

Clean Coal Today

An Update of the U.S. Clean Coal Technology Demonstration Program

Office of Fossil Energy, U.S. Department of Energy

Clean Coal Briefs

Plans are moving ahead for the **Third Annual Clean Coal Technology Conference**, which will be held at the Chicago Hilton and Towers, Chicago, IL, September 6-8, 1994. **The Center for Energy & Economic Development (CEED)** will cosponsor the conference with the **U.S. Department of Energy**. Please contact Kim Yavorsky at (412) 892-6244 for further information.

At this time, limited copies of the **Proceedings for the First and Second Conferences** are available for distribution until supplies are exhausted. Please submit your name, organization, title and address by Fax to A. Strom (301) 903-9438. The Proceedings are also available from NTIS, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161 (Conf 920979 & Conf 9309152).

The Clean Coal Technology Program has reached its mid-point. Results are coming in from most of the 22 retrofit projects from the first three rounds, and the technologies are taking their first steps toward the commercial marketplace. At the same time, the ground is being laid for construction of a new generation of advanced power generation projects.

Details of the progress of many of the Clean Coal Technology projects are

See "Briefs" on page 8 . . .

In This Issue

Rosebud Project	1
Briefs	1
Wabash River Project	4
LPMEOH™ Project	5
ENCOAL Project	6
Project Status	9
Upcoming Events	12
Reports	12

Birth of a New Industry

SynCoal™ Burn Tests Spawn Commercial Studies

COLSTRIP, MT - A state-of-the-art clean coal technology processing facility in eastern Montana may be the birthplace of a new industry which will expand markets for low-rank coal while helping electric utilities meet the strict air quality standards of the Clean Air Amendments of 1990.

This clean coal technology facility produces a product known as SynCoal™. As an advanced technique for boosting the heating value of low-rank coal, the SynCoal™ process increases Btu value by as much as 60 percent while reducing sulfur content by at least one-half. The SynCoal™ technology is now approaching the commercial threshold. Successful tests of the SynCoal™ low-rank coal upgrading process have led to the signing of a letter of intent between Rosebud SynCoal Partnership and Minnkota Power Cooperative, a North Dakota utility.

Tests, in which Center, North Dakota lignite was processed, upgraded the heating value of the lignite from under 7,000 Btu/lb to nearly 11,000 Btu/lb while also reducing the sulfur content. The upgraded lignite SynCoal™ was test burned at Minnkota's Milton R. Young Power Station, demonstrating both improved combustion and reduced slagging results. The letter of intent came to fruition based on these very successful tests.

The potential landmark agreement calls for a \$2 million study to examine the merits of scaling up the advanced clean coal technology to an \$80 million

See "SynCoal™" on page 2 . . .



Rosebud SynCoal™ 1,000 tons-per-day advanced coal upgrading facility located in Colstrip, MT.

... "SynCoal™" from page 1

commercial plant that would be sited next to Minnkota's M.R. Young Power Station near Center, North Dakota. Minnkota and Rosebud decided to carry out the commercial feasibility study to confirm the likelihood that the advanced coal technology could further improve the operations of the Young Power Station, already one of the lowest cost electric generating plants in the nation. The engineering and design study will be completed in mid-1994. If the results prove positive, a commercial plant could be in place by late 1996.

In other project activities, a 21-day test-burn of a SynCoal™ blend was completed in March at the 160-MWe J.E. Corette plant in Billings, Montana. This first long-term test-burn of SynCoal™ utilized a blend consisting of 50 percent SynCoal and 50 percent raw coal from the Rosebud mine in Colstrip, Montana. The test-burn was preceded by handling tests conducted on shipments of up to 9,000 tons-per-week of the blend. The objective of the test-burn was to identify and quantify the effects of burning this blend on the overall operation and emissions of the Corette plant. These effects were documented using existing plant instrumentation, coal and ash sample analysis, and stack

testing. Throughout the test-burn the plant was operated normally at a base load of 160 gross megawatts. No special handling or treatment of the blend was carried out at the plant and there were no problems experienced. SO₂ emissions at the plant fell from 1.4 lbs/MM Btu to 1.1 lbs/MM Btu. Additional long-term test burns are planned to start with other midwest utilities when analysis of this run is completed.

This commercial application of SynCoal™ was all made possible through the original demonstration of the process in the DOE Clean Coal Technology Program. Western Energy Company developed the technology and originally signed the cooperative agreement with DOE to build the demonstration plant under the first round of the Clean Coal Technology Program. Subsequently, Western Energy (a subsidiary of the Montana Power Company), joined with the NRG Group (a subsidiary of Northern States Power Company), to form the Rosebud SynCoal Partnership. This partnership now owns the technology and manages the \$69 million (50% DOE funded) demonstration project and the commercialization activities. The new partnership added financial strength to the demonstration

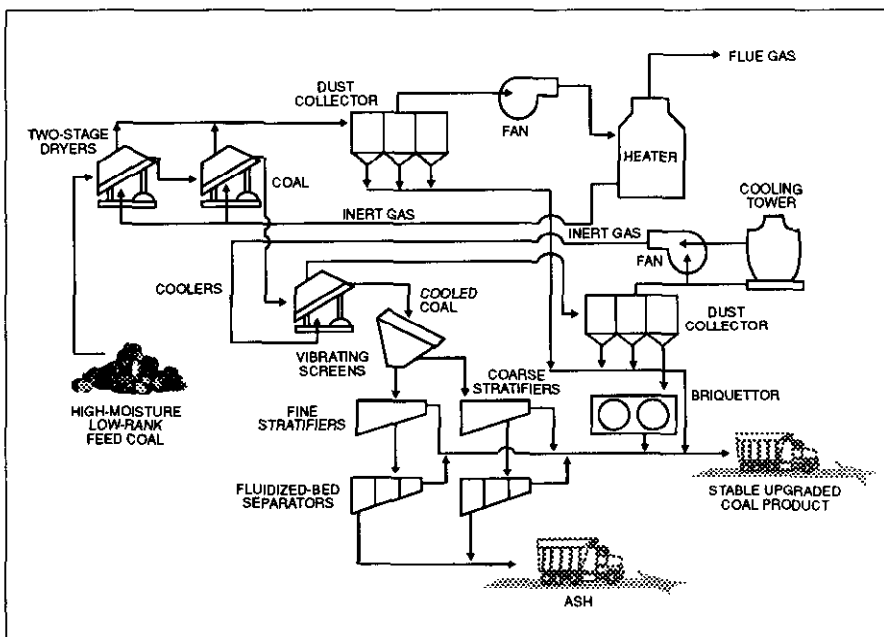
effort and allowed a full range of technical support encompassing all aspects of coal mining, transportation and utilization. Under the agreement, Western Energy is responsible for operating the facility.

The Colstrip, Montana, demonstration plant is about one-tenth the size of a commercial facility which would produce up to three million tons of product a year. When operated continuously, the demonstration plant produces 1,000 tons-per-day (up to 300,000 tons-per-year) of SynCoal™ product. The plant is adjacent to and fully integrated with a unit train facility and an active stockpile that holds up to 90,000 tons of coal, allowing for easy shipment. Since tests began, the plant has processed more than 300,000 tons of raw coal and is now operating at full capacity.

The SynCoal™ process was designed to take advantage of the large stores of Powder River Basin coal and low-rank coals found in Alaska, North Dakota, Texas, Alabama, and other areas along the Gulf Coast. Montana holds 120 billion tons of proven coal reserves, and Wyoming, the nation's largest coal producer, has 68 billion tons of reserves. Coals found in these areas are generally defined as low-rank. They are low in sulfur but contain up to 30 percent moisture, which limits their suitability for many coal-fired power plants. SynCoal™ is a high quality product with less than 5 percent moisture, sulfur content of 0.5 percent, ash content of about 9 percent, and a heating value of about 11,800 Btu per pound. Studies have shown a potential 60 million ton-per-year market for the product.

There are three major steps to the SynCoal™ process: (1) thermal treatment of the coal in an inert atmosphere, (2) inert gas cooling of the hot coal, and (3) removal of ash minerals.

During the thermal treatment process, raw coal from the stockpile is screened and fed into a two-stage thermal processing system. In the first vibratory fluidized-bed reactor, surface water is



Simplified process schematic for the SynCoal™ process.

See "SynCoal™" on page 3 . . .

... "SynCoal™" from page 2

removed from the coal by heating it with hot combustion gas. When the coal exits this reactor, its temperature is slightly higher than that required to evaporate water. The coal is further heated in a second reactor, removing pore water and promoting decarboxylation. Here, particle shrinkage causes fracturing, destroys moisture reaction sites, and separates out the coal ash minerals.

The coal then enters the coal cooler, where it is cooled to less than 50 °F by contact with an inert gas (carbon dioxide and nitrogen at 100 °F) in a vibrating fluidized-bed cooler.

In the last stage, the coal cleaning system, cooled coal is fed to deep bed stratifiers where air velocity and vibration separate mineral matter from the coal with rough gravity separation. The light fractions are sent to a conveyor while heavier fractions go to fluidized-bed separators, for additional ash removal. Fines from various parts of the cleaning process are collected in baghouses and cyclones, cooled and made available as an additional product line.

The Rosebud SynCoal Partnership plans to continue its commercialization efforts through both own-and-operate agreements and licensing. The target markets for the technology are primarily utilities and industries in the United States, Europe, and Pacific Rim nations. CCT

Update - Clean Coal Air Toxics Testing Programs

With the passage of the Clean Air Act Amendments of 1990, control of emissions of air toxics could be a significant factor in commercialization. Therefore, the Clean Coal Program has aggressively pursued air toxics monitoring in all active projects. Intensive efforts have been directed at obtaining data on emissions and removal efficiencies for advanced technologies, and providing those data to the U.S. Environmental Protection Agency for consideration in evaluating the need to regulate air toxics emissions from coal-fired utility boilers.

Final reports for air toxics sampling at the two Southern Company Services (SCS) low-NO_x projects (Wall-Fired and T-Fired) have been issued. Sample analyses and data reduction have been completed for The Babcock & Wilcox (B&W) SNRB and Coal Reburn projects. The reports have been received in draft form and will be issued in final form shortly. A draft Environmental Monitoring Report for the Integrated NO_x/SO₂ Emissions Control Project at Public Service of Colorado, Arapahoe Station, that includes air toxics monitoring data for the baseline condition was received in September 1993 and will also be issued shortly.

In addition, there were three Clean Coal projects included in the Pittsburgh Energy Technology Center R&D Air Toxics Program: Chiyoda CT-121, ABB SNOX, and Pure Air. Draft final reports were issued in February 1994. The Pure Air project results have been delayed due to analytical and funding problems, but are expected later this year.

For the SCS Wall-Fired project, there was no significant difference in emissions of inorganic or volatile organic species between overfire air operation (OFA) and low-NO_x burner/OFA operation. Most of the inorganic species

were effectively removed by the electrostatic precipitator, except for chloride, fluoride, and mercury. Volatile organics (e.g., benzene, toluene and formaldehyde) were very low, at or near the detection limit of the sampling and analytical methods, for both operating conditions. For semi-volatile organics the results for the two operating conditions are not directly comparable. During the OFA test, none of the polynuclear aromatic hydrocarbons (PAH) were detected using standard gas chromatography-mass spectrometry (GC-MS). For the LNB/OFA test, many of the compounds were detected using high-resolution GC-MS, but at concentrations one to four orders of magnitude lower than the detection limits available for the OFA test.

For the SCS T-Fired project, there was no significant change in the emissions of trace elements or acid gases with low-NO_x conditions. Results for emissions of volatile and semi-volatile organics were highly variable and inconclusive, due to uncertainties in sampling and analysis. For example, naphthalene was the only compound on the target list for PAH that was positively identified and the concentration was at the detection limit.

For the B&W SNRB project, the draft final report is currently being reviewed and no results are available yet. For the B&W Coal Reburn project, preliminary results indicate that there was no major effect on emissions of trace elements with reburn operation compared with baseline operation. Emissions of volatile and semi-volatile organics were very low under both baseline and reburn operating conditions.

Summary results for these and other projects will be provided in a future issue of *Clean Coal Today*. CCT

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Wabash River on Schedule for 1995 Startup

Largest U.S. Single Train IGCC Facility

Despite summer floods and winter storms, the Wabash River Coal Gasification Repowering Project is on schedule for a third-quarter 1995 startup. Construction activities at the project site are approaching the 40 percent completion point. General structural erection, field-erected tank work, and foundations for the gasifier island are all nearing completion. Vessels for the air separation unit have been set and fabrication of the gasifier is in progress.

The Round 4, \$396 million, 50 percent DOE funded Clean Coal Technology demonstration project is a joint venture of Destec Energy, Inc. (Destec) of Houston, Texas, and PSI Energy, Inc. (PSI) of Plainfield, Indiana. It will repower an existing 1950 vintage coal-fired steam generating plant with integrated coal gasification combined cycle (IGCC) technology.

The facility is located in West Terre Haute, Indiana, at PSI's Wabash River Generating Station. Upon completion of construction in 1995, the project will represent the largest single train coal gasification combined cycle facility in the United States, and will emit much

lower emissions than more conventional power plants fueled by high-sulfur coal.

The project will include integration of an existing PSI steam turbine generator and auxiliaries, a new combustion turbine generator, a heat recovery steam generator, and a coal gasification facility to achieve improved efficiency, reduced emissions (including sulfur oxides, nitrogen oxides and carbon dioxide), at competitive market costs—less than \$1,400/kW before DOE cost-sharing.

The new combustion turbine will generate 192 MWe and the existing steam turbine will generate an additional 104 MWe (262 MWe net) using 2,544 tons-per-day of high-sulfur, locally mined bituminous coal. This is an increase of more than 150 percent in unit capacity. The anticipated heat rate for the repowered unit is approximately 9,000 Btu-per-kilowatt-hour (38 percent thermal efficiency; higher heating basis) or a 21 percent increase in station efficiency. SO₂ emissions are expected to be less than 0.2 pound-per-million Btu (98 percent reduction). NO_x emissions are

expected to be less than 0.1 pound-per-million Btu (90 percent reduction).

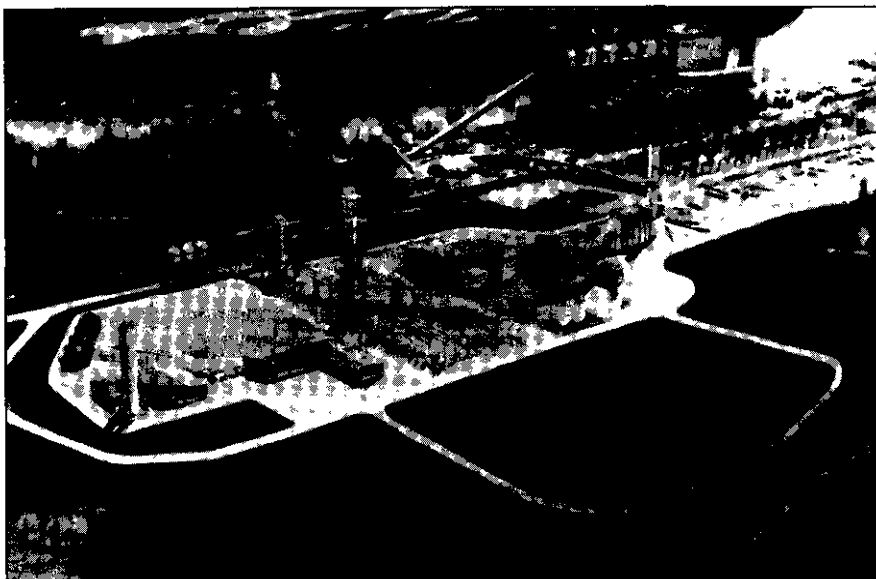
The gasifier was developed by Destec's parent corporation, The Dow Chemical Company, and marketed by Destec. Important design data for the project have been provided by a 160-MW (equivalent) pioneer facility which is still being operated by Louisiana Gasification Technology, Inc., a wholly owned subsidiary of Destec, in Plaquemine, Louisiana.

At the Wabash project, coal is ground, slurried with water, and gasified in a pressurized, two-stage (entrained-flow slagging first stage and non-slagging second stage), oxygen-blown, entrained-flow gasifier. The product gas is cooled through heat exchangers and passed through a conventional cold gas cleanup system which removes particulates, ammonia, and sulfur. The clean, medium-Btu gas is then reheated and burned in an advanced gas turbine. Hot exhaust from the gas turbine is passed through a heat recovery steam generator to produce high-pressure steam. High-pressure steam is also produced from the gasification plant and superheated in the heat recovery steam generator. The combined high pressure steam flow is supplied to an existing steam turbine. The plant will produce sulfur as a by-product, negating solid waste disposal of sulfur-bearing materials.

Destec believes a significant market for IGCC technology is developing. In particular, the need to repower existing coal-fired capacity and the need to meet the Phase II requirements of the Clean Air Act Amendment of 1990 will contribute to the increased use of IGCC technology.

Those Phase II requirements, which become effective in the year 2000, will impose much more stringent limits on the use of high-sulfur coal and on NO_x

See "Wabash" on page 5 . . .



Artist's conception of new 262-MWe Wabash River Coal Gasification repowering facility, West Terre Haute, IN.

... "Wabash" from page 4

emissions. This is particularly important to PSI, the largest in-state user of Indiana coal. Gasification technology offers PSI and other utilities the opportunity for additional fuel resources through the expanded use of higher sulfur coal reserves.

To give regulators and utilities sufficient confidence to accept IGCC as a viable technology alternative, it is essential that projects like Wabash River demonstrate the technology at commercial scale and in a utility-operating environment. Thus, DOE support in this early stage of commercialization is essential to reduce risk and gain market acceptance of the IGCC technology.

Since the signing of the Cooperative Agreement in July 1992, several significant milestones have been achieved. These include the following:

- Completion of the National Environmental Policy Act process
- Regulatory approval for construction from the Indiana Utility Regulatory Commission
- Receipt of air emissions and wastewater discharge permits from the Indiana Department of Environmental Management
- Completion of site preparation work, and
- Initiation of construction activities.

Major milestones and activities for 1994 are focused on procurement and construction. DOE will conduct a 40-percent construction review in early April. Detailed engineering is expected to be complete by mid-year. Peak construction employment of over 400 workers will occur during the summer of 1994. All major equipment is scheduled to be in place by the end of 1994, and the selection and training of operations personnel should be completed by that time. Pre-operational testing will begin in July 1995, with the 3-year demonstration period to be completed by August 1998. CCT

Site Chosen for Coal to Methanol Energy Project

The U.S. Department of Energy has agreed to move the demonstration of an advanced coal-to-methanol project to the Eastman Chemical Company Integrated Coal Gasification Facility located in Kingsport, TN. Air Products and Chemicals, Inc. and Eastman Chemical will cosponsor this novel demonstration, as one of the 45 projects in DOE's Clean Coal Technology Program. The coal gasification facility at Kingsport has operated commercially since 1983.

Through a four-year operating period the project sponsors plan to demonstrate on a commercial scale the production of methanol from coal-derived synthesis gas using the Liquid Phase Methanol (LPMEOH™) process; and to determine the suitability of the methanol for use as a low-SO_x, low-NO_x alternative fuel in stationary and transportation applications.

Integrated coal gasification combined cycle (IGCC) power generation has been gaining increasing acceptance worldwide for the production of electricity from coal. IGCC technology prevents pollution by initially converting coal into a clean burning gas, and then producing electricity from that gas in a highly efficient combined power generation system. The LPMEOH™ process has been developed to enhance IGCC power generation by producing a clean burning, storable liquid fuel (methanol) from the clean coal-derived gas for use during periods of peak electric power demand.

Operation of the commercial-scale LPMEOH™ unit at the Kingsport facility will produce at least 200 tons-per-day of methanol, and it will be possible to demonstrate the unique power production load-following flexibility of the LPMEOH™ technology, not normally associated with coal-based electric

power generation facilities. Production of dimethylether (DME) as a mixed co-product with methanol for demonstration as a storable liquid fuel is also planned.

Methanol has a broad range of commercial applications. It can be substituted for conventional fuels in stationary and mobile combustion applications. Methanol is also an excellent peaking fuel. It contains no sulfur and has exceptionally low-NO_x characteristics when burned. Among the cleanest coal technologies of generating electric power, IGCC can economically satisfy the most stringent environmental limits for SO₂ and NO_x. About 99 percent of the sulfur can be removed in the manufacturing process and converted into salable elemental sulfur or sulfuric acid. The solid waste from the gasifier is an inert, granular slag which can be used as an aggregate for road and building materials.

DME also has several commercial uses. In a storable blend with methanol, the mixture can be used as a peaking fuel in IGCC electric power generating facilities. Studies indicate that the cost of energy stored can be cheaper than using methanol alone. Also in a storable blend with methanol, DME can be used to increase the vapor pressure of the mixture. The resulting higher volatility is expected to provide beneficial "cold start" properties to methanol being used as a diesel engine fuel. Blends of methanol and DME can also be used as a chemical feedstock for the synthesis of chemicals or new, oxygenate fuel additives. Pure DME has been gaining acceptance as an aerosol in personal products. In this market, DME is being viewed as an environmentally benign aerosol to replace freon.

Methanol fuel testing will be conducted by Acurex Environmental Cor-

See "Methanol" on page 8 . . .

ENCOAL Project Resumes Operation

The ENCOAL Corporation's demonstration facility near Gillette, Wyoming, has resumed operation after a lengthy period of equipment and system modification. The \$72 million project, 50% cost-shared by DOE, has completed a new round of shakedown tests and re-commissioning of plant systems as a result of these changes. The original 1,000 tons-per-day plant, currently operating at 500 tons-per-day, converts low-rank Powder River Basin subbituminous coal from the Triton Coal Company's Buckskin Mine into two marketable fuels—a low-sulfur coal-derived liquid (CDL), which can be used as a replacement for No. 6 fuel oil and a solid-process-derived fuel (PDF) that has the benefits of high rank, low-sulfur eastern bituminous coals.

The ENCOAL Facility is designed to commercial standards for a life of at least ten (10) years. It uses commer-

cially available equipment, state-of-the-art computer control systems, best available control technology (BACT) for all environmental controls to minimize releases, and a simplified flowsheet to make only two products matched to existing markets. The intent is to demonstrate the core Liquids From Coal process and not make the project overly complicated.

The ENCOAL Project is demonstrating for the first time the integrated operation of several unique process steps:

- Coal drying on a rotary grate using convective heating
- Coal devolatilization on a rotary grate using convective heating
- Hot particulate removal with cyclones
- Integral, but stepwise, PDF cooling and passivation
- Solids stabilization for storage and shipment in a closed system
- Computer control/optimization of the entire process
- Dust suppressant on PDF solids

Seventy-eight steps over a period of 36 hours are required to achieve full operation on coal. Much of the time is spent increasing the temperatures up to a hot stand-by condition facilitating the flow of feed coal. After starting the plant with natural gas fuel, the process is maintained by combusting a portion of the volatile gases driven from the coal in the pyrolyzer. The plant start-up is computerized and has been successfully tested on automatic through the start-

up of all major equipment. Ultimately, the entire sequence of start-up and shut-down will be fully automated.

The plant's initial fifteen runs conducted in its first year of operation, through June 1993, were very encouraging in demonstration of the fundamental steps of the Liquids From Coal process while producing 5,500 barrels of oil (CDL) and about 1,500 tons of stable PDF. However, this experience strongly indicated the need to make several important modifications to the process, particularly with PDF handling. These modifications included new seals on blowers, new valves, conveyor modifications, improvements in coal-fines handling systems, improvement of the integral pyrolyzer gas seal by conversion to a new water seal in order to more effectively maintain full differential pressure across the grate of the pyrolyzer, and the addition of a new vibrating fluidized bed (VFB) which is referred to as a "finishing" step in the solid product cooling system portion of the process. Since the VFB was only available in a size corresponding to 250 tons-per-day of product, the plant raw coal feed rate was accordingly reduced to 500 tons-per-day. Allowances were made for the future installation of a second VFB.

Inserting a VFB unit into the hot solids handling system significantly increases residence time and exposure of the hot char leaving the pyrolyzer to cooling gases. The cooled char moves into the lower temperature regime of an improved rotary cooler used for final PDF stabilization and preparation for storage. These plant changes were deemed necessary to consistently and continuously produce a uniform quality PDF for shipment to an electric utility customer. Since previous supplies of PDF have required some degree of manual treatment and ground stacking in order to confirm desired quality and



ENCOAL 1,000 tons-per-day coal processing facility for clean fuels located at Triton Coal Co.'s Buckskin Mine near Gillette, WY. New vibrating fluidized bed unit is at lower right of plant.

See "ENCOAL" on page 7 . . .



Closeup view of new vibrating fluidized bed (VFB) installation during construction. VFB unit is shown at lower center of photo.

... "ENCOAL" from page 6

specifications, the continuous preparation of PDF in a closed conveyor silo system remains to be demonstrated.

Typical of first-of-a-kind projects, the completion of plant modifications required a new round of equipment commissioning, reprogramming of computer control systems, and a significant amount of individual systems testing, including the new VFB. The ENCOAL Project has resumed a series of planned test runs to verify and optimize plant operability before attempting to proceed to a steady state operation. Product fuels will continue to be monitored, stored and shipped, as appropriate, during 1994. All CDL produced is expected to be used beneficially as replacement fuel at the Great Plains Synfuels Plant while PDF will be shipped for test burns, both blended and unblended, to Wisconsin Power & Light Company. The commercial product fuels are ultimately expected to be used economically in boilers and furnaces and to reduce sulfur emissions significantly at utility and industrial facilities currently burning high-sulfur coals or oils.

SGI International, Inc. (SGI) of La Jolla, California, the developer of the

Liquids From Coal process is proceeding with commercialization opportunities for this Clean Coal Technology. SGI has signed an agreement with Chinese provincial government agencies that could signal the opening of new, large, overseas markets for a U.S. clean coal refining technology.

SGI has agreed to conduct a technical feasibility and economic evaluation for a 5,000 tons-per-day clean coal refinery that would produce two clean, high quality fuels from low-rank coals in China. The agreement was signed with

Shandong Provincial Coal Bureau and the Comprehensive Utilization Corporation of Shandong Coal Industry (CUCSCI) in Shandong Province, China.

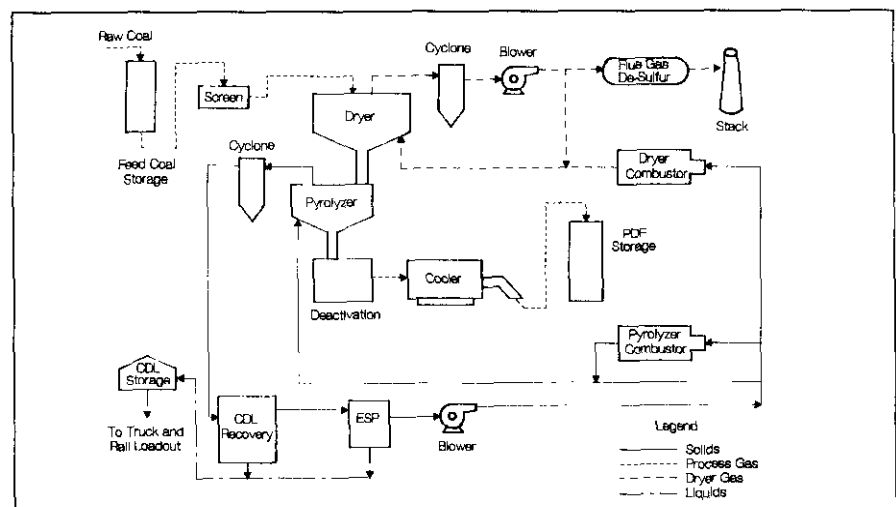
In June 1993, SGI was one of 24 U.S. companies that participated in an energy trade mission to China led by Jack Siegel, Acting Assistant Secretary for Fossil Energy.

The agreement to move forward with feasibility studies and planning for a commercial plant marks another technology now moving toward the marketplace that was pioneered in the Clean Coal Technology Program.

The agreement with the Chinese follows tests of sample coals from Shandong Province at SGI's Development Center in Perrysburg, Ohio. The successful tests showed that coals from the Beizhao and Wali mines in China would be ideal candidates for SGI's technology. SGI anticipates similar agreements later this year with other Chinese provinces where SGI is conducting ongoing coal testing and evaluation programs.

If built, the plant would be located near Longkou Harbor in Shandong Province.

China now spends about \$10 billion a year on power projects, an amount expected to double by the turn of the century. [CCT]



Simplified process flow diagram for Liquids From Coal process being demonstrated by ENCOAL.

... "Briefs" from page 1

captured in a new Energy Department publication, **Clean Coal Technology—The Investment Pays Off**. The 20-page booklet highlights project achievements in six major categories, and provides a state-by-state listing of all 45 projects. Copies of the publication are available from DOE's Office of Fossil Energy Communications at (202) 586-6503 or FAX (202) 586-5146.

Since the *Investment* publication went to press, two additional project achievements have been logged. In the first, **SGI Inc., of La Jolla, CA**, the developer of the technology being demonstrated at the **ENCOAL plant in Gillette, WY**, announced an agreement with Chinese provincial government agencies to conduct a technical feasibility and economic evaluation for a 5,000 ton-per-day Clean Coal Refinery. SGI was one of 24 U.S. companies that participated last June in an energy trade mission to China led by Acting Assistant Secretary for Fossil Energy, Jack Siegel.

Just two weeks later, **Ohio's Governor Voinovich** announced that **AirPol's GSA technology**, now in the final stages of very successful tests at TVA's National Center for Emissions Research in Paducah, KY, was selected for what will be its first commercial trials at a municipal power plant in Ohio. The AirPol technology will allow the **City of Hamilton, OH**, to switch to lower cost, higher-sulfur coals from Ohio while still meeting its emissions limits under the CAAA of 1990.

Economics was the theme of a recent **Clean Coal Technology conference held in Washington, DC on February 28 and March 1**. Papers used a standard set of economic assumptions to develop comparative costs for their technologies. Papers were presented by York County Energy Partners, American Electric Power, Pyropower, Tampella Power, Sierra Pacific Power Co., Tampa Electric Company, EER Corp., Babcock & Wilcox, ABB Environmental Systems, NOXSO Corp.,

AirPol, and Pure Air. To obtain a copy of the proceedings, contact AER Enterprises at (908) 254-6930.

On January 25, Florida Governor Lawton Chiles and the state cabinet unanimously approved a siting permit for **Tampa Electric's 260-MWe integrated gasification combined cycle (IGCC) project**. The Polk County demonstration project is expected to be up and running by mid-1996. A public hearing on the draft Environmental Impact Statement (EIS) prepared for **Tampa Electric's Polk Power Plant** was held on March 31 in Bartow, FL. The U.S. Environmental Protection Agency is the lead agency for the NEPA process on this project. DOE is serving as a cooperating agency.

Construction of two Indiana projects is proceeding on schedule. General structural work for an oxygen-blown, entrained-flow IGCC demonstration project is approximately 35 percent complete at **PSI Energy, Inc.'s Wabash River Plant in West Terre Haute, IN**. See p. 4 in this issue.

Meanwhile, steelwork erection is about 30 percent complete at **Bethlehem Steel's Burns Harbor, IN, plant** where a Round 3 project will demonstrate direct injection of granulated coal into two large iron-making blast furnaces. Operation is expected to begin during the first quarter of 1995.

Public hearings are expected to be scheduled soon on the draft EIS for **Sierra Pacific Power Company's Piñon Pine Project**, to be built at the Tracy Station east of Reno, NV. The hearings will likely take place in May in the Reno area.

DOE and American Electric Power would like to continue operation of the **Tidd pressurized fluidized-bed combustion demonstration plant** for another year. The Brilliant, Ohio, plant has logged nearly 6,000 hours of operation, but more data are needed on gas turbine survivability, enhanced sulfur capture, and hot gas filtration. Secretary O'Leary has forwarded a supple-

mental report to Congress outlining details of the planned project extension.

The **Lignite Research Council (LRC)** has announced that \$40 million could be available for demonstration projects that would be cost shared. Projects should demonstrate new or advanced cost-effective technologies that use lignite, and they should be at near-commercial or first-of-a-kind commercial scale. In addition, four RFPs have been issued for lignite marketing feasibility studies that do not require matching funds. North Dakota's lignite R&D program is a multi-million dollar state/industry partnership that concentrates on near term, practical projects to enhance the development of the state's abundant lignite resources. For further information contact Clifford R. Porter, Director, Lignite Research Council, (701) 258-7117. CCT

... "Methanol" from page 5

poration, a project team member, in stationary and mobile sources such as boilers, buses, and van pools.

Air Products conducted an extensive DOE-sponsored research and development effort of the LPMEOH™ process that began in 1981. Successful operation of the process was proven at the DOE-owned, 10 tons-per-day Process Development Unit (PDU) at an Air Products' synthesis gas facility located in LaPorte, Texas. The PDU was specifically developed to improve methods for catalytic conversion of coal-derived synthesis gas to useful liquid fuels. The LaPorte PDU tests have shown that LPMEOH™ technology is particularly well suited to coal-derived synthesis gas.

This \$213,700,000 clean coal technology project will be cost-shared with DOE providing 43 percent of the total project cost. Project definition activities are under way. Construction is expected to begin in 1995 followed by start-up and operations in 1996. Operations to demonstrate methanol/DME co-production would conclude in the year 2000. CCT

Status of Clean Coal Technology Demonstration Projects

American Electric Power. Tidd PFBC Demonstration Project.

(Brilliant, OH)

The plant has logged more than 6,000 hours of coal-fired operation, including more than 2,300 hours of operation with hot particle filters on a one-seventh gas slipstream. DOE plans to operate the plant through February 1995 and has submitted a Supplemental Report to Congress outlining the planned extension.

CQ, Inc. Coal Quality Expert.

(Homer City, PA)

All six field tests were completed in late-April, with the sixth and final test at Brayton Point, Massachusetts. A fully functional Coal Quality Expert prototype that will predict the impact of coal quality upon boiler operations, maintenance, bus bar costs, and emissions is scheduled for completion by May 1994.

EER Corporation. Enhancing the Use of Coal by Gas Reburning and Sorbent Injection.

(Hennepin and Springfield, IL)

Illinois Power has decided to retain the Gas Reburning system and sorbent silo at Hennepin for possible use in 1995 for NO_x control. Work continues on the final report of the results of long-term testing at Hennepin. At the Lakeside Station of City Water, Light & Power in Springfield, IL, parametric testing of gas reburning, sorbent injection, and combined gas reburning-sorbent injection has been completed. The one-year long-term testing program began in November 1993. Initial results show that the goals of 60% NO_x reduction and 50% SO₂ reduction are being met.

Rosebud Syncoal Partnership. Advanced Coal Conversion Process Demonstration

(Colstrip, MT)

The facility underwent a complete maintenance turnaround from June 6 to August 13, 1993 which reestablished dual train operation. New fines conveying, cooling, and loadout system were installed. Shipments of the "SynCoal" product to several Midwest utilities and industrial customers are being made for handling tests and test burns. Since tests began, the plant has processed more than 300,000 tons of raw coal and is now operating at full capacity.

York County Energy Partners. Circulating Fluidized Bed Cogeneration Project.

(North Codorus Township, PA)

An Environmental Information Volume is in the final stages of preparation and should be released to the public by early April. A draft Environmental Impact Statement is scheduled to be released for public comment later this summer.

ABB Combustion Engineering. IGCC Repowering Project.

(Springfield, IL)

Efforts continue to address the high capital cost projection for the project.

ABB Combustion Engineering. SNOX Flue Gas Cleanup Project.

(Niles, OH)

The plant continues to operate smoothly in meeting or exceeding the goals of 95% SO₂ removal and reduction of over 90% of NO_x emissions while producing a high purity sulfuric acid. The unit has accumulated over 7,000 hours of operation, and 4,800 tons of acid have been sold. Operations will continue until December 1994. The host company, Ohio Edison, will operate SNOX after the demonstration project has been completed.

American Electric Power Service Corp. PFBC Utility Demonstration Project.

(New Haven, WV)

Value engineering activities are continuing to refine the preliminary design for a 340-MW greenfield plant.

Babcock & Wilcox. Coal Reburning for NO_x Control.

(Cassville, WI)

Results of parametric and optimization testing with bituminous coal show that NO_x emissions are reduced by 50-55% between full load (110 MW) and 70 MW. From 70 to 40 MW the NO_x reductions range from 50 to 35%. Results of reburn testing on western coal are better than those obtained on bituminous coal. All testing, including air toxics emissions testing, is complete. The Final Report has been approved by the Participant and is being printed.

Babcock & Wilcox. SNRB Flue Gas Clean-Up Project.

(Dilles Bottom, OH)

The project is now in the data analysis and reporting stage. All test work has been completed. Preliminary economic analyses indicate that this combined, three-pollutant control process will cost less than a combination of the three separate flue gas clean-up processes—wet scrubbing, SCR, and pulse-jet baghouse. The first drafts of the Final Report and the Final Air Toxics Report are expected in February.

Bethlehem Steel Corp. Blast Furnace Granulated Coal Injection.

(Burns Harbor, IN)

Detailed design is complete. Plant construction, initiated in September 1993, is more than 30% complete. Approximately 4,500 cubic yards of concrete have been poured. Steel erection is about 25% complete. Operation is expected to begin in May 1995, after a two-month period for pre-operational testing.

Bethlehem Steel Corp. Coke Oven Gas Cleaning System.

(Sparrows Point, MD)

The coke ovens were placed on "cold idle" on January 24, 1992. The project has been postponed for at least two years to allow for rehabilitation of the coke ovens.

Passamaquoddy Tribe. Cement Kiln Flue Gas Recovery Scrubber.

(Thomaston, ME)

Final reports on the project are in review.

Pure Air. Advanced Flue Gas Desulfurization Demonstration Project.

(Chesteron, IN)

The FGD scrubber is operating and has demonstrated the capability to reduce SO₂ emissions by greater than 95%, thereby removing some 60,000 tons of SO₂ on an annual basis. Byproduct gypsum is 97% pure and is being sold to U.S. Gypsum. PowerChip™ gypsum operations commenced in January 1994, thereby allowing for rail transport of some by-product gypsum. Air toxics sampling has been conducted; laboratory analyses are under way. Tests with 3-3.5% sulfur coal and with 3.5-4% sulfur coal have been completed. Smooth operations are continuing.

Babcock & Wilcox. Low-NO_x Cell™ Burner Retrofit.

(Aberdeen, OH)

Testing is complete. NO_x emission reductions exceeded the 50% target level. Dayton Power & Light has accepted ownership of the LNCB™ retrofit.

See "Status" on page 10 . . .

Southern Co. Services. Chiyoda Thoroughbred 121 FGD Process.

(Newnan, GA)

Long-term test results have substantiated parametric test findings with SO₂ removals achieving a high of 97%. Using the standard 2.6% sulfur coal, normal SO₂ removal is 94%. Particulate removal is 99% and limestone utilization is about 97%. Results were essentially identical for an alternate limestone that was tested. Since the scrubber came on line in October 1992, there has been 98% reliability and availability. The scrubber has operated for 8,000 hours and has produced over 50,000 tons of gypsum. During tests conducted in January-February 1994, a 4.6% sulfur coal was fired in the No. 1 boiler at Plant Yates. The Chiyoda reactor successfully operated at about 180% of design removing 90% of the sulfur contained in the flue gas. In March 1994, the electrostatic precipitator will be deenergized and the Chiyoda reactor will operate as both a particulate and SO₂ scrubber. That test will continue for one year. Southern Co. Services intends to prepare sufficient quantities of the by-product gypsum for commercial tests to be conducted for wallboard manufacturing and as an ingredient in cement.

Southern Co. Services. NO_x Reduction for Tangentially Fired Boilers.

(Lynn Haven, FL)

Long-term test data from operating the Low NO_x Concentric Firing System Level I, II, and III equipment (three basic air/coal feed configurations tested) indicated full load NO_x reductions up to 37, 40, and 48%, respectively, compared to the baseline emission data. A report has been prepared on the completed air toxics testing. Additional Level III tests have shown that increasing the fineness of the fuel significantly reduces the unburned carbon levels of the fly ash with no effect on NO_x emissions. Final reports were submitted in the last quarter of 1993 and are under review by DOE.

Southern Co. Services. NO_x Reduction for Wall-Fired Boilers.

(Coosa, GA)

Long-term testing of the Advanced Over Fire Air (AOFA), Low-NO_x Burners (LNB), and combined AOFA and LNB has been completed. Chemical emissions testing has been completed. Low-NO_x digital control system (LNDCS) preliminary engineering is complete, and selection of an Artificial Intelligence Software supplier is under way. Testing of the LNDCS with the software package is scheduled for summer 1994.

Southern Co. Services. SCR for High-Sulfur Coal Boilers.

(Pensacola, FL)

Test operations are in progress.

Air Products and Chemicals, Inc. Liquid Phase Methanol Process.

(Kingsport, TN)

Project definition activities to establish the technical, cost, and schedule baselines and to support NEPA are continuing.

AirPol, Inc. Gas Suspension Absorption Project.

(Paducah, KY)

Parametric tests have been completed and results indicate that the GSA is capable of 90+% SO₂ removal efficiencies. Air toxics testing has been completed. An economic evaluation has shown that the capital and operating costs are 31% and 20% less, respectively, than the corresponding costs for a limestone forced oxidation system. A recently published article in Power Magazine (October 1993) compares the GSA system favorably to other dry and wet scrubbing processes.

Alaska Industrial Development Authority. Healy Clean Coal Project.

(Healy, AK)

Engineering and permitting efforts are proceeding. TRW has completed combustor design verification testing. DOE issued the final EIS on December 15, 1993.

Bechtel Corp. Confined Zone Dispersion FGD Project.

(Indiana County, PA)

Parametric testing using type S, pressurized dolomitic lime slurry injection indicated that SO₂ removals near 50% can be achieved. Reporting is in preparation and Bechtel and Penelec initiated a follow-on demonstration with a modified CZD system, which would achieve the project operating goals.

DMEC-1 Ltd. Partnership. Pressurized Circulating Fluidized Bed Demonstration Project.

(Pleasant Hill, IA)

Site arrangement drawings and cost estimates for several trade-off studies were completed. The benefits of using an 1,800 psi steam cycle pressure as opposed to a 2,400 psi cycle are being analyzed.

EER Corp. Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler.

(Denver, CO)

Long-term baseline testing of the GR-LNB system started in April 1993. Thus far, the data indicate that while NO_x can be reduced to the extent of 70%, meeting project objectives, the mean has been in the area of 66% for reasons of economics. The Low-NO_x Burners are being modified to improve operations and NO_x removal performance. In December 1993, the project was extended to test the effects of zero flue gas recirculation, overfire optimization, and gas cofiring testing. The project is now expected to be completed in June-July 1995.

ENCOAL Corp. Mild Gasification Project.

(Gillette, WY)

Plant operation resumed in January following a 6-month shutdown to complete system and equipment modifications. Nearly 1,900 hours of coal-fired operation have been logged to date.

LIFAC N. America. LIFAC Sorbent Injection Desulfurization Demonstration Project.

(Richmond, IN)

Increased opacity levels as a result of LIFAC operation caused some delay in completing parametric testing. Modifications were made to the ESP to correct the opacity problem and parametric testing has been completed. Optimization testing started in March 1994.

MK-Ferguson Co. NOXSO Flue Gas Cleanup System.

(Niles, OH)

In July 1993, NOXSO announced that the demonstration would not proceed at the planned Niles, OH, site. The sponsors are evaluating the possibility of an alternate site.

Public Service Co. of CO. Integrated Dry NO_x/SO₂ Emissions Control System.

(Denver, CO)

A combination of low-NO_x burners, overfire air, and furnace urea injection at full load resulted in up to 80% NO_x reduction. Duct injection of sodium based reagents resulted in up to 70% SO₂ reduction. Duct injection of calcium reagents with humidification resulted in a 30% SO₂ reduction. Longer term integrated testing using duct injection of sodium based reagents began on February 7, 1994. All on-site Air Toxics Monitoring has been completed. Preliminary results show that the fabric filter dust collector removed up to 97% of the trace metal emissions. Testing will be completed in mid-1994.

... "Status" from page 10

Tampa Electric. Integrated Gasification Combined Cycle Project. (Tampa, FL)

The State of Florida approved a siting permit for the plant in January. The draft Environmental Impact Statement was released for public comment in February. A public hearing on the EIS is scheduled for March 31, 1994.

Custom Coals International. Self Scrubbing Coal: An Integrated Approach to Clean Air.

(Greensboro, PA; Springdale, PA; Richmond, IN)
Preliminary design of the coal cleaning plant is more than 95% complete. NEPA approval is expected in March 1994.

New York State Electric and Gas. Milliken Clean Coal Technology Demonstration Project. (Lansing, NY)

NEPA process completed in August 1993 with EA/FONSI. Design has been completed and construction is about 85% complete.

TAMCO Power Partners. Toms Creek IGCC Demonstration Project. (Coeburn, VA)

A power purchase agreement is being sought.

Tennessee Valley Authority. Micronized Coal Reburning for NO_x Control. (Paducah, KY)

Construction should be completed in late Fall or early Winter 1994.

ThermoChem, Inc. Demonstration of Pulse Combustion in an Application for Steam Gasification of Coal. (Gillette, WY)

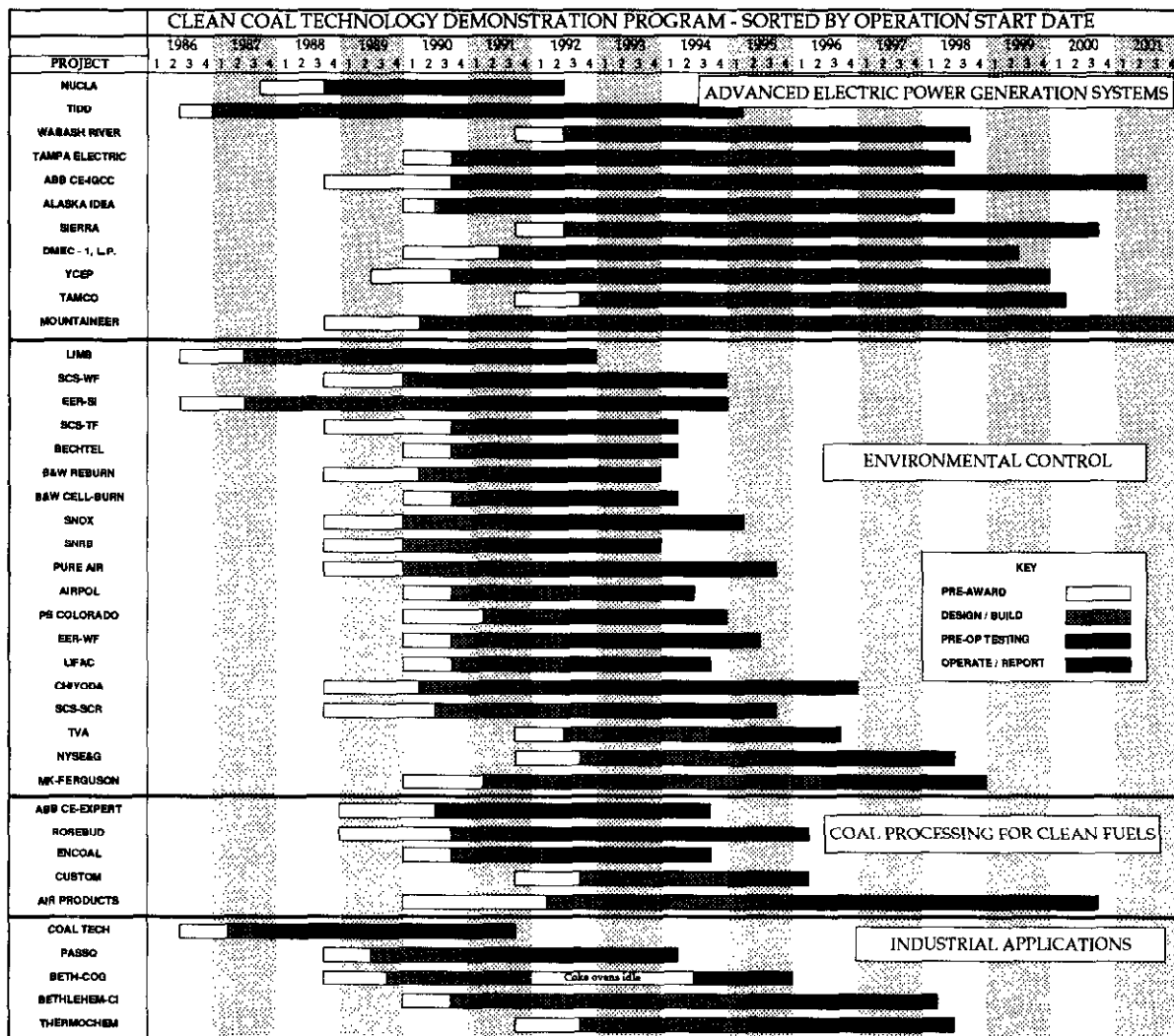
A preliminary design of the ThermoChem coal gasification demonstration plant integrated with the host K-Fuel facility has been completed. Test gasification of the design coal has been completed at ThermoChem's Baltimore, MD facility.

Sierra Pacific Power. Piñon Pine IGCC Project. (Reno, NV)

A biological assessment of the project site was completed and submitted to the U.S. Fish and Wildlife Service in February. The draft EIS is nearing completion and is scheduled to be released for public comment in April.

Wabash River Joint Venture. Wabash River Coal Gasification Repowering Project. (W. Terre Haute, IN)

Project design is approximately 95% complete and construction is more than 35% complete. General structural erection, field-erected tank work, and foundations and paving for the gasifier island are all nearing completion.



Upcoming Events

Date	Event	Contact
June 8-10, 1994	<i>University Coal Research Contractors' Review Meeting</i> Sheraton South Hills, Pittsburgh, PA	Sean Plasynski (412) 892-4867
June 12-17, 1994	<i>72nd Annual National Conference of Regulatory Utility Commission Engineers</i> , Embassy Suites, St. Louis, MO	Gordon Persinger (315) 751-7491
June 21-23, 1994	<i>Coal-Fired Power Systems '94—Advances in IGCC and PFBC</i> . Morgantown Energy Technology Center, Morgantown, WV	METC Conference Services (304) 291-4108
July 18-21, 1994	<i>10th Annual Coal Preparation, Utilization, and Environmental Control Contractors' Conference</i> , Westin William Penn, Pittsburgh, PA	Doug Gyorke (412) 892-6173
September 6-8, 1994	<i>Liquefaction Contractors' Review Meeting</i> Vista Hotel, Pittsburgh, PA	Gary Steigel (412) 892-4499
September 6-8, 1994	<i>Third Annual Clean Coal Technology Conference</i> Chicago Hilton and Towers Hotel, Chicago, IL	Kim Yavorsky (412) 892-6244

CCT Reports Update

The following Clean Coal Technology Program Reports and Comprehensive Reports to Congress have been released since the last issue of *Clean Coal Today*. Copies of the reports are available from the National Technical Information Services, U.S. Department of Commerce, Springfield, VA 22161.

December 1992	DOE/MC/26304-3497 or NTIS #DE94000029	<i>Clean Coal II—PFBC Utility Demonstration Project Annual Report</i>
April 1993	DOE/MC/27364-3468 or NTIS #DE94000007	<i>Pressurized Circulating Fluidized Bed (PCFB) Repowering Project: Annual Report, August 1991 - December 1992</i>
February 1994	EPA # 904/9-94-001 (a), (b), and (c)	<i>DRAFT Environmental Impact Statement, Tampa Electric Company - Polk Power Station (3 volumes)</i>

The following papers, authored by DOE employees or CCT participants, were delivered at recent conferences. Copies are available from the authors. For further information, contact Doug Archer, Office of Clean Coal Technology, at (301) 903-9443.

"The added value of upgrading coal." Dr. Robert E. Nickell, SGI International; *COALTRANS '93*, Amsterdam, The Netherlands, October 1993.

"CFB Cogeneration Project: An Economic Discussion." Bradley F. Hahn, York County Energy Partners; *Conference on Comparative Economics of Emerging Clean Coal Technologies III*, Washington, DC, February 1994.

"Clean Coal Technology Program Update -- The Fifth Solicitation of the U.S. Department of Energy." Jerry Pell, U.S. Department of Energy; *POWER-GEN Americas '93*, Dallas, TX, November 1993.

"Colorado Utility Upgrading Existing CFB Boiler to Current Design Standards." Richard Bohlim, Pyropower Corporation; *POWER-GEN Americas '93*, Dallas, TX, November 1993.

"The Economics of Pressurized Fluidized Bed Combustion Technology." M.I. Mudd, American Electric Power Service Corporation; *Conference on Comparative Economics of Emerging Clean Coal Technologies III*, Washington, DC, February 1994.

"Environmental Considerations of Coal Gasification Technology and the Wabash River Repowering Project." Wendy Lessig and Jessa Frederick, Destec Energy, Inc.; *POWER-GEN Americas '93*, Dallas, TX, November 1993.

"The Piñon Pine IGCC Project Economic Issues." John W. Motter, Sierra Pacific Power Company; *Conference on Comparative Economics of Emerging Clean Coal Technologies III*, Washington, DC, February 1994.

"Reburning for NO_x Reduction - Enhancing the Use of Coals by Gas Reburning and Sorbent Injection." PETC Review, Issue 9, Fall 1993.

"Reburning for NO_x Reduction - Evaluation of Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler." PETC Review, Issue 9, Fall 1993.

"Reburning for NO_x Reduction - Micronized Coal Reburning for NO_x Control." PETC Review, Issue 9, Fall 1993.

"Refining the art of coal upgrading." Anonymous; *World Coal*, October 1993.

"Scale-Up of Commercial PCFB Boiler Plant Technology." T.W. Lamar, Ahlstrom Pyropower, Inc.; *1993 International Joint Power Generation Conference*, Kansas City, MO, October 1993.

"The Simplified IGCC Process - Clean Coal Technology for Power Generation." Michael Schmid, Tampella Power Inc.; *Conference on Comparative Economics of Emerging Clean Coal Technologies III*, Washington, DC, February 1994.

"Tampa Electric Company, Polk Power Station IGCC Project." Stephen D. Jenkins, TECO Power Services Corporation; *Conference on Comparative Economics of Emerging Clean Coal Technologies III*, Washington, DC, February 1994.