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CLEAN COAL TODAY

A Newsletter about Innovative Technologies for Coal Utilization

News Bytes

April 19, 2001, is the deadline for submitting proposals under the **Power Plant Improvement Initiative**, a $95 million Fossil Energy-led effort to demonstrate advanced coal-based technology at existing and new plants (see *Clean Coal Today*, Winter 2000). On February 15, 2001, a pre-application conference was held at the National Energy Technology Laboratory in Morgantown, West Virginia. Some 38 industry representatives attended, while another 72 participated by web cast. A record of that conference, including Q&As and presentations, can be found on the NETL web site (http://www.netl.doe.gov) and click on Power Plant Improvement Initiative. The web site also contains other information: a record of the December 15, 2000, public meeting; the solicitation; relevant laws and conference

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In This Issue

JEA's Large-Scale CFB Demonstration Project Nears Construction Peak

The JEA Large-Scale Circulating Fluidized-Bed Demonstration Project currently under construction in Jacksonville, Florida is nearing peak construction activity. The project, funded under the U.S. Department of Energy Clean Coal Technology Demonstration (CCT) Program, has been several years in the making. In the mid-1990s, JEA (then known as the Jacksonville Electric Authority) began an aggressive program to improve its customer satisfaction rating.

JEA CFB under construction, preparing for commercial operation in March 2002

Chief among customer concerns was a desire to have affordable electric rates. An important secondary concern was a desire for less environmentally disruptive generation techniques. Unable to control rising fuel costs, JEA turned its attention to investing in more cost-efficient power generation technologies. The technology chosen was circulating fluidized-bed combustion (CFB), an innovative coal processing technology offering fuel diversity, additional cleaning systems (to an already-clean technology), and an environmentally responsible way to store the new fuel.

Prior to project initiation, the Northside Generating Station had two oil- and gas-fired boilers (Units 1 and 3) and another partially decommissioned unit that had not been functional for 15 years (Unit 2). The Northside Repowering Project includes design and construction of the world's first two nominal 300-MWe CFB boilers, a limestone preparation system, a material handling system, a by-product storage system, and an additional air quality control system. It also encompasses refurbishment of existing equipment such as steam turbines, condensate and feedwater systems, circulating water systems, water treatment systems, plant electrical distribution systems, control systems, and the switchyard.

JEA's Northside Generating Station's Units 1 and 2 will be repowered to function with identical new CFB combustors. Unit 3 will remain a gas- and oil-fired unit. The DOE cost-sharing agreement with JEA, providing almost $75 million (24 percent of total costs), is to offset costs of repowering the now inactive Unit 2 as one of two new units. It also includes two years of fuel

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...JEA continued

testing to demonstrate the ability to burn coal in a clean and efficient manner.

The project employs Foster Wheeler's patented CFB design, which achieves lower emissions by constantly circulating fuel mass and burning this mass at temperatures in the 1,500–1,700 °F range, which discourages formation of NO_x. Sulfur is absorbed by a solid sorbent (limestone) introduced into the lower part of the combustor. Each of the new boilers will be rated at 297.5 MWe, which is guaranteed by the vendor to be achieved on coal or petroleum coke. On coal, each boiler will consume slightly more that 105 tons per hour, plus enough pulverized limestone to capture the maximum amount of SO_2 within the furnace. Additional NO_x removal will be achieved by a selective, non-catalytic reduction (SNCR) system consisting of injection of an ammonia solution into the flue gas stream between the furnace and the cyclones.

Foster Wheeler's CFB design for JEA configures each furnace into three vertically separated zones with three cyclones affecting the solids separation from the flue gas. The solids are returned to the bottom of the furnace via three Foster Wheeler INTREX™ heat exchangers that serve as loop seals and finishing superheaters. After leaving the cyclone, the flue gas stream travels downward through the parallel backpass, where the flow is biased as required between superheat and reheat duty by means of dampers. The flue gas next passes through an economizer and exits the furnace through a combustion air preheater.

JEA has added two additional systems to the CFB technology. To further reduce sulfur oxides, an SO_2 absorption system will be added to each of the boilers, bringing total SO_2 removal to 98 percent. In addition, a new baghouse on each of the CFBs will remove over 99.8 percent of particulate emissions. Functioning together as the project's Air Quality Control System, these enhancements to the CFB boiler island will further reduce any environmental impact of the new units.

The SO_2 absorption system was designed for JEA/Foster Wheeler by Wheelabrator Air Pollution Control, Inc. This system contacts the flue gas with a lime slurry, which absorbs SO_2 in a 48-foot diameter by 118-foot high vertical tower. This provides about 12 seconds of concurrent flow. Finally, the flue gas passes through the fabric filter where particulates are removed and some final SO_2 removal is accomplished by a "better precoat" largely consisting of fugitive lime particles from the absorption step. Fly ash solids pulse-cleaned from the fabric filters are recycled to the polishing scrubber, and mixed with the fresh lime slurry that is prepared on site from purchased pebble lime.

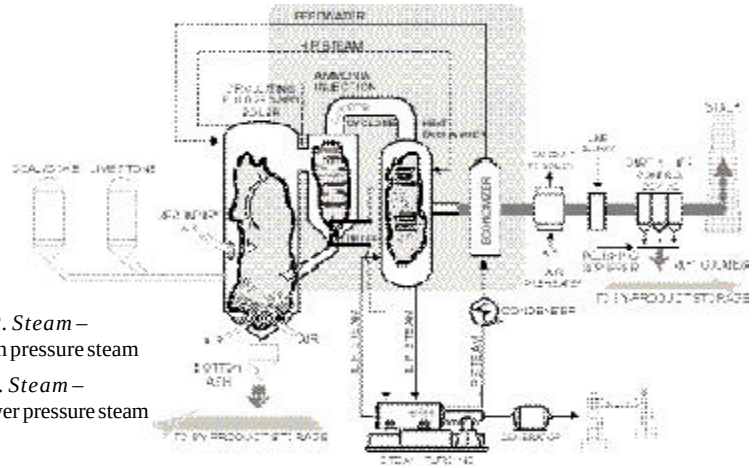
Following the fabric filter, the flue gas stream passes through the induced-draft fans, and then into a separate (for each CFB) 495-foot, 15-foot diameter flue contained within a single 480-foot concrete chimney. Continuous emission monitoring installations are contained within the chimney.

Fuel for the new CFB boilers will be delivered to the site via water, unloaded at a new fuel receiving dock, transported via a closed conveying system, and stored in two 400-ft diameter aluminum clad domes, each of which will hold 63,000 tons of as-delivered coal. These domes will not only increase energy efficiency by keeping the fuel dry, they will also serve to trap fugitive fuel dust that might otherwise become airborne particulates.

The new CFBs are expected to be base-loaded, and will increase the Northside Generating Station's generation capacity by 39 percent, and its base-load contribution by 250 percent. At the same time, the CFB technology coupled with JEA's additional environmental precautions will work to decrease overall plant emissions and groundwater consumption by 10 percent.

Construction began in August 1999. Unit 2 construction is scheduled for mechanical completion in July 2001, with first fire in October, and commercial operation in March 2002. Startup of Unit 1 is scheduled to follow in April 2002.

JEA Large-Scale CFB Combustion Demonstration Project



H.P. Steam –
High pressure steam

L.P. Steam –
Lower pressure steam

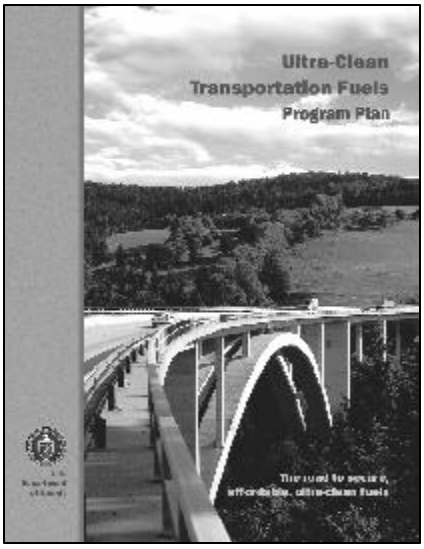
PROJECTS ADVANCE DEVELOPMENT OF ULTRA-CLEAN TRANSPORTATION FUELS

Responding to instability of fuel markets and increasingly stringent new vehicle emissions standards, the U.S. Department of Energy (DOE) initiated a research effort last year to develop improved, more economical ways to produce ultra-clean, low-sulfur fuels and better pollution control devices for cars and trucks. This Ultra-Clean Transportation Fuels (UCTF) Initiative is a combined effort of two DOE organizations — the Office of Fossil Energy (which focuses on fuel technologies) and the Office of Energy Efficiency and Renewable Energy (which is responsible for advanced engine development and vehicular emissions controls). The goal of the Initiative is to develop and deploy technologies that will produce ultra-clean burning transportation fuels from both petroleum and non-petroleum resources. These fuels will be processed alone or in combination with other hydrocarbon materials such as refinery wastes, municipal wastes, and biomass. They will enable vehicles to comply with future emissions requirements, be compatible with the existing liquid fuels infrastructure, and be cost-competitive with current fuels.

In December 2000, the U.S. Environmental Protection Agency (EPA) announced the toughest new standards ever for sulfur levels in gasoline, proposing that the average sulfur content be reduced to 30 parts per million, down from an average of nearly 300 parts per million. Sulfur in gasoline degrades the effectiveness of catalytic converters to reduce a variety of tailpipe emissions. Most refiners will have until 2006 to meet the new sulfur standard, although smaller refiners will have an extra two years. Engine manufacturers and refiners also have been challenged with meeting a new set of stringent emission standards for diesel fuels. The EPA published its new highway diesel rules in the *Federal Register* on January 18, 2001, which include a requirement to reduce the maximum sulfur standard for diesel fuel by 97 percent, from 500 parts per million to 15 parts per million, by mid-2006.

DOE issued the first solicitation of this new UCTF program on February 4, 2000, asking for proposals to develop advanced refining and fuel processing technologies that could help meet or exceed new emissions standards that would cut sulfur levels in transportation fuels by 90 percent. Also included in the solicitation was a request for proposals to design and test new types of pollution control devices for automobiles and trucks. The selection of eight project teams was announced on September 21, 2000. The selected projects have a total value of more that $176 million, with the industrial sponsors proposing that the federal government share just over $74 million of the costs.

One team, headed by EnviRes LLC (Somerville, NJ), will study an innovative concept to convert coal and petroleum coke into clean fuels. Negotiations are in progress between EnviRes LLC and DOE on development of the HyMelt® Process, a patented technology invented by Marathon Ashland Petroleum LLC and licensed to EnviRes LLC. This project will investigate the development of HyMelt® to produce large volumes of high-pressure, high-purity hydrogen from fossil fuels, such as petroleum coke, pitch, and coal, at a cost much lower than conventional production methods used in today's oil refining industry. HyMelt® also produces a carbon monoxide-rich stream that may be used as a clean fuel substitute for natural gas in the production of



electricity via an integrated gasification combined-cycle mode of operation.

Three other teams — headed by Praxair (Tonawanda, NY), Conoco (Houston, TX), and Integrated Concepts and Research Corporation (Alexandria, VA)/Syntroleum (Tulsa, OK) — will pursue a natural gas-to-liquids approach. In recent contract negotiations, Conoco outlined how to develop and commercialize innovative solutions for U.S. and global stranded natural gas reserves. Under the partnership with DOE, Conoco plans to rapidly build on the Fischer-Tropsch liquids, methanol, and DME databases to integrate liquid phase methanol with its CoPox process.

Another three teams — Phillips Petroleum Co. (Bartlesville, OK); Petro Star, Inc. (Anchorage, AK); and Research Triangle Institute (Research Triangle Park, NC) — will lead development efforts on new refining processes that remove sulfur pollutants from crude oil. The eighth winning project, proposed by Ford Motor Company, Dearborn, Michigan, will focus on a new type of emission control system for future automobiles and trucks. The system will employ a chemical process that captures smog-forming nitrogen ox-

See "Ultra-Clean" on page 4...

...Ultra-Clean continued

ides from the exhausts of internal combustion engines. On January 4, 2001, DOE received additional industry proposals under a second round of the solicitation, which currently are being evaluated.

DOE also selected eight new projects from the National Laboratory Partnership, an affiliation of DOE National Laboratories that promotes technical collaborations with industry and academia. Proposals were selected from Sandia, Oak Ridge, Idaho, and Argonne National Laboratories for 3-year research efforts to develop a range of new ultra-clean fuels. One Sandia project will develop improved hydroprocessing catalysts for producing ultra-clean transportation fuels. The catalysts will be tested using actual refinery feedstocks. Sandia also will develop and evaluate a new class of hybrid organic-inorganic membranes designed to remove carbon dioxide and other impurities from syngas before it is used in the preparation of low-sulfur fuels. A third Sandia project will develop an on-line monitor that can provide real time information on the concentrations of key sulfur species in fuels. Oak Ridge will determine the effectiveness of inorganic membranes applied to petroleum refinery catalytic cracker recycle gas in the production of hydrogen, and will develop ionic liquids to remove contaminants from natural gas, gasoline, and diesel fuels. Removal of sulfur from gasoline and diesel fuel, and separation of CO_2 from natural gas will be primary targets of this project. Idaho will conduct another project to develop an economical solid acid alkylation petroleum refinery process using supercritical fluid regeneration. It also will evaluate ion conducting ceramic membrane reactors for syngas production. Argonne will study how blended diesel fuels (such as diesel with ethanol) compare with petroleum-based diesel fuels in spray combustion characteristics and in pollutant formation.

A second phase of the UCTF Program proceeded with three pre-solicitation workshops held around the country in February. The goal was to obtain industry input on the final solicitation for Supporting Science and Enabling Technologies for Clean Fuels.

For a copy of the overall program strategy, *UCTF Program Plan*, go to: http://www.fe.doe.gov/coal_power/fuels/plan/01/index.html.

Attendees at the February 2001 UCTF Workshop in Pittsburgh, Pennsylvania

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...News Bytes continued

reports; and environmental guidance. Selections are anticipated by late August, with cooperative agreements to be negotiated by February 2002.

Two new **Post Project Assessments** are available on the Clean Coal Technology (CCT) Compendium. From the Fossil Energy web site (www.fe.doe.gov), click on Coal & Power and then click on CCT Compendium. The *Development of the Coal Quality Expert™* project is discussed, addressing a software tool for utilities and coal producers that is able to predict impacts of coal quality, capital improvements, operational changes, and environmental compliance alternatives on power plant emissions, performance, and production costs. The *Full-Scale Demonstration of a Low-NO_x Cell Burner Retrofit* Project Assessment discusses the capabilities of achieving a 50 percent NO_x reduction without degradation of boiler performance, and at lower cost than conventional low-NO_x burners. Fourteen other CCT Post Project Assessments are available on the same web site.

According to the **Industrial Commission of North Dakota**, three companies — Great River Energy, Montana-Dakota Utilities Co., and Westmoreland Power, Inc. — have submitted applications for matching funds available under the North Dakota Lignite Research, Development, and Marketing Program for the development of a 500-MWe Lignite Vision 21 Project. The Commission is partnering with the Lignite Energy Council, a state/industry partnership, to encourage construction of one or more state-of-the-art baseload power plants in North Dakota, to be available in the 2008–2010 time frame. Proposals will go before the Commission in the spring, after undergoing peer review and consideration by the Lignite Energy Council. For further information, contact Karlene K. Fine (kfine@state.nd.us).

DOE STAYS AHEAD OF MERCURY REGULATION MOMENTUM

Following many months of expectation, the U.S. Environmental Protection Agency (EPA) announced its decision in December 2000 to regulate mercury emissions from coal-fired power plants. The EPA will propose mercury regulations by 2003 and issue final rules by 2004 in an effort to curb mercury emissions from what it cites as the single largest source of mercury emissions in the United States. However, this pending regulation has not caught the U.S. Department of Energy (DOE) off-guard. In fact, the DOE Office of Fossil Energy (FE) has had an active mercury program since 1990 (see *Clean Coal Today*, Summer 2000). FE's National Energy Technology Laboratory (NETL) issued a solicitation in January 2000 offering up to $13 million over three years for industry proposals on cost-cutting mercury control methods for coal-based power systems. This program includes cost-sharing of 33 percent for large-scale demonstrations and 20 percent for pilot plant testing.

As part of an ongoing collaboration with the EPA to study and evaluate mercury control options for coal-fired power plants, NETL had performed a technical evaluation of commercial emission control technologies and emerging technologies using the NETL Mercury Control Performance and Cost Model (MCPCM). Data generated from the model provided input into EPA's regulatory determination process for mercury emissions. NETL used its model to calculate the costs of mercury control for 12 different coal-fired plant configurations, such as those having wet scrubbers, fabric filters, spray dryers, and electrostatic precipitators, representing all coal-fired plants throughout the country. To further ensure validity, NETL compared its data against similar data from pilot-scale tests and from Electric Power Research Institute estimations. The final NETL report served as a source of unbiased data for the EPA regulatory determination process.

Underlying the complexity of the issues surrounding mercury emissions, DOE notes that no single technology exists today that can uniformly control mercury emissions effectively from all plant configurations, coal types, and types of existing flue gas controls used for other pollutant control. Effectiveness varies considerably from plant to plant, or even from boiler to boiler. With present technologies, mercury removal can range from essentially no control to as high as 90 percent. The DOE goal is to develop more effective options that will cut mercury emissions 50-70 percent by 2005 and 90 percent by 2010, at one-quarter to one-half of current cost estimates.

The Zimmer Station facility, near Cincinnati, Ohio, where Babcock & Wilcox will demonstrate a cost-effective mercury removal system

Over the past 10 years, DOE has been sponsoring studies on mercury emissions from coal-based power generators to identify effective and economical control options. These studies include mercury removal from flue gas by enhancing conventional pollution controls, applying combustion modifications, and developing advanced control methods. The present FE program builds on past DOE and other R&D organizations' mercury measurement and control efforts, by conducting tests of the most promising methods at a scale large enough to assess the environmental, economic, and operational performance in commercial applications.

Through proposals submitted in response to the solicitation, DOE intends to assess:

- Mercury removal by promising control technologies in large-scale tests at three incremental levels above the baseline up to the maximum removal possible;
- The applicability of mercury control technologies to multiple power plant configurations including electrostatic precipitators, baghouses, and fabric filters;
- The possible negative and positive impacts to the overall operation of the power plant (including impacts on by-product sales, and waste disposal);
- Accurate capital and operational cost(s) at different mercury removal levels over a specified performance period;
- The greatest amount of mercury removed at the least total cost per pound of mercury removed; and
- Effective sequestration of the captured mercury in various by-products and waste material.

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...Mercury continued

In addition, DOE will evaluate controls that remove mercury along with other pollutants, including but not limited to sulfur trioxide, carbon dioxide, nitrous oxides, and hydrogen chloride. In all, the DOE goal is to ensure timely development of the most cost-effective pollution control technologies that could be installed under EPA's regulation of mercury and other hazardous air pollutants from coal-burning utilities.

TWO AWARDS

Two projects were awarded under the solicitation in September 2000 for large-scale field-testing. In one project, Babcock and Wilcox Company will demonstrate a cost-effective mercury removal system with its research affiliate McDermott Technology, Inc. The technology, expected to be applicable to coal-fired power plants equipped with wet scrubbers, will be tested at full scale at two sites: Michigan South Central Power Agency's 55-MW Endicott Station in Litchfield, Michigan, and Cinergy Corporation's 1,300-MW Zimmer Station near Cincinnati, Ohio. The Babcock and Wilcox/McDermott technology adds very small amounts of a liquid reagent to the scrubbing solution to attain its target of 90 percent mercury removal at costs one-half to one-fourth of those of today's commercially available activated carbon mercury removal methods. The project began in October 2000, and will last for 18 months. It is estimated to cost $1.75 million, with $1.2 million provided by DOE. The project team includes the two utilities that will host the tests and the Ohio Coal Development Office. If the project proves successful, Babcock and Wilcox will offer mercury control technology for commercial use in both new and existing wet flue gas scrubber systems.

Under the second award, ADA Environmental Solutions will develop a portable system that will be moved to four different utility power plants for field tests. Each of the plants is equipped with either electrostatic precipitators or fabric filters to remove solid particles from the plant's flue gas. ADA's technology includes the injection of a dry sorbent, such as fly ash or activated carbon, which adheres to mercury and enables capture by the particulate control devices. A fine water mist may be sprayed into the flue gas to cool its temperature to the range where the dry sorbent is more effective. Because cooling flue gas can increase the formation of corrosive sulfur trioxide, ADA's technology also includes a reagent injection system to control the buildup of sulfur trioxide if needed.

PG&E Generating is providing two ADA test sites (Salem Harbor and Brayton Point) that fire bituminous coals, both equipped with electrostatic precipitators and carbon/ash separation systems. Wisconsin Electric Power Company is providing a third test site (Pleasant Prairie) that burns Powder River Basin coal and has an electrostatic precipitator for particulate control. The fourth test site is Southern Company's Gaston plant, equipped with a fabric filter and Compact Hybrid Particulate Collector, and presently burning a low-sulfur bituminous coal. The 36-month project will receive $4.5 million from DOE. ADA Environmental Solutions and an 11-organization support team will provide an additional $2.2 million.

BUILDING ON PREVIOUS ACCOMPLISHMENTS

The new FE mercury program includes in-house NETL research that will build on results of over a dozen previous projects, ranging from electrostatic precipitator development for air toxics control, to vapor phase recovery, predicting distribution and fate of mercury, and sorbent research. The in-house R&D utilizes a laboratory-scale packed-bed reactor system and a pilot-scale coal combustion unit that mimics a utility boiler and includes a furnace, air preheater, and ancillary flue gas cleanup equipment. Most recently, a series of tests have been conducted on this unit to initiate operation of a sorbent injection system and obtain results on mercury removal with dry sorbent injection. Significant interaction between these two experimental units is planned for the future, with promising sorbent identified in the laboratory-scale system being evaluated in the pilot unit.

Such past activities, coupled with projects in development under the latest solicitation, have shown that more than the traditional option (activated carbon) will be acceptable for high mercury removal levels, at much lower costs than previously estimated. These new technologies will become available through both DOE's commitment to fundamental mercury research to better understand the mercury transformation mechanisms, and actual field tests of proven pilot-scale mercury removal processes.

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R&D MILESTONES

FE's Advanced Turbine System (ATS) Program receives two Department of Energy awards. A panel of citizen judges awarded the National Energy Technology Laboratory both "Bright Lights" and "Energy @23" awards for contributions to the American consumer and to innovation. The 1999/2000 Bright Lights awards panel chose five consumer-oriented innovations from 23 DOE-wide nominations. Energy @23 awards, which were chosen from a list of 100 scientific and technical innovations at DOE between 1977 and 2000, also went to FE/NETL for low-NO_x burner and atmospheric fluidized-bed combustion technologies. Abbie Layne, manager of the ATS program, accepted the Bright Lights award at a January White House ceremony. Specifically, the award noted the potential of the ATS program to reduce electricity prices by 10 percent. The program is focused on developing systems that are cleaner, more efficient, and less expensive to operate than existing turbines.

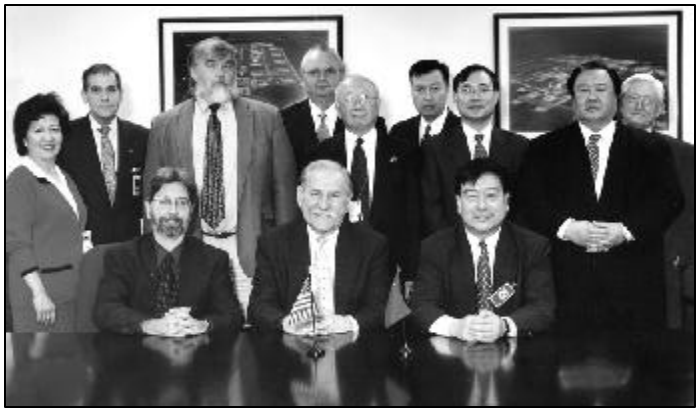
AEP funds first demonstration of pollution control technology based on FE-sponsored research. The nation's largest utility, American Electric Power (AEP), will finance the first commercial demonstration of ThermaloNO$_x$™ – a NO_x reducing device developed by Thermal Energy International, Inc. The initial underpinning research was performed by Lawrence Berkeley National Laboratory, working for FE. ThermaloNO$_x$™ is a phosphorus injection process that removes 75 percent or more of NO_x emissions from power plant exhaust gases, and will be outfitted at AEP's 375-MW unit in Conesville, Ohio. Also at Conesville, DOE and the Ohio Coal Development Office, along with AEP and Alstom Power, are conducting the first U.S. utility study on the economics of CO_2 capture involving an operating plant. The study will evaluate three conceptual retrofit schemes for capturing CO_2: coal combustion in air with a CO_2 separation system, coal combustion in O_2/flue gas mixture without CO_2 separation system, and coal combustion in air with oxygen removal and CO_2 separation by tertiary amines. Impacts on existing boilers, components, overall plant performance, and costs (especially the cost of electricity) will be evaluated.

NETL researchers make advances in mercury speciation and control techniques. Using the on-site 500 pound-per-hour pulverized-coal combustion facility, NETL researchers are investigating the distribution, fate, and control of hazardous air pollutants, particularly mercury. Researchers conducted a series of tests using activated carbon injection into the flue gas ductwork to control mercury levels. Researchers also quantified the impact on mercury removal of such parameters as temperature and carbon-to-mercury ratio. Additionally, three sampling methods for measuring the concentration of mercury species in flue gas were compared: the ASTM draft mercury speciation (Ontario-Hydro) method (a wet chemical technique); a continuous emissions monitor from PS Analytical Ltd; and a solid sorbent technique examined under a CRADA with Frontier Geosciences, Inc. Results from both the continuous emissions monitor and the solid sorbent technique compared favorably to those from the standard Ontario-Hydro method. In contrast to the standard method, both the continuous emissions monitor and the solid sorbent technique offered some advantages in terms of ease of sampling and availability of results. The accessibility of a reliable continuous emissions monitor for determining total mercury and speciated mercury will be critical to the development of control processes that reduce mercury emissions.

In December 2000, ZeTek Power opened a Wartburg, Tennessee plant to produce a fuel cell device originally developed under DOE Office of Fossil Energy Materials Program. The carbon fiber composite molecular sieve, developed by researchers at Oak Ridge National Laboratory, removes CO_2 from air entering alkaline fuel cells. The new electrical swing adsorption technique takes advantage of the electrically conductive nature of the molecular sieves. The electrical conduction arises from the contact provided between the carbon fibers that have been treated with phenolic resin. Separation of gases is achieved by swinging the electrical voltage. Separation of gases is achieved by swinging the electrical voltage. Even minute amounts of CO_2 can poison the electrolyte, thereby inhibiting proper operation of the fuel cell.

INTERNATIONAL INITIATIVES

TWO MAJOR CONFERENCES IN CHINA UNDER DOE-MOST PROTOCOL



In attendance at the December 2000 annex signing were: Seated L-R – Guido De Horatiis, DOE-FE; Robert Kripowicz, DOE-FE; Shi Dinhuan, MOST; Standing L-R – Margaret Lou, NPTO; Peter Jodoin, DOE-IA; James Ekmann, NETL; George Rudins, DOE-FE; Sun Chun, NETL; Vic Der, DOE-FE; Zheng Fangnen, MOST; Ken Hong, DOE-FE; and C. Lowell Miller, DOE-FE.

Several important international fossil energy-related annexes addressing power systems, energy and environmental technology, climate change, and oil and gas have been formalized to carry out the protocols signed in April 2000 (see Summer 2000 issue of *Clean Coal Today*). Signing took place in December 2000 when Shi Dinhuan, Director General of the Department of High-Tech Development and Industrialization, part of the China Ministry of Science and Technology (MOST), visited Washington, DC. On the U.S. end, the power systems, environmental technology, and oil/gas annexes are administered by DOE's Office of Fossil Energy, while the climate change annex will be managed by the Office of Science. The annexes will promote cooperation and information exchange, and possibly joint R&D activities in their respective areas.

Late last year, two conferences were announced to be carried out under the protocols. The First U.S.-China Symposium on CO_2 Emission Control Science and Technology is scheduled for August 22–24, 2001, in Hangzhou. The conference, sponsored by the U.S. Department of Energy and MOST, will be organized by Zhejiang University. The U.S./China Energy and Environmental Technology Center (EETC), an organization created in 1997 to enhance competitiveness and adoption of U.S. clean energy and environmental technologies, will provide technical and coordinating support. Conference topics include international perspectives on CO_2 emissions control, high efficiency conversion technologies, advanced CO_2 sequestration technologies, and renewable energy technologies for CO_2 control.

The second conference, the first U.S./China Clean Energy Technology Forum and Exhibition, will take place August 29–September 1, 2001, in Beijing. The conference is sponsored by the Department of Energy Offices of Fossil Energy and Energy Efficiency and Renewable Energy, along with MOST. The EETC and Pan-China Technology Investment Consulting Co., Ltd., will organize the conference. The forum is intended to advance technological exchanges among private industry, government agencies, research institutions, and universities from both countries, particularly in the areas of clean coal technologies and natural gas. Sessions include power systems, clean fuels, oil and gas, and environmental control technologies.

For information on the CO_2 conference, see http://www.ceee.zju.edu.cn, while the Clean Energy Technology site is http://www.88event.com. Dr. Sun W. Chun, Senior Executive Advisor, International Affairs (chun@netl.doe.gov), is the FE co-chair for both conferences. FE is actively seeking U.S. exhibitors for the conferences.

FE-NETL PROVIDES TRAINING FOR INDIAN POWER PLANT MANAGERS

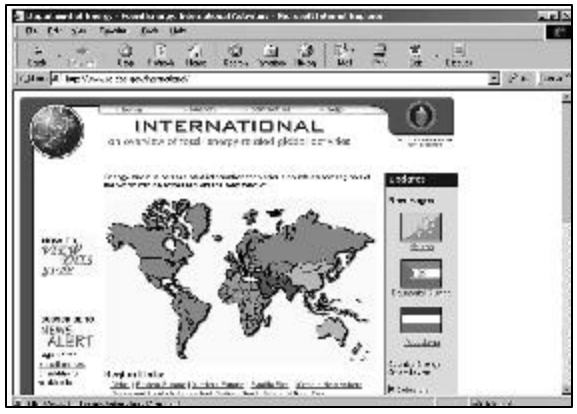
Under an agreement with the U.S. Agency for International Development (USAID) and the Government of India, the DOE Office of Fossil Energy's (FE) National Energy Technology Laboratory (NETL) has been participating in the Greenhouse Gas Pollution Prevention Project (GEP) designed to improve the efficiency of existing coal-fired power plants, utilize environmental controls, and implement advanced generating technologies at future Indian coal-fired power plants. As part of the Efficient Power Generation component of the GEP, NETL sponsored two training workshops in January and February 2001 in New Delhi, India. "Availability and Reliability Improvement Through Predictive Diagnostic Maintenance" took place on January 26–February 10, 2001, and "Fireside Performance Optimization/Emissions Control and Monitoring on Air Preheaters" was held February 18–28, 2001, with some 35 power plant managers in attendance at each workshop. The continuing series of workshops supported by FE is aimed at special areas of power plant improvement, and represents an excellent opportunity for U.S. industry to share expertise with their Indian counterparts.

Discussions focused on acoustic predictive diagnostics maintenance, which is non-intrusive and capable of assessing metal fatigue and vibration problems. Present use of ultrasonic methods in India has been limited to testing for cracks and gauging thickness, with some expansion to evaluating switchyards and transformers, and detecting electrical faults. Falcon Solutions, Inc., of West Chester, Pennsylvania, provided the specialized hands-on training, which included classroom sessions and demonstrations at a local power plant on theory and applications of acoustic techniques for plant efficiency improvement and fault diagnosis. On-site demonstrations and training with 5550 Fault Detector and Ultraprobe 2000 equipment were emphasized.

The second workshop, taught by India's National Thermal Power Corporation Power Management Institute, and the Engineering Research Center of Lehigh University, was geared toward methodologies for fire-side optimization, environmental improvements, and perfecting preheater performance. The class explored methods for reducing fuel consumption through combustion optimization, with the corresponding drop in CO_2 emissions. Training included hands-on work on air preheaters at the Badapur Power Plant. The air preheaters were monitored using new equipment, while measurements were taken and adjustments made, as taught in class.

DOE FOSSIL ENERGY INTERNATIONAL WORLD WIDE WEB SITE

The DOE Fossil Energy International site on the World Wide Web (http://www.fe.doe.gov/international) has been steadily gaining in visibility over the past three years. This site has been in existence since 1996, with the original intent of providing a business-related information resource for U.S. exporters and project developers — a "one-stop" information resource for anybody wanting to do business in the international marketplace. Lately, however, the web site has also seen use by a more diverse user base, including students, researchers, and non-energy-related businesses; in all, the site currently logs nearly 400 non-DOE visitors per day.



There are now more than 125 country pages online at the web site, plus more than 20 "Country Energy Overviews," which provide a more comprehensive look at energy generation, transmission, and usage for individual countries. In particular, these Overviews have proven to be very popular with web site visitors, and more will be added over the next few years. News alerts about site updates are provided to individuals who register as subscribers at the web site.

SECA SEEKS TO ACCELERATE FUEL CELL COMMERCIALIZATION

In June 2000, a unique public/private sector partnership, the Solid State Energy Conversion Alliance (SECA), launched an initiative to develop a next generation solid state fuel cell offering not only characteristically high efficiency, but low capital cost.

The SECA focus is on development of high-power-density, solid-oxide fuel cell systems compatible with a range of applications. In order to drive the cost of the fuel cell systems lower, SECA will simultaneously address small and large applications through a "mass customization" approach. Mass customization addresses the "chicken and egg" problem of needing high volume manufacturing to achieve low cost, and needing low cost to achieve high volume manufacturing. By producing a solid-oxide fuel cell system that addresses multiple markets with a common core module, the high volume needed for low cost should be achievable. The basic building block will be a mass-produced 3- to 10-kW solid state fuel cell module that can be combined like batteries to meet larger power needs. Target sectors include stationary, mobile, and military applications. Specific goals are to have fully functional 3- to 10-kW prototypes within four years at a capital cost of $800/kW, with costs dropping to $600/kW by 2008, and to $400/kW by 2011.

The stage for low-cost solid-oxide fuel cell technology has been set. Breakthroughs in ceramic materials, fuel cell design, and manufacturing technology are converging. These include advances in thin-film technology with solid-oxide fuel cell materials; high power density enabling innovations, such as anode supported cells; advances in fuel processing technology; and integration of manufacturing technology from related industries, such as the semi-conductor industry. The formation of SECA arises from: the technology needs created by the advent of distributed generation, driven by electric utility deregulation; climate change; environmental regulation; more efficient use of fossil energy; and the future use of hydrogen from renewable energy sources.

To effectively leverage the technology gains and market forces, SECA applies a new model for joint government and private industry technology development. The structure of SECA is designed to more closely tie R&D efforts by the government to commercialization efforts by private industry, motivate industry participation by protecting intellectual property while ensuring R&D technology transfer, and leverage resources across federal agencies.

The essence of SECA's organization is integration of a core crosscutting technology program (universities, National Laboratories, and other research-oriented organizations) with industry development team efforts to design and produce commercial systems. The core technology research to address fundamental barriers is made available to the industry teams, and the industry teams provide input to core technology research direction. Industry teams are to be selected through competitive solicitations for cost-shared cooperative agreements. Commercialization decisions to meet market requirements remain the purview of the development teams, with intellectual property protection provided by virtue of their meeting cost-sharing requirements.

The Alliance is coordinated by the National Energy Technology Laboratory and the Pacific Northwest National Laboratory. A government management team will closely coordinate industry teams, with the research and development component managed by the government. In April 2001, DOE is scheduled to select industry teams to begin implementation, as well as issue a solicitation for proposals under the Core Technology Program.

Hybrid fuel cell/gas turbine conceptual studies are planned in Fiscal Year (FY) 2003 through a competitive SECA solicitation. Following the conceptual studies, industry teams will be selected in FY 2004 to develop hybrid fuel cell systems, with efficiencies greater than 70 percent for large distributed generation and central generation applications utilizing SECA technology in support of Vision 21.

While initial efforts will use natural gas, gasoline, and diesel as the fuels, SECA systems also offer a linkage to coal. High-temperature solid state fuel cells are compatible with the temperatures and chemical composition of synthesis gas derived from coal gasification. The marriage of these two Vision 21 enabling technologies supports Vision 21 goals of near-zero emissions and 60 percent efficiency for coal-based systems.

The fundamental low cost of the high-power-density solid oxide fuel cell systems should be a significant boost to the bottom-line economics of both fuel cell/turbine hybrids and gasification technologies. Compatibility with coal-derived synthesis gas supports U.S. energy security goals, and the performance essentially eliminates environmental concerns over fossil fuel use in fuel cells.

UPCOMING EVENTS

May 14–17, 2001
First National Conference on Carbon Sequestration
Location: Washington, DC
Sponsor: DOE/NETL
Contact: Kim Yavorsky
Phone: 412-386-6044
E-mail: Kimberly.Yavorsky@netl.doe.gov

May 15–16, 2001
Unburned Carbon on Utility Fly Ash Conference
Location: Pittsburgh, PA
Sponsor: DOE/NETL
Contact: Kim Yavorsky
Phone: 412-386-6044
E-mail: Kimberly.Yavorsky@netl.doe.gov

May 16–18, 2001
Selective Catalytic and Non-Catalytic Reduction Conference
Location: Pittsburgh, PA
Sponsor: DOE/NETL
Contact: Kim Yavorsky
Phone: 412-386-6044
E-mail: Kimberly.Yavorsky@netl.doe.gov

May 21–25, 2001
Conference on Hybrid Power Systems; and 3rd International Colloquium and Exhibit on Environmentally Preferred Advanced Power Generation
Location: Newport Beach, CA
Sponsors: DOE, United Nations
Contact: Jeff Wojciechowski
Phone: 949-824-1999, ext. 115

August 20–24, 2001
Combined Power Plant Air Pollution Control Symposium "The Mega Symposium"
Location: Chicago, IL
Sponsors: EPA, DOE, EPRI
Contact: Denise Stotler
Phone: 412-232-3444, ext. 3111

September 30–October 5, 2001
11th International Conference on Coal Science
Location: San Francisco, CA
Sponsor: DOE/NETL, IEA, USGS, and ACS, among others
Contact: Karen Lockhart
Phone: 412-386-4763

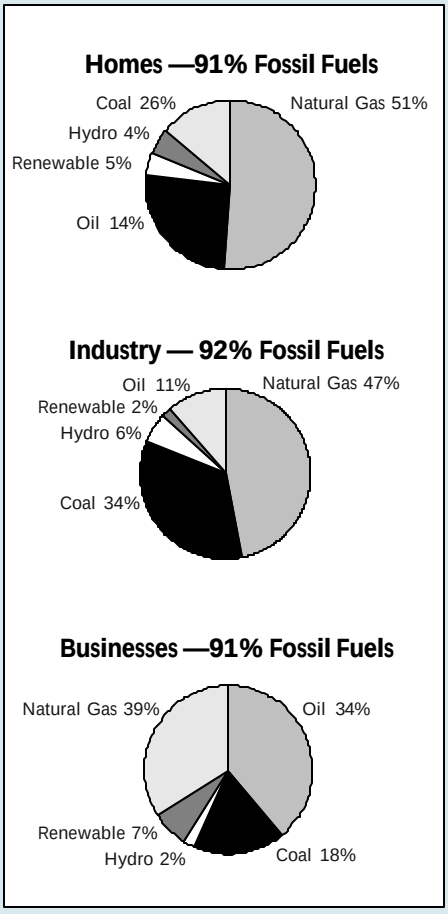
LATEST EIA COAL FACTS

DOE Energy Information Administration (EIA) figures, published recently in the *Annual Energy Outlook 2001*, point to a continued strategic role for fossil fuels and coal in the U.S. economy. According to the EIA, the transportation sector was fueled by 100 percent fossil fuels; industry, 92 percent; both the home and business sectors, 91 percent; and the electricity sector, 68 percent. Coal is responsible for 54 percent of U.S. electric power generation capacity with nuclear, 20 percent; natural gas, 11 percent; hydro, 10 percent; oil, 3 percent; and renewables, 2 percent. For homes, industry, and business, coal's contribution to total energy use is 26 percent, 34 percent, and 18 percent, respectively (see pie charts). EIA also projects a modest increase in overall coal consumption through 2020 (about 1 percent annual change), as well as a steady increase in coal consumption for electricity production through 2010, from 1,035 million tons in 1999 to 1,297 million tons in 2020.

In spite of widespread coal use, the Office of Fossil Energy has achieved continuously declining rates of SO_2, NO_x, and PM_{10} emissions from coal fired utilities, from 1970 through 1998. The efficient and environmentally conscious use of coal will be supported in part by Fossil Energy's RD&D program, which will address three key areas over the next 15 years. The Fossil Energy coal technology RD&D plans call for the following.

- By 2005: Apply environmental control and efficiency improvement technologies to existing fleets. The goals are to lower cost, increase efficiency, and improve environmental performance.
- By 2010: Develop next-generation gasification, advanced combustion systems, improved materials, and advanced sensors and controls for repowering and retrofits of existing plants.
- By 2020: Apply gas separation, CO_2 capture, fuel cells, advanced turbines, and novel gasifiers in Vision 21 integrated energy plants and carbon sequestration technologies.

For more information, check EIA's web site at http://www.eia.doe.gov (see "Featured Publications").



COAL, TIRES, AND SAWDUST MOVE TRI-FIRING CONCEPT FORWARD

Willow Island generating station in Pleasants County, West Virginia

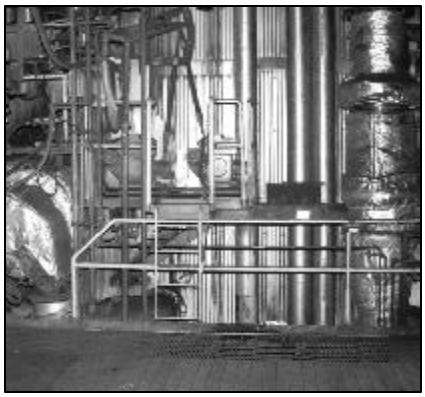
Tri-firing, and attendant emissions reductions, will be given a push under a Cooperative Agreement recently awarded by the U.S. Department of Energy (DOE) to Allegheny Energy Supply, LLC entitled *Blending Biomass with Tire-Derived Fuel (TDF) for Firing at the Willow Island (West Virginia) Generating Station*. Sawdust will be mixed with shredded tires to form a new "designer" opportunity fuel to be cofired with coal. Tri-firing has been successfully demonstrated with wood waste, petroleum coke, and coal. The use of more than one fuel allows blending to optimize beneficial impacts of cofiring. While many biomass feedstocks offer important advantages, such as low sulfur, nitrogen, and ash contents and high volatility, some disadvantages include the lower heating value, and the higher moisture content of biomass fuels compared to baseline coals. However, these biomass characteristics can be synergistically combined with other feedstocks, for example, in tri-firing concepts with TDF, which have higher heating values than baseline coals.

The award was one of 11 projects selected last summer under a solicitation funded by the DOE Office of Energy Efficiency and Renewable Energy's (EERE) Biomass Power Program, where the DOE Office of Fossil Energy (FE), National Energy Technology Laboratory (NETL) is providing management and technical support. The 11 awards cover a range of study areas including feasibility assessments, modeling, experimental R&D, and full-scale demonstrations for cofiring concepts in coal-fired utility and industrial boilers. The awards target pulverized coal, cyclone, circulating fluidized-bed, and industrial stoker boilers, and include a variety of biomass injection concepts ranging from fuel blends to novel schemes involving biomass gasification.

Under the Cooperative Agreement, the Allegheny Energy biomass tri-firing project will receive $2.97 million from DOE, while industry participants (including Allegheny Energy, Foster Wheeler, Reaction Engineering International, and Cofiring Alternatives) will provide nearly $4 million in cost-sharing. The three-year project will adapt the cyclone boiler at the 188-MWe Willow Island Unit No. 2 to cofire sawdust with coal and TDF, reducing fuel costs and nitrogen oxide emissions. The new projects will expand upon the success of earlier biomass cofiring activities initiated and supported by FE (see *Clean Coal Today*, Spring 2000, Winter 1998, and Fall 1998).

DOE's cofiring activities have been driven by the diverse interests of biomass stakeholders and the coal-fired boiler industry. Incentives include: addressing possible future greenhouse gas or renewable energy portfolio regulations; developing "green" pricing programs; assisting regional biomass development near utility stations; providing improved solid waste disposal options; further reducing SO_2 and NO_x emissions; and providing overall strategies to increase capacity and reduce costs. Although some utility cofiring is practiced in the United States and abroad, there is an ongoing need to establish long-term reliability and improve economics through process optimization. Major issues include biomass fuel handling equipment and fireside impacts, such as carbon burn-out, ash fouling, ash disposal, NO_x behavior, and other flue gas emissions. DOE recognizes that biomass cofiring must be supported by coal-fired utilities and innovative partnering with biomass stakeholders. Such partnerships will aim to reduce risk and address stringent environmental regulations under an increasingly cost-competitive environment brought about by utility deregulation.

A variety of techniques will be used to demonstrate tri-firing as an emissions reduction technique at Willow Island. Unit No. 2 is operated in a pressurized mode and



Boiler and cyclone in Willow Island Unit No. 2

equipped with a hot side electrostatic precipitator. The potassium and sodium content of biomass ash may obviate the need for sodium additives generally used to enhance the resistivity of flyash particles. The cyclone boiler also has a separate overfire air system for reducing NO_x, and substituting biomass fuels in place of coal reduces SO_2 and CO_2, as well

as heavy metal emissions. Cofiring with wood and other biomass creates a mechanism for NO_x reduction due to high fuel volatility of the biomass in the coal-fired flame region.

These results, focusing upon NO_x reduction achieved by sawdust cofiring, will be compared to results of a 150-MWe tangentially fired pulverized coal (PC) boiler at the Albright Generating Station, in West Virginia, operating under an industry cost-shared demonstration project through a DOE/EPRI Cooperative Agreement. The Albright boiler also is equipped with a separated overfire air (SOFA) system and uses sawdust of similar characteristics. Some 720 hours of testing will determine the interrelationships between cofiring and an SOFA system, where comparative impacts on NO_x, SO_2, and CO_2 emissions will be determined. Testing also will determine detailed characteristics of the biomass fuel (including handling and preparation of fuel), and the emissions consequences associated with cofiring at a level comparable to that being demonstrated at Willow Island.

Tire dumps continue to pose environmental, health, and safety concerns in the United States, with hundreds of millions of scrap tires already stockpiled. With a resource of this size, which continues to grow annually, not only can the use of scrap tires as TDF be beneficial in terms of reducing needed landfill space, it represents a significant source of potential energy. In certain regions of the United States, the high landfill "tipping fee" for scrap tires (in the range of $50–100+/ton) is several times that of the average scrap tire waste disposal cost (about $28/ton), providing an incentive to use TDF as an opportunity fuel blend feedstock to reduce the cost of power generation.

Modifications are under way, and testing at Willow Island and Albright is expected to begin this spring. The following is a list of awards under the solicitation.

BIOMASS COFIRING OPPORTUNITIES AWARDS

- *Blending Biomass with Tire-Derived Fuel for Firing at the Willow Island Generating Station* — Allegheny Energy Supply, LLC, Foster Wheeler, Reaction Engineering International, and Cofiring Alternatives
- *Development of a Validated Model for Use in Minimizing NO_x Emissions and Maximizing Carbon Utilization When Cofiring Biomass with Coal* — Southern Research Institute, Southern Company Services, Niksa Energy Associates, Reaction Engineering International, and General *Bioenergy
- *Gasification-Based Biomass Cofiring Project* — Nexant LLC, Primenergy LLC, and Western Kentucky Energy
- *Calla Energy Biomass Gasification Cofiring Project* — Gas Technology Institute; Calla Energy Partners, LLC; Parsons Infrastructure & Technology Group; and Nexant LLC
- *Urban Wood/Coal Cofiring in the NIOSH Boilerplant* — University of Pittsburgh, National Institute of Occupational Safety and Health, J.A. Rutter Company, Emery Tree Service, and Energy Systems Associates
- *Urban Wood/Coal Cofiring in the Bellefield Boilerplant* — University of Pittsburgh, J.A. Rutter Company, Emery Tree Service, and Energy Systems Associates
- *Cofiring Biomass with Lignite Coal* — Energy and Environmental Research Center, North Dakota Department of Corrections and Rehabilitation, North Dakota Department of Community Services, King Coal Furnace Corporation, and K.J. Schwartz Engineering
- *Cofiring Biomass at the University of North Dakota* — University of North Dakota, Energy and Environmental Research Center, and North Dakota Department of Community Services
- *Feasibility Analysis for Installing a Circulating Fluidized-Bed Boiler for Cofiring Multiple Biofuels and Other Wastes with Coal at Penn State University* — Pennsylvania State University, Foster Wheeler Energy Corporation, Foster Wheeler Development Corporation, and Cofiring Alternatives
- *Fuel Lean Biomass Reburning in Coal-Fired Boilers* — Iowa State University, Energy Systems Associates, and Oak Ridge National Laboratories
- *Cofiring Coal: Feedlot and Litter Biomass Fuels in a Pulverized Fuel and Fixed Bed Burners* — Texas A&M University, and State of Texas Advanced Technology Program

STATUS OF ACTIVE CCT DEMONSTRATION PROJECTS

ENVIRONMENTAL CONTROL DEVICES

Southern Company Services, Inc. – *Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler.* All testing on the original project has been completed and reported. Phase 4 has been extended 19 months to evaluate use of GNOCIS and other computer programs to decrease NO_x and LOI and increase efficiency by optimizing the use of additional plant equipment, including ESPs and sootblowers. (Coosa, GA)

ADVANCED ELECTRIC POWER GENERATION

City of Lakeland, Department of Water & Electric Utilities – *McIntosh Unit 4A PCFB Demonstration Project and McIntosh Unit 4B Topped PCFB Demonstration Project.* Lakeland Electric continues to evaluate its options to meet future power demand. During this internal review, Lakeland, Foster Wheeler, DOE, and others have been reviewing the system concept, siting, and financial issues in order to improve the project. (Lakeland, FL)

JEA – *ACFB Demonstration Project.* In September 1997, DOE signed an agreement with JEA to cost-share refurbishment of the first (Unit 2) of two units at the Northside Generating Station. A Record of Decision under NEPA has been signed. Unit 2 is scheduled for mechanical completion in July 2001, with first fire in October, and commercial operation in March 2002, to be followed by two years of demonstration. (Jacksonville, FL)

Kentucky Pioneer Energy, L.L.C. – *Kentucky Pioneer Energy Project.* A Draft EIS is in preparation and is scheduled to be released in the second half of 2001. (Trapp, KY)

Sierra Pacific Power Co. – *Piñon Pine IGCC Power Project.* The project officially ended January 1, 2001. Sierra is preparing the Final Technical Report. Integrated operation of the gasifier, hot gas cleanup system, and gas turbine had not been achieved when the project ended. However, Sierra and WPS Power Development, Inc., the prospective owners of the plant, continue to try to achieve steady-state operation of the gasifier. Successes in the project included operation of the combined cycle portion of the plant at 98 percent availability, efficient removal (by the hot gas filter) of particulates from the dirty gas, and production of good quality syngas for over 30 hours since the first syngas was produced in January 1998. (Reno, NV)

Tampa Electric Co. – *Tampa Electric Integrated Gasification Combined-Cycle Project.* Tampa's Polk Power Station has completed four-and-a-half years of successful commercial operation. As of the end of the first quarter 2001, the gasifier has operated over 21,500 hours to provide syngas to the combustion turbine to produce 6,250,000 MWh of electricity. (Mulberry, FL)

Wabash River Joint Venture – *Wabash River Coal Gasification Repowering Project.* The Wabash River Cooperative Agreement expired on January 1, 2000. The Final Report is available from the FE web site's Clean Coal Technology Compendium (www.lanl.gov/projects/cctc/). The E-GAS Technology demonstrated at the Wabash facility under the Clean Coal Program has been selected for development at the Port of Port Author, Texas, which has entered into a public/private partnership to pursue development of the E-GAS technology. The partnership was established between the Port of Port Author and privately held Sabine Power I, Limited. The estimated total cost of the project is approximately $1.75 billion. The Post Project Assessment of the Wabash River Coal Gasification Repowering Project has been prepared and is under review. The Cooperative Agreement is currently in the close-out process. (West Terre Haute, IN)

Alaska Industrial Development and Export Authority (AIDEA) – *Healy Clean Coal Project.* Demonstration operation under the Cooperative Agreement was completed in December 1999, and final reporting is nearly complete. Copies of topical reports describing the key technical activities carried out during the project's two years of demonstration operations are available on the Clean Coal Technology Compendium (http://www.lanl.gov/projects/cctc/). As the result of a settlement reached in March 2000, AIDEA turned the plant over to Golden Valley Electric Association, Inc. for custodial care in April 2000. Golden Valley has engaged a consultant to determine the technical, regulatory, and economic feasibility of a full retrofit to a conventional low-NO_x burner and lime spray dryer emission control system, and of a limited retrofit that retains the TRW entrained (slagging) combustors. Based on this determination, Golden Valley is expected to declare its intentions in April 2001. The plant will not operate until this decision is announced and the appropriate modifications are made. (Healy, AK)

Arthur D. Little, Inc. – *Clean Coal Diesel Project.* Pilot testing of the hardened elements for the diesel engine is in progress. Operational component testing will take place at the Fairbanks Morse test facility on a small 2-cylinder diesel engine. Testing is scheduled to continue until summer of 2001. Shakedown of the demonstration diesel on fuel oil is complete and break-in is in progress. Only minor problems have been encountered. (Fairbanks, AK)

COAL PROCESSING FOR CLEAN FUELS

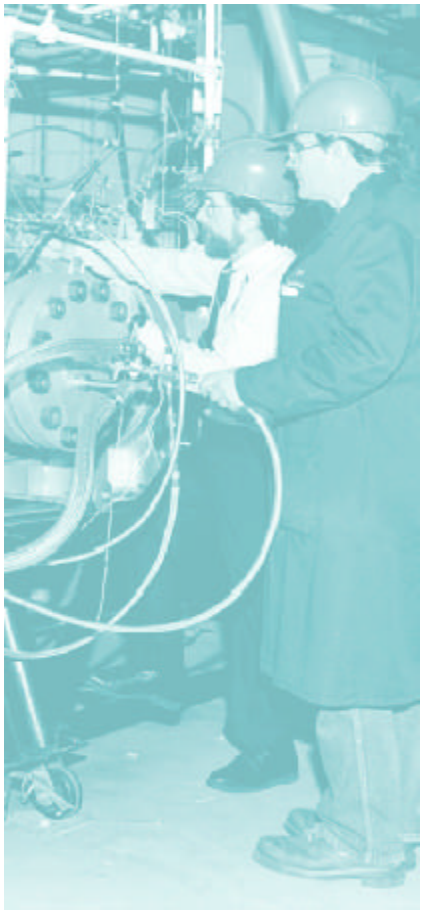
Western SynCoal LLC (formerly Rosebud SynCoal® Partnership) – *Advanced Coal Conversion Process (ACCP) Demonstration.* The ACCP Demonstration Project in Colstrip, Montana has processed over 2.8 million tons of raw subbituminous coal. Over 1.9 million tons has been supplied to customers, including industries (primarily cement and lime plants) and utilities. A new customer is now using SynCoal as a fuel supplement in its ore roaster process. The supplemental fuel system at Colstrip Unit 2 has been in operation for about two years and has been performing well. Unit 2 has consistently experienced significant benefits in improved heat rate, reduced auxiliary load, and reduced slag-related limitations. (Colstrip, MT)

Air Products Liquid Phase Conversion Company, L.P. – *Commercial-Scale Demonstration of the Liquid Phase Methanol Process.* The Liquid Phase Methanol (LPMEOH™) Process Demonstration Facility continues to experience stable operation on coal-derived synthesis gas. Several tests of the ability of the LPMEOH™ Reactor to operate in a load-following environment were performed successfully. During these tests, the reactor was placed in a standby mode of reduced temperature and constant pressure with no synthesis gas feed. After a period of 8 to12 hours in standby mode, synthesis gas feed was introduced into the reactor as quickly as possible. Significant improvements to the ramp rate were achieved by optimizing the standby mode conditions. Since being restarted with fresh catalyst in December 1997, the demonstration facility has operated at 99 percent availability, and since April 1997, the facility has produced over 77 million gallons of methanol, all of which was accepted by Eastman Chemical Company for use in downstream chemical processes. Monitoring all potential catalyst poisons, and methods for their removal and control, continue to be important. (Kingsport, TN)

INDUSTRIAL APPLICATIONS

CPICOR Management Company, L.L.C. – *Clean Power From Integrated Coal/Ore Reduction.* DOE has continued its work toward an Environmental Impact Statement for this project, a draft of which is expected to be issued in early 2001. The CPICOR Management Company (CMC) continues to perform baseline environmental monitoring and preliminary engineering and design. CMC also continues to work closely with the Australian developers of the HIsmelt Process and iron/steel engineering firms to establish a process and mechanical design database for this project. This project will be designed to produce 3,300 tons per day of liquid iron and approximately 160 MWe from the by-product gases. CMC is discussing teaming arrangements with several engineering and IPP firms. (Vineyard, UT)

ThermoChem, Inc. – *Pulse Combustor Design Qualification Test.* The Test Plan and Environmental Monitoring Plan were reviewed and accepted by DOE. Construction of the 253-tube heater bundle is complete. Shakedown of the bundle is also complete and the results were satisfactory. The measured temperature profiles were in general agreement with model/code projections, and as a result some modifications were made to improve the performance. Testing is underway and was scheduled for completion in March. ThermoChem, Inc. is planning to establish design parameters of the scaled-up heater to meet the requirements of the overall system performance for a commercial-scale steam reformer system for coal gasification and other significant commercial applications. (Baltimore, MD)



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