DOE/FE-0215P-8 Issue No. 9, Winter 1992

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

The Clean Coal Technology Program highlight of the last quarter of 1992 was the receipt of 24 proposed projects for the program's *fifth round of competition* (see article p. 5). While fewer in number than previous rounds, the total value of the fifth round proposals is nearly $6.3 billion, approaching the highest in the program's history.

The types of projects proposed reflect the program's shift from an earlier emphasis on retrofit pollution control technologies to the *advanced power generation technologies*—ultra-clean, high efficiency systems—that will be needed to meet electricity demand in the 21st century. Competition will be strong, with $568 million available in federal cost-sharing and nearly $2.3 billion being requested from the federal government. Look for winning selections to be announced later this spring.

In the meantime, operations began at several of the projects already in the Clean Coal Program, bringing to 22 the number of projects currently operating or already completed. In October 1992, *Southern Company Services, Inc.* began shakedown tests of the *100 MWe CT-121* FGD advanced scrubber demonstration project at Georgia Power's

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In This Issue

Early Tests Show High SO_2 Removals

AirPol Plant Runs Smoothly

The Tennessee Valley Authority (TVA) is testing an innovative dry flue gas desulfurization clean coal technology at its National Center for Emissions Research in Paducah, Kentucky. The demonstration is being conducted on a 10 MWe slip stream from a 150 MWe boiler fired with high sulfur coal.

The technology, called "gas suspension absorption" (GSA), was first utilized in Europe to calcine limestone for cement production. In power plant applications, the GSA process promises to combine the economic benefits of spray dryers with SO_2 removal levels close to those of wet scrubbing processes.

This is the first application of the technology on U.S. coals and the first large scale unit to treat flue gas from a coal-fired boiler application.

The technology was developed by FLS miljo a/s of Denmark, the parent company of the project sponsor, Airpol, Inc., of Teterboro, New Jersey. The total cost of the project is approximately $7.7 million, with the Department of Energy providing $2.3 million (30 percent) of the funds.

The heart of the novel process is a vertical reactor where flue gases from the air preheater are intimately contacted with lime sorbent, flyash and recycled reaction products. The lime slurry is injected through a spray nozzle located at the bottom of the reactor. The flow of lime slurry is regulated by a variable speed pump controlled by measurement of acid gas concentration in the outlet flue gas stream. Cooling water added to the reactor is controlled by continuous measurement of the reactor/cyclone flue gas exit temperature.

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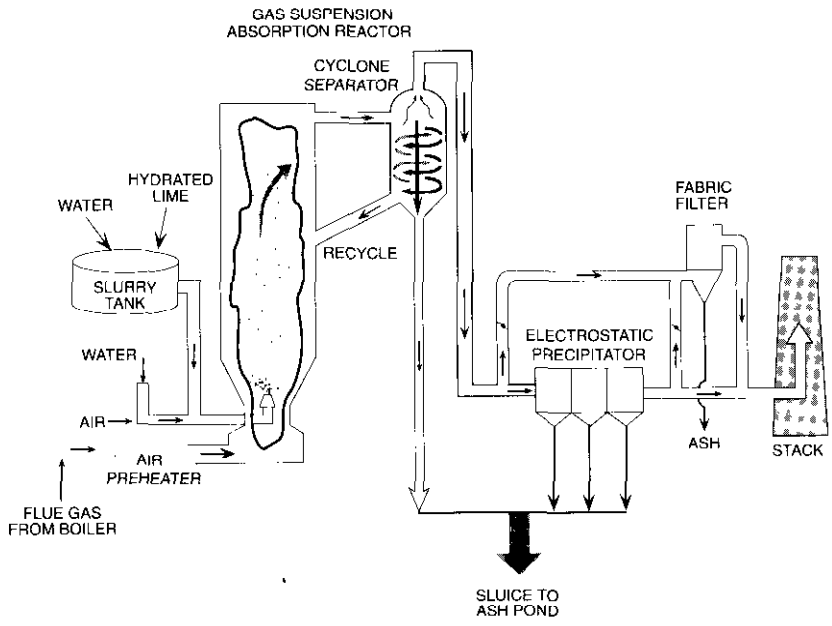

Simplified Gas Suspension Absorption Process Schematic

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After the SO_2 reaction, the solids are separated from the flue gas in a cyclone and most of these solids are recycled to the inlet of the vertical reactor. The gas stream then passes through an electrostatic precipitator where remaining particulates are collected.

Early Results Promising

Results from preliminary testing runs completed to date are very encouraging, especially as the flue gas temperature in the reactor approaches the adiabatic saturation temperature of the flue gas. Incremental changes in SO_2 removal become more significant as the approach-to-saturation temperature (AST) is reduced.

In one series of tests at constant inlet flue gas temperature of 320°F, Ca/S molar ratio 1.40, with essentially no chloride in the system and the boiler fired on 3.0 percent S coal, the AST in the reactor was gradually decreased from 40°F to 5°F. The overall system SO_2 removal efficiency increased from 65 percent to more than 99 percent at the lowest AST.

Another series of tests were conducted at the same conditions, except calcium chloride was added to the system to simulate the combustion of high chlorine coals. As the AST was decreased from 50°F to 24°F, overall system SO_2 removal efficiency ranged from 70 percent at the high AST condition to essentially complete removal at the closer AST.

Operations at ASTs below 24°F were not pursued since virtually 100 percent SO_2 removal was achieved. Although there is a higher potential for plugging at low AST and high calcium chloride conditions (because of increased moisture in the solids), plugging was not observed.

The preliminary tests were completed in January 1993 and the plant is now operating under a statistically designed test program to optimize SO_2 removal efficiency and process economics. After the completion of the test program, a four week around-the-clock test run will be conducted to demonstrate GSA system reliability and consistency of waste product properties.

The capability of the GSA process to remove air toxics will also be evaluated in mid-1993 following process optimization. Toxic species to be studied include hydrogen chloride, hydrogen fluoride and a large group of common toxic trace metals.

The project is scheduled to be completed the first quarter of 1994.

Ed Puschaver, Manager (O&M), Research & Development, at TVA's National Center for Emissions Research in West Paducah, KY examines the GSA slurry and air injection nozzles installed in the bottom of the reactor.

10 MWe GSA Plant. The reactor is on the left of the structure rising to the cyclone installed above the rectangular enclosure. The slipstream duct is shown at bottom foreground of the enclosure.

Commercial Implications

One important aspect of the process is the ability to use recycled sorbent products. Typically, a solid particle will pass through the system about 100 times before leaving as a waste product. This affords a high level of sorbent utilization and reduced operating costs.

AirPol estimates that a commercial GSA system will cost about 40 percent less than wet scrubber systems and 20 percent less than spray drying systems, yet SO_2 capture performance will reach 90 percent or more. The process should perform well with both high and low-sulfur coals.

Other advantages of the AirPol process are those typical of dry or semi-dry sorbent injection processes -- minimal space requirements, low capital costs, and ease of installation and operation.n

Correction

In the Fall 1992 Issue, the caption beneath the photo on Page 3 incorrectly listed the industrial participant for the SNOX Project. The correct participant is ABB Combustion Engineering, Inc. The Editor apologizes for any confusion.

Clean Coal Project Wins Outstanding Achievement Award

Pure Air's "Advanced Flue Gas Desulfurization Demonstration Project" was among eight projects named as Outstanding Engineering Achievements for 1992 by the National Society of Professional Engineers. The eight projects span a wide variety of engineering disciplines, and each was hailed for its overall contributions both to the engineering profession and to society.

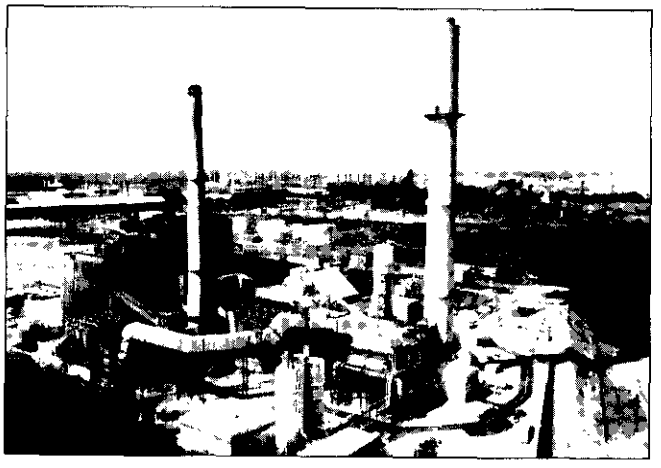
The award was presented jointly to Pure Air, Northern Indiana Public Service Company (NIPSCO, the host utility) and DOE's Pittsburgh Energy Technology Center.

Pure Air's $150 million project involves an innovative flue gas scrubber, located at NIPSCO's Bailly Generating Station on the outskirts of Chicago, IL. Sized at a nominal 600 MWe, the scrubber will reduce the Bailly power plant's SO_2 emissions by approximately 60,000 tons per year. It is the largest single-module scrubber in North America.

Project construction was completed within budget, and operations commenced ahead of schedule in June 1992, making Bailly Station the first power plant to comply with the Clean Air Act Amendments of 1990 utilizing flue gas scrubbing. Early operations have been very successful; the scrubber has exceeded its design targets by achieving SO_2 removal levels of up to 95%, and as high as 98% during testing, while producing a commercial gypsum by-product with an average purity level of 97%.

In September 1992, the first of six one-month demonstration tests was successfully completed, using the normal coal for the Bailly Station (3.0-3.5% sulfur Illinois/Indiana bituminous). Since then, operations have remained largely uneventful with continuing high SO_2 removals.

In addition to the advanced scrubbing technology, the project is demonstrating a novel wastewater evaporation system that can provide for a zero-discharge design, and the business concept whereby Pure Air owns and operates the facility, relieving the utility of the responsibility for operations. n



Pure Air's award winning Clean Coal project is located at the Northern Indiana Public Service Company's Bailly generating station, near Chesterton, IN.

Pure Air Project Helps Hurricane Relief Efforts

Thousands of homes were destroyed when Hurricane Andrew hit Florida and Louisiana from August 23-25, 1992. Many of the victims are still recovering, and one of the greatest needs is for building materials to support reconstruction. Several companies recently pooled their resources to donate 100,000 square feet of sheetrock to the Salvation Army in West Palm Beach, Florida for use in repairing damaged homes.

The sheetrock was manufactured by U.S. Gypsum, using by-product gypsum from Pure Air's Clean Coal scrubber located at the Northern Indiana Public Service Company's Bailly generating station. Rail transportation to Florida was provided gratis by CSX Corporation. n

Neal Garceau (left), Manager of U.S. Gypsum's East Chicago, IN plant, and Bob Conley, President of Pure Air, prepare to send a sheetrock shipment to the Salvation Army's hurricane relief effort in Florida.

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Comments are welcome.
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LIFAC Process Tests Now Underway

Full-scale tests of an advanced clean coal technology -- one that approaches 85 percent SO_2 emissions reduction while avoiding much of the costs and larger space requirements of conventional flue gas scrubber systems -- have begun at the 60-MWe Whitewater Valley Unit No. 2 boiler facility owned by Richmond Power & Light located in Richmond, Indiana.

Startup and shakedown tests treating flue gas began in September 1992, including baseline testing to characterize the operation of the boiler and associated subsystems. The process shakedown has taken more time than originally intended because of minor mechanical/electrical problems but the delay should not impact the overall schedule or budget. Parametric testing began in March 1993.

The Whitewater Valley facility, with its compact boiler configuration, is typical of many plants facing deadlines for reducing SO_2 emissions by the turn of the century. These smaller, older plants -- built before the initial requirements of the Clean Air Act -- often do not have the space to accommodate large scrubbing systems. Other plants are too old to justify the high capital investment and operating costs of large pollution control facilities.

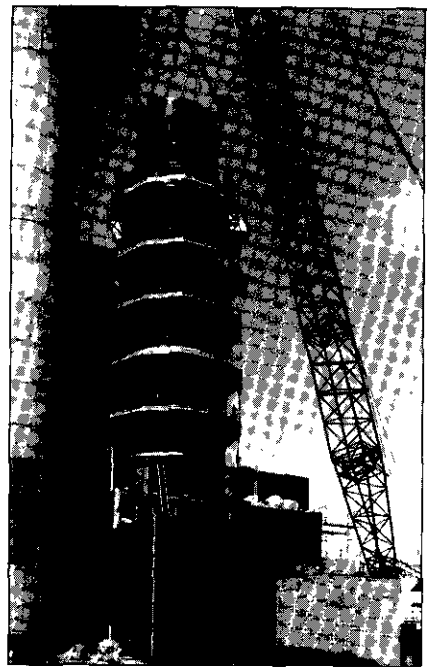
LIFAC may be an attractive solution for these installations where the system is installed essentially as an addition to the existing plant's flue gas ductwork. Another advantage is that the extra equipment, energy usage, manpower and maintenance normally required with scrubbers may be avoided with the LIFAC process.

As a result, the LIFAC system can provide levels of SO_2 removal comparable to those of conventional scrubbers while saving considerable costs.

The $22 million project, 50 percent DOE funded, is sponsored by LIFAC North America, a joint venture of ICF Kaiser Engineers of Oakland, CA and Tampella Power Corp. of Finland, which developed and patented the technology. Other project participants include the State of Indiana, the Electric Power Research Institute, the Black Beauty Coal Co., and the host utility, Richmond Power & Light.

Process Description

The LIFAC process is centered around a unique, patented system called an "activation chamber," which is actually a vertical elongation of the ductwork built between the air preheater and the electrostatic precipitator.

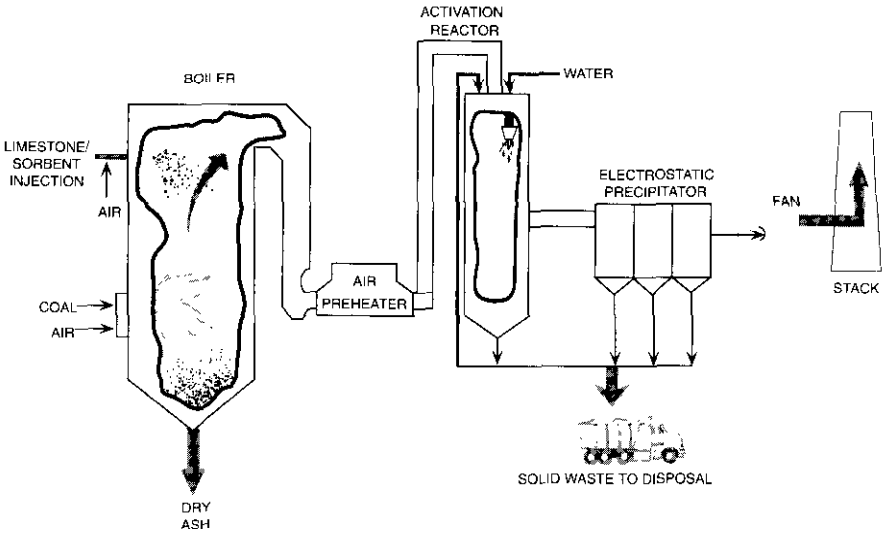


LIFAC activation chamber structure shown at a late stage of construction at the Richmond Power & Light 60-MWe Whitewater Valley Station Unit No. 2, Richmond, Indiana.

First, limestone injected into the upper boiler region calcines to lime and absorbs part of the sulfur dioxide (about 25 percent of the SO_2 removal occurs in the boiler). The gases then move through the air preheater and enter the activation chamber where they are humidified and the SO_2 capture is completed.

Residence time (chamber size) and water droplet size are controlled for effective hydration of the lime, reaction of the sorbent with the remaining SO_2 and completion of water evaporation to afford a dry reactor solids product. This fine, dry powder is easily separated from the flue gas along with the flyash in the electrostatic precipitator.

Part of the collected solids is recycled into the ductwork just ahead of the activation chamber which improves sorbent usage. The balance, considered non-hazardous, can be landfilled with the flyash without causing environmental concerns.



Simplified LIFAC Sulfur Dioxide Removal Process Schematic

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Plant Installation

Construction of the LIFAC plant began in March of 1991. Work continued through the Summer of 1992 with no need for plant downtime other than normally scheduled outages. All of the construction work associated with the LIFAC system was performed in close proximity to the exterior of the powerplant or in cramped areas inside the plant. The ductwork tie-ins and new steelwork required inside the plant are located in small, difficult to access work areas. The reactor outside is approximately thirty feet from the powerplant with the outside ductwork and piping crossing offices and other plant roof areas. All of these new structures and equipment were constructed with no interference to daily plant operations.

The plant is now in the Operating Phase scheduled to be completed late in 1994. n

Round V Update

The fifth round of the Department of Energy's multi-billion dollar Clean Coal Technology Program has attracted 24 proposals for demonstration projects that could help meet the demands for energy growth and environmental protection in the 21st century.

The majority of proposals received by the December 7, 1992, deadline reflected DOE's emphasis on high-technology approaches for using America's coal supplies in the post-2000 era.

Winning proposals are to be named by May 6, 1993.

Of the 24 candidate projects, 14 propose to construct or refurbish electric power generating facilities with such advanced concepts as coal-powered fuel cells, gasification combined cycle, fluidized bed combustion, externally fired combined cycle, a coal-fired turbine, a coal-burning diesel engine, and a magnetohydrodynamics power system. Such technologies are expected to be among the next wave of options considered in the post-2000 era when utility and other power generators will face more stringent sulfur and nitrogen emission limits and potential concerns over greenhouse gases.

If successfully demonstrated in the U.S., these cleaner, more efficient technologies also are expected to become attractive U.S. export commodities to countries that are expanding or modernizing their power generation industries.

In addition to the advanced electric power generating approaches, the proposals include advanced ways to produce liquids from coal, remove impurities from coal, improve iron ore reduction for steelmaking, clean combustion flue gases, and burn micronized coal for cogeneration.

The total value of the proposed projects approaches $6.3 billion, $2.3 billion of which is requested from the Federal government. DOE plans to make $568 million available in cost-sharing and, by law, can finance no more than half the costs of each selected project.

The fifth round of the Clean Coal Technology Program will complete one of the nation's largest energy and environmental initiatives. Begun in 1986 as an outgrowth of recommendations of the U.S. and Canadian Special Envoys on Acid Rain, the program was originally envisioned as a $5 billion government/industry effort. Higher-than-expected private sector funding is expected to push the program's total value to well over $6 billion.

To date, from the first four rounds of competition, 41 projects are either underway or have been completed. These projects have a total value of nearly $4.6 billion , 60 percent of which is being provided by the industrial participants.

DOE will make available upon request a compilation of "Public Abstracts" prepared by the proposers. The abstracts can be obtained by calling the Office of Fossil Energy Communications at (202) 586-6503 or by writing the Office of Fossil Energy, FE-5, Rm. 4G085, U.S. Department of Energy, Washington, DC, 20585. n

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Plant Yates. So far, the project has exceeded its goal for SO_2 removal of 90 percent and, with the exception of a two-week delay in December caused by flooding at the site, the plant has run continuously. Full scale tests are expected to run through 1994.

Two days after the CT-121 startup, *AirPol* began a 10 MWe demonstration of its *Gas Suspension Absorption* technology at the Tennessee Valley Authority's Shawnee station near Paducah, Kentucky (see story p. 1). The project dedication, held the previous day, attracted many people and coincided with the renaming of the station the *National Center for Emissions Control Research.*

Finally, on November 5, natural gas flow was started into the gas reburning zone of Unit 3 at the *Public Service Company of Colorado's* Cherokee Station near Denver (see story p. 6).

The first fuels from *ENCOAL's* Wyoming mild coal gasification plant were sold and shipped to customers late this fall. In October 1992, ENCOAL shipped 2,000 barrels of specification coal derived liquid from early operational runs of the plant.

Three hearings were held in December to solicit public comments on the *Draft Environmental Impact Statement (DEIS)* for the *Healy Clean Coal Project*, proposed to be built in Healy, Alaska. DOE held the hearings in Healy, Fairbanks and Anchorage, Alaska. A total of almost 175 people attended the sessions. An innovative format for the hearings was developed, creating an opportunity for two-way communication by incorporating a short off-the-record workshop in which the project and the environmental effects were described, followed by an informal question and answer period. When the workshop ended, the formal hearings resumed for the record. The public responded well to this format and people were very interested in learning about the project and the environmental effects. n

EER's Gas Reburning–Low-NO_x Burner Technologies Reducing NO_x Emissions

Energy and Environmental Research Corporation (EER) is testing a combination of natural gas reburning and low-NO_x Burners (GR-LNB) on Unit No. 3, a 172 MWe wall-fired utility boiler at Public Service Company of Colorado's (PSCC) Cherokee Station located near Denver, Colorado. The goal of the project is to achieve a 70 percent reduction in NO_x emissions from that coal-fired boiler.

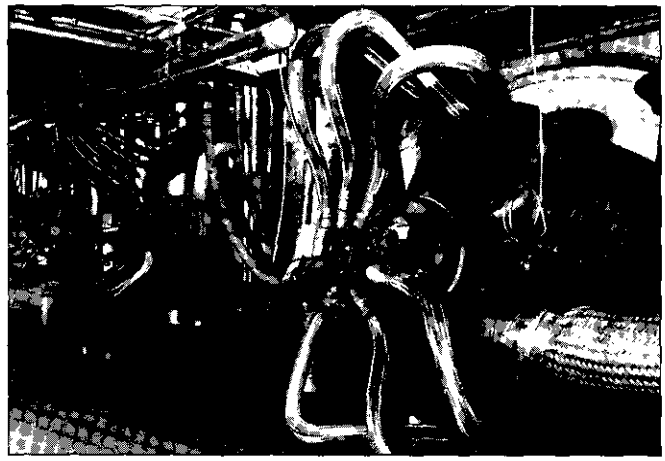
Construction and shakedown of the new system was completed in June 1992, about three months ahead of schedule.

The Riley coal-pulverizers were rebuilt during July and August 1992, with the principal aim of increasing the flow of primary air to the sixteen Foster Wheeler Internal Fuel Staging (IFS) burners, and final start-up of the gas reburn equipment was completed. During full load GR-LNB operations, all sixteen IFS burners installed by PSCC will be operated but with less coal flow. Gas reburning will supply the balance of the heat for power generation while increasing the overall level of total NO_x reduction.

Parametric testing of the combined gas reburning and low NO_x burner systems commenced in November 1992. Preliminary data indicate that the systems will be successful in reducing NO_x emissions up to 70 percent at full load.

Optimization testing of the gas reburning system was followed by a brief outage in February 1993 for minor modifications to the low-NO_x burners.

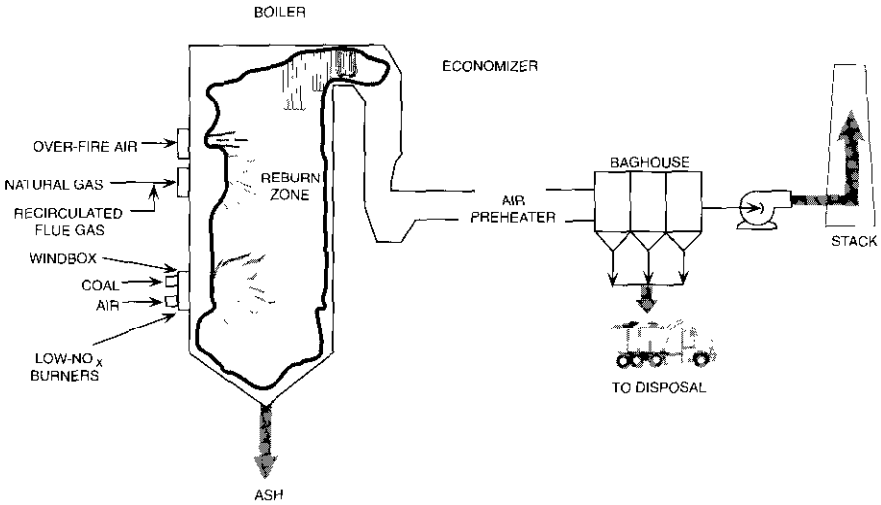
One year of long-term testing is scheduled to commence in March 1993.



One of four sets of low-NO_x coal burners is shown installed in the bottom level of the boiler, with all associated coal and air feed lines in place.

Technology Description

EER's gas reburning technology involves firing up to 20 percent natural gas above the main coal combustion zone in a boiler. This produces a slightly fuel-rich zone where NO_x produced by the coal combustion is "reburned" and converted to atmospheric nitrogen. Overfire air is added above this reburning zone to complete the combustion process.



Simplified Schematic of Combined Gas Reburning-Low NO_x Burner Technologies

The reburning system is comprised of three integrated subsystems. First, the natural gas injection system directs and controls the proper amount of gas to the reburn zone. Second, the flue gas recirculation system recycles flue gas from the economizer outlet through the use of a fan to the reburn zone where it provides furnace penetration and good mixing of the injected natural gas. Finally, the overfire air system provides combustion air to burn the remaining combustibles.

The Foster-Wheeler IFS burners retard the production of NO_x by staged combustion, employing dual combustion air registers which allow for control of air distribution at the burner, providing independent control of the ignition zone and flame shaping.

Commercialization

As the $16 million dollar project (50 percent DOE cost-shared) continues and optimized test results become available, EER will be ready to commercialize this technology.

The combined technology system is applicable to wall-fired utility and industrial boilers. Estimates indicate about

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35 existing wall-fired utility boilers, plus industrial boilers, could make immediate use of this technology, with the largest existing utility boiler estimated to be about 1,300 MWe.

Specific features of the technology that increases its potential for commercialization include: (1) can be retrofitted to existing units; (2) reduces NO_x emissions by about 70 percent; (3) suitable for use with a wide range of coals;

View of the natural gas injectors inserted into the recycle flue gas ducts that enter the boiler wall; stainless steel gas feed lines come off the gas header located above.

(4) has the potential to improve boiler operability; (5) requires minimal space and; (6) uses commercially available components.

As a side benefit, SO_2 is decreased in direct proportion to the amount of natural gas that is substituted for coal. Also increasing the attractiveness of the GR-LNB technologies, are the expected significantly lower capital and operating costs compared to selective catalytic reduction and other NO_x control technologies. n

Second Colorado Project Also Operating

Public Service Company of Colorado (PSCC) Tests Integrated NO_x/SO_2 Emissions Control System

At its Arapahoe Station in Denver, PSCC is demonstrating NO_x control with low-NO_x burners, overfire air and selective non-catalytic reduction (SNCR) of NO_x by in-furnace injection of urea, and SO_2 control with two types of dry sorbents and flue gas humidification.

The tests are being conducted on Unit Number 4, a 37 year old 100-MWe "down-fired" boiler. If successful, the technologies could become important pollution control measures for older plants, improving air quality while holding down costs to consumers. The urea injection system is the first installation on a U.S. utility coal-fired plant.

Construction was completed in mid 1992 and operational testing commenced in August 1992. Tests of the Babcock & Wilcox low-NO_x DRB-XCL™ down-fired burners with overfire air, while firing western bituminous coal, have reduced NO_x emissions 65 percent to about 0.4 lb/million Btu with no operating problems.

These are the first NO_x combustion tests on a top-fired boiler, a relatively uncommon but high NO_x emitting boiler type.

Initial baseline testing of the urea system was conducted in early 1992. NO_x removal levels of about 30 percent were obtained with minimal ammonia slip at full load . At lower loads the temperatures cooled sufficiently and only 10 percent NO_x removal could be obtained with low ammonia slips. Urea injection is very sensitive to the furnace flue gas injection temperature. Too high a temperature can cause the urea to form additional NO_x. Too low a temperature results in significant conversion of urea to ammonia and no reaction with NO_x.

A short test with liquid ammonium hydroxide was also quite successful and, at low load and minimal ammonia slip a NO_x removal of 30 percent was achieved. This work led to the installation in December 1992 of an on-line system to convert urea to aqueous ammonia so that both chemicals can be tested further.

Two types of dry sorbents for duct injection will be tested for SO_2 emissions reduction. A calcium based sorbent will be injected upstream of the air preheater. Sodium or calcium based sorbents will be injected downstream of the air preheater. Sodium based sorbents are planned to be used with the plant's normal low sulfur coal (0.4 percent). Lime based sorbents will be used for test work with high sulfur Illinois coal (2.5 percent) and the normal low sulfur coal.

Humidification—found to be extremely effective with sorbent injection tests at other Clean Coal Technology projects - will be used with the calcium based sorbents to increase their efficiency.

Testing of the low NO_x combustion systems and urea injection began in January 1993. Following these tests a variety of sorbent injection tests will begin in the second quarter of 1993. Towards the end of 1993, the plant will be operated with all technologies integrated for long term tests which will run through May 1994.

The project also includes monitoring of air toxics to determine the impact of the advanced technologies on air toxics emissions.

The Electric Power Research Institute along with PSCC is co-funding the $27.4 million project, 50 percent DOE funded. n

Status of Clean Coal Technology Demonstration Projects

EER Corporation. Enhancing the Use of Coal by Gas Reburning and Sorbent Injection. (Hennepin and Springfield, IL)

Testing at the Hennepin Station of Illinois Power was completed on January 15, 1993. Two treated lime products, High Surface Area Lime and Promoted Lime were used in the final stages of testing. The treated lime products increased SO_2 capture up to 20 percent. The overall project goals of greater than 50 percent NO_x and 50 percent SO_2 removal were achieved. Testing at the Lakeside site will start in February 1993.

Babcock & Wilcox. LIMB/Coolside Demonstration Project. (Lorain, OH)

The Final Coolside Topical Report was approved by DOE for distribution and copies are now available to the public through NTIS [Ref. DOE/PC/79798-T26 (DE93001722)]. The LIMB Extension Final Report through NTIS [Ref. DOE/PC/79798-T27 (DE93005979)].

American Electric Power. Tidd PFBC Demonstration Project. (Brilliant, OH)

The plant has accumulated nearly 3500 hours of coal-burning operation, including runs of 102 and 360 hours in which advanced ceramic filters were exposed to one-seventh of the hot gas stream. The plant is in a 5 month outage period because of blade failures in the low-pressure turbine that occurred in February 1993.

Rosebud Syncoal Partnership. Advanced Coal Conversion Process Demonstration (Colstrip, MT)

Phase III Operations that started in June 1992, are continuing. Modifications made to the demonstration facility are now being tested; these changes are expected to overcome the operating difficulties that have been experienced to date.

CQ, Inc. Coal Quality Expert. (Homer City, PA)

More than half of the planned six full-scale field tests and pilot and bench scale correlation tests have been completed. Over 100 algorithms based on the data generated from the tests are under development. The Acid Rain Advisor software package is now commercially available. Two new host sites have been selected for field test sites #5 and #6.

York County Energy Partners. Circulating Fluidized Bed Cogeneration Project. (York, PA)

YCEP is exploring the feasibility of a site change within the York County area to meet commitments to offset SO_2 emissions 2 to 1 in the community. YCEP is evaluating preliminary vendor bids for major equipment including the steam turbine and electric generator.

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 percent, thereby removing some 60,000 tons of SO_2 from the air on an annual basis. Byproduct gypsum is 97 percent pure and is being sold to U.S. Gypsum. Tests with the standard NIPSCO coal (3-3.5 percent S) have been completed.

Southern Co. Services. NO_x Reduction for Tangential-Fired Boilers. (Lynn Haven, FL)

Long-term test data from operating the Low NO_x Concentric Firing System (LNCFS) Level II equipment (one of three basic air/coal feed configurations to be tested) indicated full load NO_x reductions up to 40 percent compared to the baseline emission data. Long-term data for Level III show that NO_x emissions have been reduced by as much as 48 percent. Results of Level I long-term testing indicate full load NO_x reductions of 37 percent below baseline. Air toxics and fuel fineness data continue to be evaluated.

Southern Co. Services. NO_x Reduction for Wall-Fired Boilers. (Coosa, GA)

Long-term testing of the Advanced Over Fire Air (AOFA) and for the Low-NO_x Burners (LNB) has been completed. This 500 MWe boiler is now being operated at reduced loads to meet particulate compliance limits. Diagnostic, chemical emissions, long-term testing and digital control system testing for the LNB plus AOFA configuration will be performed following resumption of full load operations.

Passamaquoddy Tribe. Cement Kiln Flue Gas Recovery Scrubber. (Thomaston, ME)

Piping, valve and other modifications under Passamaquoddy Technology's supervision have been completed. The new chevron style mist eliminator will be completed shortly. The chevrons themselves have arrived. Testing will continue through the Spring.

Babcock & Wilcox. Coal Reburning for NO_x Control. (Cassville, WI)

Results of parametric and optimization testing with bituminous coal indicate that NO_x emissions are reduced by about 55 percent between full load (110 MW) and 70 MW. From 70 to 40 MW the NO_x reductions range from 50 to 35 percent. Air Toxics emissions monitoring and reburn testing on western coal appear to be better than those obtained on bituminous coal. Testing is now complete on this project.

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.

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

Construction of the gypsum stack was completed. Boiler tie-ins were completed and the unit has been in operation since October 1992. Preliminary results indicate 93-98 percent SO_2 removal compared to the objective of 90 percent. This scrubber has been selected to participate in the PETC Air Toxics Testing program.

ABB Combustion Engineering. IGCC Repowering Project. (Springfield, IL)

Activities are focused on refining the project cost estimate to substantially reduce the capital cost projection.

American Electric Power Service Corp. PFBC Utility Demonstration Project. (New Haven, WV)

Value engineering activities are continuing, including development of system descriptions, definition of component requirements and trade-off studies, to refine the preliminary design for a 340-MW greenfield plant.

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

Design work is more than 99 percent complete and construction, which began on March 23, 1992, is scheduled to be complete in February 1993. Facility startup and shakedown tests are scheduled to begin in February and continue through the first quarter of 1993.

Babcock & Wilcox. SNRB Flue Gas Clean-Up Project. (Dilles Bottom, OH)

Operations at Ohio Edison's R.E. Burger demonstration facility show NO_x and SO_2 reductions above 90 percent and 80 percent respectively. 1,800 and 800 hours of testing were completed on the Nextel and S Glass filter fabric bags respectively. About 3,800 hours of testing have been accumulated on three different fabrics at the Colorado Springs test facility. Fabric tests at that facility are complete and it is being dismantled.

ABB Combustion Engineering. SNOX Flue Gas Cleanup Project. (Niles, OH)

The SNOX plant is operating at full capacity producing 93 percent pure sulfuric acid, and achieving SO_2 and NO_x removals of 96 and 94 percent respectively. This SNOX project has also been selected to participate in the Air Toxics Testing Program.

Bethlehem Steel Corp. Blast Furnace Granulated Coal Injection. (Burns Harbor, IN)

The Bethlehem Steel Board of Directors has approved proceeding with the project. DOE is reviewing Bethlehem's request to continue the project into the engineering, procurement and construction stages of the project.

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

Slurry injection tests using dolomite lime have indicated that the expected level of SO_2 emissions reduction of 50 percent can be achieved and possibly exceeded. Parametric testing has been completed. The six-month continuous demonstration run initiated in August 1992, is nearing completion.

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

The October startup of the Gas Suspension Absorption (GSA) system went smoothly. In the early operations, SO_2 removal levels of 99.9+ percent were achieved.

Alaska Industrial Development Authority. Healy Clean Coal Project. (Healy, AK)

Engineering and permitting efforts are proceeding on schedule. Design verification tests on the TRW combustor began in December 1992. DOE issued its Draft Environmental Impact Statement (DEIS) in November 1992, and conducted public hearings in Alaska in December 1992. The public comment period for the DEIS closed on January 20, 1993.

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

Low NO_x burner and overfire air testing was completed on October 30, 1992. Early results indicate NO_x removals of more than 60 percent. On-site testing for Baseline Air Toxics Monitoring was completed the week of November 16, 1992. Testing of the urea and aqueous ammonia injection system began on January 4, 1993, and will continue through March 1993. Calcium injection testing will be conducted in March and April 1993. The overall testing schedule will be completed in May 1994.

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

Tampa has signed a license agreement with Texaco Development Corp. for its gasification power systems technology and a contract with GE for a 7F-based gas turbine combined cycle system. Tampa is responding to sufficiency comments received from the State of Florida regarding Tampa's Site Certification Application (permits).

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

Construction and baseline testing are complete. Parametric testing began in February, 1993.

Air Products and Chemicals, Inc. Liquid Phase Methanol Process. (Daggett, CA)

A cooperative agreement was signed on October 16, 1992. Texaco Syngas Inc.'s negotiation of a power purchase agreement for the Texaco Cool Water Project is delayed. A California Energy Commission Order, based heavily on the current economy and forecasts for natural gas price and availability in California, established a range for negotiation of the power purchase agreement. As conceived, the Texaco Cool Water Project with the Liquid Phase Methanol unit add-on cannot compete economically in California without restructuring the project's financing. Efforts to restructure the project's financing and to explore relocating the LPMEOH™ project add-on to an alternative site are underway.

Babcock & Wilcox. Low-NO_x Cell Burner Retrofit. (Aberdeen, OH)

Every other lower burner and NO_x port was inverted and shallow angled replacement impellers were installed by May 1992. These changes were made to mitigate high CO concentrations in the lower furnace that occurred when operating to achieve high NO_x emission reductions. Optimization testing was completed in July, 1992; long term baseline testing is in progress with completion scheduled for April 1993. NO_x emission reductions continue to exceed the 50 percent target level.

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

Ten test runs have been completed to date, representing approximately 900 hours of operation on coal. The first three rail cars (2000 barrels) of coal-derived liquid were shipped to an industrial customer in October 1992.

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

Preliminary design activities are proceeding incorporating the results of pilot testing.

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

Design is continuing. A topping combustor to augment the gas turbine inlet temperature was deleted from the project scope because it did not provide favorable economics under the site-specific conditions. A draft Implementation Plan for completion of the Environmental Impact Statement has been prepared and is undergoing review.

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. . . continued from page 9 "Status"

EER Corp. Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler. (Denver, CO)

Equipment start-up and check-out testing have been completed. Parametric testing of the combined gas reburning and low NO_x burner systems commenced in November 1992. Preliminary data indicate that the system will be successful in reducing NO_x emissions up to 70% at full load. One year of long term testing is scheduled to commence in March 1993.

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

Engineering and design activities are under way. A kick-off meeting was held to review project scope, objectives, schedule, and current status of design work. A draft Implementation Plan for completion of the Environmental Impact Statement has been prepared and is undergoing review.

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

The Cooperative Agreement was awarded on July 28, 1992. The Fuller company purchased Micro Fuel Corporation in September 1992 and will assume Micro Fuel's obligations in this project. TVA will sign a contract with Fuller in March 1993.

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

System design and component selection are under way. Detailed equipment design specifications and bid packages are being prepared for the gasification plant equipment and gas turbine. An environmental assessment has been prepared and is undergoing review. Start of construction is scheduled for April 1993.

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

The Cooperative Agreement was awarded on October 27, 1992, and preliminary design work is now fully underway.

Custom Coals International. Self Scrubbing Coal: An Integrated Approach to Clean Air. (Greensboro, PA; Springdale, PA; Richmond, IN)

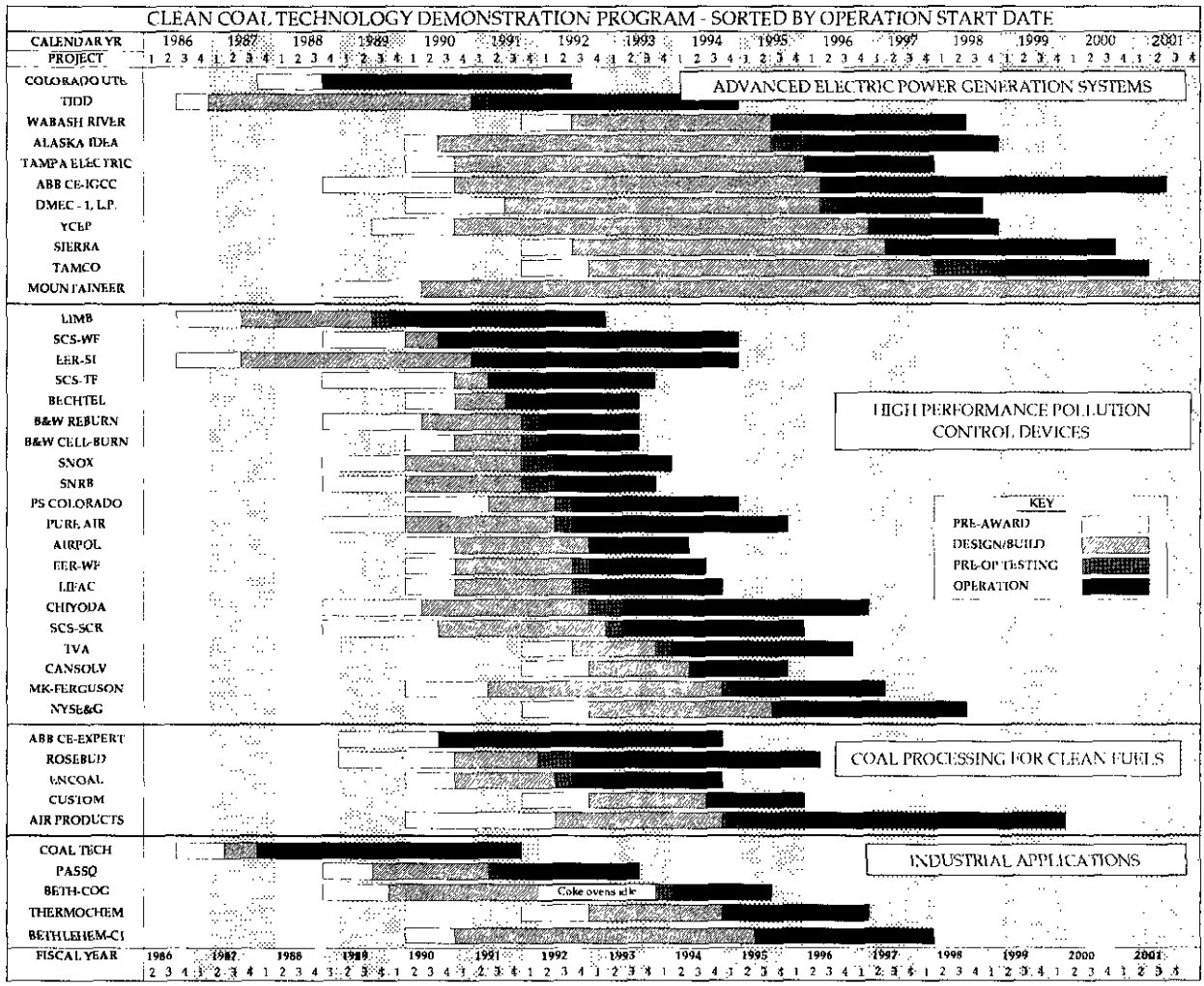
Project definition activities are continuing. Preliminary design of the coal cleaning plant is more than 50 percent complete.

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

The Cooperative Agreement was signed on October 27, 1992. Preliminary design has been initiated. A buyer for the power is being sought.

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

The Cooperative Agreement was awarded on October 20, 1992. Design activities are underway. The Environmental Assessment activities are expected to be completed this Spring.



Upcoming Events

Date	Event	Contact
April 7, 1993	***NOXSO Corp. Open House, NOXSO Pilot Plant,*** Ohio Edison Toronto Plant, Toronto, OH	Reservations Required (800) GET-NOXSO
April 16&19, 1993	***Ohio Coal Development Office Open House, B&W Low-NOx Burner™ Demonstration Project,*** Dayton Power & Light J.M. Stuart Station, Aberdeen, OH	Reservations Required (800) 435-0323
June 28-30, 1993 (Tentative date)	***Coal-Fired Power Systems—Advances in IGCC and PFBC,*** Gasification and Combustion projects), Morgantown Energy Technology Center, Morgantown, WV	METC Conf. Svcs. (304) 291-4108
August 3-5, 1993 (Tentative date)	***Power Generation Contractors Review Meeting.*** (Fuel Cell and Heat Engine projects), Morgantown Energy Technology Center, Morgantown, WV	METC Conf. Svcs. (304) 291-4108
September 7-9, 1993	***Second Annual Clean Coal Technology Conference,*** The Atlanta Hilton and Towers, Atlanta, GA	A. Strom (301) 903-2790

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.

Dec 90	DE 9100-2081	*Nucla CFB Demonstration Project: Detailed Public Design Report* (Colorado-Ute Electric Assoc., Inc.)
Mar 92	DE 9200-1299	*Demonstration Program Performance Test Summary Reports: Topical Report* (Colorado-Ute Electric Assoc., Inc.)
Mar 92	DE 9300-0212	*Economic Evaluation Report: Topical Report* (Colorado-Ute Electric Assoc., Inc.)

The following papers, authored by DOE employees or CCT participants, have been 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.

"ABB Combustion Engineering Systems' Coal Gasification System for Combined Cycle Power Generation," Herbert E. Andrus, Jr., Combustion Engineering, Inc.; *ASME International Joint Power Generation Conference*, Atlanta, GA, October 1992.

"AEP's Tidd PFBC Demonstration Plant: Start-Up and Operating Experience," D.R. Hafter, M.J. Mudd, D.A. Bauer, and H.K. Stogran, American Electric Power Services Corporation; *Electric Power Research Institute Application of Fluidized-Bed Combustion for Power Generation Utility Conference*, Boston, MA, September 1992.

"Cleaning the Water at a Clean Air Plant: Early Operating Data from the Bailly FGD Wastewater Treatment Plant," M. Sicinski, D. LaValle and M.K. Mierzejewski; *53rd Annual International Water Conference*, Pittsburgh, PA, October 1992.

"Conversion of SO_2 in Flue Gas to Sulfuric Acid Via the SNOX Process," D.C. Borio, D.J. Collins; *American Chemical Society Fertilizer Division*, Washington, DC, August 1992.

"Cost Effective Technologies for SO_2 and NO_x Control," A. Sanyal et al, EER Corporation and H. Ritz; DOE/PETC; *Power Gen '92 Conference*, Orlando, FL, November, 1992.

"Des Moines Energy Center Repowering with PCFB Technology," B.J. Ambrose and G.E. Kruempel, Midwest Power; R. Dryden, Pyropower Corporation; *Electric Power Research Institute Application of Fluidized-Bed Combustion for Power Generation Utility Conference*, Boston, MA, September 1992.

"Economic Analysis of The SNOX Process," W.H. Kingston, R.E. Bolli, M.J. Hyland; *International Joint Power Generation Conference*, Atlanta, GA, October 1992.

"Environmental Characteristics of Clean Coal Technologies," S. J. Bossart, Morgantown Energy Technology Center; *The 1992 17th Annual Meeting of the National Association of Environmental Professions*, Seattle, WA, May 1992.

"Evaluating Impacts of Clean Air Compliance Strategies," D.A. Shirer, R.J. Evans, C.D. Harrison, D.B. Kehoe; *Effects of Coal Quality on Power Plants*, San Diego, CA, August 1992.

"Gas Reburning - Sorbent Injection for Acid Rain Precursor Emission Control," D. Engelhardt, H. Rooney, R. Payne, EER Corporation and H. Ritz; DOE/PETC *1992: International Joint Power Generation Conference*, Atlanta, GA, October 1992.

"How and Why Tampa Electric Company Selected IGCC for Its Next Generating Capacity Addition," Donald E. Pless, Teco Power Services, Inc.; *Amercian Power Conference*, Chicago, IL, April 1992.

"Reducing Emissions of Air Toxics: Evaluating the Potential for Removing Trace Elements from Powder River Basin Sub-Bituminous Coals," C.E. Raleigh, R.L. Dospoy, R.J. Evans; *Air and Waste Management*, New Orleans, LA, March 1993.

"The Piñon Pine Power Project," Jonathan D. Pitcher, Foster Wheeler Energy Corporation; John W. Motter, Sierra Pacific Power Company; and Martin O. Fankhanel, The M.W. Kellogg Company; *American Power Conference*, Chicago, IL, April 1992.

"Wet Advanced FGD Design for the Bailley Generating Station," Ghassem B. Manavi and Beth Wrobel; *Power Gen '92 Conference*, Orlando, FL, November 1992.

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The following papers were presented at the *Twelfth Annual METC Gasification and Gas Stream Cleanup Contractors Review Meeting*, Morgantown, WV, September 1992.

"ABB Combustion Engineering's Coal Gasification System for Combined Cycle Power Generation." Herbert E. Andrus, Combustion Engineering, Inc.

"Design, Construction and Start-up of ENCOAL Mild Coal Gasification Project." James P. Frederick, ENCOAL Corporation.

"Piñon Pine IGCC Project Status Update, August 1992." John W. Motter, Sierra Pacific Power Company.

"Tampa Electric IGCC Project." Donald E. Pless, TECO Power Services, Inc.

"Wabash River Coal Gasification Repowering Project." Phil Amick, Destac Energy, Inc.

The following papers were presented at the *Ninth Annual International Pittsburgh Coal Conference*, Pittsburgh, PA, October 1992.

"Design, Construction and Start-Up of ENCOAL Mild Gasification Demonstration Plan." Andrew M. Ting, ENCOAL Corporation.

"High Efficiency Clean Coal Technology Products: Status of Development and Demonstration." Louis A. Salvador and Kanwal Mahajan, Morgantown Energy Technology Center.

"Second Year of Operation of the Tidd PFBC Demonstration Plant." D.A. Bauer and H.K. Stogran, American Electric Power Service Corporation.

"Status of Tampa Electric Company's Polk Unit #1 IGCC Power Plant." Donald E. Pless, TECO Power Services, Inc.

"The Des Moines Energy Center Pressurized Circulating Fluidized Bed Demonstration Project." G.E. Kruempel and S.J. Ambrose, Iowa Power, Inc., and Steve Provol, Pyropower Corporation.

"The Piñon Pine IGCC Project Overview and Update." David N. Poole and John W. Motter, Sierra Pacific Power Company; William M. Campbell and Martin Fankhanel, the M.W. Kellogg Company; and Jonathan D. Pitcher, Foster Wheeler USA Corp.

"The Wabash River Coal Gasification Repowering Project." G.J. Mann, Destec Energy, Inc.

"Toms Creek IGCC Demonstration Project." R.T. Silvonen and J.G. Patel, Tampella Power Corporation; G.A. Chirdon and M.J. Hobson, Coastal Power Production Company.

The following papers were presented at the *Eleventh EPRI Conference on Gasification Power Plants*, San Francisco, CA, October 1992.

"A Utility's Perspective on the Commercialization of Gasification Power Plants," Charles R. Black, Tampa Electric Company.

"Piñon Pine Power Project Status Report," M. Fankhanel, W. Campbell and G. Henningsen, The M.W. Kellogg Company.

"The Destec/PSI 265 MW Repowering Project," J. Cook, PSI Energy.