

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 theme for the Third Annual Clean Coal Technology Conference—**The Investment Pays Off**—was selected to highlight the successes from the unparalleled \$7 billion joint industry/government investment in a new generation of clean coal technologies. Many of those stories will be told at the annual convention, September 6-8 in Chicago, and successes from the first wave of completed projects continue to be reported.

Passamaquoddy Technology, L.P., the sponsor of a highly successful Round 2 project, reports that a Taiwanese cement company has asked them to do a preliminary study for the installation of their Recovery Scrubber™ on a new cement plant in Taiwan . . . In another overseas success, a refinery in Fort Murray, Canada, has purchased Chiyoda Corporation's advanced scrubber for its tar sands oil extraction facility. The Canadian scrubber will largely simulate the CT-121 demonstration sponsored by Southern Company Services in Georgia.

Babcock & Wilcox Company's Low NO_x Cell™ Burner, already penetrating the marketplace with five commercial sales, has been honored with a

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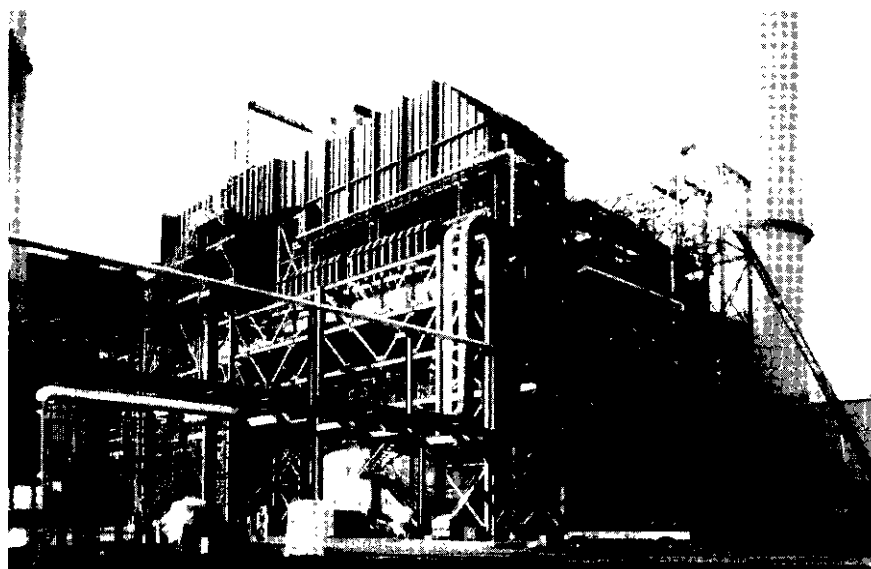
The Investment Pays Off

Continued Success With Landmark Pure Air Project

CHESTERTON, IN—Those interested in touring the Pure Air Advanced Flue Gas Desulfurization (FGD) Facility should definitely attend the Third Annual Clean Coal Technology Conference in Chicago, IL, September 6-8, 1994. The tour will be held on September 6 from 1:00-7:00 p.m. The theme of the conference is "The Investment Pays Off," and this is certainly the case for this \$152 million Round 2 Clean Coal Technology Project, which features the largest capacity SO₂ absorber module (528 MWe) in the U.S. and successful recovery of saleable byproduct gypsum. Call Kim Yavorsky at (412) 892-6244 or see page 11 for conference information.

On August 25, 1992, Northern Indiana Public Service Company (NIPSCO) dedicated the new FGD system at its Bailly electrical generating station located on the southern shore of Lake Michigan, near Gary, Indiana. This technology, which was developed by Pure Air, a partnership of Air Products and Chemicals, Inc. and Mitsubishi Heavy Industries America Inc., has demonstrated the ability to remove over 95% of the SO₂ emitted from the utility's smokestack. Since start-up the plant has achieved an availability rate of 99.996 percent with only 6.6 hours of down time and has removed 133,300 tons of SO₂ from the facility's flue gas. By-product gypsum is made into wallboard at U.S. Gypsum Company's East Chicago, Indiana plant. The total gypsum produced to date is enough to provide wallboard for the construction of approximately 35,000 new homes. The gypsum purity has averaged

See "Pure Air" on page 2 . . .



Bailly Station's SO₂ absorber tank and duct work, with the new stack, is demonstrated at the 528-MWe Advanced Flue Gas Scrubbing facility.

... "Pure Air" from page 1

96-97 percent with all of the by-product being sold for commercial wallboard production.

When the CCT demonstration project is completed six demonstration tests will have been conducted on a wide range of high-sulfur coals during three years of commercial demonstration. Two of these tests have been completed on coals with sulfur levels of 3.0 percent to 3.5 percent (test report is available) and 3.5 percent to 4.0 percent (report is being finalized).

Three DOE demonstration tests are planned for 1994, on coals with sulfur levels ranging from 2.0 percent to 4.5 percent. The sixth test is scheduled for 1995, to be run at optimal operating conditions.

Air toxics sampling was conducted during late-1993, under the auspices of DOE's Flue Gas Cleanup R&D Program. The Southern Research Institute is expected to complete laboratory analyses and issue a report on the air toxics test results shortly.

Today in our ever changing world, utilities are becoming an important source of gypsum, the by-product of flue gas desulfurization. The gypsum that

results is often purer and more consistent in quality than natural gypsum rock and surpasses the performance of natural gypsum in commercial applications such as wallboard production.

The Bailly Plant produces 100 percent of the gypsum used at U.S. Gypsum's East Chicago Plant, the second plant in North America to produce wallboard from 100 percent synthetic FGD gypsum and the sixth plant within U.S. Gypsum to use this raw material on a sustained basis. U.S. Gypsum has agreed to buy synthetic gypsum from NIPSCO for the next 20 years, turning a by-product that was once destined for costly deposit in landfills into a useful commercial product. The gypsum agreement didn't happen overnight and it didn't happen without a major investment by U.S. Gypsum. Gypsum plants are designed to process relatively dry rock gypsum and the East Chicago plant found it necessary to modify its equipment to dry and process the new raw material.

There are many different FGD technologies that produce gypsum. Most make a product similar in consistency to wet sand. At times, this type of gypsum

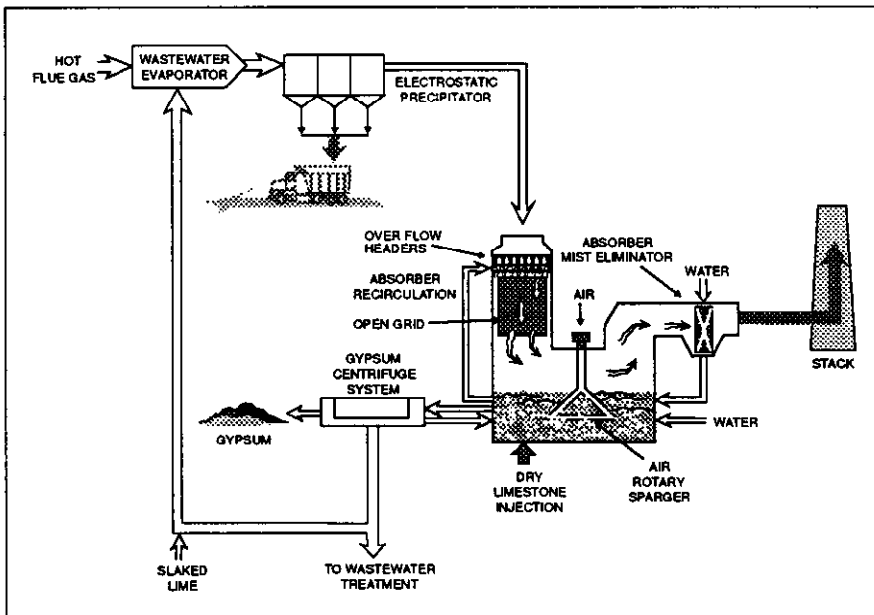
can be difficult and time consuming to unload from rail cars or trucks, has poor processing flexibility and contains agglomerates which must continuously be broken and dispersed. It requires an extensive drying process, using energy consuming drying equipment, before it can be used. Transportation related impediments may also exist such as caking when shipped over 50 miles and characteristic freezing in cold weather.

Purchase of dried FGD gypsum is costly and the powder like consistency of this product presents another handling problem, requiring special pressure differential trucks and pneumatic conveying equipment. Once on site, the gypsum must be kept in storage silos, which is another additional expense.

Now a technology from Pure Air is helping utilities produce PowerChip® gypsum, a product with all the performance and purity benefits of FGD gypsum and all the handling benefits of natural gypsum. The particle size distribution of milled PowerChip® gypsum much more closely resembles that of natural gypsum, than does conventional unprocessed FGD gypsum, making it just as easy to use as natural rock gypsum. PowerChip® gypsum is produced in relatively dry, consistently sized chips, which will not freeze together in cold weather. It requires no special storage systems, no expensive drying or conveying equipment, and no extra processing.

The PowerChip® agglomeration process utilizes a compression mill at an optimum compacting force, with an exclusive curing time and temperature relationship, that reformulates and modifies the physical structure of FGD by-product gypsum. This technology produces stable, semi-dry, agglomerated flakes of calcium sulfate dihydrate (gypsum) which range between 1/8" to 1/16" in thickness and 3/8" to 1-1/4" in length and width. The production rate of the demonstration facility is seven tons per hour. This material can be

See "Pure Air" on page 3 . . .



Process schematic of the advanced flue gas desulfurization technology which routinely removes 90-95% of the SO₂ from the Bailly Station flue gas and produces commercial gypsum for sale.

... "Pure Air" from page 2

handled, transported, and stored with existing infrastructure designed for natural rock gypsum. The mechanical agglomeration machine compacts the small, finely divided, moist crystals of FGD calcium sulfate dihydrate into larger reformulated flakes which are stable, more free flowing in silos and less dusty in transfer and processing.

Because the material can be handled like natural gypsum rock, it can be conveyed, pulverized, calcined, and mixed like the natural product in both wallboard and Portland cement production. Purity and consistency are some of this product's leading qualities. PowerChip® gypsum can be up to 10% to 15% purer than natural gypsum for better quality performance. This gypsum can be less expensive than natural rock gypsum, because the source can be as close as the local utility, eliminating high transportation costs. The cost of converting FGD wet gypsum to PowerChip® gypsum is estimated to be about \$2.50/ton.

Chloride content is a critical parameter for wallboard grade gypsum. Removal of chlorides from the gypsum can be accomplished easily by washing the gypsum, but the resultant wastewater often exceeds permit requirements. To avoid this potential problem, PureAir is demonstrating a novel Wastewater Evaporation System at its Bailly scrubber.

Part of the scrubber's process water stream is bled off to maintain an acceptable chloride level within the scrubber

vessel, and then injected into the power plant ductwork where hot flue gasses evaporate the water. Upon evaporation of the water, any dissolved salts crystallize, so that they can be collected along with fly ash by the power plant's particulate control devices. The salts are then easily disposed of with the power plant fly ash.

Pure Air will also test blending fly ash and wastewater treatment solids into the PowerChip® gypsum by-product. Although these impurities would make the gypsum unacceptable for wallboard applications, it could still be used in cement.

Pilot tests have indicated that mixtures containing a maximum fly ash loading of 20 percent to 30 percent or up to 20 percent wastewater treatment sludge, can be utilized commercially. Lab scale tests concluded that mixtures of other liquids, slurries, or solids could be added to the agglomerator and not cause a detrimental effect to the structure of the final PowerChip® gypsum.

Scrubber waste water sludge of 50% solids contains low concentrations of dissolved metals, fly ash, small gypsum crystals, inerts and trace polymers. This waste can be blended with FGD gypsum and metered into the agglomeration machine. Compacting this combined product produces a marketable product, for cement plant operators, and totally eliminates the waste by-products which normally would be landfilled.

In combination with wastewater evaporation and the co-production of wallboard grade gypsum, this process may bring coal-fired power generation technology one step closer to the goal of a zero-discharge power plant.

DOE's Clean Coal Technology Program is supporting an 18-month program to test PowerChip® gypsum at several wallboard and cement companies. Commercial demonstration of the facility started in January 1994 and initial results are very positive. Later this year the program will also test

various combinations of gypsum, fly ash, and FGD wastewater sludge, for use in the cement manufacturing market.

The successful demonstration at the Bailly plant has led to a sale of the PureAir scrubber technology in Florida. PureAir of Manatee, Limited Partnership, recently entered into a contract to provide 1,600-MWe of SO₂ scrubbing capacity at the Florida Power & Light Company's Manatee power plant, located near Bradenton, Florida. The power station uses one percent sulfur fuel oil, but is considering a switch to Orimulsion® fuel (a mixture of 70 percent bitumen and 30 percent water) with a sulfur content of approximately 2.8 percent, which necessitates scrubbing.

PureAir of Manatee will install two 800-MWe scrubber vessels and electrostatic precipitators on an own-and-operate basis. This business arrangement was pioneered at PureAir's Bailly CCT Project. The PowerChip® gypsum recycling and wastewater evaporation processes are working so well at Bailly that they are also being incorporated into the Manatee sale. Florida Power & Light estimates that switching from oil to Orimulsion® at the Manatee power plant could save its customers more than \$2.5 billion over a 20 year period.

The PureAir scrubbers will ensure cost effective compliance with environmental requirements. In addition to scrubbing the power plant flue gas, PureAir will be responsible for recycling all process by-products (i.e., gypsum and fly ash) which will be sold to wallboard and other building products manufacturers.

Florida Power & Light expects permitting of the project to take about 20 months. Conversion of the power plant to Orimulsion®, including scrubber construction, would take approximately two more years. Under the terms of the newly announced contract, PureAir will own-and-operate the Manatee plant scrubbers for a 20 year term. CCT

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Editor: Arvid Strom
Assoc. Editor: Mary Jo Zacchero

Comments are welcome and
may be submitted to the
Editor (FE-22)
(301) 903-2790
FAX (301) 903-9438

Tidd Sets Mark with Continuous 45-Day Run

A new U.S. record for continuous operation of a pressurized fluidized-bed combustion plant has been set by the Ohio Power Company (OPCo) with the completion of a 1,079-hour run at the Tidd, 70 MWe, bubbling bed demonstration plant in Brilliant, Ohio. The 45-day run, which was completed on June 13, 1994, was only 10 days short of the world record currently held by a Swedish facility. The Tidd test was terminated because of maintenance requirements and to prepare the unit for an upcoming test sequence.

The success of this extended run is especially pleasing to OPCo and its corporate parent, American Electric Power (AEP). The Tidd facility was initially plagued with numerous operational problems, which included first-of-a-kind start-up difficulties.

Over the past year, the unit has operated very consistently. In total, the Tidd Plant has accumulated more than 7,800 hours of operation since tests were initiated in February 1991. Approximately 4,400 of those hours have been accumulated over the past 11 months. Thus, the plant has operated

55 percent of the total hours in the past 11 months. As of June 13, the plant had operated for more than 60 percent of the total hours in 1994.

The Tidd demonstration plant is not only beginning to accumulate significant numbers of operational hours, but performance data are beginning to demonstrate that PFBC systems have the potential to commercially operate better than originally anticipated. Test results to date clearly indicate that, in part-load operations, and when using 12 mesh sorbent, 90 percent sulfur capture can be achieved with calcium-to-sulfur ratios (Ca/S) of 1.3. Empirical predictions indicate that under full load conditions, 90 percent sulfur capture could be achieved at Ca/S values of less than 1.2.

Future tests will be aimed at further validation and refinement of data, but the information, to date, is highly encouraging and indicates that PFBC technology is in position to compete with other advanced coal-based technologies.

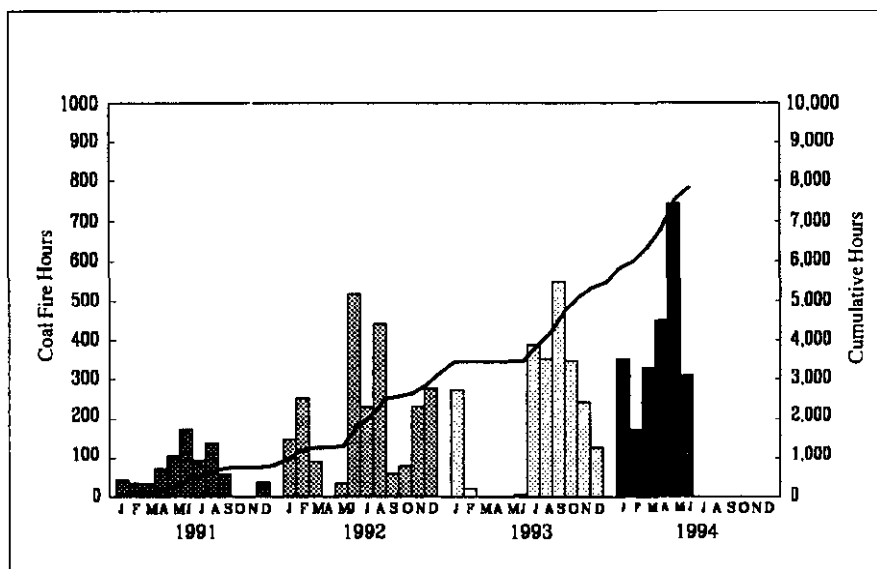
If current trends continue, future tests will demonstrate that PFBC units will be able to compete with systems where sulfur capture of 95 percent or greater is

needed. Preliminary data have been gathered which indicate that advanced ceramic particle control technologies being tested at Tidd (via a separate federal research and development cooperative agreement) have the ability to capture an additional 40-50 percent of the sulfur. Thus, bubbling bed PFBC systems, incorporating advanced ceramic filtration devices, may be able to operate economically with sulfur capture collection efficiencies of 97 percent or greater.

All of this is very good news for AEP which has been intimately involved in commercialization of the PFBC technology for nearly 2 decades. When the Tidd project was awarded as one of the first Clean Coal Cooperative Agreements in 1987, there were no commercial-scale PFBC systems operating anywhere in the world. Today, the technology is on the verge of widespread commercial deployment. PFBC systems are operating in the U.S. and Western Europe and commercial sales have been achieved in Asia and Eastern Europe. Cumulative world-wide operational experience from the four original Tidd-type units (Tidd in the United States, twin units at Vartan in Sweden, and Escatron in Spain) is now approaching 50,000 hours. This constantly growing number of commercial operating hours is strengthening industrial confidence and increasing acceptance of PFBC technology by utility and industrial users as well as financial sponsors.

Of most significance during the past several years is the increase in the number of major technology vendors involved in large-scale PFBC demonstrations. As this decade began, only one domestic vendor was involved in a large-scale demonstration of a PFBC system (the Tidd project). Today, three domestic companies are committed to PFBC commercialization and all are involved in major Department of Energy CCT

See "Tidd" on page 5 . . .



Tidd PFBC Plant operating time has increased dramatically, with the plant operating more than 55% of the time over the past year.

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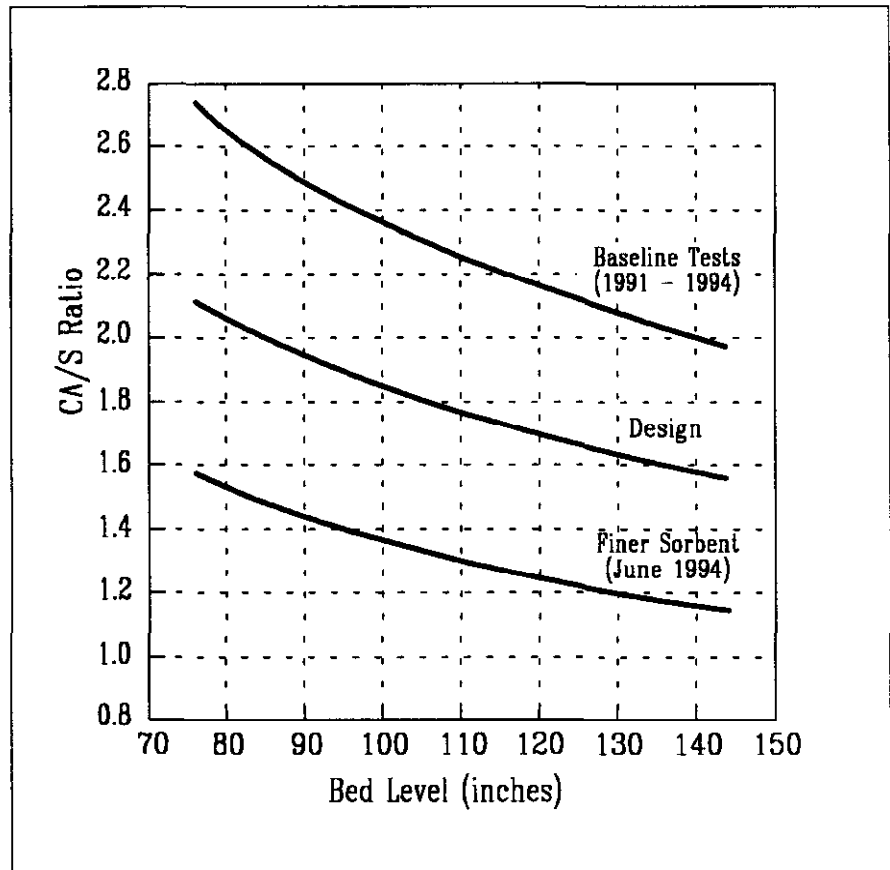
projects. They include the Babcock & Wilcox Company (B&W) of Barberton, Ohio, (Round 1 Tidd and Round 2 Mountaineer projects), the Ahlstrom Pyropower Corporation of San Diego, California, (Round 3 DMEC project), and Foster Wheeler Corporation of Livingston, New Jersey, (Round 5 Four Rivers project). These organizations will provide the competition needed for product improvement at reduced costs.

Today, PFBC technology acceptance within the marketplace is beginning to be reflected by commercial sales. While the majority of these initial orders are in the international arena and are for bubbling-bed technology such as that used at Tidd, they have clearly opened the door for commercialization of all types of PFBC systems.

As these international efforts continue and as new vendors enter the marketplace, the number of new units will undoubtedly increase rapidly. This will set the stage for global market competition to force product refinement, technology enhancement, and cost reductions that will make PFBC systems even more effective as viable options for our nation's energy future.

As part of the original Tidd Cooperative Agreement, DOE contributed \$60.2 million of the projected \$167.5 million project price tag. The Ohio Coal Development Office (OCDO) originally contributed \$10 million towards the demonstration effort. Recently, the project was approved for a fourth year of operation, and it is now estimated that the overall cost of the project, when completed, will approach \$189.9 million. DOE's contribution will amount to \$66.9 million and OCDO will provide a total of \$12.6 million; OPCo and the technology vendors (B&W and ABB Carbon AB) are providing the balance of funds. The cost totals include expenses for design, construction, subsequent plant modifications, and 4 years of operation.

Goals for the fourth year of testing are to operate the plant 50 percent of the year, and to gather data aimed at (1)



Tidd PFBC Plant. Test data demonstrate that efficient 90% sulfur removal can be achieved at low Ca/S ratios (1580°F bed temperature.)

understanding the performance and economics associated with capturing 95 percent of the sulfur, (2) demonstrating long term survivability of the in-bed tube bundles and the gas turbine, and (3) determining the integrity of ceramic elements needed for hot gas particulate filtration systems.

By the time the unit completes its fourth year of testing, it is expected to have logged a total of over 10,000 hours of operation. In completing this additional year of testing, the facility should accumulate approximately 7,000 hours of operation on the existing gas turbine blades, gather sufficient data to determine the operational aspects and economics for 95 percent sulfur capture, and accumulate more than 6,000 hours of exposure on ceramic hot gas filtration elements.

From a DOE perspective, the Tidd PFBC Project continues to serve as a showcase within the CCT Program.

The Tidd Plant has been an important step for the commercialization of PFBC and has demonstrated or is demonstrating the following:

- Modularity of construction and its associated reduction in capital costs
- Use of high-sulfur coals in an environmentally acceptable manner
- Commercial-scale verification that PFBC systems produce low levels of emissions, particularly low levels of nitrogen oxides, and the ability to capture at least 95 percent of the sulfur.
- Reliability of critical components such as the in-bed tube bundles, coal/water paste pumps, and ceramic filter hot gas cleanup technologies.
- Proof that gas turbines can operate with systems that use fuels and sorbents containing alkali. CCT

Total Environmental and Energy Management

Milliken Project in Final Construction Stage

The \$158.6 million-28 percent DOE funded-Milliken Station Clean Coal Technology project, now entering its fifth quarter of construction, is progressing ahead of schedule. Located in the town of Lansing in the fingerlakes region of New York, the Milliken Project is forging ahead in its attempt to demonstrate a combination of innovative emission reducing technologies and plant upgrades "designed for total environmental and energy management." The project controls sulfur dioxide (SO₂) and nitrogen oxide (NO_x) emissions, while minimizing any heat rate, or energy efficiency, penalties.

The goals of the project include:

- Achieving up to 98% SO₂ removal efficiency using limestone while burning high sulfur coal.
- Achieving up to 70 percent NO_x reductions using a selective noncatalytic reduction (SNCR) technology together with combustion modifications.
- Minimizing solid wastes by producing marketable by-products including commercial grade gypsum, calcium chloride, and flyash.
- Achieving zero wastewater discharge.
- Maintaining station efficiency by using a high efficiency heat pipe air heater system and a low power consuming scrubber system.

A partnership of the technological contributors to the project was formed. The partners include:

- Saarberg-Holter-Umwelttechnik (SHU) - Scrubber Technology
- Consol - Research Support
- Stebbins Engineering & Manufacturing Co. - Ceramic Tile
- Nalco Fuel Tech - SNCR Technology
- ABB Airpreheater - Heat Pipe
- DHR Technologies - Artificial Intelligence

Milliken Station is one of seven coal-fired stations within New York State Electric & Gas Corp's (NYSEG) generating system. The station is composed of two 150 megawatt units that will be retrofitted with a low-NO_x concentric firing system, and connected to the newly constructed split module flue gas desulfurization (FGD) system. In addition, Unit 2 will test the SNCR process and a high efficiency air heater system.

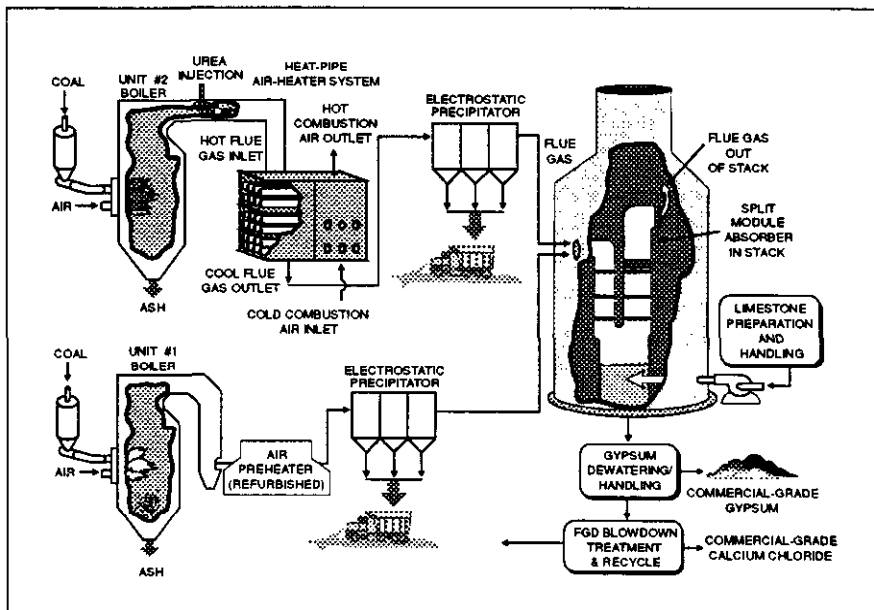
The FGD scrubber will utilize a wet limestone process maintained at a low pH by the addition of formic acid, a single loop concurrent/countercurrent absorption, and forced oxidation. The scrubber vessel does not contain packing or grid work. The lack of packing results in lower pressure drop across the absorber which aids in the energy efficiency of the system. The absence of packing also reduces the potential for plugging. The concurrent/countercurrent design also aids in reducing the pressure drop and the overall height of the absorber vessel.

A lower pH helps the limestone to dissolve more rapidly, increases the efficiency of oxidation, increases the size of the gypsum crystals, and improves SO₂ removal efficiency.

Also, the buffering provided by the formic acid allows efficient load changing capability. The process can tolerate higher chloride concentrations, which reduces the amount of wastewater that must be processed. The potential for scaling of the absorber internals is eliminated, resulting in reduced maintenance costs and improved availability.

A slipstream of recycle slurry is processed for recovery of high quality by-product gypsum and calcium chloride brine. Water is recovered and recycled to the scrubbing process, resulting in zero wastewater discharge. The SHU gypsum by-product will be consistent high grade quality, regardless of the plant load or flue gas SO₂ concentration. The gypsum will be dewatered to six percent surface moisture in vertical basket type centrifuges.

See "Milliken" on page 11 . . .



Simplified process schematic of the "total environmental and energy management" technology to be demonstrated at NYSEG's 300-MWe Milliken Station, Lansing, NY.

ENCOAL Plant Enters Production Mode

After 18 months of tests and modifications, the ENCOAL Mild Coal Gasification Plant in Gillette, Wyoming, has made the transition to a production mode, demonstrating the feasibility of the new Liquids From Coal (LFC) process.

During a recent 68-day period of sustained operation, ENCOAL's longest, the plant processed over 24,000 tons of Powder River Basin sub-bituminous coal, producing marketable coproducts of approximately 11,000 tons of Process Derived Fuel (PDF) and more than 600,000 gallons of high quality Coal Derived Liquid (CDL). The PDF and CDL, both clean fuel products of the LFC process, are expected to assist industry in meeting the long-term requirements of the Clean Air Act standards.

The ENCOAL Plant began continuous operation in early May and ran for over 2 months with only short periods of utility outages or other process interruptions. This recent period of sustained operation is noteworthy in that the plant ran at over 90 percent availability while producing acceptable products and quadrupled the duration of the longest previous run. The 500-ton feedrate is expected to reach 1,000 tons per day after additional capacity modifications are completed.

Stable, low-sulfur PDF is currently being produced and stockpiled for shipment to utilities for test burns. The first scheduled shipment will be made to Wisconsin Power and Light where test burns at different PDF/sub-bituminous coal blend ratios will yield valuable information regarding boiler performance. Significant amounts of PDF are also expected to be burned by several industrial customers in Wyoming. Tank cars of low-sulfur CDL are being shipped on a regular basis to several customers in the Midwest including the Dakota Gasification Plant in Beulah, North Dakota.

In addition to scheduled test burns, shipping and handling properties of the co-products are being analyzed. Numerous tests during the recent run confirmed storage, shipping, and handling characteristics of the new fuels. PDF was shown to be blendable with sub-bituminous coal, a factor of great interest to some potential power plant customers. CDL is similar to other industrial fuel oil; however, special handling may be required in some cases to accommodate CDL's characteristics.

The LFC technology being demonstrated at the ENCOAL Plant should expand the market for western coals and provide new choices for power producers. While low in sulfur, western coals tend to have higher moisture and lower heating values than their eastern counterparts. The LFC process improves low-sulfur western coal, producing a fuel with lower moisture levels and high heating values, making it superior to eastern bituminous coals.

Using the LFC technology, heating under carefully controlled temperatures dries and partially gasifies the coal. Hydrocarbon vapors are cleaned of particulates and cooled, producing the liquid CDL. The low-sulfur solid PDF is carefully deactivated, rehydrated, and treated with dust-suppressant before being shipped.

The LFC technology was initially developed by SGI International of La Jolla, California, and is being commercially demonstrated by ENCOAL Corporation. The LFC technology is owned by TEK-KOL, a partnership of SGI International and SMC Mining Company, a subsidiary of Zeigler Coal Holding Company. ENCOAL is a wholly-owned subsidiary of the SMC Mining Company.

Although the latest long-term run aimed primarily at sustained production of specification PDF and CDL, there were several noteworthy technical achievements in the plant. These were:

- Effective performance of solids product stabilization equipment.
- Effective use of environmental controls, meeting all emission standards.
- Effective use of water seals, in place of sand, in the coal pyrolyzer.
- Significant improvement in management of process water and coal fines produced in the plant.
- Significant improvement in plant controls and mechanical reliability.
- Determination of bulk density and other PDF handling characteristics.
- Maintaining a high availability for 68 days.
- Commercial combustion of CDL.
- Continuing an exemplary safety record for the 68-day run.

DOE has provided half of the project's \$72 million cost. Under the current agreement, test and production runs will continue through September 1994.

CCT

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R&D 100 Award by "R&D Magazine." The award, often referred to as the "Nobel Prize of Applied Research," is given annually to the 100 most technologically significant new products.

Looking ahead to newer projects, DOE and private sector partners have now signed three cooperative agreements for Round Five projects now that the mandatory 30-day congressional review for each is over. Signing for the **Coal Diesel Combined Cycle Project** took place at DOE's Morgantown Energy Technology Center (METC) on July 12. The project, to be located at **Easton, MD**, is a 14-MWe demonstration of two diesel engines fired with coal-water fuel. The project team is comprised of **Arthur D. Little, Inc., Cooper-Bessemer Re-**
See "Briefs" on page 11 . . .

Status of Clean Coal Technology Demonstration Projects

Ohio Power Co. Tidd PFBC Demonstration Project.

(Brilliant, OH)

Following the highly successful 45-day run completed in June, the plant was down for maintenance and to reconnect the hot gas cleanup slipstream. The plant was returned to operation in late July to continue the investigation of sulfur capture parameters and to obtain further data on particulate removal from the hot gas stream.

CQ, Inc. Coal Quality Expert.

(Homer City, PA)

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 August 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, long-term operations were completed in June 1994. The long-term results show that an average 66% of the NO_x and 60% of the SO₂ were removed. The project goals were 60% and 50% respectively.

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.

York County Energy Partners. Circulating Fluidized Bed Cogeneration Project.

(North Codorus Township, PA)

Several supplemental documents related to the Environmental Information Volume have been released for public review. Work continues on the draft Environmental Impact Statement, which is anticipated 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. 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)

The Final Report 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.

Bethlehem Steel Corp. Blast Furnace Granulated Coal Injection.

(Burns Harbor, IN)

Plant construction is more than 70% complete, with concrete work and steel erection essentially finished. Equipment installation is more than 70% complete, while piping and electrical are near the 65 percent completion point.

Bethlehem Steel Corp. Coke Oven Gas Cleaning System.

(Sparrows Point, MD)

The project has been postponed to allow for rehabilitation of the coke ovens.

Pure Air. Advanced Flue Gas Desulfurization Demonstration Project.

(Chesterton, IN)

The FGD scrubber is operating and has demonstrated the capability to reduce SO₂ emissions by greater than 95%, thereby removing some 60,000 tons of SO₂ on an annual basis. PowerChip™ gypsum operations commenced in January 1994, allowing for rail transport of some by-product gypsum.

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

(Aberdeen, OH)

Completion of reporting requirements is underway. A draft long-term test report has been received for review. A draft of the project's final report was received in June 1994. 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.

Southern Co. Services. Chiyoda Thoroughbred 121 FGD Process.

(Newnan, GA)

Long-term test results have demonstrated SO₂ removals achieving a high of 97%. Using the standard 2.3% sulfur coal, normal SO₂ removal is 94%. Particulate removal is 99% and limestone utilization is about 97%. Since the scrubber came on line in October 1992, there has been 98% reliability and availability. In March of 1994, the electrostatic precipitator was deenergized and the Chiyoda reactor started operations as both a particulate and SO₂ 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)

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. 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.

See "Status" on page 9 . . .

... "Status" from page 8

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 completed. The design phase has started.

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

The test program has been completed and results indicate that the GSA is capable of 90+% SO₂ removal efficiencies. 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. Award of a "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 project has been extended and is now expected to be completed in June-July 1995.

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

The plant is currently in the production mode, processing 500 tons per day of Powder River Basin coal. A record-setting 68-day period of sustained operation was completed in July. The 600,000 gallons of coal derived liquid produced during this run have been shipped to several customers; the 11,000 tons of solid process derived fuel is expected to be shipped to local users for blending with coal feedstocks.

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

Using sorbent recycling, LIFAC is able to maintain over 70% reduction of SO₂ 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/SO₂ 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% SO₂ reduction. Duct injection of calcium reagents with humidification resulted in a 30% SO₂ reduction. Longer term integrated testing using duct injection of sodium based reagents began on February 7, 1994. All on-site Air Toxics Monitoring has been completed. Preliminary results show that the fabric filter dust collector removed up to 97% of the trace metal emissions. Testing will be completed in late-1994.

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

Plant construction will start shortly. Following publication of the Final Environmental Impact Statement, favorable Records of Decision have been issued by the two Federal agencies involved in the National Environmental Act process: The Environmental Protection Agency, and the Army Corps of Engineers. The Corps of Engineers also granted a Section 404 Wetlands Permit for the project.

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

(Greensboro, PA; Springdale, PA; Richmond, IN)
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.

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

The public comment period for the draft Environmental Impact Statement ended in late July, following three public hearings in the Reno area in June. The Final EIS is in preparation.

See "Status" on page 10 . . .

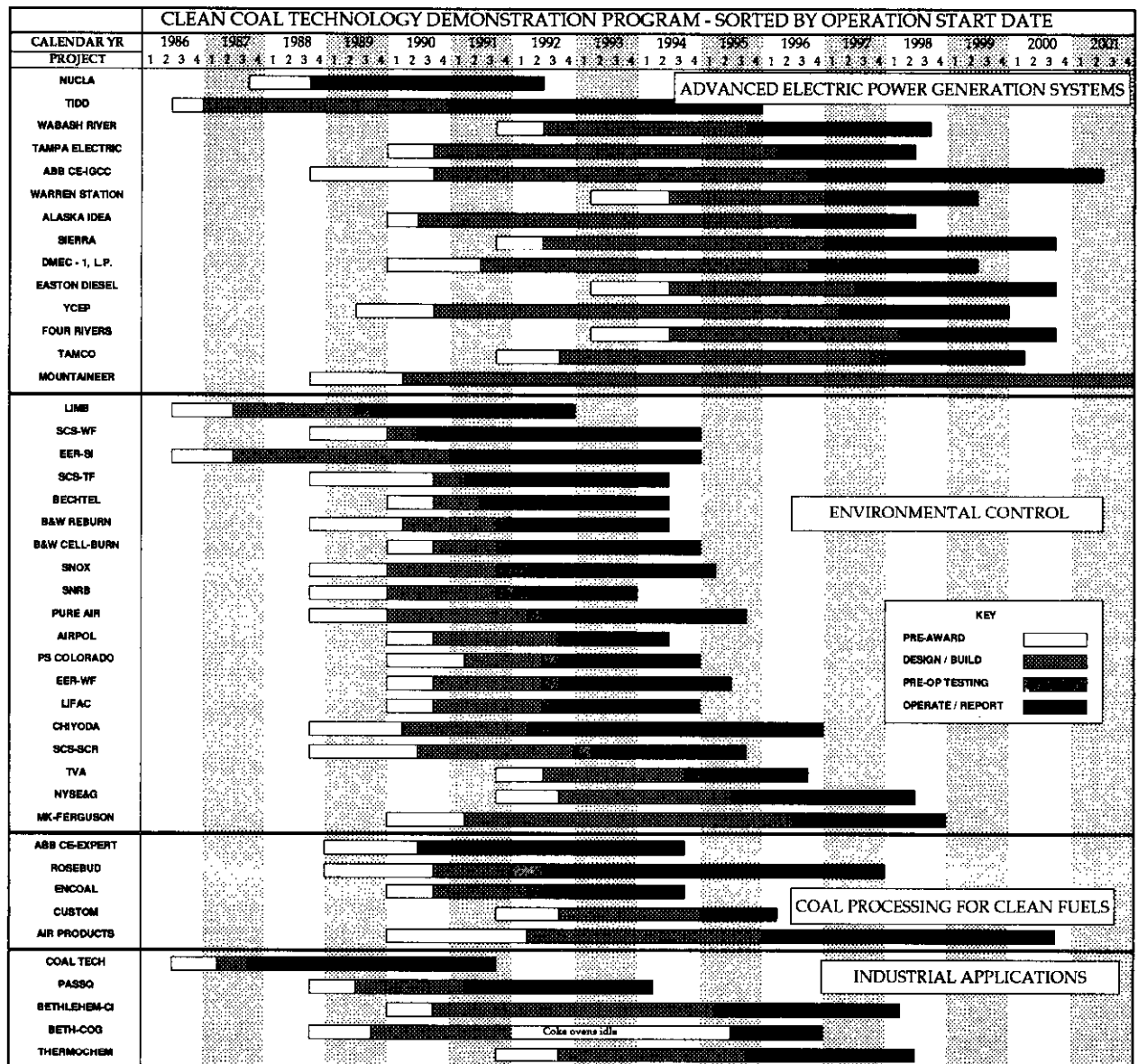
... "Status" from page 9

Wabash River Joint Venture. Wabash River Coal Gasification Repowering Project. (W. Terre Haute, IN)
 Plant construction is more than 50% complete. The gasifiers and gas turbine have been set in place, the heat recovery steam generator has been installed, and the high temperature heat recovery unit has been received on site.

Arthur D. Little, Inc. Coal Diesel Combined Cycle (Easton, MD)
 The cooperative agreement was signed by DOE on July 12, 1994.

Four Rivers Energy Partners, L.P. Second Generation Pressurized Circulating Fluidized Bed Cogeneration Project (Calvert City, KY)
 The cooperative agreement was signed by DOE on July 26 with an effective project start date of August 1, 1994.

Pennsylvania Electric Co. Warren Station Externally Fired Combined-Cycle Demonstration Project (Warren, PA)
 The cooperative agreement was signed by DOE on August 1.



... "Briefs" from page 7

croprotecting Products Division, and the Easton Utilities Commission. The Ohio Coal Development Office is also funding this novel project, which will use high sulfur Ohio coals. DOE is providing half of the estimated \$38.3 million cost of the project.

A cooperative agreement for a \$146.8 million (50% DOE funded), 66-MWe project, to demonstrate a coal-fueled, externally-fired combined cycle power generation system, was signed at METC on August 1, 1994. The repowering project would be built at **Pennsylvania Electric Company's Warren Station in Warren, PA**, and would couple a gas turbine to an external, atmospheric-pressure coal combustor via a high-temperature ceramic heat exchanger.

Also starting, effective August 1, is the **Four Rivers Energy Modernization Project.** This 95-MWe second generation pressurized circulating fluidized bed combustion cogeneration fa-

cility will be built next to a chemicals plant at **Calvert City, KY.** The project was proposed by **Air Products and Chemicals, Inc.**, and is being conducted by **Four Rivers Energy Partners, L.P.** DOE is contributing \$142.5 million, nearly 40 percent of the project's total \$360.7 million price tag.

Construction activities will get under way shortly at **Tampa Electric's** integrated gasification combined cycle power plant in **Polk County, FL**, following completion of the National Environmental Policy Act process. The final Environmental Impact Statement for the project, prepared by the Environmental Protection Agency as Lead Agency, with assistance from DOE and the U.S. Army Corps of Engineers as Cooperative Agencies, was released in June. Favorable Records of Decision were issued by EPA and USACE on July 14. CCT

... "Milliken" from page 6

This project will be the first demonstration of the production and marketing of a by-product, calcium chloride. The brine concentration system uses a falling film evaporator to concentrate downstream from the FGD blowdown stream, allowing FGD make-up water to be recycled to the plant. The calcium chloride produced from the brine concentration system will be a commercially marketable product, and will be sold as a liquid solution for use as a roadway deicing agent or as a dust suppressant.

Construction of the FGD system is about 85% complete. Boiler modifications have been completed on Unit 1, and similar modifications are presently occurring on Unit 2. The addition of the heat pipe air heater and the installation of duct work conveying the flue gas to the FGD will result in an extended outage which is expected to be completed by the end of the year. CCT

THIRD ANNUAL CLEAN COAL TECHNOLOGY CONFERENCE

Chicago, Illinois
September 6-8, 1994
The Investment Pays Off

REGISTRATION FEES

\$350, General Attendees; \$200, Government; \$400, On-Site

HOTEL INFORMATION

Chicago Hilton and Towers
1-800-HILTONS or (312) 922-4400

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.

Please complete this registration form and return to:

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

(please print)

Name: _____

Title: _____

Company: _____

Street: _____

City: _____

Country: _____

Phone: _____

State: _____

Zip: _____

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).

Upcoming Events

Date	Event	Contact
September 6-8, 1994	<i>Liquefaction Contractors' Review Meeting</i> Vista Hotel, Pittsburgh, PA	Gary Steigel (412) 892-4499
September 6-8, 1994	<i>Third Annual Clean Coal Technology Conference</i> Chicago Hilton and Towers Hotel, Chicago, IL	Kim Yavorsky (412) 892-6244
September 12-16, 1994	<i>11th Annual International Pittsburgh Coal Conference</i> Pittsburgh Greentree Marriott, Pittsburgh, PA	Bruce Utz (412) 892-5706
November 9-10, 1994	<i>Advanced Turbine Systems Conference</i> Crystal Gateway Marriott, Arlington, VA	Energetics Conference Services (410) 290-0370

CCT Reports Update

The following DOE report has been prepared. A limited number of copies are available from U.S. Department of Energy, Morgantown Energy Technology Center, ES&H Program Support Division, P.O. Box 880, Morgantown, WV 26507, ATTN: Dr. Suellen Van Ooteghem, N-02.

May 1994	DOE/EIS-0215	<i>Draft Environmental Impact Statement for the Proposed Piñon Pine Power Project/Tracy Station, Nevada</i>
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The following DOE pamphlet has been prepared. A limited number of copies are available from U.S. Department of Energy, Morgantown Energy Technology Center, IGCC Product Manager, P.O. Box 880, Morgantown, WV 26507, ATTN: Dale K. Schmidt, D-01.

June 1994	IGCC—Integrated Gasification Combined Cycle (20-page pamphlet with electricity and energy growth projections, year 2010 product goals for performance and market share, IGCC advantages and comparisons to alternatives, research and development initiatives, and CCT demonstration project summaries.)
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The following EPA reports have been prepared. A limited number of copies are available from U.S. Environmental Protection Agency Region IV, Federal Activities Branch, 345 Courtland Street, NE, Atlanta, GA 30365, ATTN: Mr. Chris Hoberg, FAB-4.

June 1994	EPA 904/9-94-002(a)	<i>FINAL Environmental Impact Statement/Volume 1: Report/Tampa Electric Company—Polk Power Station</i>
June 1994	EPA 904/9-94-002(b)	<i>FINAL Environmental Impact Statement/Volume 2: Report and Appendices/Tampa Electric Company—Polk Power Station</i>
June 1994	EPA 904/9-94-002(c)	<i>FINAL Environmental Impact Statement/Executive Summary/Tampa Electric Company—Polk Power Station</i>

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

“Coal-diesel technology looks good for Clean Coal 5.” A.K. Rao, Cooper-Bessemer Reciprocating Products Division and R.P. Wilson, Arthur D. Little, Inc.; *Modern Power Systems*, February 1994.

“Midwest Power’s Perspective of Circulating PFBC.” Paul Licht, Midwest Power Company; *Electric Power Research Institute Conference: Fluidized Bed Combustion for Power Generation*, Atlanta, GA, May 1994.

“Update on the Operation and Performance Testing of the Tidd PFBC Demonstration Plant.” D.A. Bauer, W.P. Reinhart, and M.E.

Zando, American Electric Power Service Corporation, and W.L. Irons, Ohio Power Company; *Electric Power Research Institute Conference: Fluidized Bed Combustion for Power Generation*, Atlanta, GA, May 1994.

“Summary of Findings—10 MWe Demonstration of Gas Suspension Absorption.” W.L. Gross; *Coal Utilization and Fuel Systems Conference*, Clearwater, FL, March 1994.