

CLEAN COAL TODAY

A NEWSLETTER ABOUT INNOVATIVE TECHNOLOGIES FOR COAL UTILIZATION

PROJECT NEWS BYTES

Successful firing on coal of the entrained combustion system was achieved in January 1998 at the **Alaska Industrial Development and Export Authority's Healy Clean Coal Project** site in central Alaska. This 50-megawatt, coal-fired power plant will demonstrate advanced entrained (slagging) combustion and flue gas cleanup technologies developed by TRW Inc. and the Babcock and Wilcox Company. Located in an environmentally sensitive area four miles from Denali National Park and Preserve, demonstration operations are expected to confirm that emissions of NO_x, SO₂, and particulates can be significantly reduced, while at the same time producing power more efficiently. Each combustor was successfully fired on coal individually, and both combustors were operated on coal in parallel

See "News Bytes" on page 8...

IN THIS ISSUE

IGCC Update	1
Project News Bytes	1
CO ₂ Sequestration	3
ENCOAL Final Reports	5
International Initiatives	6
International News Bytes	7
Upcoming Events	8
FE and CCT Internet Sites	9
Status of Projects	10
Completed Projects	11
CCT Conference Preview	12

IGCC – A GLIMPSE INTO THE FUTURE

Three clean coal projects offer a glimpse into the future of electric power generation. Integrated gasification combined-cycle (IGCC) plants operated by the Sierra Pacific Power Company (SPPC), Tampa Electric Company, and PSI Energy, Inc., currently provide commercial service and a proving ground for IGCC. These pioneer plants are serving to answer what it will take for new technology to penetrate the competitive, environmentally oriented electric power generation market of the 21st Century.

IGCC systems are among the cleanest and most efficient of the emerging clean coal technologies. Cleanup efficiency derives from first converting coal into a gaseous fuel without the dilution associated with introducing sufficient air for combustion. Removal of sulfur and nitrogen compounds, as well as entrained

particulate matter, occurs in a relatively concentrated fuel gas state. Only cleaned fuel gas sees the high volumes of air required for combustion. This occurs in the gas turbine. Characteristically, IGCCs remove more than 99 percent of the sulfur and control NO_x emissions to levels comparable to achieving 90 percent reduction in a conventional plant of the same size. CO₂ emissions also are reduced due to the high efficiency of the process used.

High efficiency inherent in IGCC systems results from: 1) use of gas turbines, which now are extremely efficient and becoming increasingly so; and 2) use of process heat from the gasifier and waste heat from the gas turbine to drive a steam turbine. Use of hot gas cleanup for the fuel gas in these combined-cycle systems enhances efficiency by eliminating a cooling step. Also, IGCC provides a platform for a future generation of systems offering even higher efficiency and the flexibility to provide a variety of products. Examples include integrated gasification fuel cell systems and IGCC combined with liquid fuel production.

Sierra Pacific Power Company is hosting the Sixth Clean Coal Technology Conference, and the newest addition to the family of operating IGCC plants.

See "SPPC" on page 2...



SPPC's Piñon Pine project demonstrates air-blown, fluidized-bed IGCC technology using hot gas cleanup, and evaluates a low-Btu gas combustion turbine.



The KRW gasifier island located at the Piñon Pine IGCC Project.

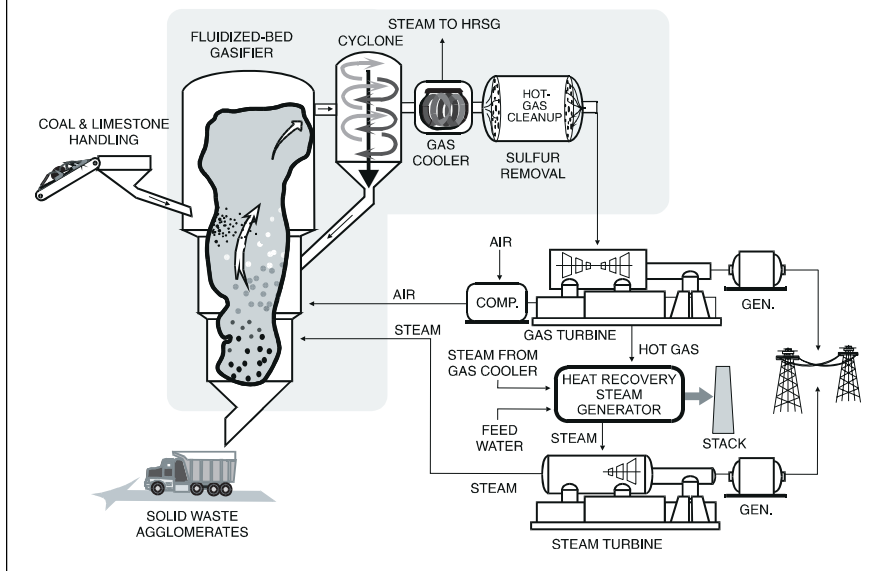
.... SPPC continued

The Piñon Pine Demonstration Plant, located at the company's Tracy Station about 17 miles east of Reno, is in its first year of operation.

This plant represents the third IGCC demonstration in the Clean Coal Technology (CCT) Program. High temperature entrained bed versions of IGCC are being tested at the Tampa Electric (Florida) and Wabash River (Indiana) sites. The Piñon Pine Plant differs from earlier versions of IGCC by using: 1) dry coal feed (rather than water slurries) together with limestone; 2) relatively low temperatures (1,750°F); 3) fluidized bed; 4) high-temperature sulfur removal; and 5) high-temperature ceramic filters for removing dust particles. In addition to very low pollutant emissions and high efficiency, the system offers low water consumption.

All of these unique aspects of Piñon Pine are part of the novel KRW Gasification Island technology owned and marketed by the M.W. Kellogg Company of Houston, Texas. It makes another technology option available to meet increasingly stringent environmental and operational performance requirements in a diverse market.

Sierra Pacific Power Company's Piñon Pine IGCC Demonstration



The plant currently uses coal from nearby Utah and limestone from local quarries. Gasification of the coal in the presence of the sorbent and subsequent oxidation of the solids results in all sulfur and ash from the coal being converted to a single calcium-rich solid, benign product. This product is suitable for landfills and has the potential for soil conditioning/enrichment or useful building materials. These various applications will be explored during the demonstration period.

Because this demonstration is being done in a very arid region, equipment and system designs chosen sought to minimize water requirements; strict total plant water management eliminated any waste water discharge. As a result, the pristine environment remains undisturbed.

This plant fully integrates the coal gasification island with a power island consisting of a gas combustion turbine, heat recovery steam generator (HRSG), and steam turbine. General Electric supplied both turbines. The MS600/FA gas turbine operates

on either natural gas or coal-derived gas. The power island provides hot air and steam to the gasification island (pictured above left).

The Piñon Pine plant is experiencing the usual problems associated with startup of a "first-of-a-kind" commercial plant. However, syngas production continues to steadily increase, and this is now another showcase of a successful advanced coal power system demonstration.



The coal conveyor moves coal to the Piñon Pine storage dome.

CO₂ SEQUESTRATION TO REDUCE GREENHOUSE GAS



Full ramifications of last year's Kyoto Protocol agreed to under the auspices of United Nations Framework Convention on Climate Change are far from clear, and the U.S. Congress currently seems opposed to the ratification of this Protocol. However, many affected parties have been actively seeking technological solutions to reduce CO₂ emissions — the primary focus of global climate change discussions.

A range of available CO₂ reduction options includes reducing electricity consumption, use of natural gas in lieu of coal, and use of non-fossil fuels, among others. However, electricity consumption is projected to increase, and the International Energy Agency (IEA) projects that coal consumption will increase both domestically and internationally into the next century. Therefore, CO₂ emission reductions are being sought through improved efficiencies, technologies to reduce emissions of CO₂, and processes for sequestering CO₂ — which are drawing great interest and support.

IMPROVE EFFICIENCY

Some higher efficiency generation technologies have been developed under the U.S. Department of Energy (DOE) Clean Coal Technology Demonstration Program, such as those demonstrated at three IGCC projects. IGCC systems produce a fairly concentrated fuel gas, undiluted by combustion air, that lends itself to removal of specific constituents. DOE also has been developing fuel cell technologies, which provide another means to produce a concentrated CO₂ waste stream, requiring minimal processing prior to transportation to a suitable disposal site. A number of technologies upon which the Office of Fossil Energy (FE) is focusing not only reduce greenhouse gas emissions, but offer other environmental benefits.

SEQUESTRATION

In a 1996 report for DOE, "CO₂ Capture, Reuse, and Storage Technologies for Mitigating Climate Change," the Massachusetts Institute of Technology (MIT) concluded that research into CO₂ capture, use, and disposal technologies is "a prudent measure since there are only a limited number of strategies to reduce greenhouse gas emissions." This report further noted that CO₂ capture and sequestration are "still in [their] infancy, with many questions needing to be addressed to make these technologies viable. At this time, it is judicious to explore all potential mitigation options in a balanced way, so that a broad range of strategies is available to help meet future policy goals." This conclusion further supported an earlier DOE and MIT research needs assessment, which identified a number of specific research areas that remain in the forefront today:

- Develop power plant systems that facilitate efficient CO₂ capture;
- Resolve technical, safety, liability, and environmental issues of deep ocean CO₂ disposal;
- Research the environmental impacts of land and ocean disposal; and

- Continue to research issues of cost, safety, liability, and institutional barriers to large-scale deployment of transportation of compressed, liquid CO₂.

In the latest Department of Energy budget for Fiscal Year 1999, FE is proposing a \$12 million research agenda that supports development of affordable carbon sequestration. A three-prong research plan includes:

- Studies of the traditional geologic (depleted oil and gas reservoirs, unminable coal seams and aquifers) and deep ocean sequestration technologies,
- Research to enhance the natural carbon uptake of forests, algae, and other carbon absorbers, and
- Research to identify and develop potential novel technologies for carbon capture and disposal.

Several research agreements to move CO₂ sequestration research forward were signed in conjunction with the Kyoto Protocol, under the auspices of the Climate Technology Initiative (CTI). The first Steering Committee meeting for *ocean sequestration*, a joint project of the U.S., Japan, and Norway, was held in December, and a site selection is expected by May. Switzerland and Canada are expected to join this ocean project by the next Steering Committee meeting in June. A second major agreement between the U.S. and Canada on *geological sequestration* would permanently store CO₂ in unminable coal beds and release trapped methane gases.

OCEAN SEQUESTRATION

The four-and-a-half year, \$3.8 million field evaluation of deepwater CO₂ disposal will be undertaken at a yet-to-be determined test site. The field tests will address the technical feasibility and environmental impacts

Worldwide CO₂ Storage Potential

Deep Ocean	5,100 to 100,000 billion tonnes
Deep Aquifers	320 to 10,000 billion tonnes
Depleted Gas Reservoirs	500 to 1,100 billion tonnes
Depleted Oil Reservoirs	150 to 700 billion tonnes

Since the world produces about 22 billion tonnes of CO₂ annually from energy production, theoretical storage capacities are more than adequate.

Source: IEA Greenhouse Gas R&D Programme

of sequestration. Ocean storage would accelerate a natural process whereby 50 percent of CO₂ currently generated indirectly reaches the ocean. If the technology is proven, deepwater sequestration could be available to 30 percent of U.S. power plants located throughout the coastal states. The field test will address the technical feasibility and environmental impacts of ocean sequestration, whereby liquefied CO₂ is pumped more than 3,000 feet below the ocean surface through a series of pipes. Estimates are that CO₂ would remain sequestered for several hundred years. The field experiment is expected to begin in the year 2000.

GEOLOGICAL SEQUESTRATION

An agreement for geological sequestration, between DOE's Federal Energy Technology Center (FETC), Environment Canada, and industry, would be led by the Alberta Research Council. CO₂ would be injected into deep, unminable coal beds, releasing methane trapped in the mines, recovering for use. Similar technology currently is used for enhanced oil recovery; however, in this case CO₂ would not escape since it would be adsorbed on the coal surface. Both the United States and Canada have an abundance of deep coal beds, and the technology could make coal bed methane production an economically attractive method of reducing CO₂. Prior to this agreement, Canada already carried out an initial

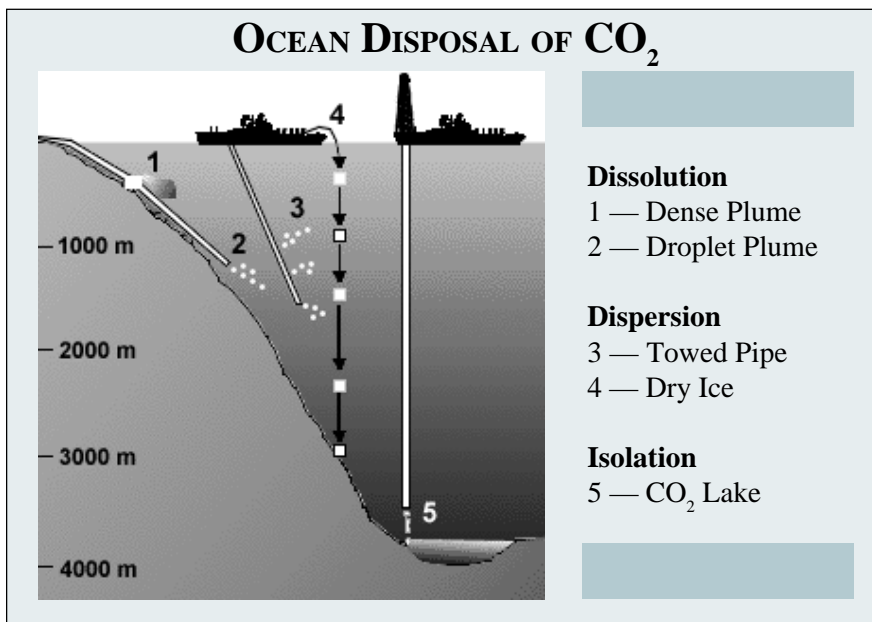
assessment on Mannville coal seams in Alberta's Fenn-Big Valley. Researchers now will inject pure CO₂ at the same site. Later, a full-scale pilot plant will evaluate continuous injection of CO₂ into a reservoir, and methane production from four surrounding wells.

In addition to these two efforts, another international agreement is being prepared to develop a new technology for greenhouse gas emissions reduction. It will address fossil fuel combustion in an atmosphere of CO₂ (recycle flue gas) and O₂, which results in a concentrated CO₂ stream amenable to sequestration. Other proposals by member nations of the CTI include hydrogen production and CO₂ storage, biological hydrogen production, chemical CO₂ fixation and utilization, and long-term scenarios for other technologies.

FUTURE DOE ACTIVITIES

Meanwhile, FETC is evaluating over 50 proposals for novel concepts for CO₂ sequestration, sought under last year's "Novel Concepts" solicitation. These proposals represent potential low-cost concepts for sequestration, biological treatment, chemical utilization, capture technology, closing the carbon cycle, and integration into power systems.

FE also is requesting funding for a new concept for future coal-based energy production — the "Vision 21 Energyplex" — a futuristic way of combining high-efficiency power technologies with advanced coal processing technologies and environmental controls to create a near-zero discharge, multi-product energy complex. Elsewhere, one DOE laboratory is looking at sequestering CO₂ by reacting magnesium-bearing rock with acid and CO₂ to produce magnesite, a magnesium carbonate.



ENCOAL® MILD COAL GASIFICATION PROJECT COMPLETES FINAL REPORTS

In mid-1997, the ENCOAL® project completed operational testing and will soon make available a series of three final reports. In addition to printed format, these reports will be available in compact disc (CD) at the Sixth Clean Coal Technology Conference in Reno, Nevada, this spring. This represents FETC's initial effort to make project-specific technical reports available in condensed electronic form.

The ENCOAL® project, located at Triton Coal Company's Buckskin mine, in Campbell County, Wyoming, upgrades low-sulfur, low-rank coals to solid and liquid fuels of higher heating value. This eliminates the derating problem associated with low-rank fuels, while taking advantage of their low sulfur content. The solid fuel, termed Process Derived Fuel (PDF™), can be used in most industrial and utility boilers and also shows promise for iron ore reduction applications. Coal Derived Liquid (CDL™) can be used as a substitute for No. 6 fuel oil. Product fuels have been used economically in commercial boilers that previously burned high-sulfur bituminous coal or fuel oils, thus reducing emissions of sulfur and NO_x.

The three final reports, available as the *Project Final Report*, the *Final Design Modifications Report*, and the *Commercial Plant Feasibility Study*, summarize five years of valuable operational data. During this time, the plant operated almost 13,000 hours processing 247,000 tons of coal. Ultimate production was 250 tons/day of PDF™ and 280 barrels/day of CDL™. By project's end, more than 83,000 tons of specification PDF™ had been shipped to seven utility and industrial customers in six states, while 203 tank cars of CDL™ had been shipped to light industrial customers in seven states.

While some commercialization issues remain — primarily the scale up of the vibrating fluidized bed (VFB) — sponsors consider that the goals for the ENCOAL® project have been met. The project has demonstrated for the first time the integrated operation of several unique process steps:

- Coal drying and devolatilization on a rotary grate using convective heating;
- Hot particulate removal with cyclones;
- Integral solids cooling and deactivation/passivation with VFB;
- Combustors operating on low-Btu gas from internal streams;
- Solids stabilization for storage and shipment;
- Computer control and optimization of mild coal gasification process; and
- Dust suppressant on PDF™ solids.

ENCOAL continues to perform feasibility studies on numerous coals, and to refine commercial plant designs for both domestic and foreign sites.

Copies of the final reports are available through Doug Jewell at FETC, (304) 285-4403 or by e-mail (djewel@fetc.doe.gov).



The ENCOAL® project demonstrates the integrated operation of a number of processing steps to produce two higher value fuel forms from mild gasification of low-sulfur subbituminous coal.

INTERNATIONAL INITIATIVES

THE U.S.-CHINA ENERGY AND ENVIRONMENTAL TECHNOLOGY CENTER



On November 15, 1997, the Tsinghua University in Beijing, China, held a commencement ceremony of the U.S.-China Energy and Environmental Technology Center (EETC). Representatives from the U.S. and Chinese governments, academic institutions, and both the Board of Directors and Steering Committee of EETC all participated at the ceremony and delivered congratulatory speeches. The EETC represents a significant step for the two countries in demonstrating a long-term relationship that builds on trust, mutual benefits, and goodwill. Many of the Chinese electronic and print media were there to report on the ceremony and interview the speakers. DOE Principal Deputy Assistant Secretary, Bob Kripowicz, referred to China's influential role in the 21st Century and the important choices it must make regarding energy and environment. "The choice of the path is China's alone to make. On our part, by working jointly with the scientists, engineers, and policy makers of China — through this Center — we hope to advance both... energy and environmental goals."



Unveiling a plaque at the EETC dedication in November 1997 are: Robert Kripowicz (Principal Deputy Assistant Secretary for Fossil Energy), Shi Ding Huan (Director, Department of Industrial Technology of China's State Science & Technology Commission), and Dr. Wu Zongxin (Director of EETC).

EETC was created and made possible under joint DOE and EPA funding. Its mission is to enhance the competitiveness and adoption of U.S. clean and environmentally superior technologies in China by focusing on education and training, promoting the use and profitability of U.S. technology, and supporting policy development in China to encourage the responsible use of coal. The EETC's activities are jointly implemented by the U.S. and the Chinese governments: U.S. DOE and EPA, China's State Science and Technology Commission (SSTC), Tulane University in New Orleans, and Tsinghua University. The Chinese government is cost sharing part of EETC's activities. A binational core team composed of members from a number of U.S. and Chinese organizations is overseeing and implementing EETC's work.

Although the opening ceremony was held in November last year, EETC office has been operational at the Tsinghua University for nearly a year. The following are some of its accomplishments.

- Establishment of a web site and home page at <http://www.tulane.edu/~uschina> to support an Internet-based energy and environmental information system. The site includes a database of more than 1,000 U.S. firms with energy and environmental technology and equipment that can serve the Chinese market.
- The conduct of joint expert studies on coal liquefaction, IGCC for retrofit and repowering, coal preparation, and superfine coal applications, with plans to investigate applications for molten carbonate fuels cells. Studies include analysis of technology readiness, need for the technology in China, and barriers to technology introduction. Some assessments are generic while others are site-specific.
- Development of a model contract for cogeneration for joint venture projects.

Specifically, the Center has helped match HTI, a New Jersey company, with China's Central Coal Research Institute and the Ministry of Coal to conduct a feasibility study on direct coal liquefaction. The study began last September and should be completed by mid-1998. The U.S. technology is competing with technologies from Japan and Germany, and EETC's representatives have helped the U.S. firm work with a strong Chinese partner.

EETC also has been working with the U.S.' Institute for Gas Technology to support the use of U-gas gasification technology in Shanghai Coke and Chemical. In November 1997, EETC sent a team of experts from FETC and the Albany Research Center to help the company conduct research that focused on refractory material for clean coal technology. Once the equipment reaches its designed output, EETC will assist with the promotion and marketing of the company's gasification technology in China.

In addition to direct clean coal activities, EETC has also focused on bioremediation technology for the treatment of China's industrial and municipal wastewater and the steam recovery process for black liquor from paper mills. EETC's activities include assisting U.S. companies on full-scale strategy development of their technology, application and manufacturing, technology transfer, and market penetration.

Besides project development and implementation, EETC has initiated many education and training programs as well. For example, working with the Tulane Business School faculty and graduate students, EETC representatives helped the MBA students coordinate a visit to China and collect a considerable amount of data to develop business prospectives for five possible projects: rice husk for power generation, two co-generation projects, one paper mill upgrading project, and H₂S control for a yellow phosphorus chemical plant. EETC has also signed a Memorandum of Understanding with the Shandong Electric Power Bureau to conduct a training program for utility managers.

To further EETC's mission of education, training, business and policy development, information exchanges, and sponsoring technical workshops and conferences, EETC will also seek expansion into new technologies, new regions in China, and an enlarged support base in the private sector that will increase the EETC's self-sufficiency.

INTERNATIONAL NEWS BYTES

An FE representatives participated in the **Annual DOE/Agency for Industrial Science and Technology Fuel Cell Technical Information Exchange Meeting** with Japan in November. The group included representatives from five U.S. fuel cell manufacturers as well as researchers from DOE's national labs and their counterparts in Japanese government and industry. Meetings are held under an agreement between DOE and Japan's Ministry of International Trade and Industry. In the near term, the Japanese fuel cell program is focused on phosphoric acid fuel cell commercialization, with emphasis on cost and size reduction, and increased reliability. For the longer term, the Japanese are interested in molten carbonate, solid oxide, and polymer electrolyte fuel cells. Although fueled by natural gas, coal could eventually be used in advanced fuel cells.

At a November meeting of the **United Nations Economic Commission for Europe (ECE)** in Geneva, a representative from FE was elected Vice Chairman of the agenda-deciding Bureau of the Committee on Sustainable Energy, a principal subsidiary body under the ECE. Under the restructured and streamlined ECE, this committee is taking over all energy related responsibilities of the former working parties on coal, energy efficiency and electric power. At the meeting, the U.S. was asked to lead a future seminar/study tour of clean coal technologies in the U.S. applicable to the transitional economies of central and Eastern Europe.

In November, a representative of FE spoke at the inaugural workshop of **The Philippine Center for Sustainable Development and Environmental Technologies** on the latest developments in clean coal technologies. The workshop, "Water, Energy, and Environmental Technologies," was held in collaboration with the Philippine Government Department of Science and Technology and De La Salle University in Manila. The country's energy plan predicts substantial

increase in the use of coal, and clean coal technologies could help mitigate environmental impacts brought about by rapid economic growth.

A team from DOE's Office of Fossil Energy (FE), including Principal Deputy Assistant Secretary Robert S. Kripowicz, participated in the **International Symposium on Clean Coal Technology**, co-sponsored by DOE, China's Ministry of Coal Industry (MOCI), and the European Commission Directorate of Energy. The conference took place in Xiamen, Fujian, China, on November 17-21, 1997. Kripowicz gave the keynote speech, "Why CCTs Are Important to the Global Economy." Other senior FE officials headed technical sessions and spoke regarding clean coal economics and coal gasification. In parallel with the conference was a workshop sponsored by the Fujian Coal Industry Administration of MOCI, a group heavily involved in a variety of coal-related projects. The workshop was targeted toward specific clean coal projects and opportunities in Fujian.

.... *News Bytes continued*

at loads of up to 30 MWe. The combustors appear to be slagging, as expected, with no ash buildup. Integrated demonstration operation with the spray dryer absorber system is expected to begin this spring. The total cost of the Alaska Industrial Development and Export Authority's Healy Clean Coal Technology Project is \$242,058,000, with DOE providing cost-shared funding in the amount of \$117,327,000.

DOE's Federal Energy Technology Center (FETC) signed an inter-agency agreement with the U.S. Environmental Protection Agency (EPA) whereby FETC will provide technical management support to EPA in fulfilling its mandate to design risk management strategies for cli-

mate change. Using EPA funds, FETC will: 1) provide general technical support; 2) search topical technical literature; 3) support program planning and administrative activities; 4) support risk management, communications, and policy analysis; and 5) develop means to effectively communicate the expanding scientific knowledge base on climate change to various stakeholders.

Under a January 20, 1998, Cooperative Research and Development Agreement, **FETC and HiMicro, Inc.**, of Richmond, Virginia, will assess various biomass and coal-fuels for co-firing applications aimed at electric power generation. Over a 3-year period, HiMicro, which specializes in the design and development of specialized mills for micronizing solid

fuels used in pulverized coal combustion, will grind various fuel feeds. FETC will run test burns of the fuels at its pilot-scale Combustion and Environmental Research Facility.

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UPCOMING EVENTS

- April 20-23, 1998** *Symposium on High-Temperature Particulate Cleanup for Advanced Coal-Based Power Systems*
Location: Birmingham, Alabama
Co-Sponsors: U.S. Department of Energy, Electric Power Research Institute
Contact: R. Dennis. FETC-Morgantown, 304-285-4515
- April 21-24, 1998** *Ukraine/U.S. Joint Conference on Ukraine Clean Coal Power Plant Upgrade Opportunities*
Location: Kiev, Ukraine
Co-Sponsors: Ukrainian Ministry of Energy and Electrification, U.S. Department of Energy, U.S. Agency for International Development
Contact: Victor Gorokhov, Science Applications International Corporation, 703-556-7192
- April 28 - May 1, 1998** *Sixth Clean Coal Technology Conference*
Location: Reno, Nevada
Co-Sponsors: U.S. Department of Energy, Center for Energy & Economic Development, Council of Industrial, Boiler Operators, Electric Power Research Institute, National Mining Association
Contact: Faith Cline, 202-586-7920
- May 12-24, 1998** *Twelfth Annual Conference on Fossil Energy Materials*
Location: Knoxville, Tennessee
Sponsors: U.S. Department of Energy, Oak Ridge National Laboratory
Contact: Judy Fair, 423-567-7270
- May 19-20, 1998** *1998 Conference on Unburned Carbon on Utility Fly Ash*
Location: Pittsburgh, Pennsylvania
Sponsor: U.S. Department of Energy Federal Energy Technology Center
Contact: Karen Lockhart, 412-892-4763
- May 20-21, 1998** *1998 Conference on Selective Catalytic and Non-Catalytic Reduction for NO_x Control*
Location: Pittsburgh, Pennsylvania
Sponsor: U.S. Department of Energy Federal Energy Technology Center
Contact: Karen Lockhart, 412-892-4763

FE INTERNATIONAL WEB SITE UPGRADES



The Fossil Energy International Activities site on the World Wide Web has been expanded with the addition of new country pages in the Western Hemisphere region (Guatemala, Honduras, Nicaragua, Paraguay, Trinidad & Tobago, and Uruguay) and the Russia/NIS region (Armenia, Georgia, and Moldova).

Many of the existing country pages have also been upgraded, with new hyperlinks to business- or energy-related information sources. An innovation at the FE International Web site is a series of newly created Country Energy Overviews. Each Overview, individualized for a particular country, includes a status summary of that country's energy infrastructure, energy and environmental policies, and privatization efforts. Seven country pages in the Eastern Europe region now include these Overviews; Western Hemisphere country pages will be next to receive these upgrades.

The URL for the Fossil Energy International main page is <http://www.fe.doe.gov/international> and it can be accessed via the "International" hyperlink in the Fossil Energy Home Page (<http://www.fe.doe.gov>).

DOE LAUNCHES NEW CLEAN COAL TECHNOLOGY WEB SITE

In February 1998, the Department of Energy established a new information resource on the Internet. The Clean Coal Technology Compendium, sponsored by the Office of Fossil Energy, is dedicated to making the maximum use of information derived from the Clean Coal Technology (CCT) Program. The compendium designers anticipate that it will become the principal source of information for stakeholders interested in implementation of CCTs. It is designed to emphasize ease of use, and contains a broad collection of different types of data and information, making it applicable to the needs of both managers and engineers. For example, by selecting the CCT program icon, one can access the latest CCT Demonstration Program Annual Program Update, and Topical Reports published periodically on individual CCT projects. The Compendium is accessible via the Internet at (<http://www.lanl.gov/projects/cctc/>).



STATUS OF CCT DEMONSTRATION PROJECTS

ENVIRONMENTAL CONTROL DEVICES

Southern Company Services, Inc. – *Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler.* Long-term testing of the advanced overfire air (AOFA), low-NO_x burners (LNB), and combined LNB+AOFA systems are complete. Final testing of GNOCIS in a closed-loop configuration is continuing. The project was extended until February 1998 to allow completion of the final report. A Draft Final Report for Phases 1-3 has been received and is being reviewed. (Coosa, GA)

New York State Electric & Gas – *Milliken Clean Coal Technology Demonstration Project.* Design coal testing of the scrubber has restarted and will continue until Spring 1998. High-sulfur coal testing will begin soon. Reports on ESP performance and LNCF-3 testing have been completed. (Lansing, NY)

New York State Electric & Gas – *Micronized Coal Reburning Demonstration for NO_x Control.* Preliminary testing was performed in early February. Short-run tests showed that NO_x could be reduced an additional 35-40%. Further testing with different LNCF III primary and overfired air settings is rescheduled until April. (Lansing, NY and Rochester, NY)

NOXSO Corporation – *Commercial Demonstration of the NOXSO SO₂/NO_x Removal Flue Gas Cleanup System.* Discussions are ongoing with a major utility to re-site this project. (Site pending)

ADVANCED ELECTRIC POWER GENERATION

City of Lakeland, Department of Water & Electric Utilities – *McIntosh Unit 4A PCFB Demonstration Project.* In combination with the *McIntosh Unit 4B Topped PCFB Demonstration Project*, these projects have been restructured and re-sited to Lakeland, Florida. Foster Wheeler gave the City of Lakeland a turnkey proposal to build a PCFB plant at Lakeland's McIntosh Power Plant. The City of Lakeland and DOE have signed both cooperative agreements, The City of Lakeland is negotiating with Foster Wheeler on the Engineering-Procure-Construct contract. (Lakeland, FL)

Jacksonville Electric Authority (formerly York County Energy Partners) – *ACFB Demonstration Project.* On September 29, 1997, DOE signed an agreement with Jacksonville (FL) Electric Authority to cost-share refurbishment of the first (Unit 2) of two units at North Side Generating Station. Capital cost of repowering Unit 2 is \$309 million, of which DOE's cost-share is \$74.7 million, or 24%. Construction is planned to begin in March 1999, with operation in early 2002, and two years of operations. Activities are underway to draft an Environmental Impact Statement. (Jacksonville, FL)

Clean Energy Partners, L.P. – *Clean Energy Demonstration Project.* Economic and power needs issues continue to affect siting evaluations. A site has been offered and is being evaluated in Southern Illinois. (Site pending.)

Sierra Pacific Power Co. – *Piñon Pine IGCC Power Project.* SPPC has achieved short-term operation of gasifier island on coke breeze. Various mechanical, instrument, and control issues are being addressed to allow safe operation on coal. The plant continues to operate in the gas combined cycle mode. (Reno, NV)

Tampa Electric Co. – *Tampa Electric Integrated Gasification Combined-Cycle Project.* During December 1997, the unit operated on Syngas 99% of its time (737 of 744 hours). The unit operated on Illinois No. 6 instead of Pittsburgh No. 8 coal. (Mulberry, FL)

Wabash River Joint Venture – *Wabash River Coal Gasification Repowering Project.* The plant completed its second scheduled routine outage for preventive maintenance. A significant petroleum coke test was completed during the fourth quarter of 1997, and a new continuous run record was set in March 1998. (West Terre Haute, IN)

Alaska Industrial Development and Export Authority – *Healy Clean Coal Project.* Construction was completed in November 1997. Startup of the entrained combustion system on coal began in January 1998. Each combustor has been successfully fired on coal individually, and both combustors have been operated on coal in parallel at loads of up to 30 MWe. The combustors appear to be slagging as expected with no ash buildups. Integrated demonstration operation with the spray dryer absorber system is expected to begin this spring. (Healy, AK)

Arthur D. Little, Inc. – *Coal-Fueled Diesel Engine Demonstration Project.* A 60% design review was held at the University of Alaska. The project is on schedule for delivery of the 18-cylinder coal-diesel engine in November 1998. (Fairbanks, AK)

COAL PROCESSING FOR CLEAN FUELS

Custom Coals International – *Self Scrubbing Coal™: An Integrated Approach to Clean Air.* The plant has temporarily halted operations due to financial and environmental constraints. A coal supplier has made an offer to buy the site and continue the project. A detailed final proposal was received from the supplier at the end of January 1998. DOE is evaluating the offer to continue the demonstration. The plant has processed over 650,000 tons of raw coal and shipped over 400,000 tons of clean coal product. (Central City, PA; Martins Creek, PA; Richmond, IN; Ashtabula, OH)

Rosebud SynCoal® Partnership – *Advanced Coal Conversion Process (ACCP) Demonstration.* The ACCP facility continues to process raw subbituminous coal, producing over 1.1 million tons of SynCoal® product to date. Nearly 1 million tons has been supplied to customers, including industries (primarily cement and lime plants) and utilities. Rosebud SynCoal Partnership is investigating the possibility of a permanent pneumatic injection system being installed at Montana Power Company's Colstrip Units 1 and 2. The pneumatic injection system would inject SynCoal® product on a steady basis to Colstrip Units 1 and 2. (Colstrip, MT)

ENCOAL® Corp. – *ENCOAL® Mild Coal Gasification Project.* ENCOAL® has completed all testing. DOE has issued all final reports in both hard copy and CD format. ENCOAL® is actively pursuing commercialization of the Liquids From Coal technology at both domestic and off-shore sites. (Gillette, WY)

Air Products Liquid Phase Conversion Company, L.P. – *Liquid Phase Methanol Process Demonstration Project.* Stable operation of the LPMEOH™ Process Demonstration Facility continues following replacement of the methanol catalyst in the reactor in December 1997. The methanol catalyst was replaced to facilitate study of the effect of catalyst poisons on the aging

phenomena. Preliminary analytical results have shown that concentrations of metal carbonyls, hydrogen sulfide, and carbonyl sulfide are within acceptable limits (generally less than 10 ppb), with the rate of decline in catalyst activity under 1 percent per day. In order to increase catalyst concentration in the reactor toward the design condition of 40 percent slurry by weight, and maintain conversion efficiency, batches of freshly activated catalyst are being periodically added (on-line) to the reactor. Methanol production rates have varied from 69,000 to 85,000 gallons per day, and overall, unit availability has exceeded 99 percent since the restart. All

methanol produced at the LPMEOH™ Process Demonstration Facility has been accepted by Eastman Chemical company for use in downstream chemical processes. (Kingsport, TN)

INDUSTRIAL APPLICATIONS

Bethlehem Steel Corporation – Blast Furnace Granulated Coal Injection System Project. Operations of C Furnace are being stabilized in anticipation of the “Pulverized Coal Trial” in April. Study of cost and availability of Colorado coal for an injection trial will continue. (Burns Harbor, IN)

CPICOR™ Management Company, L.L.C. – Clean Power From Integrated Coal/Ore Reduction. CPICOR™ has been evaluating alternative and optimum iron making technologies in an attempt to define the most technical and cost-effective plant baseline configuration. Technical readiness and power needs issues continue to be concerns that need to be addressed before the NEPA process resumes. Resolution of these issues is expected within the next quarter. (Vineyard, UT)

COMPLETED PROJECTS — PARTICIPANTS FINAL REPORTS

Environmental Control Devices

- 10-MWe Demonstration of Gas Suspension Absorption – *AirPol, Inc.* NTIS #DE960003270
- Confined Zone Dispersion Flue Gas Desulfurization Demonstration – *Bechtel Corporation* DOE/PC/90546-T10
- LIFAC Sorbent Injection Desulfurization Demonstration Project – *LIFAC-North America* NTIS #DE96004421
- Advanced Flue Gas Desulfurization Demonstration Project – *Pure Air on the Lake, L.P.* NTIS #DE96050313
- Demonstration of Innovative Applications of Technology for the CT-121 FGD Process – *Southern Company Services, Inc.* NTIS #DE94016053
- Demonstration of Coal Reburning for Cyclone Boiler NO_x Control – *The Babcock & Wilcox Company* In Review
- Full-Scale Demonstration of Low-NO_x Cell Burner Retrofit – *The Babcock & Wilcox Company* NTIS #DE96003766
- Evaluation of Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler – *Energy and Environmental Research Corporation* Not Yet Available
- Demonstration of Selective Catalytic Reduction Technology for the Control of NO_x Emissions from High-Sulfur Coal-Fired Boilers – *Southern Company Services, Inc.* NTIS #DE97050873
- 180-MWe Demonstration of Advanced Tangentially Fired Combustion Techniques for the Reduction of NO_x Emissions from Coal-Fired Boilers – *Southern Company Services, Inc.* NTIS #DE94011174
- SNOX™ Flue Gas Cleaning Demonstration Project – *ABB Environmental Systems* NTIS #DE94018832
- LIMB Demonstration Project Extension and Coolside Demonstration – *The Babcock & Wilcox Company* NTIS #DE93005979
- SO_x-NO_x-Rox Box™ Flue Gas Cleanup Demonstration Project – *The Babcock & Wilcox Company* NTIS #DE96003839
- Enhancing the Use of Coals by Gas Reburning and Sorbent Injection – *Energy and Environmental Research Corporation* NTIS #DE96011869
- Integrated Dry NO_x/SO₂ Emissions Control System – *Public Service Company of Colorado* In Preparation

Advanced Electric Power Generation

- Tidd PFBC Demonstration Project – *The Ohio Power Company* NTIS #DE96000650
- Nucla CFB Demonstration Project – *Tri-State Generation and Transmission Association, Inc.* DOE/MC/25137-3046

Coal Processing for Clean Fuels

- Development of the Coal Quality Expert™ – *ABB Combustion Engineering, Inc., and CQ Inc.* In Preparation

Industrial Applications

- Advanced Cyclone Combustor with Internal Sulfur, Nitrogen, and Ash Control – *Coal Tech Corporation* NTIS #DE92002587/92002588
- Cement Kiln Flue Gas Recovery Scrubber – *Passamaquoddy Tribe* NTIS #DE94011175/94011176

Publications are available to the public from the National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4600. For a copy of the “DOE/MC” report, contact: Library, FETC-Morgantown, 3610 Collins Ferry Road, Morgantown, WV 26507-0889, (304) 285-4184. For a copy of the “DOE/PC” report, contact: Library, FETC-Pittsburgh, 626 Cochran Mill Road, Pittsburgh, PA 15236-0940, (412) 892-6819.

SIXTH CLEAN COAL TECHNOLOGY CONFERENCE PREVIEW

The Sixth Clean Coal Technology Conference will be held April 28 through May 1, 1998, in Reno, Nevada. This year the program will focus on the ability of clean coal technologies (CCTs) to meet increasingly demanding environmental requirements while remaining competitive in both international and domestic markets. Conference speakers will assess environmental, economic, and technical issues and will identify approaches to enhance CCT deployment in an era of competing, interrelated demands for energy, economic growth, and environmental protection. Recognition will be given to the dynamic changes that will result from increasing competition in electricity and fuel markets, and industry restructuring.

Following the success of last year's conference format, this conference again will develop key issues over three days. First the issues will be identified and discussed; then they will be expanded and explored, and some resolutions will be formulated; and on the last day, summaries and conclusions will be presented by the Session Rapporteurs.

On Tuesday, April 28, the conference will be opened with an International Business Forum Brunch, which will provide a unique, informative forum on international issues that impact companies pursuing CCT opportunities in the growing and changing international market. It is designed to allow companies interested in markets abroad to discuss emerging global CCT markets with international experts. One panel will provide a regional perspective of CCTs, highlighting opportunities in Latin America, the European Union, Asia, and Africa. A second panel will focus on projects under development in China, India, Brazil, Israel, Egypt, Jordan, and Russia. Following the Brunch, the program features a tour of the Sierra Pacific Power Company's Piñon Pine Integrated Gasification Combined Cycle plant (see article on page 1). The first day will conclude with a reception at the National Automobile Museum, sponsored by Sierra Pacific.

U.S. DOE Assistant Secretary for Fossil Energy, Patricia Fry Godley, will present the keynote Opening Address on Wednesday, which will set the stage for the presentations and discussions throughout the conference on the theme: *Clean Coal for the 21st Century: What Will It Take?* The opening session also will look at issues including the importance of coal, how coal fits into the energy picture in the western United States, and worldwide coal demand. Comprehensive panel sessions will be conducted on Thursday, on four issues central to the discussion about the future of coal and the role that CCTs will play in the future.

Issue 1: CCTs — Providing for Unprecedented Environmental Concerns will focus on current and pending regulations, policy perspectives regarding climate change, implications of emissions trading on technology choices, and one country's experience (Germany) in meeting the environmental challenge.

Issue 2: Domestic Competitive Pressures for CCTs will look at the implications of restructuring, environmental issues in federal deregulation legislation, the impact and role of electro technologies, and natural gas.

Issue 3: Financing Challenges for CCTs will provide attendees the financial community's perspective on what makes a project financeable; incentives and impediments to financing due to creation of financial institution environmental standard guidelines; and project risk allocation among government, power consumers and producers, equipment suppliers, construction firms, and financial institutions.

Issue 4: New Markets for CCTs is designed to highlight new markets for CCTs such as those evolving as a result of utility competition and distributed generation, environmental requirements, independent power producers, expanding needs for upgrading low-rank coals, and case studies of the World Bank on options for emissions reductions in Shanghai and other Chinese sites.

Technical sessions on the DOE clean coal technology projects will be held Wednesday afternoon, and at Friday's Closing Plenary, Panel Session Rapporteurs will present summaries and conclusions drawn from the presentations and discussions on each issue. Following the Closing Plenary, the luncheon address will focus on climate change issues, and will feature Linda Stuntz, Partner, Stuntz and Davis. White House spokesman Dirk Forrister also has been invited to speak on climate change. Other events at the Conference include an international theme reception, and a tour of Virginia City.