



FUEL CELL SUMMIT

Volume 4, Issue 4

A quarterly newsletter from the U.S. Department of Energy to supply information on U.S. regulation of fuel cells and hydrogen.

Keep On Truckin'. . .on Hydrogen

Hydrogen electrolyzed from water using off-peak hydropower may be the alternative fuel for transportation vehicles, beginning in the Northwest. With its abundance of technology companies, entrepreneurial spirit, unique mix of renewable energy and hydropower, and concern for the environment, the Northwest is poised to play a leading role in moving toward a hydrogen economy. About 150 people from industry, government, and business gathered in Seattle in June to hear this message at the Hydrogen Production and Northwest Transportation Conference sponsored by Pacific Northwest National Laboratory (PNNL) and the Northwest Energy Technology Collaborative (NWETC).

NWETC is a joint effort of business, government, nonprofit, industry, and educational institutions in the Pacific Northwest to accelerate the emergence and growth of the energy technology industry in the region.

The conference included appearances by Washington State Governor Gary Locke and Steve Chalk, who leads the Department of Energy's Hydrogen, Fuel Cells and Infrastructure Program. It also featured presentations by technology companies, the Bonneville Power Administration, and DOE funding programs. The agenda included discussion of Canada's Hydrogen Highway proposed to run from Whistler to Vancouver, B.C., in time for the coming Olympic Games and how it might be extended to Olympia, Washington. Other topics included the Northwest Hydrogen Initiative, fuel cell powered heavy trucks and buses, FreedomCAR and the 21st Century Truck, and hydrogen-fueled airplanes.

The Northwest Hydrogen Initiative seeks to create a world-class hydrogen industry headquartered in Washington, Oregon, Idaho, Montana, and Alaska to break through economic roadblocks to using existing hydrogen technologies to power cars, trucks, electrical plants, and buildings. The 10-year Initiative's Transportation Test Bed Infrastructure is a network of hydrogen fueling stations and 1,000 hydrogen-powered vehicles in the Northwest states by 2008.

"The idea of moving to a hydrogen economy has generated significant interest in many previously unrelated sectors such as the power producing utilities that will generate hydrogen, and the transportation sector, which would use it in vehicles," said PNNL Director Len Peters. The future of energy in this nation—and even the world—will include a convergence of these two interests, and will require new partnerships and collaborations."



A convergence of hydrogen and transportation

An urban transit bus powered by a liquid-fueled proton exchange membrane fuel cell was on display at the conference and took the governor and other special guests for a ride.



Fuel cell power



Fuel Cell Powered Electric Bus at the Hydrogen Production and Northwest Transportation Conference in Seattle, WA

For additional information, contact:

Neil P. Rossmessl
at the U.S. Department of Energy
phone: (202) 586-8668
email:
neil.rossmessl@ee.doe.gov

or contact:

David L. Smith
Pacific Northwest National Laboratory
phone: (509) 372-4553
fax: (509) 372-4370
To subscribe to this newsletter, send an email to dlsmith@pnl.gov

Newsletter distribution is via email unless otherwise requested.

Visit the Fuel Cells website at:
www.pnl.gov/fuelcells



Interconnection Standards Breach the Barriers

As utilities move to a realization of distributed energy resources being a potential win-win proposition, they now view interconnection issues as barriers to improving overloaded distribution systems, reliability, and meeting the expectations of ratepayers and investors. Utilities and ratepayers now work together on codes and standards that will bring uniformity and consistency to the technical requirements for interconnection that currently vary by state and utility.

Standardized technical requirements will reduce the time and financial resources spent to design, site, install, commission, operate, and maintain DER/DG applications. Standardized building, fire, electrical, fuel gas, and safety codes will simplify contracting, permitting, and inspecting. Standardized test procedures will simplify verifying compliance and approving applications.

Utility grid interconnection has been a barrier for both the small application with no desire to export power and the larger generators intended to export high-voltage power to the interstate transmission facilities of investor-owned public utilities.

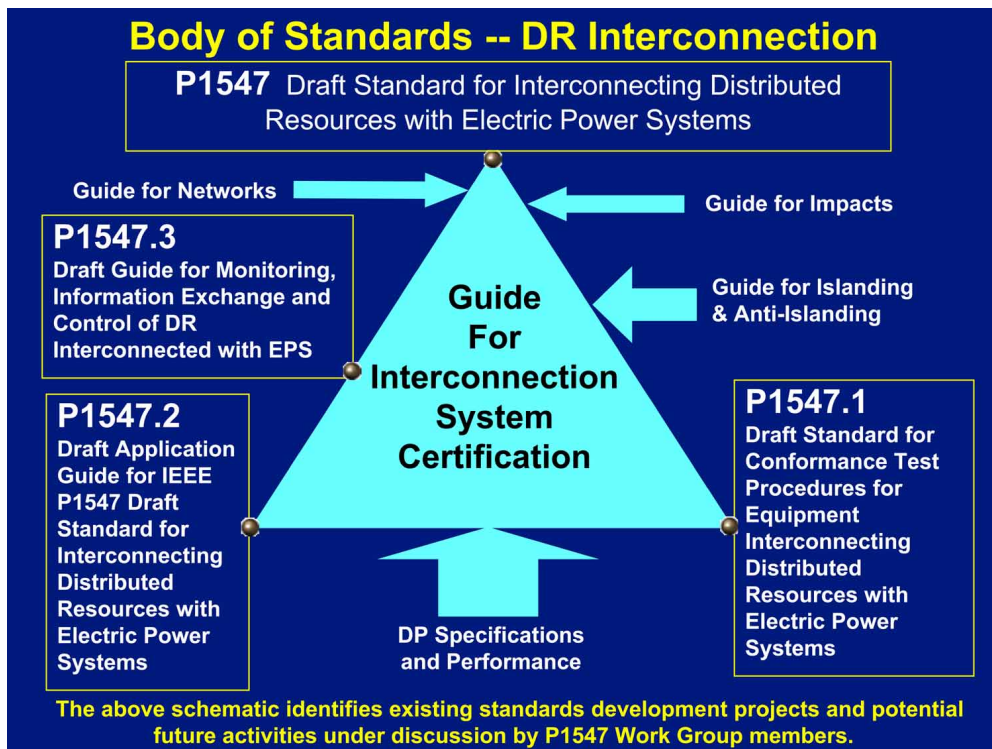
Recent actions taken by both IEEE and FERC are significantly advances in removing interconnection barriers and will have a major impact on the future of DER/DG.

IEEE Approves Interconnection Standard

The Standards Board of the Institute of Electrical and Electronics Engineers (IEEE) has approved IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems. IEEE started work on the standard in 1999. More than 350 individuals participated on the working group that formulated the standard, which can now be used in federal legislation and rulemaking, and by utilities in developing technical requirements for interconnection agreements. The standard addresses performance, operation, testing, safety considerations, and maintenance of interconnection products and services.

This standard establishes the long-awaited technical foundation to allow the interconnection of all distributed generation technologies with the electric grid. It also ensures that major investments in distributed generation technology development by the federal government and industry will result in real-world applications providing alternative sources of electric power to the electric utility operating infrastructure.

The approval of the standard will have a significant effect on how the energy industry does business in the future and will influence the way the electrical distribution system will operate — with distributed generators and two-way flow of electric energy. This national standard may be used in federal legislation and rulemaking and state PUC deliberations and by more than 3,000 utilities in formulating technical requirements for interconnection agreements.



Standards Committee Activity Updates

- ▶ **Codes & Standards Support.** The Department of Energy series of meetings with Standards Development Organizations (SDO) continues. A family of permitting guidebooks has begun with *How to Permit a Hydrogen Fueling Station Guidebook for Permitting Officials* and *Fuel Cell Resource Manual for Stationary Applications*. The Hydrogen, Fuel Cells, and Infrastructure Program's FY04 plan for codes and standards includes Task 1) Domestic Codes and Standards; 2) International Codes and Standards; and 3) Safety.
- ▶ **ICC Codes.** The 2003 *International Codes* are available. To order call 1-800-214-4321 ext. 371, or see www.iccsafe.org or www.ecodes.biz. Public Code Development Hearings will be posted (www.iccsafe.org) for public comment until January 2004. Final Action Consideration public hearings in mid-2004 will determine what is published in August 2004 as the 2004 Supplement. Contact: Eric Stafford (SBCCI), (205) 591-1853, (205) 592-7001 (fax), estaffor@sbcci.org.
- ▶ **ICC Ad Hoc Committee for Hydrogen Gas.** This committee is working on general clarification and improvements to ICC codes regarding hydrogen and hydrogen storage systems. Proposed revisions will be considered in Code Development Hearings. In November the ICC will post (www.iccsafe.org) the hearing results and receive public comments until January 2004. Contact: Darren Meyers (ICC), (800) 214-4321 ext. 307, dmeyers@iccsafe.org or Russ Hewett (NREL), (303) 384.7463, Russell_hewett@nrel.gov. See: www.iccsafe.org.
- ▶ **NFPA 5000, Building Construction and Safety Code.** The public proposal period for the 2006 edition of NFPA 5000, Building Construction and Safety Code is open through October 17, 2003. Technical committees will take action in early 2004 on public proposals. Proposal forms are available at <http://www.nfpa.org/Codes/index.asp>. Contact: Karen Stein (NFPA), (617) 984-7263, kstein@nfpa.org.
- ▶ **NFPA 55, Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks.** NFPA 50, 50A and 50B are consolidated into the 2003 Edition of NFPA 55 that includes storage and utilization requirements for all gases and covers both consumer and manufacturer sites. The standard does not apply to all conditions of off-site transportation, onboard vehicle fuel, liquefied petroleum gas, or liquefied natural gas. Contact: Carl Rivkin (NFPA), (617) 984-7418, crivkin@nfpa.org.
- ▶ **NFPA Hydrogen Coordinating Group.** NFPA-formed group to coordinate the development of hydrogen requirements at NFPA. Codes and standards text is developed to form proposals to NFPA documents. Task areas and groups include metal and chemical hydride storage and generation; high pressure storage; hydrogen siting; below grade and mounded storage; emergency power generation; methanol usage; construction codes; and hydrogen detection, venting and piping. Contact: Carl Rivkin (NFPA), (617) 984-7418, crivkin@nfpa.org or see: <http://www.nfpa.org/ECommittee/hcgroup/hcgroup.asp>.
- ▶ **ISO TC 197, Hydrogen Technologies.** The US Technical Advisory Group (TAG) met on 13 August to prepare for the 4 September Plenary meeting in Grenoble, France. Discussions included the TC 197 business plan; the option of expanding the scope of WG8 to include residential use or pursuing a standard for residential electrolyzers; and new proposals on Gaseous Hydrogen Service Stations and an amendment to ISO 14687 – Hydrogen Fuel Product Specification. Contact: Karen Hall (NHA), (202) 223-5547, khall@ttcorp.com.
- ▶ **IEC TC 105, Fuel Cell Technologies.** WG#1 (Terminology) The document is now being translated into French and will be circulated as a CDV (committee draft for voting) by year's end. If approved, expected publication is June 2004; WG#2 (FC Modules) The document will be circulated as a FDIS (final draft international standard) by year's end, expected publication is March 2004; WG#3 (Stationary FC - Safety) Next meeting is October 13-14 in Cartagena, Spain; WG#4 (Stationary FC - Performance) Submitted a CDV in August for a 5 month period; WG#5 (Stationary FC - Installation) Next meeting is October 15-16 in Cartagena, Spain; WG#6 (FC Propulsion Systems) The activities of WG#6 have been suspended as of June 2003; WG#7 (Portable FC) Goal is to submit a CD (committee draft) by early 2004. Next meeting is October 6-8 in Frankfurt, Germany; ad hoc WG#8 (Micro FC-Safety) The next ad hoc WG#8 meeting will be October 9-10 in Frankfurt, Germany. Contact: Steve Kazubski (CSA America) (216) 524-4990 ext. 8303, or steve.kazubski@csa-america.org.
- ▶ **ASME PTC 50, Performance Test Code on Fuel Cell Power Systems.** PTC 50 provides test procedures for performance characterization of all components of fuel cell power systems. The code is available at 1-800-843-2763 or www.asme.org/catalog. Contact: Jack Karian (ASME), (212) 591-8552, karianj@asme.org.
- ▶ **NFPA 853, Installation of Stationary Fuel Cell Power Plants.** The 2003 Edition is available at (800) 344-3555 or www.nfpa.org. Contact: Carl Rivkin (NFPA), (617) 984-7418, crivkin@nfpa.org.
- ▶ **NFPA 70, National Electrical Code - Article 692, Fuel Cell Plant.** The closing date for receipt of Comments on Proposals for the 2005 NEC is October 31, 2003. A comment form is at www.necdigest.com. The NEC Code-Making Panels will meet December 1-13, 2003 in San Diego, CA, to act on all the Public Comments received by the closing date. Contact: Jean O'Connor (NFPA), (617) 984-7421, (617) 984-7070 (fax), joconnor@nfpa.org.
- ▶ **IEEE P1547, Standard for Interconnecting Distributed Resources with Electric Power Systems.** The Standards Board of the Institute of Electrical and Electronics Engineers (IEEE) has approved IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems. Contact: Richard DeBlasio (NREL), (303) 275-4333, ddeblasi@tclink.nrel.gov; or Tom Basso (NREL), (303) 275-3753, thomas_basso@nrel.gov.
- ▶ **UL Web site for Distributed Generation Equipment.** UL site, www.ul.com/dge/, offers timesaving tools to aid regulators in confirming evaluated DG equipment. Information for DG manufacturers considering UL and customers current customers already undergoing a UL investigation is provided. Contact: Tim Zgonena (UL), (847) 272-8800 ext. 43051, (847) 509-6298 (fax), timothy.p.zgonena@us.ul.com; or Susan Malohn (UL STP Secretary), (847) 664-1725, susan.p.malohn@us.ul.com.
- ▶ **CSA America Fuel Cell Standards.** CSA America FC 1 and FC 3 proposed ANSI Standards have had comments addressed from last ballot and ANSI public review. In September, CSA America will re-ballot these documents for 30 days. If approved, publication of FC 1 and FC 3 will be November 2003. Contact Steve Kazubski (CSA America) (216) 524-4990 ext. 8303, or steve.kazubski@csa-america.org.

2003**OCT****Calendar of Events**

- 1 - 2 **Affordable Comfort for New England 2003.** Westford Regency Inn, Westford, MA. Contact: (800) 344-4866 Ext. 10, or see <http://www.affordablecomfort.org/html/acNE03.html>.
- 4 **2003 National Solar Tour.** Tours and events in local areas. American Solar Energy Society. Contact: Cindy Nelson (303) 443-3130 ext.101, cnelson@ases.org, or see http://www.ases.org/tour/2003_Tour/listings.html.
- 5 - 12 **First International Conference on Fuel Cell Development and Deployment.** Contact: Nigel Sammes 860-486-8379, 860-486-8378 (fax), sammes@enr.uconn.edu, or see <http://www.ctfuelcell.uconn.edu/>.
- 8 - 10 **Fundamentals of Buying & Selling Energy.** Radisson Gateway Hotel, Cleveland, OH. Association of Energy Engineers preparatory course for Certified Energy Procurement Professional (CEP) exam. Contact: (770) 381-9865 (fax).
- 8 - 10 **Hydrogen Infrastructure & Investment Roundtable II.** The Brown Palace Hotel, Denver, CO. An invitation-only event sponsored by Honda for senior-level executives. Contact: Andrew Bermingham aberm@montreuxenergy.com, or see <http://www.hydrogen.com>.
- 9 - 11 **Hydrogen Expo 2003.** Hamburg Trade Fair Grounds, Hamburg, Germany. Contact: Hamburg Messe und Congres +49 40 3569-2124, info@h2expo.de, or see http://www.hamburg-messe.de/h2expo/h2_en/start_main.htm.
- 10 - 12 **The 2003 Hydrogen Education Tour.** Colorado Convention Center, Denver, CO. Contact: Gina Yoo (303) 534-2500, gina@hydrogen.com, or see <http://www.hydrogen.com>.
- 15 - 17 **Distributed Energy Resources and Renewables Conference – 2003.** Intercontinental New Orleans, New Orleans, LA. EPRI companies. Contact: Laura Goldie (650) 855-2560, (650) 855-8759 (Fax), or see http://www.epri.com/attachments/292256_EPRIFOCDER03EventSheetRegistration.pdf.
- 16 - 17 **Energy Venture Fair IV.** Loews Philadelphia Hotel, Philadelphia, PA. Investors and companies seeking capital in the energy sector. Contact: (818) 888-4444, or see <http://www.energyventurefair.com>.
- 20 - 21 **Military Fuel Cells Conference.** Holiday Inn Hotel & Suites, Old Town Alexandria, Alexandria, VA. National Military Intelligence Association, American Institute of Engineers, and Association of Naval Aviation. Contact: (310) 563-1223, (310) 563-1220 (fax), wbudding@ttcus.com, or see <http://www.ttcus.com/mfc/logistics.html>.
- 20 - 23 **HYFORUM 2003.** China Organization for Hydrogen Energy. The Great Hall of the People, Beijing, China. Contact: +49 8151 998 923, +49 8151 998 9243 (fax), arno@fair-pr.com, or see <http://www.fair-pr.com> or <http://www.chinahydrogen.org>.
- 29 - 31 **ICC-ES Evaluation Committee.** Sheraton Birmingham, Birmingham, AL. Contact: (205) 599-9800, (205) 599-9850 (fax), es@icc-es.org, or see <http://www.icc-es.org>.
- 31 **California Hydrogen Business Council meeting.** Toyota facilities, Torrance, CA. Contact: Melissa Stock (562) 493-4014, or see <http://www.ch2bc.org>.
- 2 - 6 **Fall Board of Directors & Working Groups meetings.** Fontainebleau Hotel, Miami Beach, FL. US Fuel Cell Council. Contact: Marleen Alexander (202) 293-5500, (202) 785-4313 (fax), or marleen@fuelcells.org.
- 3 - 7 **2003 Fuel Cell Seminar.** Fontainebleau Hotel, Miami Beach, FL. Contact: (202) 973-8671, (202) 331-0111 (fax), fuelcell@courtesyassoc.com, or see <http://www.fuelcellseminar.com/index.asp>.
- 5 - 7 **Fundamentals of Buying & Selling Energy.** Harrah's Las Vegas, Las Vegas, NV. Association of Energy Engineers preparatory course for Certified Energy Procurement Professional (CEP) exam. Contact: (770) 381-9865 (fax).
- 12 - 14 **World Energy Engineering Congress 2003.** Georgia World Congress Center, Atlanta, GA. Association of Energy Engineers. Contact: (770) 447-5083 ext. 221; (770) 447-4354 (fax), or see www.aeecenter.org.
- 15 - 19 **EVS 20 International Electric Vehicle Symposium and Expo.** Long Beach Convention Center, Long Beach, CA. Electric Drive Transportation Association, World Electric Vehicle Association, U.S. Departments of Energy and Transportation. Contact: (408) 741-5870, or see <http://www.evs20.org/>.
- 19 - 21 **NAESCO Annual Conference: Accepting the New Market Reality.** InterContinental Hotel, New Orleans, LA. National Association of Energy Service Companies. Contact: (202) 822-0954, (202) 822-0955 (fax), mlb@dwgp.com, or see <http://www.naesco.org>.
- 25 - 26 **15th Annual Canadian Power Conference and Trade Show.** Metro Toronto Convention Centre, South Building, Toronto, Ontario, Canada. Independent Power Producers' Society of Ontario. Contact: Soraya Rivera (416) 322-6549 ext. 23, (416) 481-5785 (fax), or see <http://www.newenergy.org/conference.html>.



(cont'd from page 2)

Members of the SCC21 P1547 Work Group continue to work on the ancillary standards of the 1547 Series—testing, applications, and communications.

Draft Standard for Conformance Test Procedures (IEEE P1547.1). This standard specifies the type, production, and commissioning tests to demonstrate that the interconnection functions and equipment conform to IEEE 1547. Standardized test procedures are necessary to establish and verify compliance. Test procedures must provide both repeatable results, independent of test location, and flexibility to accommodate a variety of DR technologies.

Draft Application Guide (IEEE P1547.2). This guide provides technical background and application details to support and facilitate the use of IEEE P1547 by characterizing the various forms of distributed resource technologies and the associated interconnection issues. Technical descriptions and schematics, applications guidance, and interconnection examples are presented.

Draft Guide For Monitoring, Information Exchange, and Control (IEEE P1547.3). This document facilitates the interoperability of one or more distributed resources interconnected with electric power systems. It describes functionality, parameters and methodologies for monitoring, information exchange and control for the interconnected distributed resources with or associated with electric power systems.

FERC Proposes to Expedite Small Interconnections

The Federal Energy Regulatory Commission has proposed *Standardization of Small Generator Interconnection Agreements and Procedures* that should expedite the interconnection of small generators, preserve reliability, increase energy supply, and increase the number and variety of new generation sources. The proposed rule—Docket No. RM02-12-000—would apply to all the approximately 176 investor-owned public utilities that own, operate, or control transmission facilities in interstate commerce and contains procedures and provisions that state regulators could use for generator interconnections under their authority.

The proposed rule includes:

- Super-expedited procedures for interconnecting pre-certified generators 2 MW or less to a low voltage electric system;
- Expedited procedures for interconnecting generators between 2 and 10 MW to a low voltage electric system; and,

Standardized Proposed Interconnection Rule for Small Generators Fact Sheet

FERC Docket No. RM02-12-000

July 23, 2003

The Purpose of FERC's Proposed Interconnection Rule for Small Generators

- Reduce overall cost of electricity to customers by encouraging the development of alternative energy sources such as wind, solar and distributed generation.
- Reduce the time and cost for generators to interconnect by developing special procedures appropriate for small generators.
- Expedite the development of new generation infrastructure.
- Facilitate the introduction of new technologies.
- Limit opportunities for transmission providers to favor their own generation.
- Preserve reliability and safety of the transmission provider's transmission system.

How FERC's Proposed Interconnection Rule Would Benefit Small Generators

- Having one set of standardized interconnection procedures and an agreement for small generators applicable throughout the nation should reduce their costs and time involved in interconnecting to the transmission system. This will reduce their financial risk.
- Super-Expedited, Expedited, and accelerated procedures facilitate rapid interconnection.
- The procedures for interconnecting small generators, which were developed with significant input from the National Association of Regulatory Utility Commissioners and the participating state regulators, may be a model for state utility regulators to follow where they oversee small generator interconnections. This would result in greater standardization and lower costs for innovative generating technologies such as renewable energy generators.

Applicability of FERC's Proposed Interconnection Rule for Small Generators

- FERC's proposed small Interconnection Rule for small generators applies to the interconnection of generators no larger than 20 megawatts in size with the approximately 176 investor-owned public utilities that own, control, or operate interstate transmission facilities.
- FERC's proposed Interconnection Rule for small generators would apply to all interconnections to facilities subject to a transmission provider's open access transmission tariff at the time an interconnection request is made.

- Expedited procedures for interconnecting small generators to a high voltage electric system—69 kV and above—and for generators larger than 10MW to a low voltage electric system.

The proposed interconnection agreement establishes the legal rights and obligations of each party, addresses cost responsibility, lays out milestones for completing the project, and sets forth a process for dispute resolution.

FERC Sets New Standards for Larger Generator Interconnections

FERC Docket No. RM02-1-000 sets standard procedures and a standard agreement for the interconnection of generators larger than 20 megawatts—actions designed to facilitate development of needed infrastructure for the nation's electric system. The rule covering the larger generators will reduce interconnection time and cost, help preserve reliability, increase energy supply, and lower wholesale prices for the nation's customers by increasing the number and variety of independent generators that can compete in the wholesale electricity markets.



DOE Publication RL-P00-006

Printed on Recycled Paper



Coal Provides Power with No Combustion

The world's first industrial-scale fuel cell power plant powered by coal-derived synthesis gas will be the two-megawatt Direct FuelCell being installed in Indiana. The unit will operate initially on natural gas and switched over to synthesis gas in early-2004. This high-efficiency technology generates more electricity from less fuel and with less carbon dioxide emissions than traditional methods using combustion.



FuelCell Energy's DFC3000 power plant was recognized by U.S. DOE, Office of Fossil Energy, National Energy Technology Laboratory as the first industrial-scale application of the technology.

Installation of the power plant is well underway at Global Energy's Wabash River Energy, Ltd.

Michigan Offers Master's Degree in Alternative Energy

An alternative energy technology engineering master's degree program

The state of Michigan's non-profit NextEnergy is providing the spark and support for alternative fuel technology (AET) certificate, associate degree, and engineering master's degree programs at in-state colleges and universities to galvanize an alternative fuel technology economy in Michigan.

"This is a very exciting program, perhaps the first master's degree program in the nation involving alternative fuel technology," said Simon Ng, professor and co-director of the new Wayne State AET program. "We are leveraging our research excellence in all areas to encompass fuel cell catalysts, thermal management, control systems, smart sensors, process safety, vehicle design, traffic simulation, infrastructure management and engineering management to develop state-of-the-art courses in AET," said Jerry Ku, associate professor and co-director.

Wayne State University's degree program calls for subcontracting with the University of Michigan to take advantage of their expertise and provide an excellent AET education for the entire state. According to Interim Dean Ralph Kummler, the first

Integrated Gasification Combined Cycle (IGCC) Facility in Terre Haute, Indiana. Wabash River Energy is a commercial synthesis gas manufacturing facility and one of the most successful DOE Clean Coal Technology Projects.

With the mechanical and electrical installation of balance-of-plant components—equipment for fuel processing, water treatment, thermal management and inverter—completed, the fuel cell modules will be installed and operated first on natural gas. A Synthesis Gas Processing Facility will be built to render the refined coal synthesis gas suitable for the fuel cell power plant and, in early-2004, the power plant will operate on the synthesis gas.

The power plant is not dependent upon a national hydrogen infrastructure; it produces its own hydrogen. The operating temperature allows reformation to occur and generates hydrogen from fossil fuels and wastewater treatment gas. "In fact," says Michael Smith, DOE Assistant Secretary of Fossil Energy, "it can churn out enough hydrogen to generate electricity and supply cogenerations applications."

According to Harry Graves, President and CEO of Global Energy, synthesis gas can be produced from coal and renewables at prices below market pipeline gas. "Gasification Technology, IGCC projects, and fuel cells offer the most promising future for optimal efficiency, environmental benefits, and low-cost energy production. Enhanced use of coal in the U.S. supports the critical national goal of energy independence."

course—Fundamental Alternative Energy I—is planned for the winter semester and will be open to students with a bachelor's degree in engineering, and perhaps other mathematics-based sciences.

The course is the first piece in a program planned to be fully in place in the fall of 2005. WSU's plan also includes an AET graduate certificate program and an undergraduate concentration program. Associate degree and certificate programs are to be offered by Lansing Community College, Lawrence Technological University, and Kettering University. Additional courses to be developed include Fuel Cell Vehicles, Dynamics and Control of Fuel Cell Systems, Smart Sensors and Fuel Cells, Hydrogen Infrastructure and Alternative Fuel Transportation, and Fuel Cell Product Realization System: Business and Technical Integration Issues.

Ballard Power Systems Corporation, Delphi Corporation, and Energy Conversion Devices will provide curriculum advice and collaboration, lab equipment donations and summer internship positions. Ballard is a leading fuel cell manufacturer; Energy Conversion Devices is a leading company in novel alternative energy development. Delphi is a major player in automotive and electronic components and already a partner with the WSU Smart Sensor and Integrated Microsystems's lab.

G03090075