DOE/FE-0215P-13 Issue No. 14, Spring 1994

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

DOE reported to the Congress and the public on the financial status of the program in its report ***"The Clean Coal Technology Program: Completing the Mission."*** After five rounds of competition, DOE reports that it has committed about $2.4 billion directly to the 45 existing projects. Using a risk pool analysis, DOE projects that, depending on the outcome of major decision points expected in the projects in the next few years, it can meet its commitments, participate in a limited way in project cost overruns, and have between 0 and $300 million remaining.

The Congress also asked that DOE determine the need for a continued federal role in clean coal technology development beyond completing the 45 current projects. DOE's major conclusions are: 1) that a sixth round of competition is not warranted; 2) to expand its outreach/technology transfer effort based on the Executive Seminar series described in the report; 3) to implement, on a funds available basis, an International Technology Transfer Initiative; and 4) working with program participants and stakeholders, to analyze the use of commercial incentives (e.g., financial, tax, buydown) as a means of transferring CCTs to the commercial

See "Briefs" on page 6 . . .

In This Issue

Clean Coal Celebrates Earth Day 1994

Exhibits Accent Reducing Greenhouse Gas Emissions

WASHINGTON, DC - The Clean Coal Technology Program took center stage as the Nation celebrated Earth Day 1994 during the week of April 20. In a major exhibition next to the Air and Space Museum, DOE and the Nation's electric utilities demonstrated their commitment to the "Climate Challenge," a voluntary effort by utilities to reduce emissions of greenhouse gases. Exhibits ranged from electric lawnmowers and other electro-technologies to solar ovens that turned out fast-baked pizzas and chocolate chip cookies.

A cornerstone of the tent was a 20-foot DOE Clean Coal Technology Exhibit designed specially for the Earth Day event. The exhibit centered on the ability of high-efficiency power generation technologies to reduce carbon dioxide emissions. Clean Coal Technology projects featured in DOE's exhibit included the Wabash River IGCC, Tampa Electric's IGCC, Sierra Pacific's Piñon Pine IGCC, and the Tidd Pressurized Fluidized Bed Combustion project. Two other exhibits sponsored by DOE's Office of Fossil Energy included a CoalBed Methane Exhibit and a Fuel Cell Exhibit, both staffed by DOE's Morgantown Energy Technology Center.

In addition to DOE's booths, individual exhibits were hosted by Destec Energy/Public Service of Indiana, Sierra Pacific, and Tampa Electric. DOE also unveiled a new publication at the exhibition, entitled *Reducing Greenhouse Gases By More Efficient Use of Fossil Fuels*, that outlines the climate-related activities of the Office

See "Earth Day" on page 2 . . .

Vice President Gore and Secretary of Energy O'Leary at the signing of the Memorandum of Understanding pledging "Energy Partners for Climate Action."

Bethlehem on Schedule for Early 1995 Startup

Blast Furnace Coal Facility in Construction

Despite severe weather this past winter, Bethlehem Steel Corp. and Fluor Daniel Constructors have kept their first-of-a-kind Blast Furnace Granulated Coal Injection (BFGCI) Clean Coal project on a fast track for construction. When complete, the Burns Harbor, Indiana complex will be a worldwide showcase of advanced technology that can improve the competitiveness and environmental performance of major steelmaking facilities.

The facility "topped out" in mid-April, allowing for the placement of major coal milling and injection equipment, silos, bins and piping. Critical tie-ins of the new coal preparation plant to the blast furnace will be made later this year. At the present rate of activities, the $135 million construction phase and equipment commissioning will be complete by January 1995. By spring of that year, it will be possible to inject coal into either of two blast furnaces at the Burns Harbor site, reducing the amount of coke needed in the ironmaking process.

This Round 3 Clean Coal Project will employ equipment capable of producing either pulverized coal, smaller than 200 mesh, (similar in size to face powder) or granular coal, smaller than 4 mesh, (similar in size to granular sugar) and includes various improvements to two blast furnaces which will permit the incorporation and smooth transition of this new technology into the on-going operation of the two largest blast furnaces at this modern steelmaking facility.

A primary objective is to demonstrate the use of granular coal injection technology at significant rates on large U.S. blast furnaces with a variety of coal types. Expected advantages of the granular coal injection technology include (1) smaller grinding mills, (2) lower grinding costs, (3) higher injection rates, (4) accurate control of injection rates, (5) lower cost of ironmaking, and (6) availability levels of 99.9%.

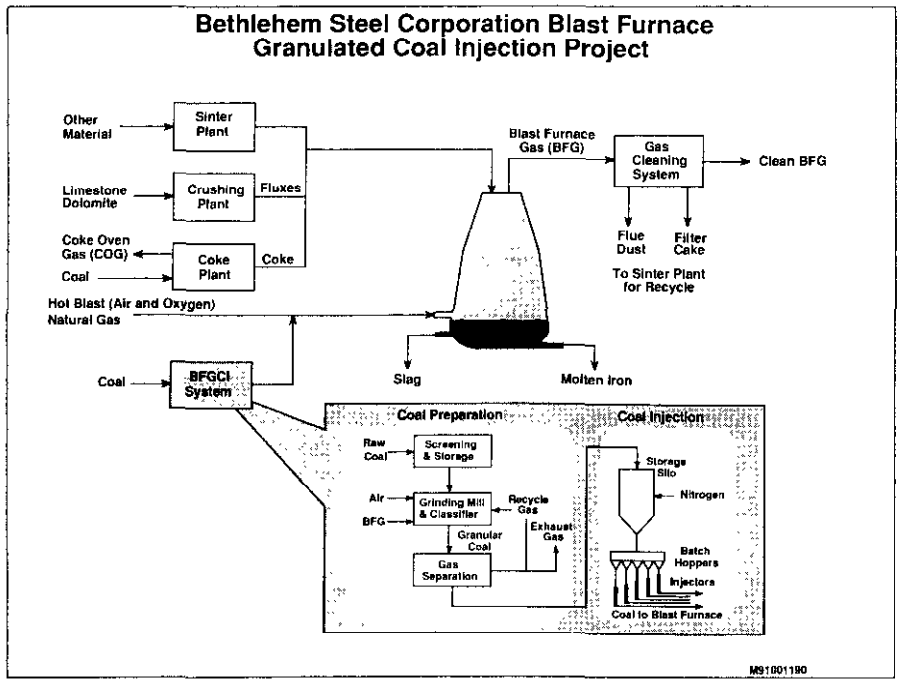
As part of this cooperative agreement, Bethlehem will share the results of coal evaluations and comprehensive system performance with other domestic steel companies.

Injecting coal directly into the blast furnaces will reduce the amount of coke needed as primary fuel, ultimately reducing cokemaking requirements, an economic and environmental plus. In addition, injecting coal into the furnaces will eliminate the need for other, more costly, supplemental fuels, such as natural gas or oil, commonly used in the ironmaking process.

Another advantage of coal injection is that a wide range of abundant, relatively inexpensive coals can be used in the process. Coke, on the other hand, can be made only from coals with specific physical and chemical properties. Any minor emissions produced by the coal preparation and injection plant are contained through the use of baghouses.

The coal injection system, which is being installed, is a proprietary process developed by British Steel plc in concert with Simon-Macawber, Ltd., a British equipment firm noted for its development of innovative technology

See "Blast" on page 3 . . .



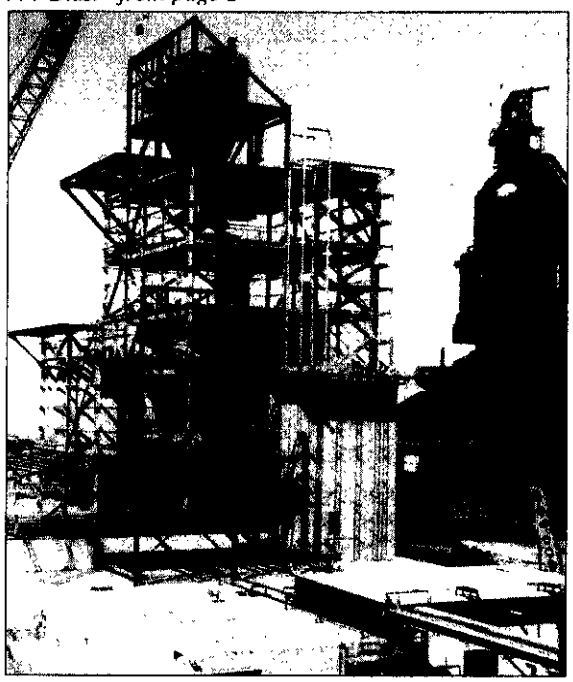
Schematic of Blast Furnace Granulated Coal Injection process to be demonstrated at the Burns Harbor facility of Bethlehem Steel.

. . . *"Earth Day" from page 1*

of Fossil Energy, including its proposed clean coal technology efforts in China and Eastern Europe. For copies of the publication call Bob Kane at (202) 586-4753.

The week's highlight came on Wednesday evening, when Vice President Gore, Secretary of Energy O'Leary, and Congressman Phil Sharp (D-IN) joined representatives of the nation's major electric organizations in signing a Memorandum of Understanding pledging to become "Energy Partners for Climate Action." CCT

. . ."Blast" from page 2



The coal preparation plant adjacent to the blast furnaces "topped out" at 200 feet in mid-April. Construction should be complete by January 1995.

for the handling of bulk materials. ATSI, an engineering firm from Buffalo, NY, which, in partnership with Simon-Macawber, has the sole rights to market the technology in North America, will assist in engineering and fabricating the injection equipment. Training and assistance during commissioning, startup, and the early phases of testing will also be provided by experienced British Steel personnel.

Joseph F. Emig, President, Burns Harbor Division, stated that "By helping us reduce operating costs, the coal injection system being installed here at Burns Harbor will improve our facility's competitiveness. Installation of this system is further evidence of Bethlehem's commitment to maintain Burns Harbor as a world leader in applied technology."

Blast furnaces make iron by melting ore in the presence of limestone and carbon usually in the form of coke; iron is later refined into steel. BFGCI technology involves injecting coal directly into an ironmaking furnace, reducing the need for coke on approximately a pound for pound basis.

Coke will be replaced with direct coal injection at a rate up to 400 pounds (or higher if feasible) per net ton of hot metal; each blast furnace at Burns Harbor can produce approximately 7000 tons of hot metal per day. The reducing environment of the blast furnace should enable virtually all of the sulfur and ash in the coal to be captured by the slag. The gases exiting the blast furnace will be cleaned by existing cyclones and wet scrubbers to remove particulates. The cleaned blast furnace gas will then be used as a fuel in other plant processes as is currently done.

The dried and sized coals will be pneumatically conveyed to the blast furnace injection facility where the coal will be pneumatically conveyed from controlled injection equipment to 28 injection tuyeres in each furnace.

The new plant control system being installed will permit individual tuyere control depending on the specific thermal, combustion, and mixing dynamics within each furnace.

In addition to reducing coke requirements, BFGCI means smoother furnace operation, faster driving rates, and high iron productivity. Some specific technical objectives of this project include testing a range of coal particle sizes, demonstrating maximum coal injection rates, operating with various types and sources of domestic coals, and illustrating that furnaces can be converted to coal injection "on-the-fly'—all without impacting overall plant performance.

Bethlehem has signed a turnkey contract with Fluor Daniel, Inc., Greenville, SC, for the engineering, procurement, construction, and startup of the system's coal handing, crushing and injection facilities. Engineering design and procurement was done by Fluor Daniel, while construction activities are under the direction of Fluor Constructors International, Inc.

The coal injection system is expected to be placed into formal operation during late Spring 1995 when a 32-month test program is scheduled to begin. CCT

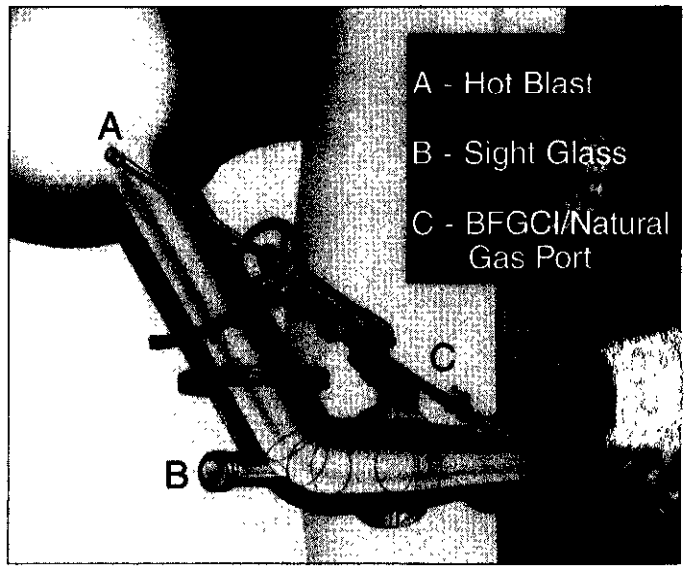


Illustration details a typical single BFGCI injection tuyere; one of 28 injection tuyeres installed on each blast furnace.

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FAX (301) 903-9438

Defining SCR Catalysts for U.S. High-Sulfur Coals

Gulf Power's SCR Test Facility in Operation

The 1990 Clean Air Act Amendments require NO_x emission limits on utility boilers fired with fossil fuels beginning in 1995. Recognizing the near term need for reliable technical and economic information to make the proper decisions for compliance with NO_x regulations, DOE has supported 17 Clean Coal projects concerned with NO_x reduction technologies. One of these projects is located at Gulf Power's Plant Crist near Pensacola, Florida.

Commercially available selective catalytic reduction (SCR) catalysts are now being evaluated on Unit 5 at Plant Crist. Cosponsors of this $23 million project with DOE are Southern Company Services, Inc., the Electric Power Research Institute, and Ontario Hydro. Crist Unit 5 is a 75 MWe tangentially fired, dry bottom boiler fired with high-sulfur (3%) coal, with a hot- and cold-side electrostatic precipitator (ESP).

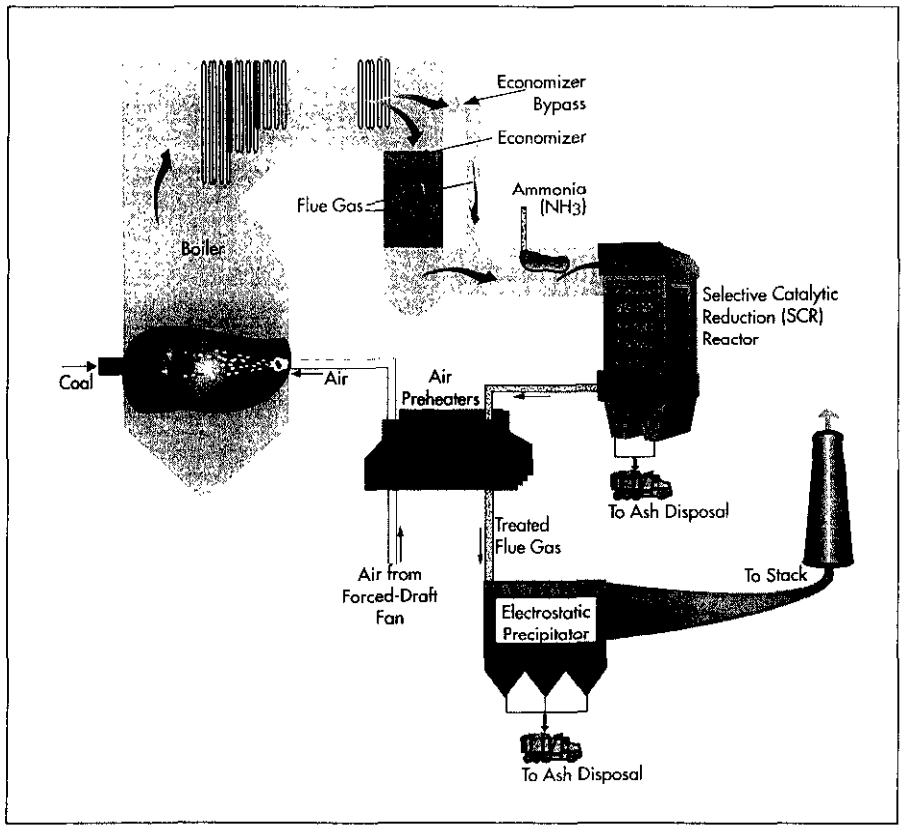
SCR technology involves the injection of ammonia (NH_3) into the flue gas passing through a catalyst bed where NO_x and ammonia react to form harmless nitrogen and water vapor. Although there are several possible plant configurations, the flue gas enters the reactor at economizer exit conditions (about 700 °F) prior to particulate removal. The quantity of NH_3 needed for a particular boiler system can be computed from measurements of the uncontrolled NO_x emission, the assumed amount of deNO_x achieved through combustion modifications, and the estimated compliance target for NO_x reduction. Under typical SCR design and operating conditions, deNO_x efficiency is directly proportional to the NH_3-NO_x ratio up to deNO_x levels of approximately 80%.

Before entering the reactor, ammonia is injected into the flue gas sufficiently upstream from the SCR reactor to allow complete mixing of the NH_3 and the flue gas. The quantity of NH_3 is adjusted to achieve the desired degree of reaction with the NO_x. The flue gas leaving the reactor passes through the air preheater where it transfers heat to the incoming combustion air. Provisions are made for removing some of the expected fly-ash fallout from the bottom of the reactor. Ductwork is also installed to bypass some flue gas around the economizer during periods when the boiler is operating at reduced load. This is done, especially on retrofits, to maintain the temperature of the flue gas entering the catalytic reactor at the proper reaction temperature of about 700 °F. The flue gas exits the air preheater to the boiler's particulate removal device.

Catalyst elements form the fundamental building blocks of SCR installations. Catalyst elements are offered commercially in two basic geometric shapes: honeycomb grid and plate. Several catalyst elements are bundled together to form a catalyst module. Commercial installations use multiple modules in several layers to form a SCR reactor. Current formulations of SCR catalyst, based on processes patented by the Japanese, typically employ vanadium pentoxide (V_2O_5) as the active material deposited on, or incorporated into, a substrate.

Although SCR is successfully and widely practiced in Japan and Western Europe to meet stringent NO_x emission regulations, numerous technical uncertainties are associated with applying SCR to U.S. coals. These uncertainties include:

See "SCR" on page 5 . . .



Simplified flow diagram for a typical SCR installation with a post air-preheater electrostatic precipitator.

. . . "SCR" *from page 4*

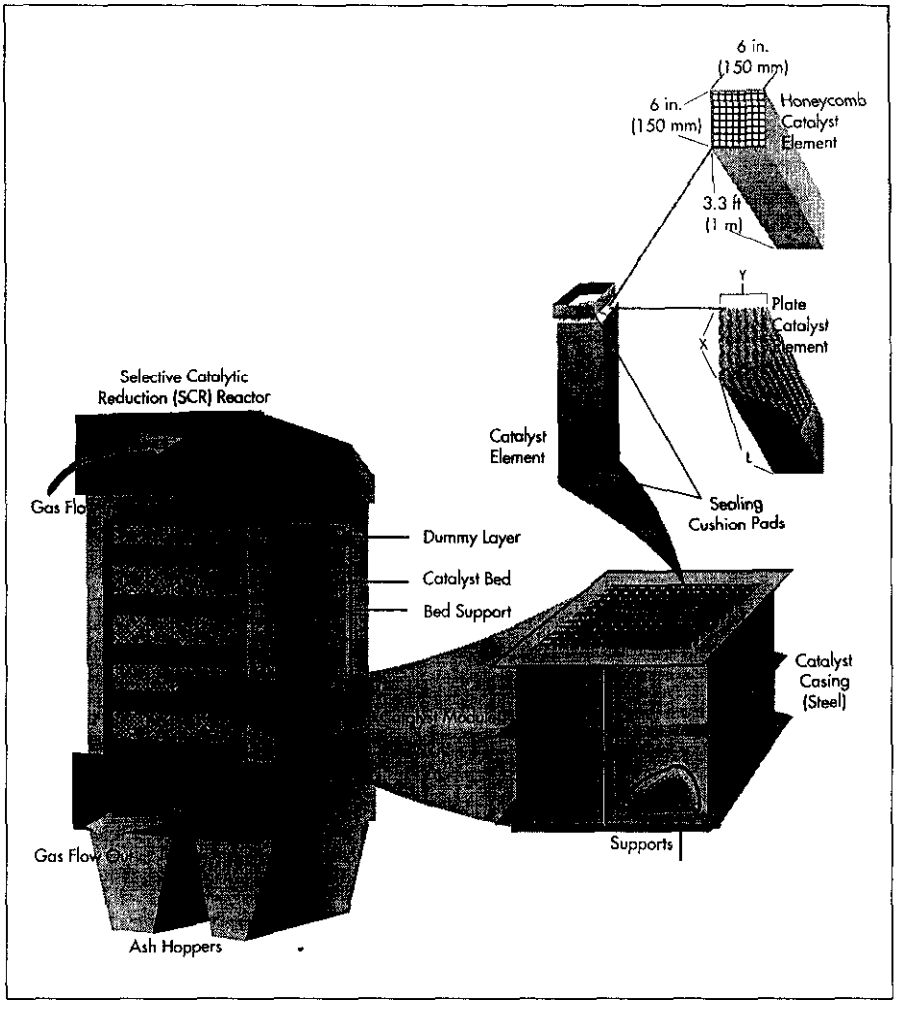
1. Potential catalyst deactivation resulting from poisoning by trace metals present in some U.S. coals that are not present or present at a much lower concentration in other fuels.
2. Performance of the technology and effects on the balance-of-plant equipment in the presence of high amounts of SO_2 and SO_3 (e.g., plugging of downstream equipment with ammonia-sulfur compounds caused by unreacted ammonia leaking through the SCR reactor, called "ammonia slip").
3. Performance of a wide variety of SCR catalyst compositions, geometries, and manufacturing methods under typical high-sulfur, coal-fired utility operating conditions.

These uncertainties are being explored by constructing a series of small-scale SCR reactors and simultaneously exposing different SCR catalysts to flue gas derived from the combustion of high-sulfur U.S. coal.

The first uncertainty will be handled by evaluating SCR catalyst performance for 2 years under realistic operating conditions found in U.S. pulverized coal utility boilers. Deactivation rates of the catalyst exposed to the flue gas from high-sulfur U.S. coal will be documented to determine catalyst life and associated process economics.

The second uncertainty will be explored by performing parametric tests with the installation and operation of air-preheaters downstream from larger SCR reactors. During the parametric tests, SCR operating conditions will be adjusted above and below design values to observe deNO$_x$ performance and ammonia slip as functions of the chan in operating conditions. Air-preheat performance will be observed to evaluate the effects of SCR operating conditions on heat transfer and boiler efficiency.

The third uncertainty is being addressed by using honeycomb- and plate-type SCR catalyst elements of various



Catalyst configuration and installation details for a typical commercial SCR application. Multiple modules in several layers make up a commercial SCR reactor.

commercial compositions from the United States, Japan, and Europe. Results from the tests with these catalysts will expand operating experience with a variety of SCR catalysts under U.S. utility operating conditions with high-sulfur coals.

Test Facility Description

The SCR test facility consists of nine reactors operating in parallel for side-by-side comparisons of commercially available SCR catalysts obtained from vendors throughout the world. With all reactors in operation, the amount of combustion flue gas that can be treated is 17,400 scfm or 12% of Unit 5's capacity (about 8.7 MWe).

There are three large SCR reactors (2.5 MWe, 5000 scfm) and six small SCR reactors (0.2 MWe, 400 scfm). Eight of the nine reactors will operate with flue gas containing full particulate loading (high dust) extracted from the inlet duct of the hot-side ESP, while one small reactor will use flue gas fed from the ESP outlet (low dust).

Each reactor train has electric duct heaters to control the temperature of the flue gas entering the reactor and a venturi flow meter to measure the flue gas flow. An economizer bypass line to the SCR test facility maintains a minimum temperature of 620 °F for flue gas supplied to the test facility. Anhydrous ammonia is independently metered to a stream of dilution air that injects the ammonia via nozzles into the flue gas

See "SCR" on page 6 . . .

. . ."Briefs" from page 1

marketplace. Copies of the Report are available from Fossil Energy's Office of Communications at (202) 586-5146 (FAX) or (202) 586-6503 (VOICE).

Negotiations are complete for three projects selected in the fifth round of the CCT Program and Comprehensive Reports to Congress have been submitted for the mandatory 30-day review. **The Coal Diesel Combined Cycle Project**, to be located at **Easton, MD,** is a 14-MWe demonstration which will utilize two diesel engines fired with a coal-water fuel made from Ohio coal. The project team is made up of Arthur D. Little, Inc., Cooper-Bessemer Reciprocating Products Division, and the Easton Utilities Commission, with additional support from the Ohio Coal Development Office . . . **The Four Rivers Energy Modernization Project** will be a 95-MWe, second generation pressurized circulating fluidized bed combustion cogeneration facility to be built next to a **Calvert City, KY** chemical plant. The project was proposed by Air Products & Chemicals . . . **The Warren Station EFCC Demonstration Project** will demonstrate a 66-megawatt externally fired combined cycle power generation system at Warren, Pennsylvania. The project was proposed by Pennsylvania Electric Company.

Having completed a 45-day run in June and surpassing the 7800 hour mark for cumulative operation, **Ohio Power's Tidd PFBC** plant is well on its way to a banner year. DOE recently amended its agreement with Ohio Power to provide for a fourth year of operation. Objectives are to verify long-term turbine survivability and demonstrate enhanced sulfur capture efficiencies.

Meanwhile, the joint venture of Destec Energy, Inc. and PSI Energy Inc., now at the halfway point in construction, continues steady progress at **PSI's Wabash River Station in W. Terre Haute, IN**. The gas turbine, major components of the heat recovery steam generator, and several portions of the gasifier have been delivered to the site. The plant remains scheduled for startup in the Summer of 1995.

The Environmental Protection Agency conducted a public hearing on the **Environmental Impact Statement (EIS) for Tampa Electric's Integrated Gasification Combined Cycle (IGCC) Project** in late March. No opposition or concerns were expressed . . . Public hearings on the EIS for **Sierra Pacific Power Co.'s Piñon Pine Power Project** were held on June 21-23. Pending a favorable Record of Decision, construction of the 95-MWe (net) project is slated to begin by the end of the year.

The success of **Southern Company Services'** demonstration of **the CT-121 Advanced Scrubbing System at Georgia Power Co.'s Plant Yates** made it the third time a CCT project has been singled out for honors by the Editors of **Power Magazine**. The April issue singled out Plant Yates for showing "just how far flue gas desulfurization has progressed over the past decade. . . proving that high performance and simplicity of operation can go hand in hand." Since it began operations in 1992, the technology has routinely removed between 93 and 98 percent of the unit's SO_2 emissions, well above the project target of 90 percent, with 98 percent reliability. Operating without an electrostatic precipitator (ESP), the advanced reactor can also capture 99 percent of particulates.

Florida Power & Light recently announced the selection of **Pure Air** technology to provide 1600 MWe of SO_2 scrubbing capacity at its Manatee Power Plant on an own-and-operate basis. The Manatee scrubber will feature two 800 MWe absorber vessels, Power Chip gypsum recycling, and wastewater evaporation.

The **CCT Demonstration Program-*Program Update 1993 Annual Report*** is now available. If you would like to receive a copy please contact the Office of Communications (numbers above) or the Office of Clean Coal Technology, Fax request to A. Strom at (301) 903-9438. Also, the CCT Office still has available copies of the *Proceedings for the 1993 Conference* held in Atlanta, GA. CCT

. . ."SCR" from page 5

stream prior to each SCR reactor. The flue gas and ammonia pass through the SCR reactors, which have the capacity to contain up to four catalyst layers.

Two U.S. catalyst suppliers (Grace, and Cometech), two European suppliers (Haldor Tropsoe A/S and Siemens AG), and two Japanese suppliers (Hitachi Zosen and Nippon Shokubai Co. Ltd.) have been chosen to supply SCR catalysts that represent various shapes and chemical compositions. The catalysts being evaluated represent the wide variety of SCR catalysts being offered commercially and possess different chemical compositions and both have honeycomb and plate-type geometries..

Advantages of SCR

SCR is the most technically advanced post-combustion technology available that is capable of reducing NO_x to the extremely low values mandated in certain areas of the world. SCR is a mature process, having been used extensively worldwide at process scales up to 800 MW on gas-, oil-, and low-sulfur, coal-fired utility power plants. Other SCR advantages include:

1. No requirement for marketing of a chemical by-product or regeneration of off-gases (it produces nitrogen and water vapor).
2. No significant re-engineering of the heat exchange cycle of a boiler.
3. No handling and transfer of solid adsorbents.
4. No requirement for the use of gases that may be unavailable at many power plant sites, creating additional operating complexity and cost.
5. SCR capital and operating costs are moderate.
6. The NO_x reduction reaction used in SCR is well studied, and the catalysts available are stable and long lived.

See "SCR" on page 12 . . .

THIRD ANNUAL CLEAN COAL TECHNOLOGY CONFERENCE

Chicago, Illinois
Sepetember 6–8, 1994
The Investment Pays Off

The public/private investment in clean coal technology pays off. The objective of the conference is to review the status and successes of the program, the role of the program in meeting domestic and global energy and environmental needs, the opportunities for commercialization in the United States and abroad, and the challenges which are being encountered. This review will be accomplished within the context of the emerging trade agreements and global energy, economic, and environmental changes.

REGISTRATION FEES

$350 General Attendees
$200 Government
$400 On-Site

Registration fee includes breakfasts, lunches, breaks, reception, tour and proceedings. For further information, please contact Kim Yavorsky, U.S. DOE at (412) 892-6244 or Fax (412) 892-4775.

HOTEL INFORMATION

Chicago Hilton and Towers
$87 Single or Double
Reservations by August 1, 1994
1-800-HILTONS or (312) 922-4400

AGENDA

Tuesday—September 6, 1994

7:00 a.m. - 8:30 p.m.	Registration
9:30 a.m. - 11:30 a.m.	International Orientation Session
11:30 a.m. - 1:00 p.m.	International Luncheon
1:00 p.m. - 7:00 p.m.	Tour: Pure Air Advanced Flue Gas Desulfurization Project

Wednesday—September 7, 1994

7:00 a.m.–5:00 p.m.	Registration
8:30 a.m.–11:30 a.m.	Plenary Session 1
11:30 a.m.–1:00 p.m.	Luncheon; Speaker - The Investment Pays Off
1:00 p.m.–3:00 p.m.	International Business Panel
3:15 p.m.–5:30 p.m.	Eastern Europe & NIS Reverse Trade Mission

Wednesday—September 7, 1994 (continued)

1:00 p.m.–5:00 p.m.	Concurrent Technical Sessions
6:00 p.m.–8:00 p.m.	Reception

Thursday—September 8, 1994

9:00 a.m.–12:00 p.m.	Pacific Rim Trade Mission
9:00 a.m.–12:00 p.m.	Emerging Issues, Environment for Domestic CCT Market
9:00 a.m.–12:00 p.m.	Concurrent Technical Sessions
12:00 p.m.–1:30 p.m.	Luncheon; Speaker - National and Consumer Economic Benefits of Coal
1:30 p.m.–4:00 p.m.	Plenary Session 2 Challenges to Commercialization and Deployment

Please complete this registration form and return by August 1, 1994 to:

The Center for Conference Management
P.O. Box 18209
Pittsburgh, PA 15236

(please print)

Name:_____

Title:_____

Company:_____

Street:_____

City:_____ State:_____

Country:_____ Zip:_____

Phone:_____ Fax:_____

I have enclosed a check made payable to CEED in the amount of $_____ to cover Conference Registration fees.

I will _____ will not _____ be attending the site visit and dinner at NIPSCO on September 6, 1994, 1:00 p.m. to 7:00 p.m. (please wear casual clothes and comfortable shoes for the tour).

Status of Clean Coal Technology Demonstration Projects

Ohio Power Co. Tidd PFBC Demonstration Project. (Brilliant, OH)
Following successful completion of a 30-day Congressional review period, the project's original 3-year operating phase has been extended by one year through February 1994. Plant operation continues, with more than 7,800 hours accumulated, including more than 3,100 hours of testing of hot particle filters on a one-seventh size slipstream.

CQ, Inc. Coal Quality Expert. (Homer City, PA)
All field tests have been completed. 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 July 1995.

EER Corporation. Enhancing the Use of Coal by Gas Reburning and Sorbent Injection. (Hennepin and Springfield, IL)
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, optimum operating conditions were established for the one-year long-term testing program which began on November 15, 1993. The completed parametric and long-term results to date show that the goals of 60% NO_x reduction and 50% SO_2 reduction are being met.

Rosebud Syncoal Partnership. Advanced Coal Conversion Process Demonstration. (Colstrip, MT)
Shipments of the "SynCoal" product to several Midwest utilities and industrial customers are being made for handling tests and test burns. Since testing began, the plant has processed more than 160,000 tons of raw coal and is now operating at full capacity. In December of 1993, a "Letter of Intent" was signed between Rosebud and Minnkota Power Cooperative to build a commercial facility in Center, North Dakota. Also, a 21-day test burn was successfully completed in March 1994, at Montana Power's Corrette Power Plant in Billings, Montana. This test burn used a 50% blend of SynCoal and raw coal.

York County Energy Partners. Circulating Fluidized Bed Cogeneration Project. (North Codorus Township, PA)
The Environmental Information Volume has been released to the public. A draft Environmental Impact Statement is being prepared and 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 resumed operations in early May after being shutdown in December 1993 for plant equipment modifications. Over 7,000 hours of operation were logged through 1993, and 4,800 tons of sulfuric acid were sold. During this period the plant operated smoothly and met or exceeded the goals of 95 percent SO_2 removal and 90 percent NO_x emissions reduction. Operations will continue into September 1994 when there will be a scheduled boiler outage. The host company, Ohio Edison, will receive ownership and operate SNOX after the demonstration project has been completed.

Appalachian Power Co. PFBC Utility Demonstration Project. (New Haven, WV)
Value engineering activities are continuing with the objective of refining the preliminary design for a 340-MW greenfield plant.

Babcock & Wilcox. Coal Reburning for NO_x Control. (Cassville, WI)
All testing, including air toxics emissions testing, is complete. The Final Report has been approved by the Participant and is being reproduced.

Babcock & Wilcox. SNRB Flue Gas Clean-Up Project. (Dilles Bottom, OH)
The final report for SNRB™ air toxics testing has been re-issued. The first draft of the final report for SNRB™ was issued to Participants in June 1994. The demonstration unit has been dismantled, thus restoring the Burger site. Some of the major components from the demonstration unit were shipped to Alliance, Ohio for incorporation into B&W's new 100 million Btu combustion test facility. This unit will be used on a B&W/DOE contract for air toxics emissions parametric studies.

Bethlehem Steel Corp. Blast Furnace Granulated Coal Injection. (Burns Harbor, IN)
Plant construction is more than 50 percent complete, with steel erection at the 60 percent mark. Approximately 6,000 cubic yards of concrete have been poured; all critical concrete work is now 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)
The Final Report on the project has been received, and the project is complete.

Pure Air. Advanced Flue Gas Desulfurization Demonstration Project. (Chesterton, IN)
The FGD scrubber is operating and has demonstrated the capability to reduce SO_2 emissions by greater than 95%, thereby removing some 60,000 tons of SO_2 on an annual basis. PowerChip™ gypsum operations commenced in January 1994, allowing for rail transport of some by-product gypsum. Air toxics sampling has been conducted; laboratory analyses are under way.

Babcock & Wilcox. Low-NO_x Cell™ Burner Retrofit. (Aberdeen, OH)
Completion of [illegible] requirements is underway. A draft long-[illegible] was received for review. A draft of the project's final report was received in June 1994. The project was successful, significantly exceeding the goal of 50% reduction in NO_x emissions, without adverse effects on boiler operations. Dayton Power & Light has accepted ownership of the LCNB™ demonstration retrofit. Further, Allegheny Power Systems has, through their subsidiary, West Penn Power, purchased retrofit LNC™ burners and coal feed piping for two 555 MWe boilers.

See "Status" on page 9 . . .

. . . "Status" from page 8

Southern Co. Services. Chiyoda Thoroughbred 121 FGD Process. (Newnan, GA)

Long-term test results have demonstrated SO_2 removals achieving a high of 97%. Using the standard 2.3% sulfur coal, normal SO_2 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 9,000 hours and has produced over 60,000 tons of gypsum. During tests conducted in January-February, 1994 a 4.6% sulfur coal was fired to 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 of 1994, the electrostatic precipitator was deenergized and the Chiyoda reactor started operations as both a particulate and SO_2 scrubber. This test will continue until the end of 1994. Southern Company Services intends to prepare sufficient quantities of the by product gypsum for commercial tests to be conducted for wall board 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 three Low-NO_x Concentric Firing System configurations indicated full load NO_x reductions up to 37, 40, and 48 percent, 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 have been submitted and are being reviewed 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. Relative to the pre-NSPS burner base case, long-term testing NO_x reductions were 24%, 48%, and 67%, respectively for AOFA, LNB, and combined AOFA/LNB technology. Low-NO_x digital control system (LNDCS) preliminary engineering is complete, and selection of the initial Artificial Intelligence Software supplier is complete. Testing of the LNDCS with the software package is scheduled for summer of 1994.

Southern Co. Services. SCR for High-Sulfur Coal Boilers. (Pensacola, FL)

Test operations are in progress. NO_x removal and ammonia slip results for all catalysts are as good as or better than design expectation.

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 DOE's responsibility under NEPA are continuing.

AirPol, Inc. Gas Suspension Absorption Project. (Paducah, KY)

The test program has been completed and results indicate that the GSA is capable of 90+% SO_2 removal efficiencies. Air toxics testing has been completed and the results are currently being analyzed. 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. Last fall, a published article in Power Magazine (October 1993) compared 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, successfully firing a full-scale pre-combustor module using a newly designed coal feed system. DOE issued the final EIS on December 15, 1993, and the Record of Decision on March 10, 1994. Award of "General Construction" contract is scheduled for Summer/Fall 1994.

Bechtel Corp. Confined Zone Dispersion FGD Project. (Indiana County, PA)

Clean Coal Final Reporting is in preparation and Bechtel and Penelec are discussing the possibility of a follow-on demonstration with a modified CZD system, which would achieve the project goals.

DMEC-1 Ltd. Partnership. Pressurized Circulating Fluidized Bed Demonstration Project. (Pleasant Hill, IA)

The results of plant configuration studies are being analyzed, and the available options are being studied by the host utility.

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 indicates that while NO_x can be reduced to the extent of 70%, meeting project objectives, the mean has been in the range of 66% to 70%. The Low-NO_x Burners have been modified in an effort to bring operating performance up to objectives at lower boiler operating levels. The manufacturer has been engaged in optimization and other studies with these modified burners. The project has been extended to test the effects of zero flue gas recirculation, overfire optimization, and gas cofiring testing and is now expected to be completed in June-July 1995.

ENCOAL Corp. Mild Gasification Project. (Gillette, WY)

The plant is operating successfully after a series of process and equipment modifications. At the time of this writing, the plant had passed the 1,200-hour mark in a long-term run to produce sufficient solid product for a utility test burn. The plant is currently processing 500 tons per day of Powder River Basin coal.

LIFAC N. America. LIFAC Sorbent Injection Desulfurization Demonstration Project. (Richmond, IN)

Using sorbent recycling, LIFAC is able to maintain over 70% reduction of SO_2 with peak reduction reaching 85%. Operations ended in early June 1994.

MK-Ferguson Co. NOXSO Flue Gas Cleanup System. (Niles, OH)

The demonstration will not proceed at the planned Niles, OH, site. The sponsors are currently in discussions with two major potential host organizations.

Public Service Co. of CO. Integrated Dry NO_x/SO_2 Emissions Control System. (Denver, CO)

A combination of low-NO_x burners, overfire air, and furnace urea injection into the furnace at full load resulted in up to 80% NO_x reduction. Duct injection of sodium based reagents resulted in up to 70% SO_2 reduction. Duct injection of calcium reagents with humidification resulted in a 30% SO_2 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 late-1994.

See "Status" on page 10 . . .

. . . "Status" from page 9

Tampa Electric. Integrated Gasification Combined Cycle Project. (Tampa, FL)
Plant design continues. A public hearing on the Environmental Impact Statement (EIS) was held on March 31; the public comment period on the draft EIS closed on April 11. Publication of the final EIS and Record of Decision is expected to occur in July.

Custom Coals International. Self Scrubbing Coal: An Integrated Approach to Clean Air. (Greensboro, PA; Springdale, PA; Richmond, IN)
The foundation for the Coal Cleaning Plant has been completed. Structural steel erection started in May. Shakedown of the plant is scheduled for December 1994.

New York State Electric and Gas. Milliken Clean Coal Technology Demonstration Project. (Lansing, NY)
Construction is well underway. The new scrubber facility has been completely enclosed. The stack is complete. Work is continuing on the scrubber module and gypsum facility.

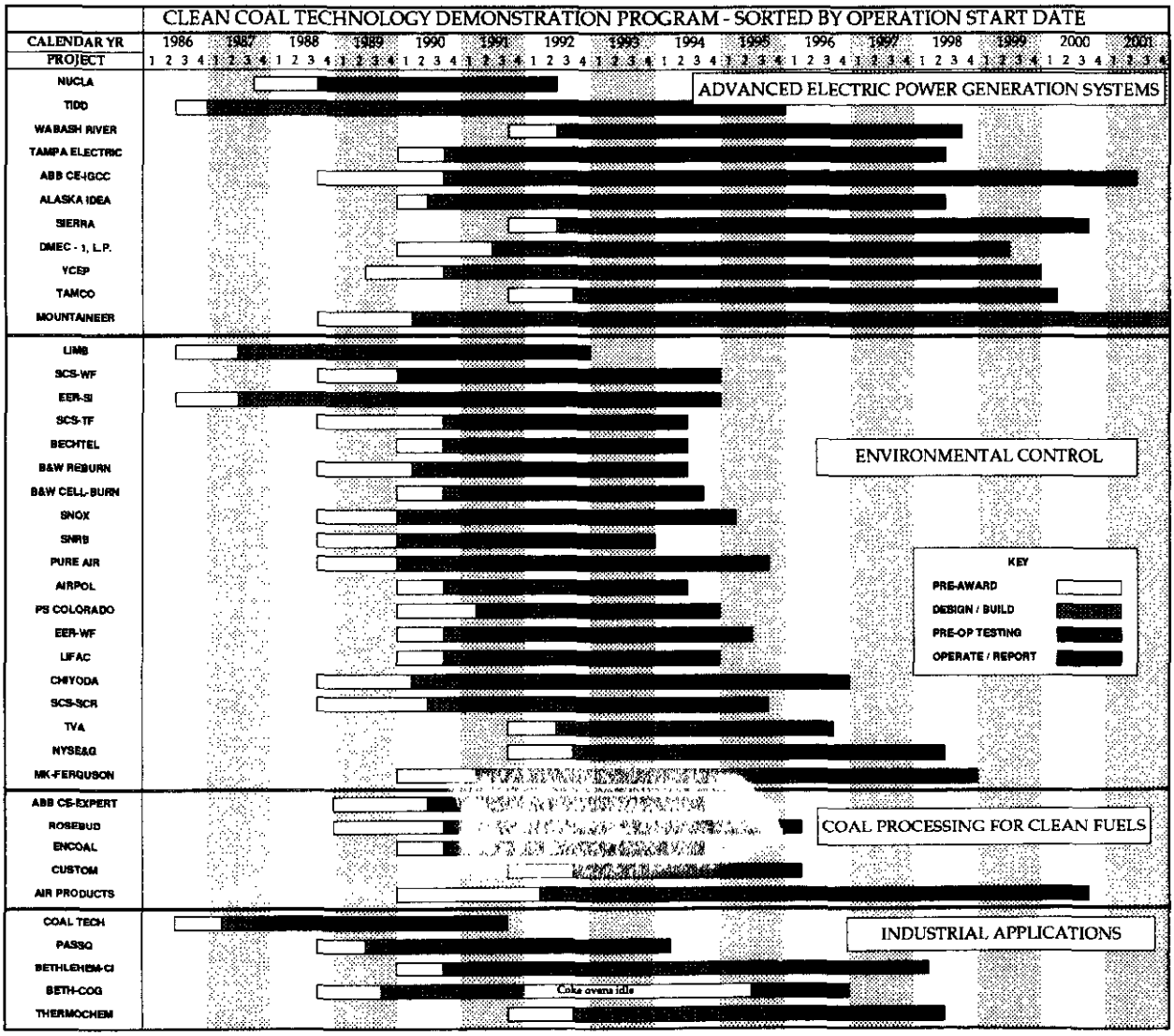
TAMCO Power Partners. Toms Creek IGCC Demonstration Project. (Coeburn, VA)
Project definition and preliminary design activities are under way. A power purchase agreement is being sought.

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 coal gasification plant integrated with the host K-Fuel facility has been completed. Environmental information is being prepared for use in the NEPA process. Test gasification of the design coal has been completed.

Sierra Pacific Power. Piñon Pine IGCC Project. (Reno, NV)
Activities are currently focused on design and permitting. The draft Environmental Impact Statement has been completed and released for public comment. Public hearings are scheduled for June.

Wabash River Joint Venture. Wabash River Coal Gasification Repowering Project. (W. Terre Haute, IN)
A 40 percent construction review was conducted in April. Project construction is now nearly 50 percent complete. The gas turbine, major components of the heat recovery steam generator, and several portions of the gasifier have been delivered to the site.



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.

October 1993	DOE/MC/27363-3629	*Tampa Electric Company Polk Power Station Unit No. 1—Annual Report, January–December 1992*
March 1994	DOE/FE-0299P	*Clean Coal Technology Demonstration Program—Program Update 1993*
May 1994	DOE/FE-0295P	*Four Rivers Energy Modernization Project (Comprehensive Report to Congress - CCT-V)*
May 1994	DOE/FE-0296P	*Coal Diesel Combined-Cycle Project (Comprehensive Report to Congress CCT-V)*
May 1994	DOE/FE-0309P	*Clean Coal Technology Program: Completing the Mission (Report to Congress)*
June 1994	DOE/FE-0307P	*Clean Coal Technology Export Markets and Financing Mechanisms (Report to Congress)*
June 1994	DOE/FE-0266P	*Warren Station EFCC Demonstration Project (Comprehensive Report to Congress CCT-V)*

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.

"NO_x Control Using Reburn Technology: Its Results, Promise, and Potential." John C. Welling, Fuller Company, *207th American Chemical Society National Meeting and Exposition*, San Diego, CA, March 1994.

"Gas Reburning and Integrated Technologies for SO_2 and NO_x Control." B.A. Folsom and T.M. Sommer; *Comparative Economics of Emerging Clean Coal Technologies III*, Advanced Power and Environmental Control, Washington, DC, February 1994.

"A Comparison of the Solid Waste Management Practices of Coal-Fired Electric Utility Participants in the Clean Coal Technology Program of the Pittsburgh Energy Technology Center." T.C. Ruppel; *19th International Technical Conference on Coal Utilization & Fuel Systems*, Clearwater, FL, March 1994.

"Micronized Coal Reburning for NO_x Control on a 175 MWe Unit." D.T. Bradshaw, T.F. Butler, J.U. Watts, C.L. Howler, and M.D. Lawley; *Joint ASME/IEEE Power Generation Conference*, Kansas City, MO, October 1993.

"Gas Reburning and Integrated NO_x and SO_2 Control: Ready for Commercial Installations." B.A. Folsom, R. Payne, and R. Lyon; *American Chemical Society National Meeting*, San Diego, CA, March 1994.

"Application of the British Gas/Lurgi Fixed-Bed Gasifier Design for Clean Coal Technology Round Five Coal Gasification." R.F. Edmonds, Duke Energy; D.E. Kluttz, Duke Engineering & Services, Inc.; J.H. Garstang, British Gas; and P.K. Herbert, Lurgi Energie and Umwelttechnik GmbH; *American Power Conference*, Chicago, IL, April 1994.

"Coal-Fueled Diesels for Modular Power Generation Performance and Emissions Characteristics Based on 1.8 MW System Test." R.P. Wilson, A.K. Rao, Arthur D. Little; and W.C. Smith, Morgantown Energy Technology Center; *American Power Conference*, Chicago, IL, April 1994.

"Project Overview and Status: Four Rivers Energy Modernization Project." E.P. Holley, J.J. Lewnard, and S.T. Wang, Air Products and Chemicals, Inc.; G. von Wedel, Lurgi Lentjes Babcock Energietechnik GmbH; K.W. Richardson, Foster Wheeler Energy Corp.; and H.T. Morehead, Westinghouse; *American Power Conference*, Chicago, IL, April 1994.

"Clean Power from Integrated Coal/Ore Reduction." D.H. Wakelin, LTV Steel Company; K.S. England, Centerior Energy Corporation; E.J. Harbison and R.N. Miller, Air Products and Chemicals, Inc.; *American Power Conference*, Chicago IL, April 1994.

"Tri-State's Nucla Station: Demonstration to Commercialization." S.A. Bush and M.A. Fellin, Tri-State Generation and Transmission Association, Inc.; M.A. Friedman, Combustion Systems, Inc.; *American Power Conference*, Chicago, IL, April 1994.

"The Midwest Power PCFB Demonstration Project Ahlstrom PYROFLOW Pressurized Circulating Fluidized Bed Technology." S.J. Provol and R. Dryden, Pyropower Corporation; and G. Kruempel, Midwest Power; *American Power Conference*, Chicago, IL, April 1994.

"Baseline Performance of a 200 MWe Pressurized Fluidized Bed Combustor." M.E. Zando and D.A. Bauer, American Electric Power Services Corporation; *American Power Conference*, Chicago, IL, April 1994.

"Repowering with Coal Gasification Technology." M.W. Roll, Destec Energy, Inc.; *American Power Conference*, Chicago, IL, April 1994.

"Wabash River Coal Gasification Repowering Project." M.D. Foster, PSI Energy, Inc.; *American Power Conference*, Chicago, IL, April 1994.

"The Wabash River Coal Gasification Repowering Project Challenges." David G. Sundstrom, Destec Energy, Inc.; *Alternate Energy '94*, La Quinta, CA, April 1994.

"The U.S. Department of Energy PFBC Perspective—1994 Update." Larry K. Carpenter and Randall J. Dellefield, Morgantown Energy Technology Center; *Electric Power Research Institute Conference: Fluidized Bed Combustion for Power Generation*, Atlanta, GA, May 1994.

Upcoming Events

Date	Event	Contact
July 18-21, 1994	***10th Annual Coal Preparation, Utilization, and Environmental Control Contractors' Conference***, Westin William Penn, Pittsburgh, PA	Doug Gyorke (412) 892-6173
August 17-18, 1994	***Contractors Review Meeting '94 for Fuel Cells*** Morgantown Energy Technology Center, Morgantown, WV	METC Conference Services (304) 291-4108
September 6-8, 1994	***Liquefaction Contractors' Review Meeting*** Vista Hotel, Pittsburgh, PA	Gary Steigel (412) 892-4499
September 6-8, 1994	***Third Annual Clean Coal Technology Conference*** Chicago Hilton and Towers Hotel, Chicago, IL	Kim Yavorsky (412) 892-6244
September 12-16, 1994	***11th Annual International Pittsburgh Coal Conference*** Pittsburgh Greentree Marriott, Pittsburgh, PA	Bruce Utz (412) 892-5706
November 9-10, 1994	***Advanced Turbine Systems Conference*** Washington, DC area	Mary Lee Blackwood (301) 621-8432

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Project Status

The SCR demonstration facility construction has been completed and start-up/shakedown was finished in early June 1993. Long-term performance testing began in July 1993 and will be completed in 1995. Immediately after catalyst loading, all reactors were operated briefly to obtain fly ash samples for the Toxicity Characteristics Leaching Procedure (TCLP) analysis. The TCLP results indicated no detectable amounts or change in constituents between baseline ash samples and ash samples from the SCR process outlet.

The start-up and commissioning tests demonstrated that each of the SCR reactors is operating on the same basis in terms of process gas feed. Distribution measurements on the individual reactors are in good agreement with the original design requirements. The results of these tests validate the test facility and should guarantee the quality of data obtained in long-term operation and parametric testing.

Catalyst testing to date has indicated that all catalysts are achieving NO_x removal and ammonia slip targets within the SCR design parameters.

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