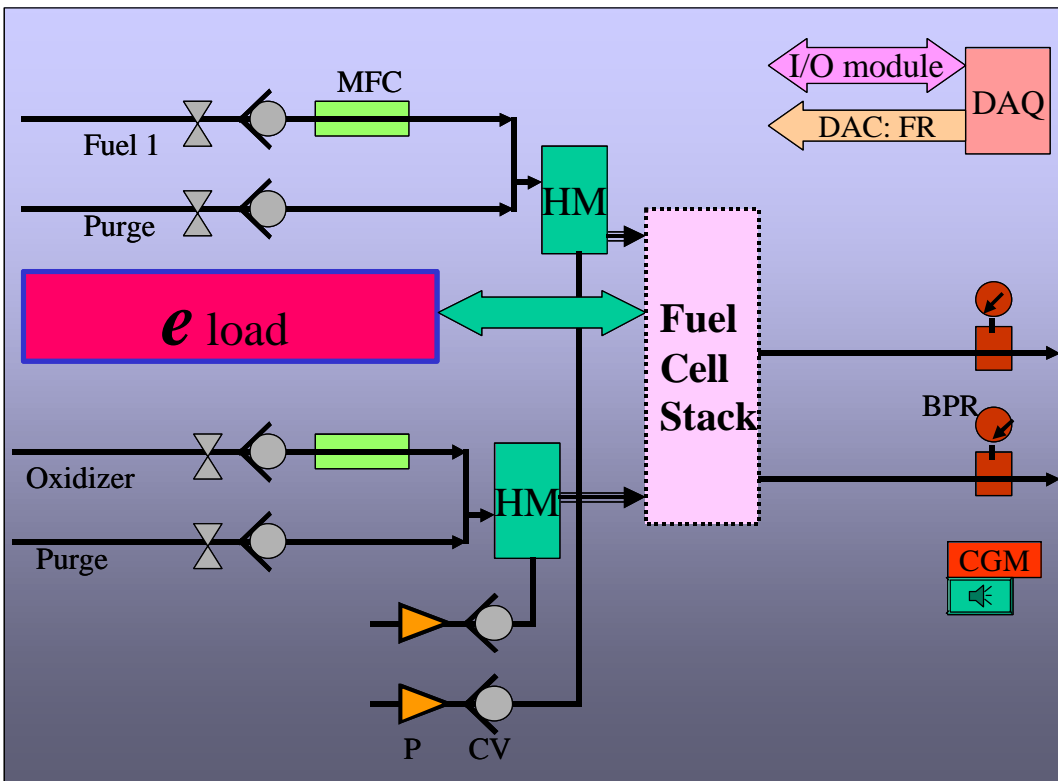
Safety features of FCTS include:

1. Safety alarm. The system gives warning signals for over temperature, over flow rate, over current, or H₂ leakage events.
2. Emergency switch. This button turns off all electricity.

Testing software for FCTS is MITS Pro. Using the software, various control types can be set for the testing, such as CC, CV, CL, CP, rest; staircase; cyclic voltammetry (polarization curve); pulse; OCV; DCIR; and calibration.

Data collected are voltage, current, time, temperature, energy, power, capacity, and flow rates. *

Arbin Fuel Cell Testing System Block Flow Diagram



Abbreviations

BPR	Back Pressure Regulator
CGM	Combustible Gas Monitor
CV	Check Valve
DAC	Digital/Analog Converter
DAQ	Data Acquisition
FR	Flow Rate
HM	Humidifier
I/O	Input/Output
MFC	Mass Flow Controller
P	Pump

Arbin Holiday Party Snapshots

Arbin annual Holiday/Xmas party last year took place at the College Station Ramada Inn on December 15, 2000. The catered party brings all employees and families together for an evening of fun and joy. A buffet-style dinner consisted of beef brisket and almond chicken, with cheesy rice, steam veggies, salad, rolls and varieties of desserts were served throughout the evening.

The evening started with a speech from Arbin President/Owner, Dr. John Zhang, who gave a summary of the company's increased performance for the year (sales increased

by 36% in 2000 compared to the sales in 1999). Dr. Zhang extended his appreciation to everybody's hard work, especially during the big structural shift to Modular Plug & Play in the course of the year.

Dinner was served afterwards, followed by games and dancing. Door prizes were drawn throughout the event. It was a night of fun for the grown-ups, as well as the youngsters.

Another year passed, and a new millennium dawns with new challenges to be faced with a fresh spirit of Arbin team. *



Taking a turn on the buffet line



Mingling with co-workers and families

Arbin Factory Training

Feb 5-6 & 19-20
 Mar 5-6 & 19-20
 Apr 2-3 & 23-24
 May 7-8 & 21-22
 Jun 4-5 & 18-19
 Jul 9-10 & 23-24
 Aug 6-7 & 20-21
 Sep 10-11 & 24-25
 Oct 8-9 & 22-23
 Nov 12-13 & 26-27
 Dec 10-11

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Come See Us

18th Int'l Seminar & Exhibition on Primary & Secondary Batteries
 March 5-8
 Fort Lauderdale, FL
Booth #L5

Int'l Power Sources
 April 9-11
 Manchester, UK

Batteries 2001
 April 17-19
 Paris, France
Booth #12

The year 2000 was another milestone for Arbin with a big shift towards the Modular Plug and Play structure for most of the systems. A completely new product, the Fuel Cell Testing System (FCTS) was introduced late last year, as well as the new version of Arbin multi-functional virtual testing suite, MITS Pro. In this hi-tech industry, new technology, which ultimately leads to new products, evolves and changes constantly. As a result, learning and training need to catch up with the trends.

China travel to the headquarters for training. Currently, there are three engineers from Tianjin and two staff members from Beijing in training at Arbin headquarters. Each trainee receives instructions in different departments within Arbin including hardware and engineering, software, production and customer support. The length of training varies from one to three months for each trainee. *

For Arbin-Tianjin and Beijing employees, training means surviving the 20-hour plane rides to College Station, TX and receiving a hands-on training on the new products. At least once a year, selected employees at both offices in



From left: Candy Zhang and Richard Feng from Beijing Office, Roy Zhang Liu Hong Wei, and Tim Jiang from Tianjin Office



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Long Beach Meeting Report

The 16th Annual Battery conference, held every year at Long Beach CA, traditionally opens up the conference year for Arbin and this year was no exception. A very well organized conference, the event included delegates from all over the world. The division of the conference into a high power and a low power track offered double exposure for the exhibitors and the attendees.

Visitors who stopped by the Arbin exhibit booth were comprised of both old and new friends. Particular interest was expressed in Arbin's integrated temperature chamber and battery testing system.

Overall, the conference presented another good opportunity



for Arbin's Sunil Modi (right in the picture) to meet our customers face to face in a non-business setting and exchange ideas about the future of battery testing and the related technologies.

We look forward to meeting everyone again at the next conference at the 18th International Seminar on Primary & Secondary Batteries in March. *

Industry Events

Feb 20-23
GSM World Congress 2001
Cannes, France
Phone: +44 171 453 5493
www.gsmworldcongress.com

March 4-8
Applied Power Electronics (APEC)
Anaheim, CA
Phone: (202) 973-8664
www.apec-conf.org

March 5-8
18th International Seminar & Exhibition on Primary and Secondary Batteries
Fort Lauderdale, FL
Phone: (561) 367-0193
www.powersources.net

March 11-16
Corrosion & NACEExpo 2001
Houston, TX
Phone: (281) 228-6252
www.nace.org

March 25-30
190th ECS Meeting
Washington, DC
Phone: (609) 737-1902 x 103
www.electrochem.org

March 26-30
Capacitor & Resistor Technology Symposium (CARTS 2001)
St. Petersburg, FL
Phone: (256) 536-1304
www.cti-us.com

April 9-11
International Power Sources Symposium
Manchester, UK
Phone: +44(0)1892 652881
www.ipss.org.uk/index.html

April 17-19
Batteries 2001
Paris, France
Phone: +33 1 53 24 33 33
www.batteries2001.com

April 22-24
Small Fuel Cells 2001
Washington, DC
Phone: (617) 232-7400
www.knowledgefoundation.com

April 23-25
Fuel Cell Power 2001
Nice, France
Phone: (207) 781-9800
www.intertechusa.com