

CLEAN COAL TODAY

A NEWSLETTER ABOUT INNOVATIVE TECHNOLOGIES FOR COAL UTILIZATION

PROJECT NEWS BYTES

In December 1999, George Rudins, DOE Office of Fossil Energy Deputy Assistant Secretary for Coal and Power Systems, was named 1999 winner of the **Washington Coal Club's Achievement Award**. The membership of the Washington Coal Club comprises private sector and government representatives working on coal issues and, for the past 20 years, has annually recognized members of Congress, industry, labor leaders, and government officials. Rudins was cited for his leadership in advancing clean coal technologies, as well as promotion of innovative concepts for pollution control, climate change mitigation, and carbon sequestration. He is also the author of FE's Vision 21 plan for a futuristic, virtually non-polluting fossil fuel energy plant.

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WABASH COMPLETES FOURTH YEAR OF COMMERCIAL OPERATION

One of the world's pioneering commercial-scale coal gasification-based power facilities, Wabash River's Integrated Gasification Combined-Cycle (IGCC) plant, has successfully completed its fourth year of commercial operation and processed over one-and-a-half million tons of coal. A winner of *Power* magazine's 1996 Powerplant Award, as well as other honors, Wabash River is one of the cleanest coal-fired facilities in the world, and has contributed greatly to the commercial potential of this advanced coal-based power generation technology. Gasification is already in wide use for syngas-to-chemical production, and under the DOE Office of Fossil Energy Vision 21 initiative, coal-based IGCC is expected to coproduce power and high-value chemicals and clean transportation fuels.



The 262-MWe Wabash River IGCC project repowered an existing facility.

DOE selected Wabash River in September 1991 as a Clean Coal Technology (CCT) Program Round IV demonstration project, and the Cooperative Agreement between the industrial participants and DOE was signed in July 1992. Commercial operation began in December 1995. The Cooperative Agreement ended in January 2000 after a four-year commercial demonstration, and the plant continues in commercial operation.

The original Participant was the Wabash River Coal Gasification Repowering Project Joint Venture, formed in 1990 by Destec Energy, Inc. of Houston, Texas and PSI Energy, Inc. of Plainfield, Indiana. Destec owned and operated the gasification facility, and PSI Energy owned and operated the power generation facility. In 1997, Houston-based Dynegy, Inc. purchased Destec. A final transfer took place last December when Global Energy, Inc. purchased Dynegy's gasification assets and technology. PSI Energy remains the owner and operator of the generating facility.

MAJOR REPAYMENT MADE TO DOE

Global Energy plans to market and license the Destec Gasification Process under the name: "E-GAS Technology™." Dynegy has repaid DOE \$550,000 — \$300,000 for the facility and \$250,000 for the technology. Global Energy

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...Wabash continued

will promote commercialization of the technology, and make repayments on future equipment sales or licenses for a 20-year period.

THE PROJECT

The project is located at PSI's Wabash River Generating Station near West Terre Haute, Indiana. PSI repowered a 1950s vintage steam turbine and installed a new syngas-fired combustion turbine while continuing to utilize locally mined high-sulfur Indiana bituminous coal. The repowered steam turbine produces 104 MWe that combines with the combustion turbine generator's 192 MWe and the system's auxiliary load of 34 MWe to yield 262 MWe (net) to the PSI grid.

GASIFICATION PROCESS

The Wabash Project features the integration of the E-GAS process with an advanced General Electric MS 7001 FA high-temperature gas turbine. The E-GAS process features an oxygen-blown, two-stage entrained flow gasifier capable of operating on both coal and petroleum coke, with continuous slag removal.

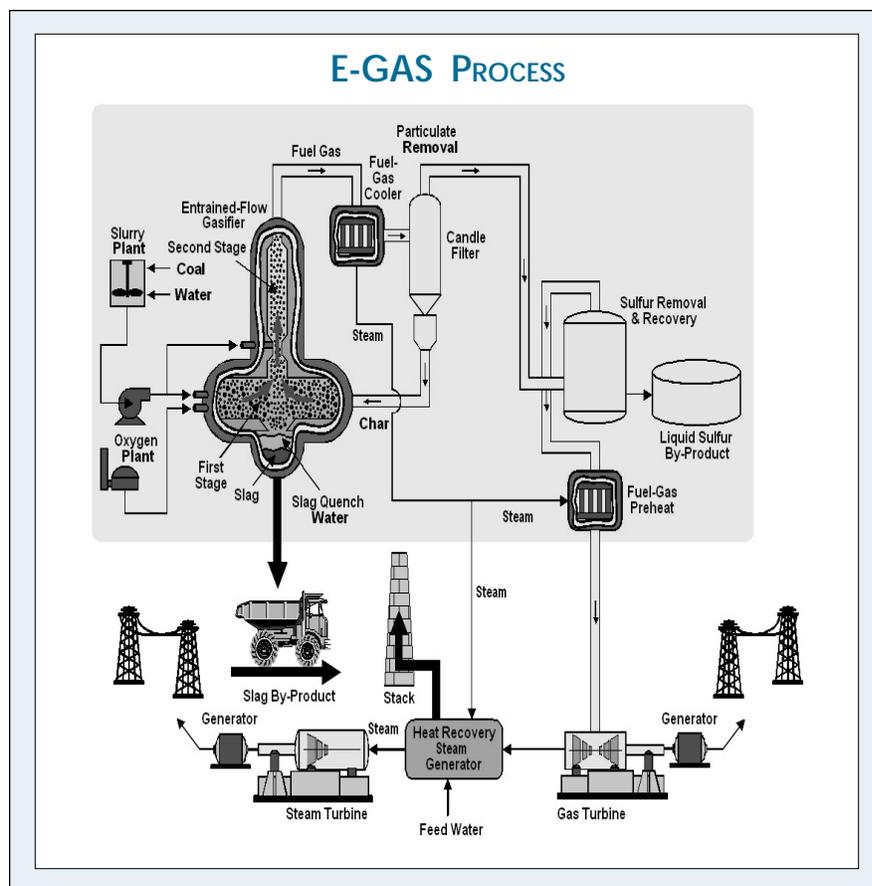
As illustrated in the schematic, syngas is generated from gasification of a coal/water slurry with 95 percent oxygen in a reducing atmosphere at 2,600 °F and pressure of 400 psig. The syngas produced from coal comprises 45.3 percent carbon monoxide, 34.4 percent hydrogen, 15.8 percent carbon dioxide, 1.9 percent methane, and 1.9 percent nitrogen, and has a higher heating value of 277 Btu per standard cubic foot (dry basis). The ash melts and flows out of the bottom of the vessel as a vitrified slag (frit) by-product. Additional coal/water slurry added to the second gasification stage undergoes devolatilization, pyrolysis, and partial gasification to cool the raw gas and

increase its heating value. The syngas flows to a heat recovery unit, producing high-pressure saturated steam that is superheated and used to drive a steam turbine. Subsequently, the particulates (char) in the raw gas are removed with a hot/dry candle filter and recycled to the gasifier where the remaining carbon is converted to syngas. After particulate removal, the syngas is water-scrubbed for chloride removal and passed through a catalyst that hydrolyzes carbonyl sulfide to hydrogen sulfide. The hydrogen sulfide is removed using methyl-diethanolamine absorber/stripper columns. The syngas is then burned in a gas turbine that produces electricity. Gas turbine exhaust heat is recovered in a heat recovery steam generator to produce steam that drives the steam turbine to produce more electricity.

Over its four years of operation, the plant has demonstrated an im-

pressive record of continually increasing reliability and syngas production, with 2.7×10^{12} Btu in 1996, 6.2×10^{12} Btu in 1997, and 8.8×10^{12} Btu in 1998. Overall, plant availability has increased from 56 percent in 1997 to 72 percent in 1998 and 79 percent in 1999. Thermal efficiency (HHV) is 39.7 percent on coal and 40.2 percent on petroleum coke compared to the 33–35 percent figure for conventional pulverized coal-fired plants. The greater the thermal efficiency, the less coal is needed to generate a given amount of electricity, thereby reducing both fuel costs and carbon dioxide emissions.

Emissions from Wabash River's IGCC facility are 0.1 pounds of SO_2 and 0.15 pounds of NO_x per million Btu of coal input. This SO_2 emission rate is less than one-tenth the emission limit set for the year 2000 by the acid rain provisions of the Clean Air Act Amendments of 1990. Particu-



late emissions are less than the detectable limit set by EPA-approved emission measuring methods.

Another major environmental advantage at Wabash is the production of useful by-products. From startup through the end of 1999, Wabash has recovered and sold 33,888 tons of

elemental sulfur (99.99 percent purity) for agricultural applications.

The IGCC technology demonstrated at Wabash River is an ideal candidate for repowering the more than 95,000 megawatts of existing U.S. coal-fired utility boilers that are more than 30 years of age, and for

meeting the needs of a burgeoning foreign power generation market.

For more details on this and other CCT Program Demonstration Projects, please visit the Clean Coal Technology Compendium web site at <http://www.lanl.gov/projects/cctc/>.



Award-winning Wabash River IGCC plant continues in commercial operation after four years of successful demonstration.

....News Bytes continued

ENCOAL assets and responsibilities assumed by SGI International. SGI International (SGI) has purchased all ENCOAL plant assets from AEI Resources, which includes assuming full responsibility for marketing and repayment obligations to DOE. SGI has been actively securing customers for the plant's products in order to support the re-start of the mothballed demonstration plant. The company is adding new partners to share plant operating costs, and anticipates re-start by mid-2000. In a related action, SGI International has signed a long-term agreement with American Electric Power (AEP) to transport upgraded coal from the ENCOAL Demonstration Plant near Gillette, Wyoming to AEP's Cook Coal Terminal at Metropolis, Illinois for further barge delivery to various SGI customers, including AEP. This agreement provides a valuable in-

centive for SGI to restart the plant as well as move ahead with a larger commercial plant.

Fuel cell subcontract approved for Kentucky Pioneer IGCC Project. DOE has reviewed and approved the subcontract between Fuel Cell Energy (FCE) and Kentucky Pioneer L.L.C. FCE is planning to build and operate a 2-MWe molten carbonate fuel cell (MCFC) on a slipstream of clean syngas from the 400-MWe plant. FCE will scale up the design of their module from an existing 250-kW test facility. The FCE activity will cost about \$34 million, of which DOE will fund 50 percent. The IGCC project is planned for an existing power plant site in eastern Kentucky and is currently in the design and permitting stage. When completed, this will be the largest commercial-scale IGCC and MCFC facility to operate on coal-derived syngas.

Rosebud SynCoal reorganizes to better align interests. Western SynCoal Co., Montana Power's research and development arm for enhanced coal technologies and products, has reorganized to reduce administrative costs and better align its interests with those of Western Energy Co., an affiliated coal mining company. Under the new structure, Western SynCoal and two other entities, SynCoal Inc. and the Rosebud SynCoal Partnership, will form Western SynCoal LLC, a limited liability company. Western SynCoal was the operating entity of the partnership formed in 1992 between subsidiaries of The Montana Power Company and Northern States Power Company (NSP) to enhance low-quality coals by improving their heating values while removing moisture, sulfur, and ash through an Advanced Coal Conversion Process (ACCP). Over the years, Western SynCoal bought out NSP's interest.

COAL-DERIVED FUELS AND THE ULTRA-CLEAN TRANSPORTATION FUELS INITIATIVE



Clean Fuels Brochure is available from NETL (412-386-6072).

are compatible with the existing transportation infrastructure. Within DOE, the Office of Fossil Energy (FE) and the Office of Energy Efficiency (EE) are jointly funding this initiative. With respect to coal-derived fuels, FE's focus is on the fuels industry, while EE's focus is on the vehicle industry.

This new generation of advanced fuels will achieve significant decreases in air polluting emissions while increasing current vehicle performance. Although petroleum-based fuels are projected to dominate the fuel production supply and infrastructure in the near term, clean fuels derived from non-petroleum feedstocks, such as coal, biomass, and natural gas, are expected to be developed as blending stocks for petroleum fuels and eventually as replacements. The availability of ultra-clean fuels from these resources will revolutionize future advances in transportation and lead to a cleaner, healthier environment. Estimates are that this program will result in producing clean fuels that will enable fuel utilization efficiency to be doubled when used in advanced engine systems by the year 2020.

The major issues facing transportation energy use include potential health effects of pollution resulting from transportation emissions, in particular, ozone non-attainment and particulates; increasing emissions of the greenhouse gas carbon dioxide; concern for national security from our continuously increasing reliance on imported oil; and our interest in availability and affordability of petroleum-based liquid fuels due to expansion of transportation fuel demand.

To address these issues, FE is integrating and coordinating activities in the Oil Processing, Gas-to-Liquids (GTL), and Coal-Derived Transportation Fuels and Chemicals programs that are promoting the development of advanced ultra-clean transportation fuels for ultra-low emission vehicles. The Coal-Derived Fuels Program will: coordinate government/industry/public partnerships; establish consortiums to identify the transportation industry's needs; assist in implementing technology development efforts; and continue active support and participation in the engine/vehicle development efforts of EE's Office of Transportation Technology (OTT). The Coal-Derived Fuels Program aims to convert our vast coal resources into clean and efficient near-zero-sulfur fuels. It will contribute to the Initiative by, among other things:

Just as the oil embargo of the 1970s directed attention to improving efficiencies and developing alternative fuels, recent soaring oil prices have forced most gasoline and fuel oil purchasers to dig deep into their pockets and again question current fuel consumption practices. It therefore is timely that the U.S. Department of Energy has established an "Ultra-Clean Transportation Fuels Initiative," in collaboration with industry and the U.S. Environmental Protection Agency (EPA), to mobilize and develop market-viable advanced clean fuels from the nation's resources that

- Developing technology that will contribute to and directly support production of 20 percent of the nation's transportation fuels from domestic stocks by the year 2020;
- Developing the next generation of advanced clean fuels enabling vehicle manufacturers to meet post-2010 ultra-low emission requirements;
- Producing ultra-clean fuels that will meet EPA Tier II emission standards (0.07 g/mi NO_x, 0.01 g/mi particulate matter) by 2008, and by 2012 producing zero-sulfur blendstocks;
- Developing a "coal-based" U.S. carbon products industry by 2015 that will increase U.S. output of finished carbon products by five-fold while increasing domestic employment from 50,000 to 150,000; and
- Supporting the deployment of coproduction (fuels and electricity) facilities at a saving in carbon emissions of 350,000 tons per year per plant.

These efforts will synchronize FE's fuel and EE's vehicle development activities. As an alternative to the near-zero-sulfur fuels being developed by FE, OTT will attempt to improve the sulfur tolerance of exhaust aftertreatment equipment, which currently is degraded in the presence of sulfur. OTT also will test new versions of reformulated fuels, develop a systems approach to fuel/vehicle combinations, and determine effects of alternative fuels on emissions.

CURRENT STATUS

Today, a stand-alone coal-based (Fischer-Tropsch) F-T plant could be constructed for a capital investment of about \$54,000 per daily barrel. A 50,000-barrel per day plant would cost about \$2.7 billion, and the required selling price of fuels would be about \$28 per barrel on a crude oil

equivalent basis. It is expected that continued research and development will reduce plant capital cost to about \$40,000 per daily barrel with a threshold selling price of \$20 per barrel. In a coproduction plant, where electricity is generated along with F-T fuels, the required selling price is \$25 per barrel provided that the electricity is sold competitively and the capital investment of the plant is \$1,400 per kilowatt. Continued research in fuel development and plant cost reduction could reduce the selling price to \$18 per barrel.

R&D ACTIVITY

The Ultra-Clean Transportation Fuels Initiative identifies three phases of R&D. In the pre-2010 period, coal-based R&D will focus on development of improved, low-cost, high-efficiency conversion of natural gas to liquids, and development of coal-based fuels. Research activities may include development of advanced

synthesis reactors, and inexpensive, desirable catalyst formulations for diverse synthesis gas compositions. In the mid-term (2010-2015), coal-based R&D efforts will continue to focus on the development of advanced, lower cost synthesis gas production technologies for GTL and coal-based fuels. Research activities may include ceramic membrane reactor development for synthesis gas, hydrogen, and oxygen production. The long-term objective (post-2015) is to promote technology to produce large quantities of ultra-clean fuels from foreign and domestic resources. R&D efforts will focus on using these advanced fuels efficiently and integrating them effectively into the transportation infrastructure.

CLEAN FUELS SOLICITATION

EPA recently proposed new auto emission standards reducing allowable sulfur emissions from gasoline

from the current level of 300 ppm to 30 ppm by 2005. In response, DOE recently announced a \$75-million clean fuels solicitation that will accept proposals for:

- Projects to produce ultra-clean fuels from a variety of energy resources including crude oil, petroleum coke, refinery wastes, natural gas, and coal, and verify fuel performance by testing in engines;
- Projects to develop innovative emission control systems; and
- Projects of longer duration that could lead to innovative fuel-making processes.

Up to \$15 million could be awarded for each project, and R&D efforts may take up to five years. The first evaluation will be conducted on proposals received by June 30, 2000, and a second evaluation for proposals received by December 1, 2000.

NEW NATIONAL LABORATORY ESTABLISHED



In December 1999, the Federal Energy Technology Center was designated as the Department of Energy's 15th National Laboratory — the National Energy Technology Laboratory (NETL). In signing the designation document, Secretary of Energy Bill Richardson remarked that, "It is time we elevate the profile and prestige of this world-class facility, which has been helping solve energy and environmental programs for more than 50 years." (The Center's history of contributions to fossil energy R&D is traced in the Winter 1998 issue of *Clean Coal Today*.)

The new NETL will be the fossil energy counterpart of the National Renewable Energy Laboratory in Colorado. Secretary Richardson praised the NETL use of R&D partnerships with industry, universities, not-for-profit organizations, and other national labs to facilitate technology transfer. The NETL will continue to do business as a strictly government-owned government-operated facility.

The Secretary cited NETL's "strong and lasting capability as the federal government's center of coal-related expertise." The new laboratory will expand the reputation already achieved in coal by setting up a Center for Advanced Natural Gas Studies to coordinate development of new technologies, and improve the way gas is found and produced, as well as recommend new efforts to ensure that gas supplies remain abundant and affordable. Meanwhile, important work will continue in four R&D focus areas that support coal and power systems: computational energy science; carbon sequestration science; gas energy system dynamics; and ultra-clean fuels science and technology. Rita Bajura will remain as Director of the NETL.



U.S. Senator Robert Byrd (WV) and NETL Director Rita Bajura watch as Energy Secretary Bill Richardson designates NETL as a national lab.

UNITED STATES ENERGY ASSOCIATION'S FOCUS ON COAL



The United States Energy Association (USEA) is a membership association of approximately 150 organizations that span the spectrum of the U.S. energy industry. It serves as the U.S. Member Committee of the World Energy Council (WEC), and is also a partner with U.S. Department of Energy (DOE), the U.S. Agency for International Development (US-AID), and the U.S. Trade Development Agency (USTDA) in implementing energy cooperation programs around the globe.

From its beginning in 1924, with the creation of the WEC, USEA has focused a significant portion of its attention on the role that fossil fuels play in the global energy industry. Recent USEA initiatives have addressed both domestic and international concerns, playing a critical role particularly in Eastern Europe in support of DOE, US-AID and USTDA activities.

Poland, Hungary, Slovakia, and the Czech Republic participated for eight years in USEA's Utility Partnership Program. When the Berlin Wall fell, these countries began a process of integration with Western Europe and eventual accession into the European Union. Atmospheric emissions from coal-fired power plants were at unacceptable levels due to a variety of factors, including a lack of environmental controls during the Soviet era. U.S. technology, environmental standards, and business practices by cooperating with U.S. utility partners greatly facilitated an effort to reduce emissions by a factor of ten. Strategies to achieve European Union standards are in place in all four countries.

Elsewhere, Brazil is in the process of developing a fossil fuel industry to meet rising demands for electric power. Since the first Brazilian delegation hosted by USEA in 1991, Brazil has moved forward creating both a natural gas import infrastructure and a domestic coal industry. USEA has been instrumental in encouraging Brazil to allow foreign investment in electric power. Seminars and exchange visits have focused on developing the institutional and regulatory structures for both economic and environmental regulation. Also, increased knowledge of U.S. technology in mining operations and coal combustion have given both industry and government leaders the confidence necessary to support significant growth in coal and natural gas use in Brazil.

China and India will both witness continued growth in coal combustion to meet growing societal demands for electric power. Global environmental issues compel the United States to be actively engaged with both government and industry leaders in both countries. USEA's partnership programs, supported by DOE, US-AID, and the U.S. energy industry, have focused attention on coal cleaning and preparation technologies, power plant efficiency improvements, and system operation issues.

Additionally, USEA participates in the U.S. China Energy & Environment Technology Center, which is a joint program of Tulane University and Tsinghua University in Beijing. This effort, still in its development stage, has the potential to be a leading center of energy and environmental cooperation

between the public and private sectors of China and the United States.

In September 1999, the World Energy Council formalized the creation of the Ad Hoc WEC Committee on Cleaner Fossil Fuel Systems. Growing out of the International Energy Agency (IEA) Conference on the



Central & South West (CSW) and Shandong Electric Power Group Corporation (SEPCO) participated in a signing ceremony in September 1997 to commence a USEA/DOE-funded utility partnership. Seated are partnership signators: (L-R) Barry Worthington, Executive Director, USEA; Glen Files, Senior V.P., CSW; and Liu Zhen ya, President, SEPCO.

Strategic Value of Fossil Fuels, this committee's purpose is to focus attention on the role of fossil fuels in the global energy system — which is precisely the objective that USEA has pursued.

USEA's original role as Secretariat for the IEA conference has continued with its role as Secretariat to the committee. In 1999, the committee organized a highly successful conference in Ankara, Turkey under the auspices of President Demirel. Turkey presents potential investment opportunities for U.S. developers, and is a nation of major geopolitical significance to the United States. The Ankara conference has led to an improved understanding of key issues between the U.S. and Turkey, and Turkey's neighboring countries.

The new, Ad Hoc Committee met last year as part of Polish Energy

Day held in Krakow. A key debate between fossil fuel proponents and opponents provided the global gathering an unusual opportunity to further a common understanding of the unique contribution that fossil fuels provide. A program highlight was the announcement that the Turow power plant, modernized with Foster Wheeler boilers, received McGraw Hill's Powerplant of the Year award.

The Committee will continue an aggressive effort to promote recognition of the value of fossil fuels in the global energy sector, with its workshop, "Cleaner Fossil Fuels Systems: A Business Agenda for Africa," to be held in Dakar, Senegal from June 26-28, 2000.

One notable factor that allows this committee to be perhaps the most active and effective is the committee leadership. Chaired by Barbara McKee, Director of DOE's Office of Coal and Power Imports and Exports, and with USEA serving as Committee Secretariat, the United States has exerted unusual and posi-

tive leadership in promoting fossil energy technologies. DOE's leadership has mobilized support for this initiative from WEC organizations in Europe, the Middle-East, Asia, Africa, and Latin America.

Additional USEA initiatives in global climate change and national energy policy further the interests of the U.S. fossil fuel industries. An active participant in DOE's Clean Coal Technology Program, USEA has utilized both the WEC network and the 60 energy partnership programs to promote cooperation that ultimately will lead to deployment of U.S. coal technologies globally.

The U.S. fossil fuel industry was well recognized in both the program and the exhibition at the 17th Congress of the World Energy Council, which USEA organized and hosted in Houston in 1998. U.S. DOE Secretary Bill Richardson opened the Congress and hosted a series of bilateral ministerial meetings with many of the 50 energy ministers in attendance.

USEA now will begin to organize participation of the U.S. industry in the 18th WEC Congress in Buenos Aires in 2001. Continuing its activities within the WEC, as well as the energy partnership program, USEA plans to add its considerable voice to those highlighting the role of fossil fuels in our global energy supply.

This guest piece was submitted by Barry K. Worthington, Director of the United States Energy Association (USEA).

The USEA is one of a number of Clean Coal Technology Program stakeholders involved in efforts to promote U.S. technologies.

For additional information, contact USEA at:

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Washington, DC 20004-3022
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Internet: www.usea.org

UPCOMING EVENTS

April 10-13, 2000 —

*The Use & Disposal of Coal Combustion By-Products at Coal Mines:
A Technical Interactive Forum*

Location: Morgantown, WV

Sponsors: Office of Surface Mining and NETL

Contact: Kimberly Vories (618) 463-6463; kvories@mergw.osmre.gov

May 16, 2000 —

2000 Conference on Unburned Carbon on Utility Flyash

Location: Pittsburgh, PA

Sponsor: NETL

Contact: Karen Lockhart, (412) 386-4763, e-mail: lockhart@netl.doe.gov

May 17-18, 2000 —

2000 Conference on Selective Catalytic, Selective Non-Catalytic Reduction for NO_x Control

Location: Pittsburgh, PA

Sponsor: NETL

Contact: Karen Lockhart, (412) 386-4763, e-mail: lockhart@netl.doe.gov



RESULTS SUCCESSFUL FROM TREATED-WOOD/COAL COFIRING TESTS

DOE's National Energy Technology Laboratory (NETL) recently completed a successful pilot-scale pulverized coal combustion study of cofiring pentachlorophenol (PCP) and creosote-treated wood. The pilot-scale results showed that PCP/creosote-treated wood could be successfully cofired with pulverized coal without increases in air toxic emissions, including trace organics and metals. Air toxics emissions were typically very low, and often near or below detection limits — attributable to the high pulverized coal combustion temperatures. This testing was conducted at the NETL Combustion and Environmental Research Facility (CERF) in a project sponsored by the Office of Fossil Energy (FE) and DOE's Office of Energy Efficiency and Renewable Energy (EERE) Biomass Power Program.

Treated woods, such as telephone poles, transmission poles, and railroad ties, are an attractive renewable fuel for cofiring with coal compared to other biomass fuels, given their typically very low moisture (<10%), sulfur (<0.3%), nitrogen (<0.4%), and ash (<2%) contents, as well as high heating value (over 9,000 Btu/lb) and bulk density. Such treated woods are readily available (millions of tons across the U.S.), often with very high disposal/landfill costs (up to \$80/ton) to utilities and other industries. Increasingly, landfills in certain regions are considering turning away treated woods. As utilities approach state regulators with requests to modify permits to allow for cofiring, they now will have results of pilot-scale tests showing the minimal impact of cofiring treated-wood wastes. In the past, utilities had no readily available test-burn data, so these results are likely to provide utilities an impetus to cofire such treated wood wastes.

The cofiring tests used a baseline Upper Freeport bituminous coal and 10 percent cofiring (energy basis) with PCP-treated and creosote-treated wood. Most utilities envision using 5 percent cofiring heat input or less of treated wood, based on day-to-day resource availability and a practical need for multiple biomass sources. However, the 10 percent level allowed a more stringent assessment of air toxics with the treated wood fuels.

While competition for lumbermill sawdust and other biomass residues typically drive a local market where utilities might be expected to pay \$10-20/ton, the high landfill costs of treated woods could enable even more favorable economics. For example, by cofiring treated woods, utilities could potentially reduce their out-of-pocket landfill costs for utility-generated waste (e.g., spools, cross arms), while also helping local industries and customers deal more economically with treated-wood waste disposal issues. Coal-fired utilities could thus consider cofiring such treated woods as a means of reducing power generation costs while utilizing renewable energy and reducing emissions of greenhouse gases.

Because of the PCP and creosote chemicals used for wood preservation (which are also responsible for the low moisture and high heating value of the treated woods), utilities, environmental groups, and state regulators need to be confident that the treated woods can be successfully cofired in pulverized coal utility boilers without harmful air toxics emissions, especially trace organics such as dioxins, furans, and formaldehyde.

In planning the pilot-scale CERF cofiring tests, input from numerous organizations was obtained, including various utilities, Electric Power Research Institute, Foster Wheeler, Cofiring Alternatives, and Entropy, as well as local and state regulators from the Allegheny County Health Department and State of Pennsylvania Department of Environmental Protection. FE and EERE recognize that biomass cofiring must be supported by coal-fired utilities and innovative partnering with biomass



Established in 1989 to evaluate combustion emissions, the CERF is used to assess fuel quality, heat transfer, and emissions control on a pilot scale.

stakeholders to realize multiple benefits, reduce risk, and address stringent environmental regulations under an increasingly cost-competitive environment brought about by utility deregulation. This diverse organizational participation resulted in a CERF cofiring test program that included a comprehensive assessment of air toxics including: dioxins, furans, polycyclic aromatic hydrocarbons (PAHs), heavy metals (e.g., mercury, antimony, arsenic, cadmium, chromium, cobalt, lead, nickel, and selenium), formaldehyde and

additional aldehydes/ketones, other organic volatile compounds, total hydrocarbons, hydrogen chloride, and particulates.

In preparation for the air toxics sampling, activities were undertaken to assess fuel processing, combustion, as well as environmental, health, and safety (EH&S) considerations to ensure the success of the test program. Preliminary CERF testing was conducted to examine particle size and carbon burnout considerations for various residence times and burner conditions for cofiring treated wood fuels, and collect data relevant to scalability issues. For example, these CERF tests showed that treated wood cofiring could slightly reduce NO_x emissions while not causing an increase in fly ash loss-on-ignition relative to the baseline Upper Freeport coal.

During December 1999, Entropy (a certified, independent contractor from Research Triangle Park, North Carolina) conducted the required air toxics sampling. CERF air toxics tests were conducted at about 0.37 million Btu per hour (MMBtu/hr) and 20 percent excess air with burner settings and temperatures typical of pulverized coal combustors, in order to compare the baseline Upper Freeport coal with 10 percent treated wood cofiring. Three sets of air toxics samples were collected under isokinetic conditions using multiple EPA-method sampling trains in four locations that were maintained at about 310–320 °F upstream of the CERF baghouse.

As an example of the test results, average formaldehyde and other aldehyde/ketone levels were barely detectable in the 0.2 to 3 parts-per-billion range (corrected to 3 percent dry O_2 basis), corresponding to equivalent, uncontrolled levels of only about 7×10^{-7} to 6×10^{-6} lb per million Btu.



NETL contractor conducts stack emission sampling tests.

Dioxins and furans were about 10,000–100,000 times lower than the aldehydes/ketones, with over two-thirds of the analyzed compounds showing up as “not detected,” and total uncontrolled dioxin and furan levels estimated at less than 4×10^{-11} and 2×10^{-11} lb/MMBtu, respectively. PAH data were nearly all non-detectable, and mercury and other heavy metals were also very low.

In addition to the importance of the absolute magnitude of these extremely

low emission levels, and the fact that so many compounds were near or below detection limits, the resulting air toxics measurements from the treated-wood cofiring tests showed no significant increases relative to the baseline coal. In fact, in several cases, air toxics emissions were actually somewhat lower than the baseline coal testing. This is indicative of high particle burnout and combustion achieved during the treated-wood cofiring tests, and is consistent with an observed trend for reduced fly ash loss-on-ignition during treated-wood cofiring tests.

The details of these pilot-scale CERF combustion and emissions test results will be published shortly to assist industry, state regulators, and other stakeholders in assessing the potential environmental and permit barriers for cofiring PCP/creosote-treated woods in pulverized coal utility boilers. Follow-on work will enable evaluation of these pilot-scale results with full-scale boiler tests, and will demonstrate scalability to provide digital data that can assist in future commercialization.

NEW PUBLICATIONS

Clean Coal Technology: The Investment Pays Off

Available from U.S. DOE, Fossil Energy
Office of Communications (202-586-6503)

Bethlehem Steel Topical Report (#15)

Available from NETL Morgantown Library
(304-285-4686 or 304-285-4184),

or on the Clean Coal Technology Compendium web site:
<http://www.lanl.gov/projects/cctc/topicalreport/documents/topical15.pdf>

OC&PS Strategic and Multi-Year Program Plans

Available from U.S. DOE, Office of
Coal & Power Systems web site:

http://www.fe.doe.gov/coal_power/programplans/



INTERNATIONAL INITIATIVES

FE SHARES GASIFICATION TECHNOLOGY OPTIONS WITH JAPAN

At the request of the Japanese Institute of Applied Energy and the New Energy Development Organization (NEDO), the DOE Office of Fossil Energy (FE) hosted a one-day workshop held in Washington, D.C. in January 2000 on municipal solid waste (MSW) treatment options designed to address Japan's landfill shortage and, secondarily, to produce power. NEDO's plans are aimed at developing high-temperature processes to transform MSW into vitrified ash and additional power-generation capacity. Particular interest was expressed in the high-temperature gasification systems under FE's Coal & Power Systems programs.

MSW treatment options discussed at the workshop included high-temperature gasification, combustion, and cofiring, as well as such downstream possibilities as coproduction of chemicals, fuels, and electricity. Japan's interest stems from the absence of a landfill option for MSW as volumes increase.

Japan generated 51 million tons of waste in 1996, and the average annual increase since 1992 has been 225,000 tons/year, making development of effective recycling and disposal methods imperative and making MSW a major power generation fuel option. Currently, Japan has 1,800 small, low-efficiency incineration facilities, only nine percent of which generate a total of 890 MWe.

Japan's goal is to convert or establish new MSW process facilities to generate 5,000 MWe of power by 2010, representing an increase of almost 800 facilities that coproduce power. Currently, Japan relies on a pyrolysis furnace to produce pyrolytic gas from MSW, which in turn fuels a melting furnace to transform the remaining waste from the pyrolysis unit into "molten slag." Heat from the combustion melting furnace raises steam to drive a steam turbine for power generation at an efficiency of about 30 percent. On the other hand, high-temperature gasification systems under development in the United States use the synthetic gas produced in the gasifier to generate power in a gas turbine and apply the turbine exhaust heat to drive a steam turbine (combined-cycle), which results in efficiencies of over 40 percent and a vitrified slag usable in construction applications.

The workshop agenda included a presentation to Japan on high-efficiency waste power generation, and discussions of representative R&D, Clean Coal Technology projects, and Vision 21 research program goals as all three address Japan's current need. Various gasification projects were discussed, along with FE's gasification data base, and power/fuels coproduction. Japanese attendees were particularly interested in Global Energy's presentation on the latest Clean Coal Technology Demonstration project, the Kentucky Pioneer IGCC facility, which will gasify a briquetted mixture of coal fines and MSW to produce power by gas and steam turbines in combined-cycle, and a molten carbonate fuel cell. One product of FE's R&D effort, a demonstration plant to make slurry fuels from either MSW or municipal sewage sludge for cofiring in a conventional pulverized coal power plant (the "E Fuels from Slurry Carb" process), is already in use on a small scale in Japan using MSW.

In all, American workshop participants presented a strong case to their Japanese counterparts that gasification is a cost-effective option for solid waste and sewage sludge elimination, while simultaneously recycling incinerator organic emissions into usable solid waste products that do not require landfilling.

DOE PARTICIPATES IN INTERNATIONAL CONFERENCE IN INDIA

A DOE Office of Fossil Energy (FE) representative and several contractors played a major role in an international conference entitled "*Power Plant Operation, Efficiency and Environmental Protection*," held in February in New Delhi, India. The conference was organized by the National Thermal Power Corporation (India) and the U.S. Agency for International Development (US-AID) in association with the National Energy Technology Laboratory (NETL), Electric Power Research Institute, and Tennessee Valley Authority (TVA). The conference attracted some 350 attendees, including senior officials from the

government of India, and private sector representatives. Approximately 25 American public and private sector presentors shared experiences with their Indian counterparts. As part of this conference, TVA, under a Cooperative Agreement with NETL, provided attendees with a two-volume study entitled “*Guidelines for Heat Rate Improvements at Coal-Fired Power Plants in India*,” performed under the Greenhouse Gas Pollution Prevention Project with funding from the US-AID. This report culminates an in-depth study of the Indian power industry, and focuses on identifying critical issues and opportunities for improving overall heat rates and efficiencies of currently operating coal-fired plants. DOE and US-AID share the long-range hope that many of the recommendations will be incorporated by the Indian power industry.

As part of this conference, FE also helped to organize a workshop entitled “*Identification of Barriers and Utilization Options: Large Volume Applications of Fly Ash in India*.” Some 90 attendees from the Indian power industry discussed areas such as policies and standards, geomaterials and agricultural applications, and construction applications/technologies. FE supported these sessions with consultants and speakers from the U.S. coal and power research community.

COAL-RELATED WEB SITES

Rather than just surfing the Internet for additional information on clean coal and other coal-related topics, the following has been compiled to provide readers with a preliminary listing of some of the available web resources, presented in general categories. When using this list, please note that the addresses are case-sensitive and will not work if not typed in as listed. This listing will be updated periodically, and recommendations should be submitted to the editor (phoebe.hamill@hq.doe.gov).

Federal Government

- U.S. Department of Commerce (<http://www.ita.doc.gov/td/energy/coal.htm>)
- U.S. DOE Albany Research Center (www.alrc.doe.gov)
- U.S. DOE Clean Coal Technology Compendium (<http://www.lanl.gov/projects/cctc/>)
- U.S. DOE Energy Efficiency and Renewable Network (www.eren.doe.gov)
- U.S. DOE/Energy Information Administration (EIA) (<http://www.eia.doe.gov>)
- U.S. DOE/EIA coal site (<http://www.eia.doe.gov/fuelcoal.html>)
- U.S. DOE/EIA Energy Outlook (<http://www.eia.doe.gov/emeu/steo/pub/contents.html>)
- U.S. DOE/Fossil Energy International (<http://www.fe.doe.gov/international/index.html>)
- U.S. DOE/National Energy Technology Laboratory (www.netl.doe.gov)
- U.S. DOE Office of Fossil Energy (www.fe.doe.gov)
- U.S. DOE Office of International Affairs (www.ositi.gov/international)
- U.S. DOE Office of Science (www.er.doe.gov)
- U.S. Department of Interior Office of Surface Mining (www.osmre.gov/osm.htm)
- U.S. Environmental Protection Agency (www.epa.gov)
- U.S. Department of State (<http://www.gcdis.usgcrp.gov/>) and
(http://www.state.gov/www/global/global_issues/climate/index.html)
- U.S. Mine Safety and Health Administration (<http://www.msha.gov/>)
- U.S. Trade Representative (<http://www.ustr.gov/>)

General Coal Information

- American Coal Foundation (<http://www.acf-coal.org>)
- Center for Study of Carbon Dioxide and Global Change (www.CO2science.org)
- Coal Education (www.coaleducation.org)
- Energy and Mineral Law Foundation (www.emlf.org)
- Foundation for Clean Air Progress (<http://www.cleanairprogress.org/studies/>)
- GES Fossil Fuels Links Center (www.bydesign.com/fossilfuels/links/)
- Global Climate Coalition (www.globalclimate.org)
- Greenhouse Gas R&D Programme (www.iea.green.org.uk)

See “Web Sites” on page 12...



...Web Sites continued

Greening Earth Society (www.fossilfuels.org)

National Energy Foundation (<http://www.xmission.com/~nef/>)

National Energy Education Development Project (<http://www.need.org/>)

International

Asia Pacific Economic Cooperation (www.apec.sec.org.sg)

British Columbia and Yukon Chamber of Mines (www.bc-mining-house.com/)

Chamber of Mines and Energy of Western Australia (www.mirelswa.asn.au)

Coal Exporters Association (www.nma.org/coal%20Exporters%20Association.html)

Coal Association of Canada (<http://www.coal.ca>)

International Energy Agency (IEA) (<http://www.iea.org/homechoi.htm>)

IEA Coal Research - The Clean Coal Center (<http://www.iea-coal.org.uk/>)

The World Coal Institute (U.K.) (<http://www.wci-coal.com/home.htm>)

Journals

Artigen Science News (www.artigen.com/newswire/scitech.html)

BBC News (<http://news.bbc.co.uk/hi/english/sci/tech/>)

Coal International (www.coalinternational.co.uk/)

Coal Information Network (www.coalinfo.com/index.html)

Coal Daily (www.fieldston.com/cd.html)

Coal Age (www.coalage.com)

Coal Transportation Report (www.fieldston.com/ctr.html)

Environmental News Network, Inc. (www.enn.com/new/)

Mining India's Journal of Mining, Metals & Fuels (www.miningindia.com)

World Climate Report (www.greeningearthsociety.org/climate)

States

Illinois Clean Coal Institute (www.ici.org)

Kentucky Coal Association (www.kentuckycoal.org)

Ohio Coal Development Office (<http://www.odod.ohio.gov/tech/coal/default.htm>)

Southern States Energy Board (<http://www.sseb.org/>)

University of North Dakota, Energy and Environmental Research Center
(<http://www.eerc.und.nodak.edu/index.html>)

Virginia Coal Council (<http://vcc.netscope.net>)

West Virginia Coal Association (www.wvcoal.com)

West Virginia Coal Association (<http://www.wvcoal.com/>)

Trade Associations

American Coal Ash Association (www.acca-usa.org)

American Boiler Manufacturers Association (www.abma.com)

American Public Power Association (www.appanet.org)

American Coal Foundation (<http://www.acf-coal.org>)

Center for Energy and Economic Development (www.ceednet.org)

Council of Industrial Boiler Owners (www.cibo.org)

Edison Electric Institute (www.eei.org)

Electric Power Supply Association (www.epsa.org)

Electric Power Research Institute (www.epri.com/)

Institute of Gas Technology (<http://www.igt.org/>)

National Mining Association (www.nma.org)

Lignite Energy Council (www.lignite-energy-council.org/hotlinks.htm)

National Rural Electric Cooperative Association (www.nreca.org)

North American Electric Reliability Council (www.nerc.com)

U.S. Energy Association (<http://www.usea.org/>)

Western Coal Council (www.westcoal.org)

World Energy Council (<http://www.worldenergy.org/wec-geis/>)



R&D MILESTONES



American Electric Power (AEP) completes testing of a Selective Non-Catalytic Reduction (SNCR) System on its 600-MW Cardinal Plant Unit 1 in Brilliant, Ohio. The testing was part of a cooperative agreement with the National Energy Technology Laboratory (NETL) to demonstrate a urea-based SNCR technology to reduce NO_x emissions by 30 percent beyond the level achieved using low-NO_x burners (LNBs). Ultimately, the system provided approximately 30 percent reduction in NO_x across the load

range, while maintaining slip near 5 ppm. Balance-of-plant issues, such as air heater pluggage and fly ash contamination, did not present problems. A consortium of EPRI member utilities, AEP, and the Ohio Coal Development Office joined with NETL in sponsoring the project — one of the largest domestic SNCR installations burning high-sulfur coal.

Mineral Technologies International, Inc. (MTI), nears completion of scale-up of an integrated process for recovery of coal fines. MTI is demonstrating an approach that combines packed column flotation with the NETL-developed GranuFlow process for effective fine coal recovery and dewatering under a Phase II Small Business Innovation Research grant. A 1-foot diameter column had been tested and is now installed at the second of two sites, Anker Energy's Sentinel coal preparation plant in Philippi, West Virginia. Initial results indicate superior cleaning relative to the conventional froth flotation units at the plant, with the column producing 5 percent ash fine coal (-100 mesh) compared to the 9 percent ash in the plant product. Further testing will involve recovery of additional coal from the flotation tailings stream.

FE-funded activity files for patent of novel mercury control process. Under a cooperative agreement between NETL and McDermott Control Technology, with funding from the Ohio Coal Development Office, McDermott has developed a mercury control technique that precipitates oxidized mercury in a dry or wet scrubber before it is reduced by transition metals. The patent, "Use of Sulfide-Containing Liquors for Removing Mercury from Flue Gases," is a continuation-in-part of a previous patent application that also resulted from the DOE/NETL agreement.

Eltron Research Inc. evaluates oxygen-blown gasification of coal fines. Under a Small Business Innovation Research grant, Eltron Research Inc. of Boulder, Colorado is developing a catalytic membrane reactor (CMR) for oxygen-blown gasification of coal fines. The tubular CMR employs proprietary mixed-oxide anion and electron-conducting brownmillerite materials, and is coated with an oxygen reduction catalyst on the inside and a gasification catalyst on the outside. The CMR reduces oxygen from the air and transports the oxide anion through the membrane to the gasification zone outside where coal, in the presence of steam, is oxidized to carbon monoxide and hydrogen. The process does not require a separate air separation unit, and is expected to offer process simplicity and economic advantage. Major focus during the Phase II R&D is on membrane material selection, catalysis, reactor design, and process operating conditions. Two lab-scale, membrane-based gasifiers have already been designed and constructed for fixed-bed and fluidized-bed operation.

Collaborative effort under way to develop hydrogen separation membrane operating under high temperature/pressure conditions. NETL, in collaboration with Argonne National Laboratory (ANL), is developing membrane technology to efficiently and economically separate hydrogen from a mixed gas stream. The new "cermet" (mixed metal-ceramic) membrane, fabricated at ANL, has been shown to operate at temperatures up to 900°C and pressures up to 250 psi, as demonstrated in a recently constructed membrane testing unit at NETL. This test provides an important step toward assessing performance at operating temperatures and pressures encountered in commercial gasification systems. Previous screening tests at ANL were limited to low pressure conditions. Preliminary flux measurements indicate that the permeability of the cermet material is comparable to that for metallic membranes. In further testing, pressure differentials will be increased up to 400 psi. Test results were presented at the 218th American Chemical Society National Meeting and will be the subject of an article in an upcoming monograph titled "Advances in Hydrogen Energy."

STATUS OF ACTIVE CCT DEMONSTRATION PROJECTS

ENVIRONMENTAL CONTROL DEVICES

Southern Company Services, Inc. – *Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler.* Long-term testing of the advanced overfire air (AOFA), low-NO_x burners (LNB), and combined LNB+AOFA systems are complete. Final testing of GNOCIS is complete. Phase 4 has been extended 19 months to evaluate additional equipment for NO_x control and to demonstrate on-line optimization techniques. (Coosa, GA)

New York State Electric & Gas – *Milliken Clean Coal Technology Demonstration Project.* The Final Report was reviewed and published. (Lansing, NY)

New York State Electric & Gas – *Micronized Coal Reburning Demonstration for NO_x Control.* All testing has been completed at the Kodak site in Rochester, New York. The goals and objectives for the site have been met or exceeded. The system will remain in operation, allowing Kodak to effectively reduce NO_x in accordance with its agreement with the State of New York. The Final Report was reviewed and published. (Ithaca, NY) (Lansing, NY and Rochester, NY)

NOXSO Corporation – *Commercial Demonstration of the NOXSO SO₂/NO_x Removal Flue Gas Cleanup System.* Project was unable to restructure, and the Cooperative Agreement was rejected by the Bankruptcy Court.

ADVANCED ELECTRIC POWER GENERATION

City of Lakeland, Department of Water & Electric Utilities – *McIntosh Unit 4A PCFB Demonstration Project and McIntosh Unit 4B Topped PCFB Demonstration Project.* Lakeland Electric is re-evaluating its options to meet future power demand. (Lakeland, FL)

JEA – *ACFB Demonstration Project.* In September 1997, DOE signed an agreement with JEA to cost-share refurbishment of the first (Unit 2) of two units at the Northside Generating Station. Unit 2 is scheduled for operation in early 2002, to be followed by two years of demonstration. (Jacksonville, FL)

Kentucky Pioneer Energy, L.L.C. – *Kentucky Pioneer Energy Project.* Kentucky Pioneer Energy, L.L.C. has replaced the Clean Energy Partners, LP as the project participant and has moved the site to a new location in Trapp, Kentucky. NEPA activities are in progress. (Trapp, KY)

Sierra Pacific Power Co. – *Piñon Pine IGCC Power Project.* In the fourth quarter of 1999, Sierra Pacific made improvements to the filter fines collection system, and added eight more filters to the pressurization line into the filter fines depressurization hopper, bringing the number of filters in that line to 10. The additional filters were necessary to reduce the space velocity on each filter element — an important step to prevent blinding during depressurization. Sierra has been testing the system that withdraws LASH (limestone and ash) from the gasifier. When checkout of the LASH removal system is complete, Sierra will begin to restart the plant. The project will end January 1, 2001, or when Sierra sells the Piñon Pine facility, whichever comes first. Selling all generating facilities is a condition of Sierra's July merger with Nevada Power. Sierra continues to operate the plant normally in the gas combined-cycle mode. (Reno, NV)

Tampa Electric Co. – *Tampa Electric Integrated Gasification Combined-Cycle Project.* Tampa's Polk Power Station has completed three years of successful commercial operation. The gasifier has operated 17,500 hours, and the combustion turbine has operated 19,500 hours producing over 6,500 MWh. The gasifier has operated for a record 83 percent on line for the past 6 months. (Mulberry, FL)

Wabash River Joint Venture – *Wabash River Coal Gasification Repowering Project.* In response to a request from the Participant, DOE approved the sale of the Wabash River IGCC facility and the Destec/Dynegy gasification technology to Global Energy. As a result, on December 27, 1999, the Participant provided \$550,000 repayment to DOE — nominally \$300,000 on the facility sale and \$250,000 on the technology sale. Global Energy will promote commercialization of the technology and make repayments on future equipment sales or licenses for a 20-year period. The Wabash River Cooperative Agreement expired on January 1, 2000. Most of the 1999 calendar year operating statistics

have now been reported. The extended turbine outage from March to June 1999 adversely affected the 1999 operating statistics; however, the facility was able to set another quarterly production record of 2.7×10^{12} Btu of syngas in 1999. From startup in 1995 through the 1999 operating year, the facility has produced 6.4×10^{12} lbs of steam burning 23.9×10^{12} Btu of specification syngas. The time on coal was 15,067 hours, and 1,550,061 tons of coal were processed. (West Terre Haute, IN)

Alaska Industrial Development and Export Authority – *Healy Clean Coal Project.* A 90-day commercial operation test was completed on November 15, 1999. Demonstration operation under the Cooperative Agreement was completed in December 1999, and final reporting is under way. Under the terms of the Power Sales Agreement (PSA) between the Alaska Industrial Development & Export Authority (AIDEA) and host utility, Golden Valley Electric Association, Inc. (GVEA), the plant was to operate at not less than 50 MW (net) of station service, at a capacity factor of not less than 85 percent for a period of 90 consecutive days. The plant exceeded these requirements. Equipment inspections were completed in December 1999. Test results would not support a commercial operation acceptance determination. Based on the findings by the independent engineer who witnessed the test for the purpose of commercial operation acceptance, GVEA did not accept the plant for commercial operation and stated that the PSA was terminated. Both AIDEA and GVEA contested the determination. Subsequently, on March 8, 2000, AIDEA and GVEA reached a settlement. Under the settlement agreement, AIDEA will turn the plant over to GVEA, who will pursue retrofitting the plant to conventional combustor technology. (Healy, AK)

Arthur D. Little, Inc. – *Clean Coal Diesel Project.* Preparatory work is under way prior to preliminary performance checkout of the diesel engine. Fuel oil will be used instead of coal slurry to ensure that the diesel engine is in running condition and support systems are operating properly. Preliminary performance checkout should begin by summer of 2000. Upon completion, work will begin to modify the engine so it can operate on coal slurry. (Fairbanks, AK)

COAL PROCESSING FOR CLEAN FUELS

Custom Coals International – Self Scrubbing Coal™: An Integrated Approach to Clean Air. The project has completed close-out procedures and is no longer active. (Central City, PA; Martin Creek, PA; Richmond, IN; Ashtabula, OH)

Western SynCoal LLC (formerly Rosebud SynCoal® Partnership) – Advanced Coal Conversion Process (ACCP) Demonstration. Rosebud SynCoal Partnership has been reorganized and merged into a new entity, Western SynCoal LLC. The ACCP Demonstration Project in Colstrip, Montana has processed over 2.3 million tons of raw sub-bituminous coal. Over 1.6 million tons has been supplied to customers, including industries (primarily cement and lime plants) and utilities. The first year of testing the supplemental fuel system at Colstrip Unit 2 has been completed. The system has been performing well. Colstrip Unit 2 has experienced significant benefits in improved heat rate, reduced auxiliary load, and reduced slag related limitations. Work is on-going to learn how to optimize the application of supplemental fuel use. (Colstrip, MT)

Air Products Liquid Phase Conversion Company, L.P. – Liquid Phase Methanol Process Demonstration Project. The Liquid Phase Methanol (LPMEOH™) Process Demonstration Facility continues to experience stable operation on coal-derived synthesis gas. On-line withdrawals of spent catalyst and additions of fresh catalyst slurry have remained successful in adjusting methanol production rates. Since being restarted with fresh catalyst in December 1997, the demonstration facility has operated at greater than 99 percent availability, and since April 1997, has produced over 51 million gallons of methanol, all of which was accepted by Eastman Chemical Company for use in downstream chemical processes. The monitoring of all potential catalyst poisons, and methods for their removal and control continue to be an important part of the on-going plant operation. (Kingsport, TN)

INDUSTRIAL APPLICATIONS

Bethlehem Steel Corporation - Blast Furnace Granulated Coal Injection System Project. All testing has been completed. The Final Report has been submitted, accepted by

DOE personnel, and is available to the public. Tests clearly demonstrated that granular coal injection can be used on a large blast furnace with good results. In addition, the furnace operation shows that low volatile coal replaces more coke than does lower-carbon-content, high volatile coal. The high volatile coal required 31.4 kWh/ton to pulverize and only 19.6 kWh/ton to granulate. Providing granulated coal instead of pulverized coal reduces the cost of power for size reduction. (Burns Harbor, IN)

CPICOR Management Company, L.L.C. – Clean Power From Integrated Coal/Ore Reduction. DOE has continued its environmental analysis for preparing an Environmental Impact Statement for this project. The CPICOR Management Company (CMC) continues to perform baseline environmental monitoring and preliminary engineering and design in support of the NEPA process. CMC also continues to work closely with the Australian developers of the HIs melt® Process to establish a process and mechanical design database for this project. This project will be designed to produce 3,300 tons per day of liquid iron and approximately 160 MWe from the by-product gases. (Vineyard, UT)

ThermoChem, Inc. – Pulsed Combustor Design Qualification Test. Foundations have been poured and installation of the steam reformer 253-tube pulsed combustor test vessel and structure is in progress. Installation is scheduled for completion in June 2000. Testing will be conducted during June and July 2000. The Process Data Unit, using Black Thunder, Wyoming subbituminous coal, is expected to be completed during April and May 2000. (Baltimore, MD)



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