OFFICE OF FOSSIL ENERGY, U.S. DEPARTMENT OF ENERGY • DOE/FE-0215P-32 ISSUE NO. 32, WINTER 1998

# CLEAN COAL TODAY

A NEWSLETTER ABOUT INNOVATIVE TECHNOLOGIES FOR COAL UTILIZATION

## PROJECT NEWS BYTES

During October 1998, operations at the **Wabash River Coal Gasification** facility resulted in over a trillion BTUs of syngas production and the third longest run to date. By October, the plant had attained 10,000 hours of commercial operation and processed over 1 million tons of coal. March and April 1998 were also months during which the facility produced over one trillion BTUs of syngas. The technology is nearly ready to move into commercial operation, but availability and capacity must first be improved.

Operating results from **Air Products Liquid Phase Conversion Company's Liquid Phase Methanol (LPMEOH™) Demonstration Project** in Kingsport, Tennessee during 1998 have produced several significant accomplishments. The design catalyst loading in the

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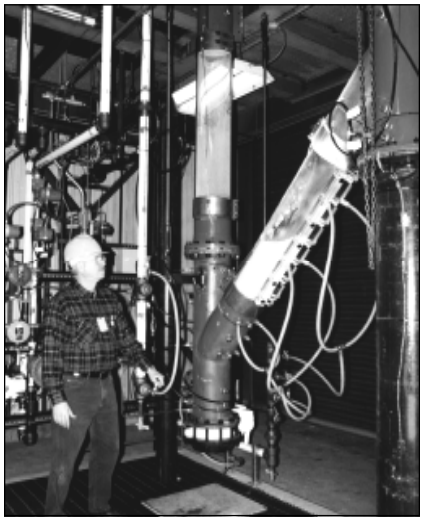
## IN THIS ISSUE



## FETC'S "IN-HOUSE" R&D

The DOE Office of Fossil Energy's Federal Energy Technology Center (FETC) has only recently emerged from the melding of two distinguished institutions steeped in a 50-year history of contributions to fossil energy research and development (R&D). The synergy realized through the integration of technical resources holds promise for even greater things to come from in-house R&D efforts that target some of the most challenging problems yet faced by the energy industry.



*The Circulating Fluidized-Bed Cold Model simulates fully integrated operations for solids transfer and control systems.*

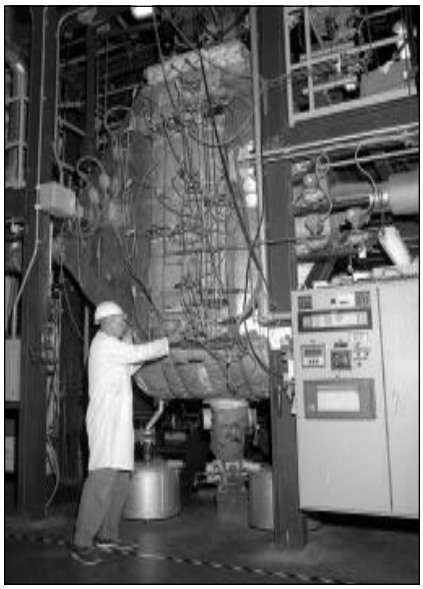
The Synthetic Fuels Act of 1944 paved the way for the Bureau of Mines (BOM) to establish a fossil energy in-house R&D program that first took root at the University of West Virginia in Morgantown in 1946. The BOM synthetic fuels research — looking for new forms of energy, particularly gas and oil substitutes — expanded its R&D portfolio by opening offices in Pittsburgh a year later. Pittsburgh activities included combustion and environmental aspects of fossil fuels. In the late 1950s, the Morgantown site performed pioneering work on entrained gasification that influenced the design of commercial gasifiers that are used today. In the 1950s and 1960s work on cleanup of sulfur-containing gases in coal combustion flue gas and in fuel gases (so-called sour gases) made from coal was performed by Pittsburgh researchers. The fuel gas cleanup technology realized commercialization by the Benfield Corporation, which became a major supplier of sour gas cleanup equipment throughout the world. Both sites, which were operating as the Morgantown Energy Research Center and the Pittsburgh Energy Research Center by 1975, became Energy Technology Centers in 1977 under the newly created Department of Energy. In 1996, the two centers were combined to form FETC — one organization with a single management structure.

In response to increasingly stringent standards on pollution emissions and concerns about global climate change, a significant number of FETC's in-house R&D programs now focus on responding to "Vision 21" goals. Vision 21 seeks

*See "FETC" on page 2...*

....FETC continued

to develop a portfolio of technologies that can be integrated into powerplexes. These powerplexes would use a multiplicity of fuels (coal, biomass, petroleum coke, wastes) to produce numerous commodities (electricity, steam, clean fuels, chemicals) with near-zero pollutant emissions at efficiencies



*Side view of the Moving-Bed Absorber. This unit was used to develop the Moving-Bed Copper Oxide Process.*

greater than 60 percent. Coupled with carbon sequestration (a Vision 21 enabling technology designed to capture and permanently store carbon dioxide and other greenhouse gases), a Vision 21 energy facility would provide no environmental impact outside of its "footprint." Vision 21 builds on previous Office of Fossil Energy work and programs, such as the Clean Coal Technology Demonstration Program, which have made progress in advanced technologies such as integrated gasification combined-cycle, fluidized-bed combustion, indirect fired cycles, fuel cells, and gas turbines. To achieve Vision 21 goals, additional R&D has been identified in key core technology areas: fuel-flexible gasification, high-performance combustion, fuel cell/turbine hybrids, gas separation, and syngas conversion technologies. Enabling technology research areas include materials, catalysts and sorbents, instrumentation, "virtual" plants, and carbon sequestration.

FETC's Office of Science and Technology (OST) directs in-house R&D. Some 280 engineers, scientists, and technicians perform hands-on research and development in combustion, gasification, flue gas cleanup, liquefaction, and solids separation at nine on-site facilities (see box on next page), and assist with R&D at three off-site facilities. Larger-scale work is routinely contracted off-site because of the space, equipment, and cost requirements. In fiscal year 1998 alone, these researchers received seven patents, and filed for still another seven.

## RECENT ACCOMPLISHMENTS

Over the last three years, OST has tested several regenerable sorbent flue-gas cleanup processes in support of the Advanced Research and Environmental Technologies (AR&ET) Program. A key thrust of the program is the development of cost-effective retrofit environmental control technologies for utility boiler combustion systems. A promising process developed at FETC is the Moving Bed Copper Oxide Process, which converts $SO_2$ and $NO_x$ into salable by-products. The process is being scaled-up for utility applications as part of a Low Emissions Boiler Systems contract.

Other OST work includes developing both fluid/transport-bed and moving-bed desulfurization regenerable sorbents for coal gasification applications. The moving-bed version of this sorbent system is the only one that meets all performance criteria for the Tampa Electric Company's integrated gasification combined-cycle system, a Round III clean coal technology project. Also, computer modeling software is being developed for multi-phase transport of granular solids in a gas or liquid using an OST-created first principals code.

One of the goals of the Solids Fuels and Feedstocks Program (formerly the Coal Preparation Program) is to ensure a low-cost, environmentally acceptable supply of solid fuels and innovative carbon products. One OST-grown technology responds to this need by addressing the upgrading, handling, transportation, and storage problems associated with coal fines. Known as GranuFlow, the already patented process has the potential to greatly enhance today's coal-cleaning technologies and to remediate waste slurry ponds by recovering fine coal. Discarded coal becomes a free-flowing product that is easier to handle and store, even in extremely cold weather.

## DEVELOPING TECHNOLOGIES WITH PARTNERS

Because FETC's in-house R&D program is complemented by versatile, well-equipped first-class facilities, the Center is positioned to illustrate, chart, and forecast technological advancement of its own Fossil Energy (FE) systems and those of private companies and other agencies. It forms partnerships with outside organizations and aggressively pursues better, efficient ways of utilizing fossil energy, important to the industrial partner and to DOE's FE Program overall. Partnering with industry provides a fresh perspective on FE-related research and leverages DOE research dollars. Two examples of successful OST partnering efforts are:

*Advanced Turbine Systems (ATS):* The ATS Program, which directly feeds into Vision 21, is striving to develop ultra-high efficient and su-

per clean turbine systems while decreasing the cost of generating electricity by 10 percent. With partners from private industry, OST develops active and semi-passive control strategies to reduce combustion instabilities, or exploit pulsed-combustion mechanisms in lean, pre-mix gas turbines, thereby improving efficiency and reducing emissions. Fuel cell efficiency can also be increased through these strategies as OST develops a gas-phase reactor for use in conjunction with a gas turbine to fully burn and utilize the hydrogen and carbon monoxide that remain unreacted in the fuel cell. Computerized gas-flow simulations are being studied as well to improve the performance of the fuel cell/advanced turbine hybrid system. Several patents are pending or have been issued for this work.

*Integrated Gasification Combined Cycle/Pressurized Fluidized-Bed Combustion:* These programs rely on the transfer and handling of large quantities of fine solids. OST's Circulating Fluidized-Bed Cold Model simulates fully integrated operations for solids transfer and control systems. The facility is equipped with non-mechanical valves because conventional valves cannot withstand extreme operating conditions associated with transporting solids from commercial-scale, coal-conversion processes. Through a Cooperative Research and Development Agreement (CRADA) with M.W. Kellog, OST tests various types of non-mechanical valves, provided by theDOE Power Systems Development Facility in Wilsonville, Alabama.

## WHAT'S NEXT

A fairly new effort within OST centers around a human health issue: monitoring, analyzing, and eventually controlling minute airborne particles. Ambient particulate matter finer than 2.5 microns ($PM_{2.5}$) is a concern being addressed by a U.S. Environmental Protection Agency (EPA) rule and the Advanced Research & Environmental Technology Program. FETC, in collaboration with the EPA, Electric Power Research Institute, industry, states, and academia, will set up air sampling stations throughout the nation to gather data that will ultimately be used to identify how these fine particles are formed. OST is installing and will operate monitoring equipment on the FETC grounds. OST will analyze samples obtained from its equipment and participate in the analysis of samples from other monitoring sites.

As mentioned previously, a major research opportunity lies in carbon sequestration. FETC has worked with industry and assumed a key role in analyzing ways of safely storing $CO_2$ in the ground, injecting the gas into brine fields to enhance oil recovery, tapping saline reservoirs, and, to a lesser extent, evaluating deep ocean injection. OST will use its high-pressure water-tunnel facility to simulate the effects the ocean may have on forming $CO_2$ hydrates.

During the next few years, OST expects to perform more applied and exploratory research while doing less proof-of-concept research. This shift in emphasis is anticipated because of projected decreases in FE-program budgets. Research efforts are expected to become more involved with advanced distributed power systems, transportation fuels, gas hydrates, sequestration, biofuels, and global climate change mitigation. Partnerships among OST, states, and industry will multiply, particularly as mining waste remediation and related environmental issues gain more prominence in the future.

*A number of specialized research facilities supported by FETC are available for cooperative work with industry and universities.*

### FETC USER FACILITIES

- Combustion and Environmental Research Facilities
- Computational and Simulation Facilities
- 500-lb/hr Coal Combustor
- Circulating Fluidized-Bed Coal Model
- Solid Fuels Process Research Facility
- Gas Desulfurization Laboratories
- Fluidized-Bed Gasifier
- Modular Gas Cleanup Rig
- Gas Process Development Unit
- High-Temperature Gas-Stream Cleanup Test Facility
- Dynamic Gas Turbine Combustor
- Low-Emissions Combustion Test and Research Facility
- 1-L Continuous Stir Test Reactor System
- Slurry-Bubble Column Facility

# R&D MILESTONE HIGHLIGHTS

## CO-PRODUCTION ENERGY PLANT DESIGN RELEASED

*The Program Research and Development Announcement (PRDA) for the Feasibility of an Early Entrance Co-Production Plant (EECP) was placed on the Federal Energy Technology Center's homepage on November 18, 1998, for comment.* The scope of the effort will include concept design, feasibility and market analysis, and supporting research leading to a preliminary design for a site-specific EECP facility. This facility would process multiple carbonaceous feedstocks including coal for producing clean power, transportation fuels, and/or chemicals. This activity is a forerunner of the Department's strategy for a new generation of modular energy plants called Vision 21. These new plants will be fuel flexible, highly efficient, and non-polluting. Vision 21 plants will be built for site-specific markets, and would produce combinations of highly efficient electric power and other products such as ultra-clean transportation fuels, chemicals, and hydrogen. Vision 21 plants also will offer the opportunity to close the carbon cycle, thereby significantly reducing the production of greenhouse gases. The solicitation will result in multiple awards that will be cost-shared between DOE and the private sector.

## PROCESS SYSTEMS DEVELOPMENT FACILITY

*The Process Systems Development Facility (PSDF) in Wilsonville, Alabama forges ahead with reactor system testing.* The third run of the transport reactor has just recently been completed under combustion conditions using two bituminous coals, one dolomite, and three limestones as feedstocks. In fact, one combination of bituminous coal and limestone (which was the same combination proposed for testing under the Lakeland clean coal technology project) recorded the longest continuous coal feed period at the PSDF, a record 382 hours. Also during this testing, operation of the coal feed and ash removal systems were significantly improved. Outstanding sulfur capture, at 97 percent, was achieved using two different limestones at calcium-to-sulfur ratios of about 1.6.

## $CO_2$ MINERAL SEQUESTRATION RESEARCH CLUSTER

*Researchers sponsored by a variety of Fossil Energy programs have established a $CO_2$ Mineral Sequestration "Research Cluster"* to better coordinate research and work toward common goals. The ability to sequester $CO_2$ is essential if the U.S. is to continue to utilize its vast coal resources. The research cluster is currently looking at carbonation of naturally occurring magnesium- and calcium-bearing minerals as a sequestration option. Carbonation may offer the potential for a highly stable long-term storage option for $CO_2$. In November 1998, a working group meeting was held at Albany Research Center where technical personnel from the Albany Research Center, Arizona State University, Federal Energy Technology Center, and Los Alamos National Laboratory met and produced a research framework and milestone schedule. The group identified major stakeholders and plans for sharing data among participants and producing a project prospectus.

## NEXT-GENERATION CHAR REACTIVITY MODEL

*As part of a FETC-sponsored effort, Brown University, in collaboration with Sandia National Laboratory, has developed the next-generation char reactivity model.* This model, which uses a liquid crystal approach to simulate coal structure, is intended to overcome the shortcomings of the empirically-based Arrehnius formulation currently employed in most combustion codes. The model has the ability to account for the interactions between combustion conditions, coal structure, and burning behavior. The research is the subject of a paper, "Kinetics of Orientational Order ... and Their Application to Carbon Material Synthesis," slated to appear in the December 1998 *Modeling and Simulation in Materials Science and Engineering*, an Institute of Physics journal. Publication of these developments recognizes the uniqueness of the approach being employed and its potential application to other systems, including liquid crystalline materials. It reaffirms coal as a material deserving of modern scientific inquiry.

# —PITTSBURGH COAL CONFERENCE—

## PANEL HIGHLIGHTS ASIA ENERGY PICTURE

The panel "Environmental Policy Concerns," at the Fifteenth Annual International Pittsburgh Coal Conference held in September 1998, made encouraging points about the future for coal use and CCTs in the Asia Pacific region in spite of the current financial crisis. The panel was moderated by Dr. C. Lowell Miller, director of DOE's Office of Coal Fuels and Industrial Systems. Panelist Charles J. Johnson, of the East-West Center in Hawaii, reported that coal now fuels some 45 percent of Asia's primary energy supply, while oil is the primary fuel outside of China and India. Johnson predicts that coal consumption in Asia would increase by a minimum of 75 percent between 1997 and 2020, even though coal's share of the total energy mix in Asia will decrease. He further expects that the current economic downturn will last only 2-3 years in countries where strong economic reforms are introduced.

According to Johnson, the long-term outlook for coal in Asia depends on the region's long-term ability to meet environmental constraints at prices competitive to other fuels. As to whether Asia will have the ability to meet environmental challenges, including greenhouse gas reduction, conference panelists noted progress, but agreed that Asians consider greenhouse gas emissions a relatively low priority. Particulate emissions, because of their immediate health dangers, receive most attention, followed by $SO_2$ and $NO_x$. Use of particulate controls (especially ESPs) is increasingly common, and Johnson predicts that levels will stabilize and begin a downward trend within 10-15 years. $SO_2$ similarly could be stabilized in 15-20 years, assuming current laws are enforced.

Johnson further estimates that the higher-income Asian countries will have 50 - 75 percent of new capacity equipped with $SO_2$ control after the year 2000. Less than 50 percent of China's new capacity will have such controls, but by sheer numbers China will be the major user of $SO_2$ controls.

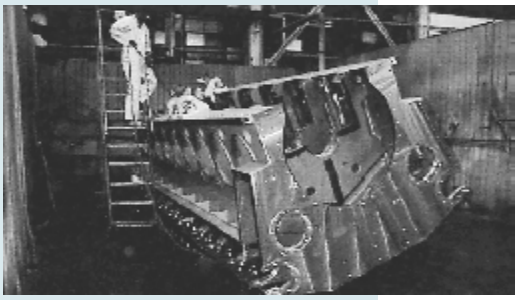
The panel agreed that the use of environmental controls increases when financing is provided by an international body, such as the World Bank or Asian Development Bank, and when IPPs are involved in a project. Miller cited an APEC survey "Atmospheric Emissions Regulations in APEC Economies and their Compliance at Coal-Fired Plants," which reports that atmospheric concentration limits are becoming more strict throughout the region and regulations are now being extended to included emissions at the stack. Xiaodong Wang, of the United Nations Development Program/Global Environmental Facility, noted that the Chinese government is giving increased attention to coal-related environmental problems by legislation and specific restrictions on coal use. In 1995, China passed a revision of its original 1987 "Prevention and Treatment of Air Pollution Law." The 1987 law regulated only particulates, while the new law also regulates $SO_2$ and $NO_x$ emissions from coal combustion. Additionally, new mines of high-sulfur and ash coal in China must now be accompanied by washing plants (currently only 20 percent of Chinese coal is washed). Under regulations to implement the law, new power plants burning 1 percent sulfur coal must install FGD, while plants over 3,000 MW must have $NO_x$ control. Wang noted that although the new environmental law is vague and not uniformally enforced, it provides a legal framework to allow for stricter air pollution control in the future.

In the discussion session that followed regarding $CO_2$, Johnson argued that developed countries should work with developing countries to establish energy efficiency goals coupled with technology transfer mechanisms for clean coal technologies. This was offered in lieu of the use of caps, to which developing countries object. Although stabilizing greenhouse gas emissions before 2020 appears unlikely due to lack of technology for household and small industrial emissions, the growth trajectory for $CO_2$ can be decreased through use of more efficient clean coal technologies, substitution to natural gas for coal, demand side management, and ultimately, $CO_2$ sequestration. According to Miller, manmade emissions of greenhouse gases could be reduced by 50 percent with widespread deployment of CCTs.

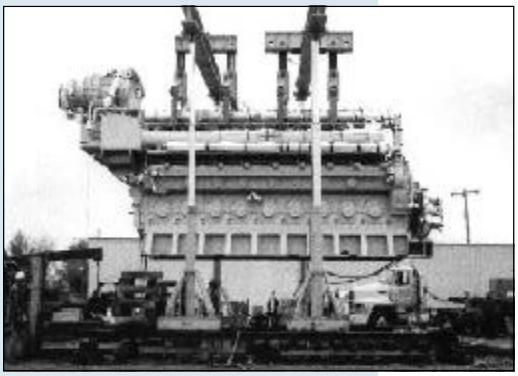
Johnson noted that the use of natural gas can be hindered by lack of government exploration incentives and inadequate infrastructure. Coal is expected to have an economic advantage in Japan, Taipei, Phillippines, South Korea, and China; and coal remains competitive in Indonesia, which lacks a natural gas infrastructure, and Vietnam, which blends coal and hyro power in the North (and uses gas in the South). China, Indonesia, and Vietnam have indigenous coal supplies. A natural gas pipeline is likely to be built in Indonesia, but to date the government has a strong pro-coal stance. Natural gas has the long-term advantage in Indonesia and Malaysia. Dr. Miller highlighted the potential of coal-biomass co-firing in IGCCs and fluidized bed combustors, particularly if they can cogenerate steam for district heating.

Conference Proceedings are available on CD-Rom for $30 plus shipping. Please contact the Pittsburgh Coal Conference at (412) 624-7440, phone, or (412) 624-1480 fax.

# COAL-FUELED DIESEL ON SCHEDULE FOR JANUARY 1999 DELIVERY TO FAIRBANKS, ALASKA



*Pielstick diesel engine block being cleaned prior to assembly in Beliot, Wisconsin.*



*Typical 18-cylinder engine lift and installation.*

*Concrete foundation to support the coal-diesel engine and generator being poured inside heated tent during subfreezing weather in Fairbanks.*

Delivery and installation of the Colt-Pielstick coal-diesel will culminate a 15 month cycle for the fabrication, shipping, and installation of this large 18-cylinder engine, as well as an intensive construction activity at the University of Alaska-Fairbanks(UAF) where the engine will operate. Fabrication (top photo) of the engine in Beloit, Wisconsin was completed in September, and dynamic testing completed in November 1998. In mid-December the engine is scheduled to travel 2,000 miles by train from Beloit to Seattle, Washington, some 800 miles by ocean barge to Anchorage, Alaska, and a final 500 miles by train to its final home in Fairbanks, Alaska. Special equipment (shown in middle photo) will be needed to hoist the 100-ton engine onto its 10 foot high concrete pedestal at the UAF power plant.

In preparation for the engine's arrival in January 1999, UAF personnel have been working quickly to complete the foundation and basic housing for the engine during the Alaskan short summer. With subfreezing weather arriving in early October, UAF had to install a heated tent around the engines' pedestal during the concrete pouring to insure the concrete cured correctly (bottom photo).

In the mid-1998, DOE gave final approval to Arthur D. Little (project participant) to complete final design and initiate construction on the 6.4-MWe coal diesel engine and a 100 ton-per-day Low Rank Coal Water Fuel (LRCWF) processing plant. The Coal Fired Diesel Demonstration Project, selected under Round V of the Clean Coal Technology (CCT) Program, consists of the design, construction, and operation of the 6.4-MWe, 18-cylinder diesel engine modified to operate on Alaska subbituminous coals.

The coal fired diesel will be fueled with a coal slurry prepared using an advanced coal drying process to produce LRCWF. The process allows the dried coal to be reduced to micron size and then slurried in water for injection into the diesel engine. The LRCWF is also an alternative to fuel oil in conventional oil-fired industrial boilers. The UAF is working with Arthur D. Little to install and operate the 18-cylinder coal-diesel engine and a retrofitted 5-MWe oil-fired boiler on LRCWF at their campus in Fairbanks, Alaska. The new engine would also provide black-start capability for the University.

The Coal Fired Diesel Project is the only power generating technology within the CCT Program for applications of 50 MWe or less. The technology is expected to operate at very low $NO_x$ and $SO_x$ emission levels (30 percent below current New Source Performance Standards). The demonstration plant is expected to achieve 41 percent efficiency, and future plants are anticipated to achieve 48 percent efficiency, resulting in 25 percent lower $CO_2$ emissions compared to conventional coal steam plants. The DOE NEPA

process was completed with the publication of an Environmental Assessment in May 1997 and a Finding of No Significant Impact in June 1997. All environmental permits have been received.

The Pielstick diesel engine, manufactured by Coltec Industries, has modifed fuel injectors, exhaust valves, and piston rings and a lubricating oil system to accommodate the abrasive wear of the LRCWF. DOE has been working with diesel manufactures to develop the technologies to harden these components since the mid 1980s. Coltec plans to use hard sapphire inserts in the injector tips, an advanced technology previously tested on smaller diesel engines manufactured by GE locomotive and Cooper-Cameron Inc., to reduce injector hole wear.

Team members working with Arthur D. Little, Inc. include: the University of Alaska, Alaska Science and Technology Foundation, Coltec Industries, and Usibelli Coal Co. The total value of the agreement is over $48 million, with DOE cost-sharing approximately $24 million. The objective of the demonstration is to obtain long-term (over 6,000 hours) durability data of a heavy-duty coal-diesel engine using LRCWF.

## BIOMASS/COAL CO-FIRING GAINING FAVOR WITHIN BIOMASS INDUSTRY

U.S. DOE's Office of Fossil Energy (FE) had a strong presence at the October BioEnergy '98 Conference in Madison, Wisconsin making a number of presentations. The Conference was sponsored by DOE's Great Lakes Regional Biomass Energy Program and the Council of Great Lakes Governors. Over 500 attendees participated in discussions of all aspects of the biomass industry, including waste utilization, agriculture/forestry, energy crops, biogas, biodiesel, ethanol, combustion, gasification, fuel cells, microturbines, and power generation. Of particular interest was a paper presentation and featured tour of Madison Gas & Electric's Blount Street Station. The Station successfully demonstrated switchgrass/coal co-firing during 1996-1997 and currently co-fires nonrecyclable paper/plastic waste, under an industry cost-shared cooperative agreement that FE started with the Electric Power Research Institute (EPRI).

A panel session included a representative of Northern Indiana Power Service Company (NIPSCO), who announced plans for a co-firing demonstration at the NIPSCO Bailly Station, site of the successful Pure Air on the Lake Clean Coal Technology Project. The project will take advantage of synergies between petroleum coke and clean urban wood waste. The NIPSCO Bailly Station co-firing demonstration is the direct result of a successful biomass/coal co-firing demonstration at the NIPSCO Michigan City Station under the DOE/EPRI Cooperative Agreement. The Agreement has recently received significant cofunding from DOE's Office of Energy Efficiency and Renewable Energy (EERE) Biomass Power Program to build upon FE's efforts. A representative from Foster Wheeler presented results from the NIPSCO Michigan City demonstration, while General Public Utilities (GPU) Genco outlined results of coal/sawdust co-firing at the Seward Station, which is now beginning a 3-year demonstration under the DOE/EPRI Cooperative Agreement.

Other FE-related projects discussed at the Conference included cyclone boiler coal/wood waste co-firing at the TVA Colbert Station, and an industrial stoker boiler demonstration at the Pittsburgh Brewing Company using shredded pallets and coal in a project led by the University of Pittsburgh with funding from the U.S. Department of Agriculture (USDA) Forest Service. Biomass/coal reburning technologies being developed by Energy and Environmental Research Corporation with cofunding from USDA, and a joint co-firing R&D project between researchers at FETC, Sandia National Laboratories-Livermore, and the National Renewable Energy Laboratory (NREL) were also discussed.

Of significance were comments from biomass stakeholders that promoted and reinforced advantages of co-firing with coal. High thermal efficiencies can be achieved at low costs while taking advantage of the existing infrastructure to meet practical needs of the U.S. power industry. These needs include reducing emissions, addressing possible renewable portfolio standards, adding capacity, and assisting regional development with energy crops and biomass waste residues. While this is consistent with what has been widely reported in DOE Laboratory and industry studies, such discussion within the biomass industry can help build the needed partnerships with coal utilities. An initiative to hold a BioEnergy Summit next year, announced by DOE/EERE at the conference, should provide a good opportunity to better align stakeholders with DOE efforts in technology development, programs, and partnering.

# INTERNATIONAL INITIATIVES

## APEC's Focus on Coal

On October 9-10, 1998, Energy Ministers of participating nations in the Asia Pacific Economic Cooperation (APEC) held their third meeting in Okinawa, Japan to consider policy issues, many of which are important to vendors of clean coal technologies and other fossil energy technologies in foreign markets. U.S. Energy Secretary Bill Richardson led the U.S. delegation. APEC was formed in 1989 to address issues of growing regional interdependence. Members include 18 countries bordering the Pacific Ocean with a combined Gross Domestic Product of $13 trillion in 1995. Concurrent with the Minister's meeting, the DOE Fossil Energy-led Experts Group on Clean Fossil Energy (part of the APEC's Energy Working Group) hosted its Sixth Annual Technical Seminar with a focus on practical oil, gas, and coal use technologies for developing economies.

Coal is of extreme importance to the Pacific Rim because of large indigenous supplies. In fact, an APEC-sponsored workshop last February in Honolulu, Hawaii, "Energy Security: Fuel Supplies for the Power Industry," concluded that coal would continue to play a significant role in the region's fuel mix. Natural gas was seen as desirable due to its environmental benefits and potential availability, while oil use in the power sector was not expected to grow.

The Energy Ministers first met in Sydney, Australia in August 1996, and in Edmonton, Canada, in August 1997. Each Minister's meeting finalizes a list of "declarations" including policy statements. Although not legally binding, the declarations show the direction in which most members wish to proceed. The Energy Working Group carries out the mandates of the Ministers and prepares a draft agenda for the following year. At Okinawa, Ministers considered a number of fossil energy-related issues from Sydney and Edmonton, as well as new initiatives.

Implications of the Asian financial crisis pervaded this year's discussions. Ministers agreed that energy can play a key role in economic recovery. Investment in infrastructure, a key goal, could induce a multiplier effect. In spite of the economic downturn and projected slower growth in demand, the region's demand for energy is expected to outpace energy production by a wide margin. The Asia Pacific Energy Resource Centre, established by the Energy Working Group, presented the Ministers with a new forecast, which predicts that total primary energy demand in the region will increase 41 percent over the period 1995-2010. This growth will require large amounts of investment capital. To reduce dependence on imported oil, APEC nations are interested in diversifying energy supplies, developing financing for power infrastructure, and encouraging energy efficiency.

The Ministers who met at Okinawa endorsed a work program (initiated at Edmonton) on environmentally sound infrastructure for all energy sources. Concerns are not only for environmentally sensitive siting, but maintenance practices and employee training. The goal of the work program is to provide impetus to the application of predictable, transparent, and consistent energy policy practices.

Policy recommendations to accelerate investment in natural gas infrastructure (part of the Natural Gas Initiative launched in Edmonton) were also approved. Recommendations were included in the report, "Accelerating Investment in Natural Gas Supplies, Infrastructure and Trading Networks in the APEC Region." The Initiative stresses not only the building of pipelines, but addressing regulatory and cross-border issues that may act as impediments.

Reducing costs through cooperation in energy standards was another endorsement by the Ministers that has potential bearing on coal and the standards for equipment to be sold. APEC members' economies have been surveyed to determine the range of testing practices and procedures and the degree of mutual recognition of facility test results. The standards notification provision endorsed by the Ministers would increase transparency and consistency in energy efficient product standards within APEC. To improve energy efficiency, Ministers

also endorsed a voluntary "pledge and review" system. Energy efficiency means not only "green" technologies, but better use of conventional fossil fuel resources.

Although APEC is an organization of government representatives, the Energy Ministers have directed the Energy Working Group (EWG) to expeditiously engage with businesses on measures to improve investor confidence in APEC nations' energy sectors. The EWG has established a Business Network comprising two private sector energy executives from each member economy. The Ministers instructed the EWG to work with industry to implement the principles in the "APEC Manual of Best Practice Principles for IPPs," which was endorsed at Edmonton.

DOE's delegation to the EWG is led by David J. Jhirad. He is assisted in this activity by George Zeigler (george.zeigler@hq.doe.gov). Information on the EWG (and APEC) also can be obtained from the EWG home page (http://www.dpie.gov.au/resources.energy/apec/activities.html). The next APEC coal workshop open to the public is the Coal Flow Seminar, to be held in Yohohama, Japan, February 1999.

## FE SUPPORTS TAIWAN, CHINA'S CCT PROJECTS

*Key U.S. and Taiwan team members met on developing followup activities. Seated (L-R) Dr. M.W. Gilliland, Tulane University; Dr. R.S. Lin, National Taiwan University; Dr. W. W. Clark, Jr., Lawrence Livermore National Laboratory. Standing (L-R) S.T. Hsien, Tulane University; Dr. J.S. Chern, Energy Commission, Ministry of Economic Affairs, Taiwan; T. Atwood, U.S.DOE/FE; Dr. B. Hsieh, U.S.DOE/FETC; Dr. F. Lau, Institute of Gas Technology, U.S.A.; L. Saroff, U.S.DOE/FE.*

Agreements are being prepared with Taiwan, China allowing the DOE Office of Fossil Energy (FE) to provide technical expertise, training, and scientific exchange activities in the areas of clean coal technology, coal utilization, and waste and by-product utilization. A major expected outcome includes FE technical support for an IGCC pre-feasibility study. FE would advise Taiwan on project financing (a mix of Taiwan government and private funding), plant siting, and technology selection. The agreement would first be signed between FE and the Taipei Economic and Cultural Representative Office (TECRO), and then between the Energy Commission of the Ministry of Economic Affairs and the American Institute in Taiwan. After the agreements are finalized, both Taiwan, China and the United States hope to branch out into other cooperative work — fuel cell development, independent power production, rural electrification, computer modeling for energy policy decisions, environmental management, cement and steel factory cleanup, and paper mill waste treatment. Tulane University's U.S./China Institute has been active in coordinating and supporting FE efforts on these agreements.

FE began working a year and-a-half ago with Taiwan to promote adoption of clean coal technologies. Taiwan imports about 96 percent of its primary energy — mostly oil, coal, and liquefied natural gas. The country seeks to develop a long-term energy policy and emissions control strategy, preferably regional in scope.

Last April, National Taiwan University organized a Clean Coal Technology Workshop in Taipei, with funding from the Taiwan Environmental Protection Administration and Tulane University's U.S./China Institute. In addition to local speakers and speakers from Hong Kong University of Science and Technology, 15 U.S. experts from various parts of DOE (including FETC and FE headquarters), the U.S. Environmental Protection Agency, and industry groups gave presentations. Topics addressed by U.S. speakers included regional air pollution and health, advancement of CCTs including the IGCC technology, U.S. DOE's

*See "Taiwan" on page 10 ...*

*...Taiwan continued*

Combustion 2000 Program, environmental control technologies, and modeling the commercial potential and environmental impacts of new technology. Three DOE-developed models were presented: RAINS-Asial (Argonne), MARKA-MACRO (Brookhaven), and META*Net (Lawrence Livermore).

Workshop participants agreed to work as a team to develop a strategy for regional cooperation in energy and environmental planning. Participants also agreed on a policy recommendation for Taiwan's National Energy Conference (held the following month) recognizing the value of IGCC. Because of its efficiency and environmental advantages, IGCC will be a preferred technology for new plants and to replace conventional coal-fired plants. The FE team was one of the few foreign groups invited to the high-level conference, which was organized by the Ministry of Economic Affairs.

The conference emphasized energy policy and the adjustment of the energy mix to address the major issue of global climate change and international $CO_2$ reduction. At the conference closing, the Premier of Taiwan proposed policy measures to limit nuclear power plant buildup until 2010, and allocate 10 billion NT dollars (equivalent to more than US $300 million) over the next five years to implement energy conservation and develop new clean energy technologies. For the mid-term, Taiwan would slightly increase coal use.

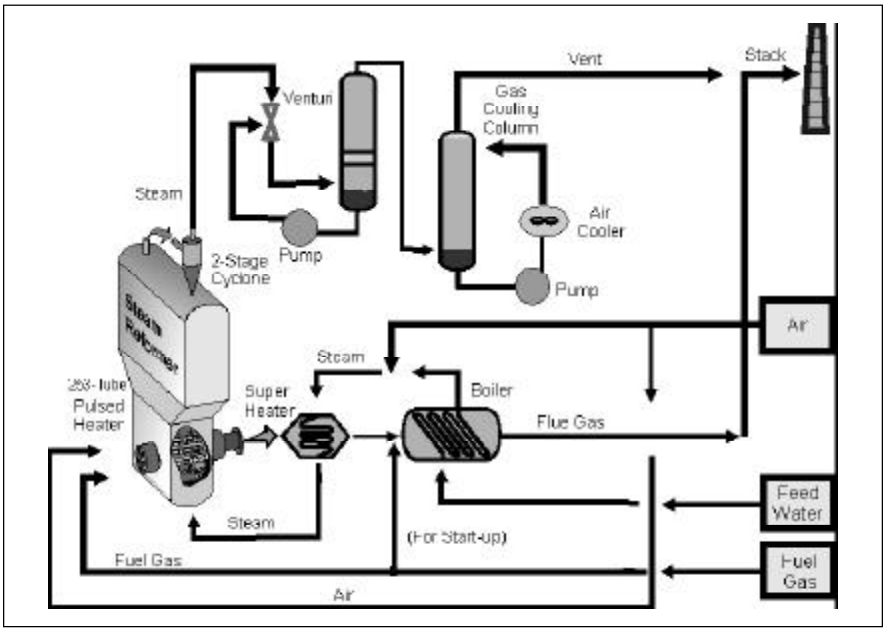
# THERMOCHEM, INC. CCT-IV PROJECT REVISED

On September 10, 1998, the Acting Assistant Secretary for Fossil Energy approved the revision of ThermoChem, Inc.'s CCT-IV Cooperative Agreement for a scaled-down, 16-month clean coal technology project titled "Pulse Combustor Design Qualification Test." The project initially proposed was a commercial demonstration facility that would employ 10 identical 253-resonance-tube pulse combustion units. After fabrication of the first combustor unit, the project went through restructuring. The revised project will instead demonstrate the operational readiness/commercial viability of a single 253-resonance tube pulse combustor unit. All project testing will be performed at the Manufacturing and Technology Conversion International, Inc. (MTCI) test facility in Baltimore, Maryland.

This project will demonstrate MTCI's fluidized-bed gasifier concept, which incorporates an indirect heating process for thermochemical steam gasification of coal to produce hydrogen-rich, clean, medium-Btu content fuel gas without the need for an oxygen plant. Indirect heat transfer is provided by the multiple resonance tube pulse combustor by immersing the combustor tubes in the fluidized bed of the steam gasification reactor. Pulse combustion increases heat transfer rate by a factor of 3 to 5, thus greatly reducing the heat transfer area required in the gasifier. The revised project will demonstrate the effectiveness of the combustor fabricated by the sponsor.

The pulse combustor is the most critical element of the process because it provides a highly efficient and cost-effective heat source for the fluidized bed, steam-reforming gasification reactor. Demonstrating the existing resonance tube pulse combustor is essential to commercializing the technology, and this scaled-up, 253-resonance tube pulse combustor is 3.5 times larger than any previously operated by ThermoChem, Inc.

The project will demonstrate operation of the pulse combustor with natural gas as the fuel. A key parameter to be verified is the scale-up criteria used



in designing the 253-tube resonance tube pulse combustor. Appropriate controls and instrumentation requirements must also be established and operationally verified. A smaller, existing Process Data Unit (PDU) available for testing the pulse combustion technology will be employed to gasify coal feedstock to provide fuel gas data, including energy content, species concentration, and yield. This PDU will also provide data on char produced by the process.

Total estimated cost of the project is $8.6 million, with DOE cost-sharing 50 percent ($4.3 million). A commercial client has indicated an interest in the technology using a specific coal, which will likely influence the coal feedstock selection for the initial test program. The first major milestone is completion of the design task by early 1999. NEPA requirements were satisfied on November 30, 1998, with a Categorical Exclusion.

**CLEAN COAL TODAY**

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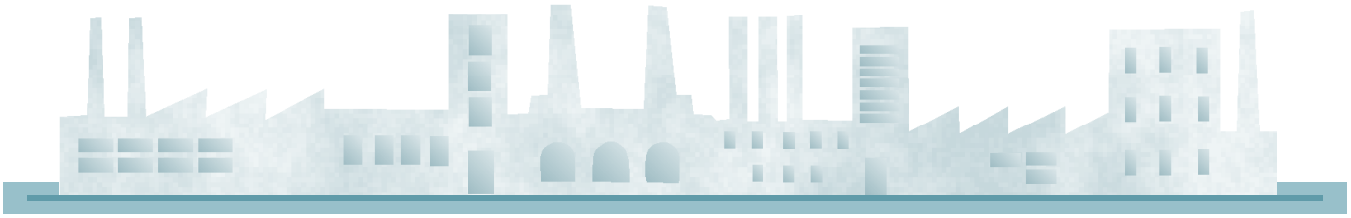

*...News Bytes continued*

LPMEOH™ Reactor has been exceeded without indications of mass transfer limitations. Since restarting with fresh catalyst in December 1997, the demonstration facility has operated at greater than 99 percent availability, including two record-setting periods of uninterrupted operation — 65 days through April 1998 and 94 days through October 1998. The production rate has reached 77,000 gallons per day. Catalyst life has met or exceeded the design target for operation in the environment of trace poisons present in coal-derived synthesis gas. Process variable studies are ongoing to maximize the reactor volumetric productivity and determine the long-term catalyst performance. Since startup, the demonstration facility has produced over 29 million gallons of methanol, all of which has been accepted by Eastman Chemical Company for use in downstream chemical processes.

The **Clean Power from Integrated Coal/Ore Reduction** (CPICOR™) Clean Coal Technology project being conducted at the Geneva Steel facility in Vineyard, Utah has changed the technology to be used for direct ironmaking. With DOE's concurrence, the CPICOR™ Management Company (CMC) changed the primary direct ironmaking vendor from Voest Alpine Industrienlagenbau (VAI), owner of COREX® technology, to Rio Tinto Group of Australia, owner of HIsmelt® technology. The switch to HIsmelt® technology means a large oxygen plant and combined cycle technology are no longer included in the project. The HIsmelt® Process is currently being operated / developed at a 100,000 metric tons-per-year plant near Perth, Australia. The HIsmelt® Process is completely cokeless and will operate on a large variety of coals and ores. The CPICOR™ Demonstration will produce 3,000 metric tons per day of liquid iron for direct steelmaking and approximately 170 MWe of by-product power. Project completion is scheduled for December 2004.

On September 22, 1998, **NOXSO Corporation** announced its failure to raise the $15-$18 million in additional equity financing requisite for continuing the Commercial Demonstration of the NOXSO $SO_2/NO_x$ Removal Flue Gas Cleanup System. In the absence of sufficient resources to continue operations, plans are to liquidate the assets of NOXSO. However, the project is considered to be active because it is an asset being auctioned.

Tanoma Coal Sales, Inc., under the name of Laurel Energy L.P., of Latrobe, Pennsylvania, had offered to purchase the **Custom Coals International Self-Scrubbing Coal™** Laurel facility, and continue the project. However, the firm was unable to reach agreement with the Pennsylvania Department of Environmental Protection regarding environmental liabilities. DOE approved the continuation and completion of the project with Laurel Energy L.P., but Laurel Energy has since rescinded the offer to purchase the Laurel facility. On December 16, 1998, the Laurel facility and site were auctioned off to C.J. Betters of Aliquippa, Pennsylvania. As in the case of NOXSO, this project is still deemed to be active.

## UPCOMING EVENTS

**March 16-18, 1999 — *Historically Black Colleges and Universities Private Sector R&D Technology Transfer Symposium***
*Location:* Miami, FL
*Co-Sponsors:* U.S. DOE, and Florida International University
*Contact:* Bill Chisholm
*Phone:* (304) 285-4730
*e-mail:* wchish@fetc.doe.gov

**March 8-11, 1999 — *24th International Technical Conference on Coal Utilization & Fuel Systems***
*Location:* Clearwater, FL
*Co-Sponsors:* ASME-FACT,CSTA, and U.S. DOE, in cooperation with FETC
*Contact:* Barbara Sakkestad, CSTA
*Phone:* (202) 296-1133
Fax: (202) 223-3504
*e-mail:* barbarasak@aol.com

**May 18, 1999 — *Conference on Unburned Carbon in Utility Flyash***
*Location:* Pittsburgh, PA
*Sponsor:* FETC
*Contact:* Karen Lockhart
*Phone:* (412) 892-4763

**May 19, 1999 — *Conference on Reburning for $NO_x$ Control***
*Location:* Pittsburgh, PA
*Sponsor:* FETC
*Contact:* Karen Lockhart
*Phone:* (412) 892-4763

**May 20-21, 1999 — *Conference on Selective Catalytic and Non-Catalytic Reduction for $NO_x$***
*Location:* Pittsburgh, PA
*Sponsor:* FETC
*Contact:* Karen Lockhart
*Phone:* (412) 892-4763

**June 21-24, 1999 — *Seventh Clean Coal Technology Conference***
*Location:* Knoxville, TN
*Co-Sponsors:* U.S. DOE, CEED, CIBO, EPRI, NMA
*Contact:* Faith Cline
*Phone:* (202) 586-7920
*Fax:* (202) 586-8488
*e-mail:* faith.cline@hq.doe.gov

# SEVENTH CLEAN COAL TECHNOLOGY CONFERENCE

It is time to mark your calendars for the Seventh Clean Coal Technology Conference, to be held at the Hyatt Regency Knoxville in Knoxville, Tennessee on June 21-24, 1999. This year's theme is ***21st Century Coal Utilization: Prospects for Economic Viability, Global Prosperity, and a Cleaner Environment***. The program will focus on the ability of clean coal technologies (CCTs) to ensure continued use of coal as an essential component of the United States' energy supply. Included will be a site tour of the Liquid Phase Methanol Project, hosted by Air Products Liquid Phase Conversion Company, L.P.

Application of CCTs will ensure coal's place in satisfying the growing demand for energy, while continuing to meet increasing environmental demands and remaining competitive in domestic and international markets. Speakers will address environmental, economic, social, and technical issues associated with satisfying the growing global energy demand, and will identify approaches that will help enable CCTs to resolve those issues and eliminate the impediments to deployment. Recognition will be given to the dynamic changes that are resulting from both domestically and internationally increased competition in electricity and fuel markets, restructuring of global utility industries, and global climate change initiatives.

The near-term commercial potential of CCTs has progressed significantly over the past 12 years of focused industry/government partnership — the DOE Clean Coal Technology Demonstration Program. At the same time, the U.S. DOE Clean Coal R&D Program continues to develop innovative, advanced technologies that hold the promise of providing energy from fossil fuels in the longer term. Imaginative concepts such as Vision 21 now focus the investigative effort on developing new technologies to address the environmental, economic, social, and market conditions anticipated in the near future. This Conference provides a forum to discuss benchmark issues and the role as well as the need for these technologies in the next millennium.

For information about the Conference and registration, contact Ms. Faith Cline by phone (202-586-7920), facsimile (202-586-8488), or by e-mail (faith.cline@hq.doe.gov). Future updates will be placed on the DOE Fossil Energy Home Page (http://www.fe.doe.gov/cleancoal/).

For hotel reservations, contact the Hyatt Regency Knoxville (800-233-1234). A block of guest rooms has been reserved at a special Conference rate of $79.00 per night plus tax; to guarantee this rate, reservations must be made by May 14, 1999.

# STATUS OF ACTIVE 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 is complete. A Draft Final Report for Phase 4 has been approved. (Coosa, GA)

**New York State Electric & Gas** – *Milliken Clean Coal Technology Demonstration Project.* All testing has been completed. The final report is in preparation and is scheduled to begin review in late December. The report should be published by the end of the first quarter of 1999. The project was a complete success. All demonstration goals were met or exceeded. The unit is currently in operation and is scheduled to stay in operation as part of the plant's compliance strategy. (Lansing, NY)

**New York State Electric & Gas** – *Micronized Coal Reburning Demonstration for $NO_x$ Control.* All testing has been completed at the Kodak site in Rochester, New York. The goals and objectives for the Kodak site have been met or exceeded. The system is in operation and will remain in operation, allowing Kodak to effectively reduce $NO_x$ in accordance with their agreement with the State of New York. Testing at the Milliken site is still ongoing. Final testing is scheduled to commence in Mid December 1998 and complete before the end of March 1999. The final report should be published by late summer of 1999. (Lansing, NY and Rochester, NY)

**NOXSO Corporation** – *Commercial demonstration of the NOXSO $SO_2$/$NO_x$ Removal Flue Gas Cleanup System.* Project is on hold pending results of bankruptcy proceedings.

## 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.* These projects have been restructured and resited to Lakeland, Florida. The City of Lakeland continues to negotiate with Foster Wheeler on the turnkey contract. (Lakeland, FL)

**Jacksonville Electric Authority (JEA)** (formerly York County Energy Partners) – *ACFB Demonstration Project.* On September 29, 1997, DOE signed an agreement with Jacksonville 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, followed by two years of operations. Activities are underway to draft an Environmental Impact Statement. (Jacksonville, FL)

**Clean Energy Partners, L.P.** – *Clean Energy Demonstration Project.* Clean Energy Partners (CEP) has begun specific project definition, preliminary design, and permitting activities. This will be a two-stage repowering activity on a coal-fired station owned by the AMEREN Holding Company located in Illinois. The Project will be designed to use locally mined Illinois Basin high-sulfur coals. DOE has approved this site and will begin the NEPA process in early 1999. (St. Louis, MO).

**Sierra Pacific Power Co.** – *Piñon Pine IGCC Power Project.* This project continues to make progress achieving integrated operation of all systems. Since all major systems are first-of-a-kind technologies, any perturbations impact the total plant operation. Earlier problems with the "Fines Handling" system have been resolved after new solids level measuring devices were installed. Recent upsets in the combustion turbine impacted operation of the power island for approximately three weeks. The gasifier continues to operate smoothly through numerous startup-turndown cycles with reproducible production of specification quality syngas. The plant continues to operate normally in the gas combined cycle mode. (Reno, NV)

**Tampa Electric Co.** – *Tampa Electric Integrated Gasification Combined-Cycle Project.* Tampa's Polk Power Station has completed two years of successful commercial operation. As of the end of the third quarter of 1998, the unit has achieved an over 70% gasifier on-stream factor, the gasifier has operated 9,948 hours, and the combustion turbine has operated 8,831 hours, producing over 2,623,000 MWH. The gasifier and combustion turbine set continuous operating records of over 49 and 51 days respectively. (Mulberry, FL)

**Wabash River Joint Venture** – *Wabash River Coal Gasification Repowering Project.* The Wabash River Coal Gasification facility is currently running solidly at full load. Setting production records is becoming more routine indicating that the technology is maturing. Some of the initial technical difficulties with the first commercial application of several novel technologies have been resolved. The technology is currently in a state where it is ready to move into commercial operation; however, there is a need to improve the availability and capacity of the facility. The Cooperative Agreement requires a 39 month Demonstration Period scheduled to terminate on February 28, 1999. The Joint Venture Manager has requested a "No Cost" time extension to the Cooperative Agreement, which will extend the period of performance to May 31, 1999. The request will enable the participants to improve the availability and capacity of the facility. The request for a "No Cost" time extension is being evaluated at this time. (West Terre Haute, IN)

**Alaska Industrial Development and Export Authority** – *Healy Clean Coal Project.* Operation of the Healy Clean Coal Project continued into the fall with encouraging results. A slag buildup problem in the plant's precombustors that was experienced when feeding a 50/50 blend of run-of-mine and waste coal was solved by modifications to improve mixing in the precombustors and improved coal pile management. Since the modifications, precombustor slag buildup has not caused any unplanned outages. Emissions from the plant continue to be within permit levels when operating at full load, or 62 MW (gross). The Demonstration Test Program includes performance guarantee tests, environmental compliance tests, major system characterization tests, and integrated commercial operating tests. (Healy, AK)

**Arthur D. Little, Inc.** – *Coal-Fueled Diesel Engine Demonstration Project.* As of December 1, 1998, construction of the engine facilities building is 40% complete. Completion of the building is timed for the arrival of the engine at Fairbanks in late January. This one month slippage in delivery of the engine will not impact the demonstration testing. (Fairbanks, AK)

## COAL PROCESSING FOR CLEAN FUELS

**Custom Coals International** - *Self Scrubbing Coal™: An Integrated Approach to Clean Air*. Status of project is on hold pending results of the recent sale of the facility. (Central City, PA; Martin 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 1.3 million tons of SynCoal® product to date. Nearly 1.3 million tons has been supplied to customers, including industries (primarily cement and lime plants) and utilities. Rosebud SynCoal Partnership has signed a letter agreement with Montana Power Company's Colstrip Unit No. 2 to design, install, commission and operate a pneumatic injection system for Colstrip Unit No. 2. The Unit 2 SynCoal Fuel Project would inject SynCoal® product on a steady basis to Colstrip Unit No. 2. Construction is nearly complete with anticipated start-up in January 1999. (Colstrip, MT)

**Air Products Liquid Phase Conversion Company, L.P.** – *Liquid Phase Methanol Process Demonstration Project.* The Liquid Phase Methanol (LPMEOH™) Process Demonstration Facility completed a record-setting 94-day period of continuous, stable operation on coal-derived synthesis gas this fall. The production rate has reached 77,000 gal/day. The reactor was operated at a temperature of 235°C, somewhat lower than the design temperature 250°C. Over this operational period, the rate of decline in catalyst activity has either met or exceeded the design target of 0.4 percent per day. Fresh catalyst additions made to the reactor increased the catalyst loading to over 135 percent of design. Process variable studies are currently underway. Since being restarted with fresh catalyst in December 1997, the demonstration facility has operated at greater than 99 percent availability. (Kingsport, TN)

## INDUSTRIAL APPLICATIONS

**Bethlehem Steel Corporation** – *Blast Furnace Granulated Coal Injection System Project.* The "western coal trial" was initiated with the Sanborn coal, which is a Colorado "B" seam coal. During September 1998, the operation of both C and D furnaces was difficult because of a higher incidence of both scheduled and non-scheduled delay periods not related to the Sanborn coal. In late October, the Sanborn coal supply was getting low and a baseline had not been established for the C furnace with granular coal, so a decision was made to obtain the pulverized data on the D furnace since a baseline had been established for the D furnace using Sanborn granular coal. Early in the pulverized portion of the "Western Coal Trial," the grinding mill developed mechanical problems and the D furnace was receiving over-sized coal. The grinding mill is being investigated at this time; however, the coal supply is getting low and researchers are attempting to stretch the coal supply by decreasing the coal input as far as possible without adversely affecting the furnace. (Burns Harbor, IN)

**CPICOR™ Management Company, L.L.C.** – *Clean Power From Integrated Coal/Ore Reduction.* CPICOR™ has begun specific project definition, preliminary design, and permitting activities for a nominal 3,000 metric ton-per-day liquid metal direct iron reduction project using the HIsmelt® Process. HIsmelt is an Australian-developed technology licensed by Rio Tinto. A large pilot plant near Perth, Australia, has convincingly shown that this technology will readily use a variety of raw iron ores, reverts, and raw coals including the low rank forms found in the western United States. The thermal and steam output from the direct iron reduction process will be used to produce approximately 170 MWe of power. DOE has approved incorporation of this new technology into this project, and the NEPA process will begin in early 1999. (Vineyard, UT)

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