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Issue No. 17, Summer 1995

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 Fourth Annual Clean Coal Technology Conference—The Global Opportunity—focuses on the domestic and international markets for clean coal projects. Both of these markets will be well represented at the conference. Mark your calendars for conference dates: September 5-8, 1995, in Denver, Colorado. See page 11 for Registration Form.

In other news, DOE has received it's second repayment check, in the amount of $27,399, from Tri-State Generation and Transmission Association, Inc., for the Nucla CFB Demonstration Project.

DOE issued a Finding of No Significant Impact in May for Penelec's Warren Station Externally Fired Combined-Cycle Demonstration Project, thus completing the National Environmental Policy Act process for this project.

ThermoChem, Inc.'s Demonstration of Pulse Combustion in an Application for Steam Gasification of Coal has been relocated to North Shore Mining Company's Taconite plant in Silver Bay, Minnesota. ThermoChem is now completing tasks to define the demonstration at the new site.

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In This Issue

Healy Celebrates a Successful Groundbreaking

After years of planning and permitting, construction started in May on the $267 million Healy Clean Coal Project (HCCP). The HCCP involves construction and operation of a 50-megawatt coal-fired power plant located in Healy, Alaska, near the Denali National Park and Preserve. The plant will use innovative combustor and flue gas technologies to demonstrate combined removal of sulfur dioxide (SO_2), nitrogen oxide (NO_x), and particulates. Following the groundbreaking in May, construction will continue through late 1997. Testing to provide operational data is scheduled to begin in 1998, and commercial operation in 1999.

Project participants recently held a celebration event for the Denali Borough residents, project sponsors, and those involved in bringing the project from the conceptual phase to construction. A special "HCCP celebration train" was chartered to take participants from Fairbanks to Healy to participate in the festivities, which included a facility tour, VIP speeches, refreshments, and music provided by the Healy student band. Dignitaries from Alaska attending this event included Governor Tony Knowles, U.S. Senator Ted Stevens, and U.S. Senator Frank Murkowski. Senator Murkowski summed up the delegation's sentiments by recalling an Alaskan achievement: "We were the first in advanced technology of developing oil. Then we went with (oil development at) Endicott, and this is what we have done here with clean coal technology."

Mike Kelly, the event's Master of Ceremonies and General Manager of Golden Valley Electric Association (GVEA), introduced representatives from the U.S. Department of Energy: Alan Edwards, Principal Deputy Assistant Secretary for

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Alan Edwards, Principal Deputy Assistant Secretary for Fossil Energy, joins Alaska Governor Tony Knowles and Congressional representatives in celebrating the start of construction at Healy.

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Fossil Energy, and Lowell Miller, Associate Deputy Assistant Secretary for Clean Coal, both from Headquarters; and Tom Sarkus, Director, Project Implementation Division, and Bob Kornosky, Project Manager, both from the Pittsburgh Energy Technology Center, Office of Clean Coal Technology.

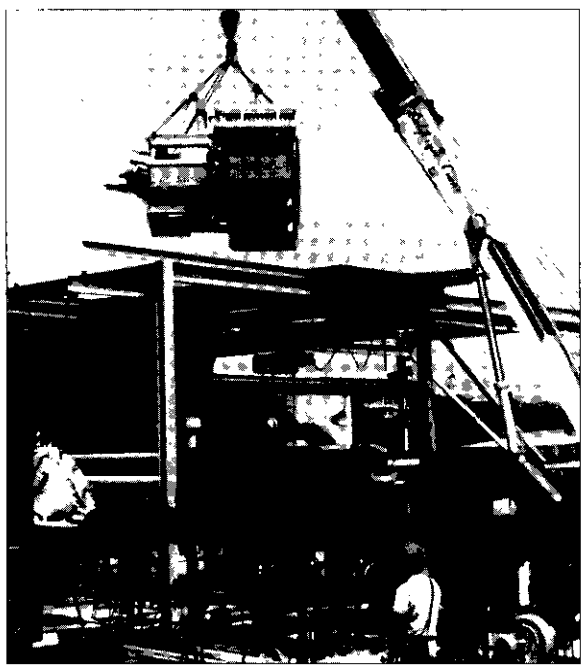
Peak employment is anticipated during June and July 1996, with over 290 employees undertaking technical and finishing work. During the test operation period, the project is expected to require 30 to 40 operators/participants. The project, when completed, will generate 35 permanent jobs.

This increased employment created by the project meets the mission of the Alaska Industrial Development and Export Authority (AIDEA), a public corporation of the State of Alaska, to create and retain jobs and diversify the state economy. AIDEA, a participant under the DOE Cooperative Agreement, is providing private sector financing for the HCCP. Far-reaching benefits of the HCCP extend from creating jobs and expanding the local economy, to demonstrating an environmentally sound technology for burning coal. In the short term, economic expansion and a slight population growth will occur in the area as a direct effect of construction activity. In the long term, economic expansion will continue as new businesses emerge and existing businesses expand to serve the project and meet the needs of residents.

The HCCP consists of a power plant utilizing TRW's slagging combustor to burn coal in stages minimizing the formation of NO_x and SO_2. Pulverized limestone is added to the combustor and converted by heat in the flue gas to lime. The lime reacts with SO_2 in the flue gas and removes it as a sulfate.

A second technology, Joy Technologies' spray dryer absorber with sorbent recycle, recovers the sulfates and unreacted lime and uses the unreacted lime to scrub the flue gas, further reducing the SO_2 content. The process uses a conventional boiler that produces steam for a turbine to produce up to 55 megawatts of electricity for use by the GVEA.

Performance goals are NO_x emissions of less than 0.2 lb/million Btu, particulates removal of 0.015 lb/million Btu, and SO_2 removal greater than 90 percent. The performance coal consists of 50 percent run-of-mine and 50 percent waste coal. (Coal will be supplied from Alaska's Usibelli Coal Mine.) The waste coal has a lower heating value and higher ash content.



The full-size precombustion module (at TRW's San Juan Capistrano test facility) is undergoing design verification testing of the slagging combustor, to be installed in the 50-MWe Healy Clean Coal Project.

A coal-fired precombustor increases the air inlet temperature for optimum slagging performance. The TRW slagging combustors are bottom-mounted on the boiler. The main slagging combustor consists of a water-cooled cylinder that slopes toward a slag opening. The precombustor burns 25-40 percent of the total coal input. The remaining coal is injected axially into the combustor, rapidly entrained by the swirling precombustor gases and additional air flow, and burned under substoichiometric (fuel-rich) conditions for NO_x control. The ash forms drops of molten slag, which accumulate on the water-cooled walls and are driven, by aerodynamic and gravitational forces, through a slot into the slag recovery section. About 70-80 percent of the ash in the coal is removed as molten slag. The hot gas is then ducted to the furnace where, to ensure complete combustion, additional air is supplied from the tertiary air windbox to NO_x ports and to final over-fire air ports located in the furnace.

Pulverized limestone ($CaCO_3$), for SO_x control, is fed into the combustor where most is flash calcined. The mixture of this lime (CaO) and the ash not rejected as liquid slag, called flash calcined material, is removed in the fabric filter (baghouse) system. A small part of the flash-calcined material is disposed of, but most is conveyed to a mixing tank where water is added to form a 45 percent flash-calcined-material solids slurry. The slurry leaving the mixing tank is pumped to a grinding mill where it is mechanically activated by abrasive grinding. Feed slurry is pumped from the feed tank to the spray dryer absorber where the slurry is atomized using Joy Technologies' dry scrubbing technology. Sulfur dioxide in the flue gas reacts with the slurry, as water is simultaneously evaporated and SO_2 is further removed from the flue gas by reacting with the dry flash-calcined material on the baghouse filter bags.

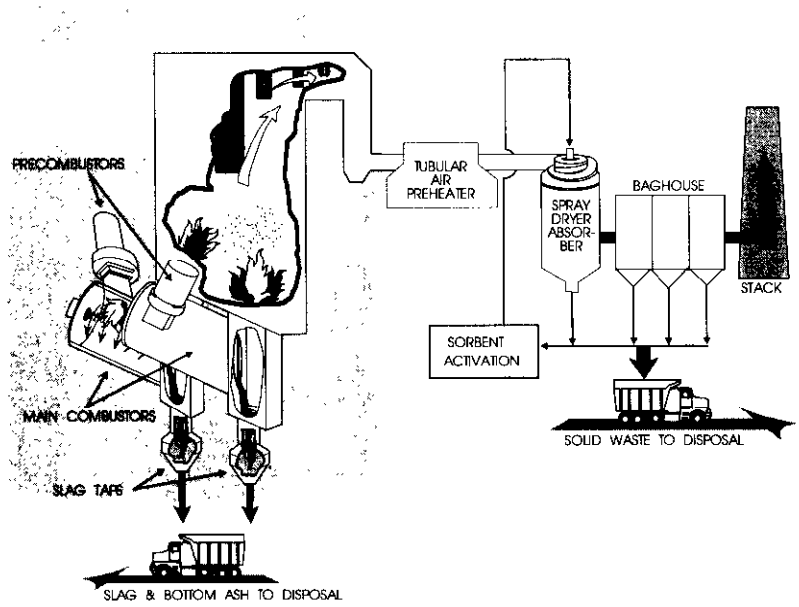
This innovative technology has a wide range of applications and is appropriate for many utility or industrial boilers in new and retrofit uses. It can be used in coal-fired boilers as well as in oil- and gas-fired boilers because of its high ash removal capability. Since cyclone boilers were designed to operate with slagging conditions, they may be the most amenable type to retrofit with the slagging combustion system. The commercial availability of cost-effective and reliable systems for SO_2, NO_x, and par-

ticulates control is important to potential users planning new capacity, repowering, or retrofitting existing capacity in order to comply with requirements of the Clean Air Act Amendments of 1990.

The HCCP facility will be built adjacent to an existing coal-fired generation facility, Unit No. 1, owned and operated by GVEA. In order to address air quality concerns in Denali National Park and Preserve, a Memorandum of Agreement among DOE, the Department of Interior, AIDEA, and GVEA, requires Unit No. 1 to be retrofitted with low NO_x burners and a system of duct injection of sorbent to reduce SO_2. If visibility is impaired after new pollution control equipment is installed, additional measures will be taken. While the power output from the combined units will be three times that of the older facility, the combined emissions from both units are expected to be only slightly greater than current levels.

The new plant will augment the current capacity of Fairbanks-based GVEA, whose service area continues to see increased demand. The Fort Knox gold mine, under development near Fairbanks, will consume 70 percent of the 50 megawatt output of the project.

Funding for the $267 million project is being provided through an award of $117.3 million from DOE and $125 million from an Alaska state grant, power revenues, and project participant contributions. CCT



The Healy Project is to be a nominal 50-MWe facility consisting of two pulverized-coal-fired combustor systems.

. . . *"Briefs" from page 1*

During a 62-day period of operation, the ENCOAL mild gasification plant recently completed 800 consecutive hours (33 days) of operation without a shutdown. This record-setting event was accomplished while the plant was producing compliance fuels from Wyoming sub-bituminous coals for utility and industrial customers.

In another development, TEKOL Partnership, licensor of the liquids from coal mild gasification technology being demonstrated by ENCOAL, will be evaluating select Russian coals to determine their suitability for mild gasification.

In March and April, the TAMCO Power Partners and Bethlehem Steel projects were ended. We regret the inability of the industrial participants to resolve issues that became the basis for not going forward with these projects.

Construction activities are nearing completion on the Wabash River Repowering Project at West Terre Haute, Indiana. By the end of April 1995, the main air compressor had been operated, air and steam "blows" were being performed, refractory work was completed, and about 75 percent of the hydrotesting activities were finished. The target date for commercial operation is August 15, 1995. When the plant goes into operation, it will be the largest single train coal gasification combined cycle power plant operating in the United States.

The Pyropower pressurized circulating fluidized bed combustion project is in the process of being restructured. Pending changes include: moving the project site from Des Moines, Iowa, to North Chicago, Illinois; incorporating Commonwealth Edison and Ahlstrom Development Corporation as general project partners; and increasing the size of the project from 70 megawatts to 120-150 megawatts.

Bethlehem Steel's Blast Furnace Granulated Coal Injection Project at the Burns Harbor plant in Indiana has completed construction and commissioning. Startup is nearly 50 percent completed; low levels of coal injection have been achieved in both blast furnaces.

At the Pinon Pine IGCC Project, Sierra Pacific has authorized construction contractors to move on-site and initial site preparation has begun. CCT

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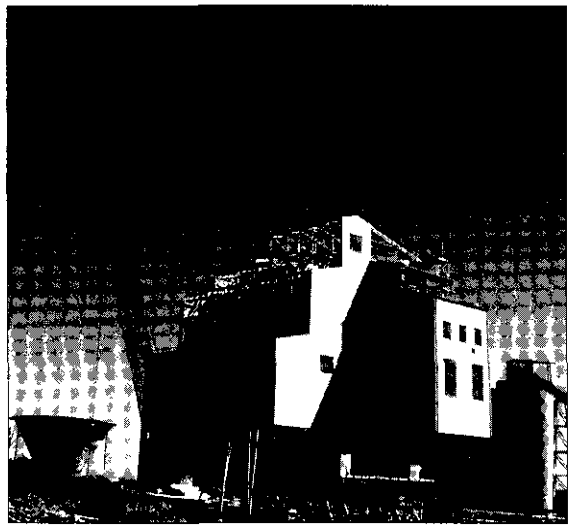
Custom Coals Nears Completion

Construction of the Custom Coals International (CCI) advanced coal cleaning plant near Central City, Pennsylvania is moving at a rapid pace and should be completed this fall. Construction began in December 1993. The CCI project, a joint venture of Genesis Coals Limited Partnership and Genesis Research Corporation, treats high-sulfur bituminous coal to produce two coal types—Carefree Coal™ and Self Scrubbing Coal™ — which comply with the Clean Air Act Amendments of 1990 (CAAA). The process has the potential for bringing most non-compliance coals from east of the Mississippi River into year 2000 CAAA compliance goals. Both new coal types are designed to be competitively priced, high-Btu fuels that can be used without major plant modifications or additional capital expenditures. These coals offer an alternative to flue gas desulfurization, low-sulfur coal burning, and fuel switching.

Under this clean coal project, Self Scrubbing Coal™: An Integrated Approach to Clean Air, four test coals will be treated at the Laurel Coal Preparation Plant, in Pennsylvania, and will be test-burned at three utilities in Indiana, Ohio, and Pennsylvania. Tests using raw coal to provide baseline data are scheduled to begin later in 1995. CCI and its subcontractor, CQ Inc., will collect baseline performance data and then develop a preliminary test plan. This plan will provide the basis to compare power plant performance data from test burns of Carefree Coal™ and Self Scrubbing Coal™. Baseline performance data also will serve as a basis for assessing environmental and health impacts/benefits of the coal processing technologies. In January 1994, DOE completed an environmental assessment for the project, resulting in a Finding of No Significant Impact.

Self-Scrubbing Coal™ has the potential of bringing into compliance about 164 million tons/year of bituminous coal that cannot meet emissions limits through conventional coal cleaning. This represents more than 38 percent of the bituminous coal burned in 50-MWe or larger U.S. generating stations. The technology produces coal products that can be used to reduce a utility or industrial power plant's total sulfur emissions by 80-90 percent.

The technology combines conventional coal cleaning with new technology that uses finely ground magnetite in an aqueous suspension to clean very fine sized coal, which is separated in an advanced cyclone for sulfur and ash removal. This technology was developed and patented at the Department of Energy Pittsburgh Energy Technology Center (PETC). As PETC researchers were pursuing their laboratory findings, CCI was in the process of developing and patenting a similar technology. Realizing that the PETC technology complemented their own process, CCI licensed the "Micro-Mag" patent from PETC in early 1993.



An advanced coal-cleaning plant designed to use existing and new technologies to produce Carefree Coal™ and Self-Scrubbing Coal™

Sulfur in coal occurs chiefly as pyrite and organic sulfur. The former is sulfur combined with iron particles, while the latter is sulfur chemically combined with the coal. Conventional physical coal cleaning processes are able to remove approximately 40 percent of the inorganic sulfur. CCI's process extends coal cleaning to finer sizes of coal. Run-of-mine coal is subjected to a combination of coarse cleaning and selective crushing in a dense-media cyclone separation process, using ultra-fine magnetite slurries. This unique separation system removes non-combustible material from the coal, including more than 90 percent of its pyritic sulfur, resulting in the product Carefree Coal™. Both pyrite and ash are reduced as much as possible while at the same time maintaining a high Btu recovery.

However, the Carefree process alone cannot produce compliance coal from coals high in organic sulfur. In these cases, the Self-Scrubbing process adds a sorbent, such as dolomite or limestone, as well as promoters and catalysts. The finest fraction of the Carefree Coal™ is pelletized with the sorbent. During combustion at a utility plant, 30-35 percent of the remaining pyritic and organic sulfur react with the dolomite or limestone, reducing SO_2 emissions even more than the Carefree process.

Carefree Coal™ employs a three-product separation process to separate cleaned coal, "middlings," and refuse. The first separation floats the nearly pure coal at a low gravity, and sinks all other particles. The second separation, at a high gravity, floats the middling particles and sinks the pyrite and refuse. The clean coal and refuse separated during this two-step process are removed from the circuit, and only the middling particles are crushed, in closed circuit, to pass ° mm and then cleared in two size fractions. The 16 x 150-mesh size fraction is cleaned first in spiral separators, followed by advanced heavy media cy-

clones. The 150 x 500 mesh material is only cleaned in advanced heavy media cyclones.

Dewatering is accomplished by centrifuges for the coarse and intermediate size fractions. The finest coal is thermally dried, and can be discharged to the clean coal conveyor or be used in a briquetting process. The briquetting machine (compactor) uses pressure to form the fine clean coal into stable briquettes measuring 2" x 1" x 3/4".

DOE's funding of the CCI technology has helped the technology gain international credibility. In August1994, a U.S.-led consortium, with CCI as the principal partner, signed a cooperative agreement with the People's Republic of China to build a coal-cleaning plant, a 500-mile underground pipeline to bring coal from Shanxi province in northwest China to the coastal province of Shandong, and a dewatering and port loading facility. The work included under this agreement is valued at $888.6 million.

Letters of intent have recently been signed with three power plants in Poland to purchase 7.5 million tons of clean coal products annually. Under this proposed project, CCI will build, own, and operate coal cleaning plants on independent sites (not state-owned) near raw coal fields. Power plant customers will purchase processing services from the CCI facilities. Raw coal purchased by the power plants will be delivered to the processing plant for cleaning and then shipped to the power plant. This model has been chosen to eliminate the raw coal production risk element for project financing purposes. CCI is proceeding with plans to formalize contracts with various Polish power plants to purchase the processed cleaned coal. The company projects an eventual market of 10 to 14 million tons of processed clean coal products per year. While revenues from processing contracts are substantially less than for clean coal sales, the profits are expected to reach $20 million annually when the market is fully developed. CCT

Tidd Concludes Four-Year PFBC Test Program

After 11,442 hours of operation on coal, and the generation of more than 500,000megawatt-hours of electricity, the Tidd Demonstration Plant in Brilliant, Ohio, successfully completed its 4-year test run and was shut down. Operators manually tripped the plant for the last time at 8:27 a.m. on March 30, 1995. The Tidd Plant, one of the countries pioneering clean coal technology projects, established a technical foundation for cleaner, more efficient power plants into the next century. In recognition of these efforts, American Electric Power Company was awarded the 1991 *Power Magazine* Powerplant Award, and the 1992 National Energy Resource Organization award for demonstration of energy efficient technology.

This Round-I Clean Coal Technology Project was awarded in March 1987 with an objective to demonstrate pressurized fluidized bed combustion (PFBC) technology at a large scale. Specifically, the project was to demonstrate that combined-cycle PFBC technology is a cost-effective, reliable, and environmentally attractive alternative to conventional coal-fired electric power generation with a flue gas desulfurization system.

The Tidd facility demonstrated a bubbling bed PFBC system that operated at a pressure of 12 atmospheres (175 pounds per square inch). The gas turbine compressor supplied pressurized combustion air to fluidize the bed of material which consisted of a coal-water paste, coal ash, and a sorbent (limestone or dolomite). The sorbent in the bed reacted with sulfur to form calcium sulfate, a dry granular bed-ash material that is much easier to handle than wastes from conventional power plants and will likely have commercial value when produced by future power plants. The effective mixing of the coal allowed the unit to burn at lower temperatures than a conventional combustor, thus minimizing the amount of nitrogen oxides generated. Hot, high pressure gases from the pressurized combustor were routed to a gas turbine to drive a generator that produced electric power. Heat from the boiler produced steam to drive a conventional steam turbine-generator. It was demonstrated that the "combined cycle" of gas and steam turbines raised the efficiency of the process, further reducing emissions, lowering the levels of carbon dioxide formed, and reducing the cost of the electricity.

The project demonstrated that more than 95percent of sulfur dioxide pollutants could be removed via PFBC technology, thereby giving future power plants an attractive alternative to add-on scrubber technology. In addition to demonstrating a high level of sulfur removal, the plant's sustained periods of steady-state operation boosted its availability significantly above design projections, thus heightening confidence that PFBC technology will be a reliable, baseload technology for future power plants. American Electric Power is now inspecting the unit and documenting operations.

The Tidd Project also served as a test site for future devices that can clean unburned particles from the hot combustion gases with minimal losses in efficiency. A "slip stream" of hot gases from the boiler was used to test advanced, ceramic barrier filters. Data acquired during 6,000hours of operation will help in the design of the hot gas cleanup devices that will be needed as the technology further evolves.

Total project cost, including design, construction, and operation of the demonstration plant, was nearly $190million, with the Department of Energy supplying $67million, or 35 percent. The project's co-sponsors—Ohio Power Company, Ohio Coal Development Office, the Babcock & Wilcox Company, and ABB Carbon—provided nearly $123million. CCT

EER Completes Three Demonstration Tests

Energy and Environmental Research Corporation (EER), under Clean Coal Technology Program Rounds I and III, has completed demonstration tests of three gas reburning systems on coal-fired utility boilers and shown that gas reburning is consistent in reducing NO_x, by 60 to 75 percent, with no adverse operational or boiler durability impacts. Gas reburning involves firing natural gas (up to 20 percent of total fuel input) above the main coal combustion zone in a boiler. This upper-level firing creates a slightly fuel-rich zone. NO_x drifting upward from the lower region of the furnace is "reburned" in this zone and converted to harmless molecular nitrogen. Overfire air in the highest zone of the furnace completes the gas combustion.

Gas reburning can be installed as a stand-alone technology or integrated with other emission controls. In these demonstrations, it was integrated with sorbent injection for SO_2 control at two units in Illinois: Illinois Power's Hennepin Station, 100 miles southwest of Chicago; and City Water, Light and Power's Lakeside Station on Lake Springfield. Low-NO_x burners, in addition to gas reburning, were employed at the EER project at Public Service Company of Colorado's Cherokee Station Unit No. 3 near Denver.

Hennepin Station's Unit 1 has a net capacity of 71 MW, and is tangentially fired with three burner elevations. It normally fires Illinois bituminous coal but is also equipped to fire up to 100 percent natural gas. Baseline (uncontrolled) NO_x emissions were reduced by 75 percent to 0.19 lb/10^6 Btu. Following optimization tests, plant operators operated the gas reburning system in normal commercial service which involved daily cycling. The average emissions were 0.245 lb/10^6 Btu, a 67 percent reduction from baseline.

Lakeside Station's Unit 7 is a 33-MW net, cyclone-fired unit, which normally fires an Illinois bituminous coal and is used for supplying peak power during winter and summer. Baseline NO_x emissions were 0.95 lb/10^6 Btu. In parametric and optimization tests, gas reburning reduced NO_x emissions by 74 percent to 0.26 lb/10^6 Btu. Following optimization tests, the gas reburning system operated in normal commercial service. The average emissions were 0.344 lb/10^6 Btu, a 66 percent reduction from baseline.

Gas injection nozzles for the Wall-Fired boiler at the Cherokee Plant of PSC

The Hennepin Plant Unit 1 and Cherokee Station's Unit 3 were equipped to fire natural gas through the main burners, providing an opportunity for gas reburning to be evaluated using gas as the main fuel. Tests were conducted at full load, firing 100 percent gas entirely through the main burners and in the gas reburning mode. Switching from 100 percent coal to 100 percent gas without gas reburning reduced NO_x to 0.14 and 0.32lb/10^6 Btu for Hennepin and Cherokee, respectively. Gas reburning operation reduced NO_x emissions by an additional 56 and 64 percent, respectively. Minimum NO_x emissions were 0.14 and 0.05 lb/10^6 Btu, which correspond to total reductions of 81 and 93 percent from the uncontrolled baseline.

The test at Cherokee combined gas reburning and Foster Wheeler's low NO_x burners. Unit 3 has a net capacity of 158 MW and is front wall fired with 16burners in a 4 x 4 array. It is fired using Colorado Yampa coal that contains 0.35 percent sulfur. Baseline NO_x emissions were 0.73 lb/10^6 Btu. Low-NO_x burners typically reduced NO_x by 35 percent to 0.48lb/10^6 Btu. During optimization tests, gas reburning and low NO_x burners achieved a 72 percent reduction in NO_x to a level of 0.20 lb/10^6 Btu. The average emissions in the long-term tests were 0.26 lb/10^6 Btu, a 64 percent reduction from baseline.

The initial design at Cherokee was modified for both the low-NO_x burners and the gas reburning system with the goal of improving NO_x reduction and correcting material failures. The low-NO_x burner was changed by improving the design of the internal passages used to convey coal to the point where it is combusted and by changing the type and thickness of the metal alloys used to fabricate the burner. The reburning system was modified by replacing flue gas recirculation (FGR), which propels natural gas into the boiler, with high velocity injectors without FGR, and decreasing the size of the overfire air ports from improved control of air flowrates. FGR was considered the more conservative approach for initial demonstration, since the penetration and mixing are controlled by the FGR flowrate, independent of the natural gas flowrate.

At Cherokee, the "second generation reburning" (without FGR) was found to work just as well as the FGR system, and at lower capital cost. Hence, EER plans to continue with this design. However, EER will continue to use FGR at the other two project sites—Hennepin and Lakeside. CCT

DOE Report to Congress: CCT Expressions of Interest in Foreign Countries

An important avenue for future deployment of Clean Coal Technologies (CCTs) is international markets. The U.S. Department of Energy (DOE), responding to Congressional guidance, issued a solicitation on November 18, 1994, for Expressions of Interest (EOIs) in commercial projects employing CCTs in countries that project significant growth in greenhouse gas emissions. Companies were requested to identify the extent to which various types of Federal incentives would accelerate the international availability of these technologies. In July 1995, DOE's Office of Fossil Energy submitted the *Report to Congress: Expressions of Interest in Commercial Clean Coal Technology Projects in Foreign Countries,* which summarized the 77 submissions from 33 respondents.

The solicitation was a reflection of the Congress' view that the dissemination of CCTs overseas should be an integral part of DOE's policy to reduce greenhouse gas emissions in developing countries. Companies were advised that DOE did not have funds for sponsoring the projects, but Congress wanted further information to consider the technical, economic, and environmental aspects of incentives for developing CCTs internationally. Congressional guidance mandated that the proposals incorporate the following:

- sponsorship by a U.S.-based company or consortium;
- location in a developing country that is projected to have significant growth in greenhouse gas emissions; and
- demonstration of a technology capable of reducing greenhouse gas emissions, effective and versatile in use of various coal types, and likely to be utilized on a broad commercial scale.

The solicitation posed two important questions:

1. What are the greatest opportunities for commercializing U.S. technologies abroad (short- and long-term); and
2. What role can DOE best play to facilitate commercialization of these technologies?

The respondents substantiated DOE's assessment that the greatest opportunities for exporting CCTs, especially advanced power systems, were in China, the Pacific Rim, South Asia (India and Pakistan), Eastern Europe, and the Newly Independent States. These are regions where significant growth in greenhouse gas emissions is expected. Based on major economic development in these countries, there also are opportunities for coal processing and environmental control devices, which are key responses to problems associated with expanding coal use.

Types of Proposed Clean Coal Technologies

The companies proposed projects employing U.S.-developed CCTs in 21 countries, in four market sectors: advanced electric power generation, environmental control devices, coal processing for clean fuels, and industrial applications. U.S. industry has a strong technical edge in each of these sectors and therefore has significant export opportunities under favorable market conditions. The total generating capacities proposed in the EOIs varied from 20 MWe in Indonesia from 2 EOIs, to over 6,500 MWe in China from 20 EOIs. Total costs over the lives of these projects range from $250,000 to $2.5 billion ($U.S.).

The China EOIs included 11 proposals for advanced electric power generation systems, 6 of which involved IGCC, 2 PFB, 2 AFB, and 1 advanced combustion. Four others addressed coal processing for clean fuels, both coal preparation and new fuel forms; two involved environmental control devices; and three were other types of technologies. China is projected by DOE to be the largest single market country, with a $717 million average annual export potential for CCTs under current conditions. These exports can create an estimated 25,000 direct and indirect U.S. jobs annually.

Commercialization and Incentives

DOE has two fundamental and complementary objectives with respect to international CCT deployment: (1) to promote the advantages of high-efficiency, environmentally compatible CCTs in foreign countries; and (2) to facilitate efforts by U.S. companies to compete on a level playing field. The Report to Congress provides details about the potential for international commercialization

See "EOI Report" on page 8 . . .

Type of CCT / Number of EOIs

Emissions controls: combined SO_2 and NO_x	2
Industrial applications	2
Emissions controls: NO_x	3
Advanced combustion	4
Miscellaneous	4
Emissions controls: SO_2	5
Coal preparation	6
New fuel forms	6
Atmospheric fluidized bed combustion (AFB)	7
Pressurized fluidized bed combustion (PFB)	8
Integrated gasification combined cycle (IGCC)	14
Computer software and modelling	16

. . . "EOI Report" from page 7

of CCTS, as reported by the EOIs and as estimated by independent research. It also projects increases in exports and job creation through active promotion by the United States.

The largest barrier to CCT project deployment and export is financing, and where the greatest problem exists—in developing and transitional countries—also is where CCT projects are most needed. Not surprisingly, financing is the primary focus of incentives requested by the respondents. As reported by the EOIs, international commercialization of CCTs is directly tied to a range of financial incentives that can be grouped into three categories:

- funding of initial project development,
- funding of projects, and
- other assistance.

U.S. firms requested a total of $1.4 billion in Federal funding out of a total of $7.15 billion in EOI project costs. Of that, firms requested:

- $156 million out of $929 million for "funding initial project development" for prefeasibility and feasibility studies, engineering, project development, and export assistance;
- $1.2 billion out of $4.6 billion for "funding of projects," including project components and direct project funding; and
- $35.9 million of $1.65 billion in "other assistance," including financial assistance, general export assistance, and technical assistance for host countries.

Other areas of financial assistance identified in the EOIs are low-interest loans, loan guarantees, electricity price guarantees, and cost-sharing to offset the risks of clean coal technologies. Desired technical assistance to host countries identified in EOIs includes: government regulatory reform, financial reform, and contract development; training on clean coal technologies; and training on the use of software analytical tools related to technical aspects of coal use.

There also are a number of other incentives requested in the EOIs that are not direct requests for financial assistance. Many respondents requested assistance from U.S. Government programs to help facilitate the exchange of information and people necessary to stimulate this growing segment of international trade. Some programs and mechanisms already exist to provide this type of assistance. DOE also can help to overcome barriers related to the technical risk of deploying advanced CCTs. Some options include providing potential CCT users with needed information, helping adapt U.S. CCTs to foreign markets, or reducing the technology risk of investing in advanced CCT projects.

Future Federal CCT efforts would benefit from a coordinated response of multiple Federal agencies, in addition to DOE. Such coordination already is under way through such groups as the Trade Policy Coordinating Committee subgroup on Clean Coal Technology. The report presents a variety of such approaches that would encourage and support international deployment of CCTs such as:

Salient Characteristics of the Expressions of Interest Received, by Proposed Host Country

Country	No. of EOIs	Total Cap. (MWe)	TotalCost ($U.S.)
Australia	1	na	$1,400
Brazil	1	na	$5,500
Bugaria	1	4,000	$250
China	20	6,537	$2,509,840
Czech Republic	5	4,210	$455,250
Eastern Europe	4	700	$578,000
Estonia	1	3,000	$250
Hungary	2	4,000	$3,225
India	10	1,110	$2,081,000
Indonesia	2	20	$65,400
Kazakhstan	1	4,000	$250
Kyrghyzstan	1	3,000	$250
Latvia	1	1,600	$250
Lithuania	1	4,000	$250
Mexico	1	100	$160,000
Pacific Rim	3	740	$650,000
Pakistan	1	350	$120,000
Poland	5	4,120	$163,650
Romania	1	4,000	$250
Russia	6	100	$117,000
Slovak Republic	1	4,000	$250
Slovenia	1	2,000	$250
Ukraine	4	4,550	$162,250
Unspecified	3	100	$80,750
Totals	**77**	**58,237**	**$7,150,000**

1. Make existing Federal programs more effective. This includes activities that could be implemented with little or no added budget commitments. Many of them require coordination of the efforts of multiple Federal agencies.
2. Develop an ongoing program of DOE technical assistance. Such assistance could be provided to foreign governments, other U.S. agencies, and U.S. companies. It would gain leverage from DOE's existing strengths in technology transfer.
3. Implement low-cost information exchange programs. Ensure that U.S. industry has the information it needs about foreign markets in a timely manner and that potential foreign customers have information about U.S. offerings.
4. Coordinate market-responsive research and development. The purpose would be to work with U.S. industry and their foreign partners to adapt U.S. technologies to the special needs of foreign markets.
5. Provide innovative export financing mechanisms. In some cases, needs may be satisfied by existing programs. However, in other instances, businesses might required additional commitments of Federal funds.

The report also describes the higher-cost financing options requested in the EOIs, including financing incremental costs of advanced technologies, government funding of a portion of project costs, performance guarantees for advanced technologies, and partial funding of foreign demonstration projects. All such options would require an incremental commitment of Federal funds.

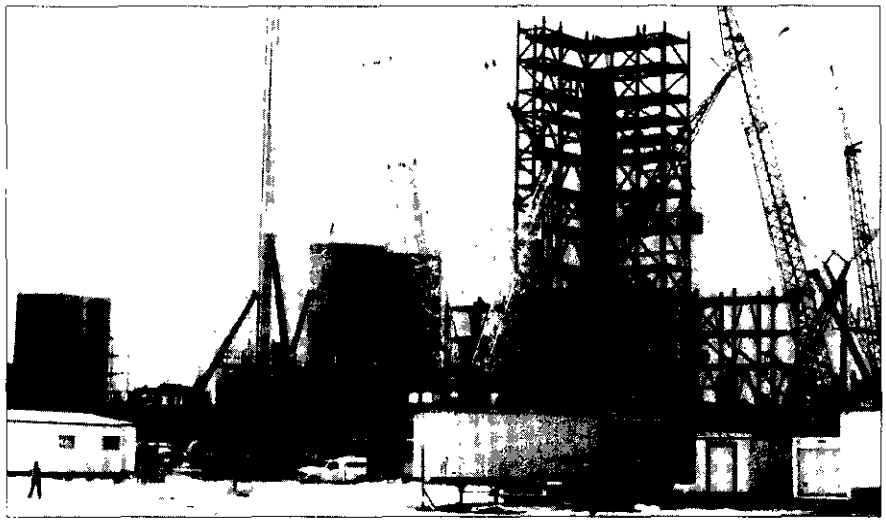
In many cases, Federal export credit is available for projects from the Export-Import Bank or the Overseas Private Investment Corporation through existing programs. No funds are earmarked for CCT projects, nor does the government bear the costs or risks of advanced technology under these programs.

Supporting documentation for the Report is included in comprehensive appendices: the original *Federal Register* notice; Technology Assessments describing the four categories of CCTs; and summaries of all EOIs, including project/technology description, technology status, environmental performance, economics, and market potential based on information provided in the submissions. [CCT]

Copies of the *Report to Congress: Expressions of Interest in Commercial Clean Coal Technology Projects in Foreign Countries*, DOE/FE-0334, can be obtained from DOE, Office of Scienctific and Technical Information (OSTI), P.O. Box 62, Oak Ridge, TN 37831, or from the National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

Fifth Annual Clean Coal Technology Conference

Tampa, Florida • Fall 1996



Groundbreaking was held November 2, 1994, for the 250-MWe (net) IGCC portion of the planned 1,150-MWe Polk Power Station in Lakeland, Florida. Progress on the gasification tower foundation is shown.

The Fifth Clean Coal Technology Conference, currently being planned for Fall of 1996, will feature a site tour of the Tampa Electric Integrated Gasification Combined-Cycle (IGCC) Project. Located in Lakeland, Florida, at Tampa Electric Company's Polk Power Station, Unit 1, this 250-MWe plant features a demonstration of IGCC technology in a greenfield, commercial electric utility application. It will use Texaco's pressurized, oxygen-blown entrained-flow gasifier technology, incorporating both conventional, low-temperature acid-gas removal and hot-gas moving-bed desulfurization.

Construction is projected to be completed before the Conference convenes in Tampa next Fall, and Conference attendees will be able to tour this site as the project begins its demonstration phase.

Clean Coal Conference Schedule

Tuesday, September 5

7:00a - 5:00p	Registration
9:00a - 11:30a	International Orientation Sessions Program/Conference Overview
11:30a - 1:00p	Welcome Luncheon
1:00p - 2:00p	*Orientation Sessions for Tours*
2:00p - 7:00p	Tour 1: Cherokee Station Tour 2: Arapahoe Station

Wednesday, September 6

7:00a - 5:00p	Registration
7:00a - 8:30a	Speakers' Breakfast
8:30a - 12:30p	Plenary Session I
12:30p - 1:30p	Luncheon Speaker
1:30p - 3:00p	Panel Session I — International Business
1:30p - 3:00p	Concurrent Technical Sessions I & II
3:30p - 5:30p	Panel Session 2 — Transitions in the International Power Sector
3:30p - 5:30p	Concurrent Technical Sessions I & II (continued)
6:30p - 8:30p	Reception

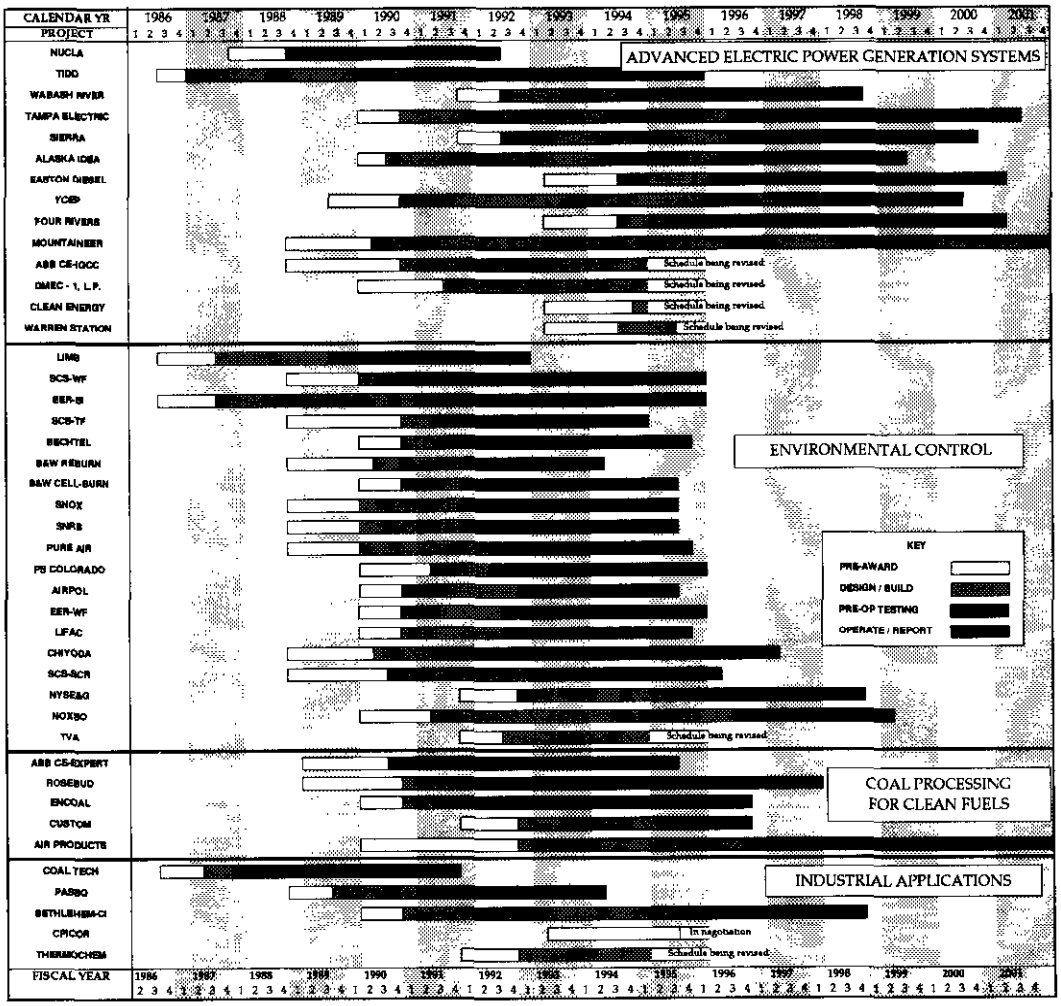
Thursday, September 7

7:00a - 12:00p	Registration
7:00a - 8:30a	Speakers' Breakfast
8:30a - 12:00p	Panel Session 3 — Transition to Competition in Electrical Power Generation Industry and Its Impact
8:30a - 12:00a	Concurrent Technical Sessions III & IV
12:00p - 1:30p	Lucheon Speech — Completing the Mission
1:30p - 5:00p	Plenary Session II — Domestic Challenges
1:30p - 5:00p	Concurrent Technical Sessions III & IV (continued)

Friday, September 8

8:00a - 9:00a	Speakers' Breakfast
9:00a - 12:00p	Technical Session — International Projects
12:00p - 2:00p	Buffet Luncheon — Panel Discussion on Future International Expectations for CCT Deployment

Clean Coal Technology Demonstration Program—Sorted By Operation Start Date



Fourth Annual Clean Coal Technology Conference

—The Global Opportunity—

DENVER, COLORADO
SEPTEMBER 5-8, 1995

The Fourth Annual Clean Coal Technology Conference will focus on the marketability of clean coal projects domestically and abroad. The international community will be well represented at the conference.

The success rate of clean coal projects in the U.S. for coal-fired electricity generation is a beacon to foreign governments that are working toward effectively using advanced NO_x and SO_2 control technologies to substantially reduce emissions for a cleaner environment.

Conference is cosponsored by the U.S. Department of Energy, Center for Energy & Economic Development, and National Mining Association.

TOPICS OF INTEREST

- Site Tours: Public Service Company of Colorado Cherokee and Arapahoe Stations
- Technical Papers on DOE CCT Projects
- The World Economic and Energy Outlook
- Global Opportunities
- CCTs and Coal's Role in an Expanding World Economy
- Transition to Competition in Domestic Electric Power Generation Industry and Its Impact on CCT Markets
- Completing the Mission
- Domestic Challenges
- Successes in International Coal Technology Deployment
- International Business
- Lessons Learned from International Solicitation of Expressions of Interest
- Transition in the International Power Sector
- International Projects (China, India, Indonesia, Poland, Ukraine)

CONFERENCE REGISTRATION
The attached Conference Registration Form should be returned with payment no later than August 25, 1995. Cancellations must be received prior to August 25, 1995 to be granted a full refund. The Registration Fee covers continental breakfast, lunches, breaks, and reception. General, $350; On-Site, $400; Spouses, $150. (The fee for spouses will cover the same amenities.)

HOTEL RESERVATIONS
All events are scheduled at the Denver Marriott City Center, downtown Denver, Colorado. The conference rate is $77.00 per person, including tax (single or double). To guarantee this rate reservations must be made by August 21, 1995. Reservations can be made by calling 800-228-9290, or 303-297-1300. Mention the Clean Coal Technology Conference to get this special rate.

AIRPORT TRANSPORTATION
The Airporter Commuter and D.A.S.H. provide shuttle service between the hotel and the Denver airport. These services are located in the baggage claim area of the new Denver International Airport and run approximately every 20 minutes. The cost is $15.00 one-way. Call Airporter, 303-333-5833, or D.A.S.H., 800-525-3177 to make a reservation. Limousine, taxi, and bus transportation also are available.

EXHIBITS
Exhibit space is available at the Marriott Denver City Center hotel.

CONTACT
For additional information on the conference or exhibit space, please contact Ms. Kim Yavorsky, 412-892-6244 / FAX, 412-892-4775.

Site Tours September 5: Public Service Company of Colorado Cherokee and Arapahoe Stations

Please Complete and mail this registration form to:

The Center for Conference Management

P.O. Box 18209

Pittsburgh, PA 15236 USA

Phone: 412-892-6244

Fax: 412-892-4775

Please Print
Name:_____
Title:_____
Company:_____
Phone:_____ Fax:_____

I will___will not___attend the Welcome Luncheon, Tuesday, Sept. 5
I will___will not___attend the Tours, Tuesday, Sept. 5
I will___will not___attend the Sessions, Friday, Sept. 8

Registration Fees: Pre-Registration $350—On-Site $400—Spouses $150
To register your spouse, copy and complete this form--fee includes: tours, continental breakfasts, reception, and luncheons.

I have enclosed my registration check
MADE PAYABLE TO CEED *in the amount of* $_____

Upcoming Events

DATE	EVENT	CONTACT
Sept. 5–8, 1995	***Fourth Annual Clean Coal Technology Conference: "The Global Opportunity"*** Denver Marriott City Center, Denver, Colorado	Ms. Kim Yavorsky Phone 412-892-6244
Sept. 11–14, 1995	***12th Annual Pittsburgh Coal Conference*** Pittsburgh, PA	Ms. Ann McDonald Phone 412-624-7440
Oct. 22–25, 1995	***14th Conference on Coal Gasification in Power Plants*** San Francisco, CA	Ms. L. Nelson 415-855-2041 (FAX)

CCT Reports Update

The following reports are available from U.S. Dept. 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.

April 1995	DOE/EA-1007	Environmental Assessment for the Warren Station Externally Fired Combined Cycle Demonstration Project
May 1995	DOE/EIS-0221	Final EIS for the Proposed York County Energy Partners Cogeneration Facility

This document is available through DOE, Office of Scientific and Technical Information (OSTI), P.O. Box 62, Oak Ridge, TN 37831, or from the National Technicial Information Service (NTIS), U.S. Dept. of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

June 1995	DOE/FE-0334	Report to Congress: Interest in Commercial Clean Coal Technology Projects in Foreign Countries

The following reports are available from U.S. Dept. of Energy, Pittsburgh Energy Technology Center, Bldg. 920 Wallace Road, Pittsburgh, PA 15236, Attn: Mr. Lloyd Lorenzi (412) 802-6159.

June 1995	DOE/EA-1080	Environmental Assessment for Commercial Demonstration of the NOSXO SO_2/NO_x Removal Flue Gas Cleanup System
June 1995	DOE/EA-1029	Environmental Assessment for Commercial-Scale Liquid-Phase Methanol (LPMEOH™) Process