



CLEAN COAL TODAY

A NEWSLETTER ABOUT INNOVATIVE TECHNOLOGIES FOR COAL UTILIZATION

PROJECT NEWS BYTES

A public environmental scoping meeting was held on July 15, 1999, on the proposed **Clean Power from Integrated Coal/Ore Reduction (CPICOR)** Clean Coal Technology Demonstration Project. The Department of Energy issued a Notice of Intent (NOI) to Prepare an Environmental Impact Statement (EIS) for the CPICOR Project, which would be located within Geneva Steel Company's existing plant at Vineyard, Utah. The technology will demonstrate integration of the High Intensity Smelting (HISMELT®) direct, coke-free, ironmaking process with technology to generate electricity using steam heated by combustion offgas. An existing blast furnace

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ENERGY SECRETARY ISSUES CARBON SEQUESTRATION CHALLENGE

Energy Secretary Bill Richardson issued a challenge to the attendees of the Seventh Clean Coal Technology Conference to expand the future options for coal use by developing carbon sequestration technologies on a global basis. Leading up to this challenge, Richardson reflected on the history and success of the Clean Coal Technology (CCT) Demonstration Program, which is, by all accounts, the most successful government/industry technology development and demonstration partnership.



Energy Secretary, Bill Richardson, addressing conference attendees after the site tour in Kingsport, Tennessee.

The challenge for the CCT Program was to develop and demonstrate new ways to control pollutants at existing and new power plants more reliably and at lower costs; to generate new ways to produce cleaner fuels; and to create new ways to generate electricity that incorporate entirely new, more efficient, and cleaner concepts.

Richardson recapped how those at the conference, the nation as a whole, and the international community have invested heavily in these CCTs. This effort has led to important improvements. For example, Richardson noted that in the 1980s, NO_x removal cost almost \$3,000 per ton removed, compared with only \$200 per ton today. The CCT Program also is responsible for developing entirely new options for turning coal into gas, which is then used to generate electricity "in ways to achieve unprecedented environmental cleanliness." Citing these technologies as a "preview of the future," Richardson stated that "in my opinion, the future is as bright for coal as it is for any energy resource . . . if we continue our commitment to technology."

According to Richardson, coal's potential will only be achieved "if the technology is developed to make coal an environmental fuel-of-choice." He stated his belief that the tools exist to make this happen, and underscored DOE's commitment to coal's future.

Richardson compared the regional acid rain challenge of the 1980s to today's challenge of greenhouse gas emission control, citing global climate change as a challenge similar in concept but far broader in scope. He noted

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that the two predominant options for reducing greenhouse gas emissions have been to use energy more efficiently and to increase the use of low-carbon and carbon-free fuels.

In addition, Richardson stressed a third option to the U.S. climate change strategy, namely developing new coal-based technologies and new ways to capture and control the release of carbon. He cited the Vision 21 concept, to develop virtually pollution-free, coal-fired power plants within the next 15 years. These plants will produce no air pollutants and no landfill wastes, and will double the amount of electricity that currently is extracted from coal, while simultaneously producing commercial by-products. Richardson noted that DOE has increased the Vision 21 R&D budget to \$29 million in Fiscal Year 2000.

With respect to Vision 21, Richardson noted that it “starts us down the final path of making coal part of tomorrow’s solution. But it

doesn’t get us all the way there.” He cited carbon sequestration as the ultimate technology, which will offer the means to “achieve truly massive reductions in carbon levels at relatively low costs.” To this end, DOE is supporting R&D and is coordinating efforts with the Departments of Interior and Agriculture as well as with the Environmental Protection Agency and others. Richardson noted that sequestration offers a major advantage over other climate change options in that it “does not require wholesale changes in the world’s energy infrastructure.” Richardson reminded attendees that the world’s infrastructure, largely based on fossil fuels, works at relatively low cost, and uses low-cost and globally abundant fossil fuels. This infrastructure “represents a huge capital investment — an architecture that will not be discarded overnight. With carbon sequestration, it won’t have to.”

In Richardson’s estimation, “[s]equestration could be the single most important factor in the truly long-range future of coal and, in

fact, for all of fossil fuels. It makes coal part of the energy answer, rather than part of the environmental problem.”

Again reflecting on the CCT Program, Richardson noted that “we are on the drawing board with respect to carbon sequestration just as we were 20 years ago with clean coal technologies.” He called for cooperation with industry and academia as DOE develops a long-range program of sequestration research partnerships on a global basis. Richardson looks forward to encouraging teaming between U.S. government, industry, and academia “that extends across international borders.”

...News Bytes continued

would eventually be displaced. A Record of Decision whether to provide cost-shared funding for the project – the final step in the National Environmental Policy Act process – is expected late next year.

The **Alaska Industrial Development and Export Authority (AIDEA)** and Golden Valley Electric Association, Inc. (GVEA) received a word of thanks at a July 21, 1999, community meeting in Healy. The gathering was a followup meeting with the community to ensure that the mitigation efforts taken to lower the noise level created by the Healy Clean Coal Project (HCCP) were successful. In the spring of

1998, soon after the start-up of the HCCP, AIDEA received complaints about noise created by the plant. AIDEA quickly hired an acoustics engineer who recommended purchase of an induct fan silencer. As a result, noise levels were reduced by 11 decibels, a nearly 50 percent reduction.

A draft Environmental Impact Statement for the **Jacksonville Electric Authority Large-Scale Atmospheric Fluidized Bed Demonstration Project** was released to the public on August 25. A 45-day public comment period ensues. A public hearing was cancelled due to a threatened hurricane, but is to be rescheduled.



CLEAN COAL TECHNOLOGY IN THE NEXT MILLENNIUM

Over 230 people from 12 countries gathered in Knoxville, Tennessee for the Seventh Clean Coal Technology Conference. The conference, with the theme of "21st Century Coal Utilization: Prospects for Economic Viability, Global Prosperity and a Cleaner Environment," was held June 21–24, 1999. Cosponsors included The Center for Energy & Economic Development, the National Mining Association (NMA), the Electric Power Research Institute, the Council of Industrial Boiler Owners, and the U.S. Department of Energy (DOE). Air Products and Chemicals, Inc. and the Eastman Chemical Company hosted the conference and a site visit to the Liquid Phase Methanol project they are sponsoring at the Eastman Chemical Company facility in Kingsport, Tennessee.

DOE Assistant Secretary for Fossil Energy, Robert W. Gee, provided opening remarks, reflecting on how far coal technologies have come and the promise for the future. Gee noted that progress in power system technology has far surpassed projections made in the 1970s, when only magnetohydrodynamics was expected to approach 50 percent efficiency. Now gasification, fluidized-bed combustion, and advanced gas turbine technologies provide a clear path to the 50 percent efficiency threshold. Moreover, only 20 years ago, environmental control was more art than science. Through Clean Coal Technology (CCT) Program advances in science-based gas cleanup technology, more than \$40 billion in utility compliance costs have been saved.

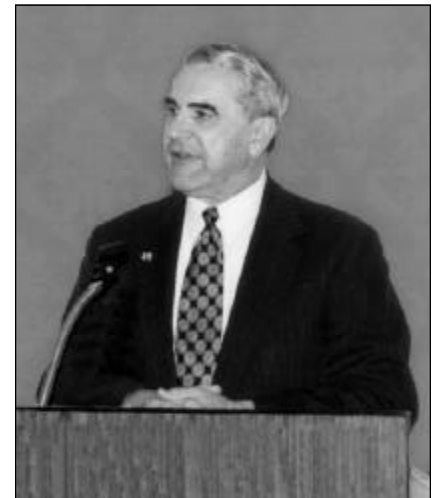
General Richard L. Lawson, President of the NMA, and Dr. E. Linn Draper, Jr., Chairman, President & CEO of American Electric Power provided a coal industry and utility perspective to the keynote session. Lawson saw performance as the key to countering public policy unfavorable to coal and emphasized that, as a result of coal, the United States has lower energy costs than any other industrialized nation. Draper emphasized the need to preserve fuel diversity, which could be compromised if the public's negative perception of coal leads to public policies limiting coal use.

Despite challenges facing coal, there is growing recognition of the importance of fuel diversity with a place for coal, the potential for carbon sequestration technology to mitigate greenhouse gas emissions, and overseas markets for coal-based generation. Following are some of the conference highlights.

DEPLOYING CCTs

According to an upcoming report by the President's Council of Advisors on Science and Technology (PCAST), there are deficiencies in the process of moving technologies from the demonstration phase to widespread deployment. Despite successful demonstrations under the CCT Program, work remains to move the technologies into the marketplace. The report indicates that a "buydown" phase must ensue, during which the incremental cost between the new technology and conventional technology is covered. During this buydown phase, cost and risk are reduced as the technology is replicated and design and manufacturing methods are refined and standardized. PCAST concludes that a public entity is required to provide the policy and financial support for the buydown.

As to the extent of buydown that might be needed, CCTs currently have efficiencies higher than conventional pulverized coal (PC) units but lower than natural gas combined-cycle (NGCC) units. It was noted that, upon technology maturity, CCT capital costs will be 20–25 percent lower than those for PC, but 50 percent higher than for NGCC. Integrated gasification combined-cycle (IGCC) and pressurized fluidized-bed combustion (PFBC) technologies are cost competitive with PC now, but not NGCC. IGCC and PFBC could be competitive with NGCC in 2010 if fuel prices follow projected trends. However, participants noted that the fuel price differential between coal and natural gas must be greater than \$2.00 per million Btu for the CCTs to be competitive with NGCC.



General Lawson, President of the National Mining Association, a keynote speaker at the CCT conference.

Other barriers to new coal technologies, identified by developers at the conference, include capital risk twice that of NGCC, which also results in higher taxes, insurance, and financing costs. Furthermore, deregulation was said to favor less capital-intensive projects. Longer

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...Clean Coal continued

construction schedules for coal plants result in a slower response to market signals for new capacity and an increased chance of changing environmental regulations. Also, revenue requirements dictate higher capacity factors; and coal faces other risks like climate change regulations and public opposition.

It was observed that, from an environmental perspective, CCTs provide high levels of pollution control and efficiency, but still fall short of NGCC. Carbon sequestration represents a levelizing factor for coal technologies in carbon control, but much work remains to be done.

Panel participants agreed that achieving widespread CCT deployment and the benefits of fuel diversity requires providing financial support to the developer. The preferred financial mechanisms are incentives, rather than grants or subsidies. It was noted that incentives must address higher capital costs, higher operating cost and risk, and start-up risk. These factors can be addressed by investment tax credits, production tax credits, and risk pools, respectively. Such an incentives program would qualify technologies on the basis of increased efficiency over time and would be limited in scope and duration.

GLOBAL COMMUNITY RESPONSIBILITY

The panelists suggested that a global community responsibility exists to put energy resources and the needed advanced technology into the hands of one-third of the world's population currently lacking access to commercial forms of energy. Advanced technology is capable of supporting economic growth without compromising the environment. In addition, population growth

will contribute to an estimated 50 percent increase in global energy consumption over the next two decades. Coal must play a role in meeting energy demand because it is the predominant indigenous resource for many of the developing economies. However, advanced coal technology must overcome hurdles of lower cost alternatives, risk-averse decision makers, the "NIMBY" syndrome, and significant expectations for renewables.

Developing countries will realize a 290 percent growth in energy requirement relative to 1990. The associated financial requirement is an estimated \$5 trillion, which developing countries cannot meet along with other infrastructure needs. Industrialized countries therefore must be willing to share their prosperity in targeted efforts to bring energy to rural impoverished regions of the world. The World Bank was cited as having a number of policies to help bring modern forms of energy to such areas.

According to participants, the commercial debt financing market does not look promising for new coal technologies. The debt financing market expects corporate entities, or governments, to shoulder the risk until such time as the technology reaches commercial maturity. Furthermore, computer decision making models invariably choose gas over coal plants because of lower capital cost and permitting ease. The operating assumption is, therefore, that new generation over the next 15–25 years will be supplied overwhelmingly by simple cycle or combined-cycle gas-fired plants.

However, it was noted that the emergence of pressurized fluidized-bed combustion (PFBC) technology provides opportunities for equipment developers, technology users,

and governments to bring new technologies into the marketplace. PFBC is realizing increasing commercial acceptance. This can be traced to the user industry championing the technology, government cooperation in cost and risk sharing, and the developers commitment to resolve problems as equipment design evolves. Partnering has proven PFBC at 70-MWe scale. Now, technology is moving to the next level of capacity, 360 MWe (Japan's Karita Plant), using the same formula of cooperation. Continued cooperation will be needed to achieve widespread deployment.

COAL IN TOMORROW'S FLEET

Speakers noted that the energy business is changing. In this new energy business environment, research and development is not considered one of the factors driving corporate growth and value generation. The energy trading and marketing function will drive actions in the energy business. Traders think in primarily financial and commodity market terms, which includes conducting daily assessments of "value at risk" and viewing generating assets as "real options."

The growing use of options analysis for corporate decision-making, or "real options," represents a decision-making revolution, according to *Business Week*. R&D investments and technologies are considered "real options" because investment today can generate the possibility of new opportunities tomorrow. Also, technologies such as clean non-gas fossil fuel systems are options that can be hedged against future price risk and price volatility. As an example, a plant that could produce syngas from coal or other low-cost fuel at a price of \$4.00 per

million Btu (not competitive in today's market) theoretically has value today as a hedge against natural gas exposure in the future. Values could be \$500–750/kWe, based on 15 years' sales projections and the degree of fuel price volatility. The question then becomes whether the syngas plant can be built for \$500–750/kWe.

Between 1950 and 2050, estimates are that global population will quadruple and urbanization will happen even faster. Electricity is believed to be key to sustainable growth in productivity, agriculture, fresh water, and emission reduction, with the potential to reduce primary energy consumption 25 percent by 2050. Decarbonization leading to an electricity/hydrogen energy system is considered achievable, but requires an innovative portfolio of generation options. Carbon intensity of world primary power has steadily declined from 1900 to present, largely due to electrification. To continue the trend, a tripling of world generat-

ing capacity, or 10,000 GW, is needed by 2050.

Industry representatives identified several targets for coal-based generation technologies by 2020 along with several cross-cutting enabling technologies. The targets are capital costs of \$800/kW, efficiencies of 50–60 percent, SO₂ removal of 99 percent, NO_x emissions of .05 lb per million Btu, and 100 percent waste utilization. The enabling technologies to reach these targets are high temperature/high pressure filters, advanced combustion turbines, high temperature steam cycle materials, and hazardous air pollutant controls. With these capabilities, coal can account for 20 percent of primary energy in a balanced 2050 portfolio.

One option presented to address many of these issues was the Vision-21 "powerplex." Carbon capture and sequestration offer an opportunity to remove the single greatest concern over continued reliance on fossil fuels — global cli-

mate change from greenhouse gas emissions. In addressing CO₂ capture costs, analysts selected three representative power generation technologies. Their analysis showed that the incremental cost of electricity for CO₂ capture today is 1.1–1.7 cents/kWh for IGCC; 1.9–2.1 cents/kWh for NGCC; and 2.3–3.1 cents/kWh for PC. This suggests that coal-based IGCC could compete with natural gas in a greenhouse gas emission-constrained world. The potential to reduce these costs is great, by either improving thermal efficiency of the basic plant or reducing the energy requirement for CO₂ capture, such as improving separation technologies.

Technical sessions provided updates on the active CCT projects, as well as updates on R&D needs and technology opportunities. For the complete CCT Conference Proceedings, please contact Faith Cline at faith.cline@hq.doe.gov or (202) 586-7920.

COMPLETED CCT PROJECTS SUMMARIZED IN NEW PUBLICATIONS

A new series of reports is being issued providing definitive summaries of completed Clean Coal Technology (CCT) projects, with an emphasis on results. These *Project Performance Summary* documents, generally 12 pages in length, rely primarily on the Final Technical Reports issued by the project sponsor, but include information from other publicly available sources as well.

The *Project Performance Summary* documents first place the project in a programmatic context, describe the project and its genesis, define the technology and unique features, and provide a brief summary of key results. The balance of the document presents operational, environmental, and economic performance data in the context of test conditions and key parameters affecting performance. Also addressed are potential commercial applications and those parameters that have particular impact on site-specific applications. Included at the end is a bibliography of key reference material for those wishing to obtain more detailed information.

To date, *Project Performance Summary* documents have been prepared for the following projects: 180-MWe Demonstration of Advanced Tangentially Fired Combustion Techniques for the Reduction of NO_x Emissions; Demonstration of Coal Reburning for Cyclone Boiler NO_x Control; Nucla ACFB Demonstration Project; Tidd PFBC Demonstration Project; ABB Environmental Systems SNOX™ Flue Gas Cleaning Demonstration Project; Full-Scale Demonstration of Low-NO_x Cell Burner^R Retrofit; Cement Kiln Flue Gas Recovery Scrubber™; Advanced Flue Gas Desulfurization Demonstration Project; 10-MWe Demonstration of Gas Suspension Absorption; and SO_x-NO_x-Rox Box™ Gas Cleanup Demonstration

The documents are available on the CCT Compendium (www.lanl.gov/projects/cctc). For information on the Project Performance Summary documents, please contact Gene Kight (FE-20) at gene.kight@hq.doe.gov or (301) 903-2624.

INTERNATIONAL INITIATIVES

U.S./TURKEY CONFERENCE HIGHLIGHTS FOSSIL ENERGY

DOE was among the sponsors of the highly successful conference, "Prospects for Cleaner Fossil Fuels Systems in Sustainable Development: Communicating Their Strategic Value in the Euro-Asian Region," held in Ankara, Turkey in May. Other conference sponsors included the World Energy Council (WEC), as well as the WEC Turkish National Committee and the Regional Working Group for Cooperation in the Field of Energy, the U.S. Agency for International Development, and the U.S. Energy Association.

The highlight of the conference was the appearance of the President of Turkey, Suleyman Demirel. In his remarks, the President emphasized the role of Turkey as a major energy distribution point as well as energy consumer. Turkey's average energy demand is predicted to grow 8-10 percent per year through 2010. A \$280 billion investment program is planned for the energy sector over the next 30 years.

While the most timely energy issue is planned commencement of the Baku-Ceyhan oil pipeline and the Trans-Caspian natural gas pipeline, Turkish energy officials highlighted the importance of coal. Turkey has 8 billion tons of lignite (brown coal) reserves as well as some "hard" coal. Sixty percent of coal produced is used for generating electricity, with the remainder going for industry and household use. By 2020, lignite and hard coal are expected to represent 20 percent of installed capacity.



Senior U.S., Turkish, and World Energy Council (WEC) energy officials meet in Ankara, Turkey to discuss regional energy issues.



Barbara N. McKee, Director of FE's Office of Import & Export, and Robert W. Gee, FE Assistant Secretary, address WEC conference attendees.

DOE's Office of Fossil Energy (FE) showed a strong presence at the conference, with Barbara McKee, Director of the Office of Coal and Power Systems (OC&PS) Import & Export serving as President of the first day's session. Robert W. Gee, FE Assistant Secretary, Keynote Speaker, spoke of technology as a link between a more prosperous economic future and a cleaner environment, and discussed the benefits of carbon sequestration. Vic Der, Director of OC&PS Power Systems, emphasized that nearly half the world's projected energy increase is seen to occur in developing Asia, and discussed the need for investment in power generation platforms to meet this demand.

Turkey has a number of coal-fired power plants and low-grade coal resources. The efficiency of power plants was discussed as well as the potential for public/private power partnerships. A spokesman for GE indicated that European IGCCs, fueled by coal as well as other fuels, are performing well, and saw a growth in IGCC over the next few years. Coal provides over 50 percent of electricity production in Germany, and 97 percent in Poland. For China and India, the figure is 70 percent.

Privatization was seen by conference participants to be of key importance. Dr. Klaus Brendow of the WEC saw market-oriented restructuring as a main condition to clean coal technology deployment. Such a restructuring may be able to surmount the barriers of poor coal quality. Prior to the conference, the FE delegation and private sector representatives met with representatives of the Turkish energy sector who asked for U.S. technical advice in the privatization process. As a result of the meeting, FE will draft an Energy Science and Technology Agreement to formalize the effort. At the meetings, Turkish officials also expressed interest in U.S. mining technology and the possibility of information exchanges.

FE VISITS RUSSIA ON INFORMATION EXCHANGE MISSION

During June, a delegation from DOE's Fossil Energy and International Affairs visited Moscow, Russian Federation, for technology information exchange with Russian organizations concerned with coal, coal technology, and power production. Specific discussions were directed toward the use of clean and efficient coal technologies as a component of environmental protection; new technologies and equipment to improve combustion efficiency in thermal power plants; advanced gas turbines and gasification combined cycle technologies; and working toward a common understanding of the present and future strategic value of fossil fuels for electric power and fuels production in Russia and in the U.S.

Russian organizations visited included: the Fossil Fuels Institute of the Ministry for Fuel and Energy of Russia; the All-Russian Thermal Engineering Institute; the Office of the Deputy Minister, Ministry of Fuel and Energy of Russia; the Moscow Center for Energy Efficiency, and the Committee of Coal Industry of the Russian Federation. As a result of the visit, a number of areas for cooperation were identified that could be of potential mutual benefit. It was agreed that DOE would initiate preparation of a draft Annex under the existing bilateral Science and Technology Agreement, specific to the development and utilization of clean and efficient fossil fuels, that will identify and institutionalize cooperation between the DOE and Russian counterpart governmental organizations.

RECENT FE INITIATIVES IN INDIA

With funding from the U.S. Agency for International Development (USAID), and in conjunction with Tennessee Valley Authority (TVA) and the Electric Power Research Institute (EPRI), the Office of Fossil Energy (FE) is preparing to support the efficiency improvement testing aimed at greenhouse gas reduction at the 210-MW Unit No. 7 of the Maharashtra State Electricity Board's coal-fired Koradi Power Plant in India. Such baseline testing determines performance of key parameters — air/fuel ratio, power required by auxiliary systems at the plant, and performance of the steam turbine, condensor, and coal mills. While the plant is operating, equipment is monitored and compared by a computer program to design data taking into account age and condition of the equipment. The program recommends setting adjustments to bring the equipment up to its most efficient performance.

A "walk-down" was scheduled to assess the amount of work that needs to be completed during the maintenance outage of the Koradi Unit No. 7. Testing is scheduled to start in November with TVA and FE personnel present in an oversight role. The plant personnel have formed "performance optimization groups" dedicated to key components. Equipment is being ordered to duplicate efficiency improvement testing on other units. The U.S. efficiency improvement methodology appears to have gained acceptance following testing at several coal-fired power plants in India, including plants of the National Thermal Power Corporation, which generates one-quarter of India's total power.

In another effort, FE, along with USAID support, sent an electrostatic precipitator (ESP) specialist to India to determine the effectiveness of "sodium conditioning" on ESP performance, given the high ash loading conditions experienced at Indian coal-fired power plants. With a very simple test setup, approximately 0.25 percent by weight of sodium was added to the coal being fed to one of the four 67-MW units at a power plant in Korba, India. The results were outstanding. The normal stack particulate loading of 340 milligrams per standard cubic meter (a very dirty looking stack plume) was reduced to 60 milligrams per standard cubic meter, which is an essentially clean stack to the naked eye. The sodium material used is considered a waste product and the primary cost was shipping; thus the addition to the cost-of-electricity was less than one-half of one cent.



Power plant in Korba, India

ROSEBUD RECRUITS CUSTOMERS FOR UPGRADED COALS



ACCP Raw Coal Handling System (in foreground).

of SynCoal® while supplying six long-term customers and conducting substantial commercial development studies.

The ACCP being demonstrated in Colstrip, Montana consists of thermal processing coupled with physical cleaning to upgrade high-moisture, low-rank coals, producing a fuel with improved heating value, ash slugging potential, and low sulfur content. The process and product, patented as SynCoal®, has been developed by the Rosebud SynCoal Partnership. Western SynCoal Company, a subsidiary of Montana Power Company's Energy Supply Division, is the managing general partner.

The Cooperative Agreement with DOE for the ACCP demonstration facility was signed in September 1990 with an anticipated 66-month duration.



ACCP storage silos.

crushing and unit-train loadout facility and benefits from the existing mine and community infrastructure. The production unit, having a capacity of approximately 1,000 tons per day of upgraded coal, is one-tenth the size of a commercial facility.

From initial startup in March 1992 through June 1999, over 2.1 million tons of raw coal has been processed and over 1.4 million tons of SynCoal® has been produced. Nearly all of the SynCoal® products have been sold and shipped to a variety of utility and industrial customers. The plant has consistently operated at its design 68 ton-per-hour feed rate and 75 percent target

Through hard work, teamwork, and flexibility, Rosebud SynCoal Partnership has demonstrated that upgrading low rank coals can be commercially successful. Since the 1992 initial startup of the Advanced Coal Conversion Process (ACCP) Demonstration, co-sponsored by the U.S. Department of Energy (DOE) Clean Coal Technology (CCT) Program, the ACCP Demonstration has successfully produced and sold 1.4 million tons

The project schedule has been extended three times, in order to exploit development opportunities resulting from successful demonstration. The currently expected completion date is June 2001.

The ACCP facility is located within one of the largest coal mines in the nation — Western Energy Company's Rosebud Mine at Colstrip. The plant is integrated within the existing coal

availability. The product produced and delivered to customers has the following typical characteristics:

- Moisture..... 2.49%
- Ash..... 10.85%
- Sulfur..... 0.76%
- Btu/lb..... 11,761

Rosebud SynCoal sells about half of its production to five industrial customers. The remaining production is sold to Colstrip Unit 2 as a supplemental fuel.

COLSTRIP UNIT 2

The close proximity of the Colstrip Generating Station has made it a logical customer for SynCoal®. Until December 1997, the 490,000 tons of SynCoal® supplied to the four units was blended with raw coal and fed into the plants through the conventional coal handling systems. The dusty, self-heating nature of the SynCoal® led to consideration of an alternative delivery system. A mill explosion and subsequent fire (not directly related to SynCoal® use) in December 1997 caused a unit outage, and the parties then committed the project to a specialized SynCoal® handling system at Unit 2 which began operation in February 1999. The new receiving and feed system delivers the SynCoal® directly to three of the unit's five pulverizers and effectively blends the SynCoal® with the raw coal, providing close to instantaneous control of the blend and firing elevation within the boiler.

Results through June have shown a nearly continuous improvement in operation of Unit 2 compared to the identical Unit 1, which does not use SynCoal®. Heat rate improvements, auxiliary load reductions, and decreased slag related deratings have been noted. The successful demonstration at Colstrip provides a showcase platform from which to commercialize the technology and

address the challenges facing the low rank coal industry worldwide.

ASH GROVE CEMENT

One of the initial customers was Ash Grove Cement Company of Montana City, Montana, which used SynCoal® for its direct fired kiln. Ash Grove switched from natural gas to SynCoal® in January 1994 and has taken regular shipments ever since, over 204,000 tons through June 1999. Ash Grove and other cement manufacturers find the biggest benefits from SynCoal® to be high Btu values, along with low sulfur and moisture. This has resulted in greater production rates, higher production quality, and lower fuel transportation costs.

SynCoal® is shipped to Ash Grove's facility Montana City in covered hopper railcars, and unloaded by gravity into a dense phase pneumatic conveying system which transfers the product to a 600-ton storage silo. The storage system was originally a cement unloading facility and was modified to accommodate the SynCoal®. The SynCoal® is blended with petroleum coke at the throat of the pulverizer to take advantage of the ultra low-cost petroleum coke. The high volatile characteristic of the SynCoal® allows the petroleum coke to be used more effectively.

CONTINENTAL LIME INC.

Continental Lime Inc. has been using SynCoal® off and on since 1994, in addition to western U.S. subbituminous coal. Through June 1999, Continental had purchased over 53,000 tons of SynCoal® product. The company owns and operates the Indian Creek plant located near Townsend, Montana. Lime is produced in two pre-heated kilns, fired by a SynCoal®/petroleum coke blend, with lime sizing and storage at the plant site to supply a full range

of bulk quick lime products. Lime production capacity is approximately 1,000 tons per day or over 300,000 tons per year. A hydration plant was completed several years ago, capable of producing 300 tons of hydrated lime per day.

Continental conducted test burns with SynCoal® from April 1994 to January 1995. Handling issues required plant and delivery system modifications. A pneumatic receiving and inerted storage system was completed in February 1998, and Continental resumed SynCoal® use with delivery by pneumatic truck.

WYOMING LIME PRODUCERS

Wyoming Lime conducted its first test burn of 90 tons in November 1993 and made handling modifications, converting receiving to pneumatic off-load, establishing separate storage facilities for SynCoal®, and improving transfer from storage to burner. The company began taking regular deliveries in September 1995 and to date they have purchased over 55,600 tons. The plant produces approximately 150,000 tons per year of quick lime for use primarily in the electric utility industry. The SynCoal® is used in conjunction with sub-bituminous coal in their direct-fired kiln for calcining the limestone to make pebble quick lime. Company officials state that use of SynCoal® is largely responsible for the plant's continuous record run of 220 days.

HOLNAM INC.

Holnam test burned SynCoal® at its Trident Cement plant in Trident, Montana from November 1994 to February 1995 with very good results. However, at that time SynCoal® could not compete with contracted natural gas prices. During February and March 1999, Holnam again tested the fuel, and began to receive

regular deliveries this May. Several modifications are being made to coal handling facilities, including the addition of a dilute phase pneumatic truck unloading system, modifications to the storage silo discharge gates, the addition of an inert gas system, using nitrogen to prevent spontaneous combustion. To date, over 15,000 tons of SynCoal® has been delivered.

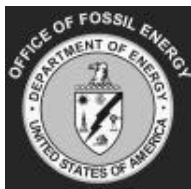
BENTONITE PERFORMANCE MINERALS

Bentonite Performance Minerals, part of Halliburton, exemplifies a unique use of SynCoal® as a chemical additive at its bentonite mine and processing facility in Colony, Wyoming. Bentonite is processed and mixed with ground SynCoal® during the manufacture of mineral binder systems for the cast metals industry.

SynCoal® provides a source of volatiles and fixed carbon that helps produce a smoother casting finish and improves release of the casting from sand molds. While the use of carbonaceous products is not new to the cast metals industry, the use of SynCoal® is relatively new to the industry. As a manufactured coal product, it offers uniform moisture content and other physical and chemical properties that are more difficult to control in normal run-of-mine coal products. Bentonite has taken over 62,000 tons of SynCoal® product since 1993.

Through successful demonstrations at a variety of commercial sites, the SynCoal® team is positioned to continue answering the challenges yet to be faced as it continues operations into the next century.

FOSSIL ENERGY ROLE IN DEREGULATION



As part of a continuing dialogue with industry, FE policymakers and technical personnel heard from a panel of representatives in June from the utility, trading, and distributed generation sectors regarding electricity deregulation and its effect on fossil generating technologies. Participants thought that FE R&D programs should be cognizant of the financial payoffs for flexibility and short response times dictated by deregulation. FE is interested in understanding market forces as they may affect technology needs, in order to help determine its R&D focus.

Setting the stage for the discussion, Assistant Secretary for Fossil Energy Robert W. Gee noted three phenomena occurring in the utility sector that will have an impact on technology choice: vertical deintegration of formerly integrated utilities into separate businesses for generation, transmission, and distribution; emergence of new "merchant" plants; and "convergence" of utilities into other business lines such as chemical production and telecommunications.

Representatives of FE received feedback on important issues and trends in a deregulated environment, such as the growth and institutionalization of various trading practices. A spokesman for the utility planning and marketing sector emphasized that, as a result of the establishment of large, liquid wholesale (and in some states, retail) markets for electricity, in which the price of electricity can vary by an order of magnitude or more between low usage and high usage days, the price of electricity is now six times more volatile than that of crude oil. The wholesale utility sector is using market mechanisms common in the commodities market to not only purchase and sell power, but also to hedge risks. These financial instruments include not just standardized contracts, but also options, spot sales, and futures contracts.

The government perspective continues to veer from the private sector approach as it focuses on long-term goals, such as climate change, rather than the private sector's increasingly short term horizon, driven by a need to show short-term payoffs from R&D. Both increased volatility and increased risk under deregulation have resulted in a record number of mergers in the electricity sector, and across fuel lines.

When asked about incentives for getting advanced technologies into place, a representative from the trading sector said that the government should consider the value of R&D from a trading perspective now, rather than from an anticipated payoff 15 years in the future. He noted that less advanced, "lower tech" technologies have greater trading value now. While longer term R&D is valuable, it may not result in any payoff. He acknowledged that if the goal of the long term R&D is in part to develop means to reduce pollution, where the costs of the pollution aren't currently reflected in costs, then the definition of "payoff" would also change.

FE representatives emphasized that the Vision 21 option would offer technology options to help shape the marketplace, not predict it. However, they indicated there may be advantages to looking at technologies not just as power choices but as traders options in the future.

State environmental regulation was also cited as a significant driver in a deregulated environment. A representative from the distributed generation sector attributed fuel cell development in California to the State's strict emissions standards. He argued that the portfolio standards to promote renewable energy, which have been adopted by some states under deregulation, are a legitimate way to achieve public policy objectives. These rules simply become a condition of doing business and are not retrogressive or onerous.

Another representative of the distributed generation sector saw value in government R&D to reduce the costs of electrolysis to produce hydrogen. This method can be used locally, with inexpensive off-peak electricity and averts the necessity of hydrogen pipelines, which the public may perceive to be dangerous. The speaker noted that electricity deregulation, by making cheap, off-peak electricity more available, helps reduce the cost of electricity for electrolytic production of hydrogen, thus making it a more likely source of fuel for fuel cells.

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R&D MILESTONES

The Federal Energy Technology Center (FETC) published a critical review of mercury emissions measurement and its control in the June issue of the Journal of the Air and Waste Management Association. The review described potential technologies for mercury emission reduction from utility plants. Recent efforts have focused on either adding some type of sorbent to adsorb the mercury, improving the mercury capture effectiveness of existing pollution control technologies, or using new technology for mercury control. The review also described research performed at FETC, collaborative efforts conducted with the Electric Power Research Institute and Environmental Protection Agency, and research sponsored through various programs managed by FETC. Future research will focus on plant-specific factors affecting mercury emissions. Scale-up of promising mercury control technologies will be necessary before any regulatory decisions can be made based on sound science.

Researchers at FETC have submitted a patent application for a new particulate filter which is modular, less expensive, and more temperature resistant than current rigid ceramic filters. The Concentric Annular Rigid Filter features multiple concentric filter elements with passages for the gas to flow within and among the elements. Concentric design allows for a more compact filter with fewer elements than conventional systems (49 CAR filter elements being equivalent to over 300 conventional candle filter elements). Development of advanced particulate removal is essential to commercialization of such technologies as integrated gasification combined cycle and fluidized bed combustion, as well as the improvement of existing systems of pulverized coal combustion and waste incinerators.

In August, FE selected three companies to lead teams to design an “early entrance co-production plant” – facilities to produce a combination of electricity, heat, fuels, or chemicals. This is the first step toward advanced technology concepts that could lead into near pollution-free “Vision 21” plants. Waste Management and Processors, Inc. of Frackville, Pennsylvania will lead a team to study conversion of coal waste into premium transportation fuels and electricity. Dynegy Power Corporation, of Houston and its team will evaluate producing power and chemicals from a plant fueled with coal and non-coal feedstocks. Two technologies demonstrated under the Clean Coal Program – Dynegy’s gasification being demonstrated at the Wabash project, and Air Products & Chemicals’ Liquid Phase Methanol process – will be employed. The third team, led by Texaco Natural Gas, Inc. of Houston, will provide high quality transportation fuels and electricity from coal and petroleum coke.

Recent studies at FETC to improve the filterability of product Fischer-Tropsch wax from iron catalyst powder have reduced the time required to filter the heavy wax. The Fischer-Tropsch process converts coal, methane, or biomass-derived hydrogen, along with carbon monoxide, into diesel range hydrocarbons and waxes. The waxes are easily hydro-cracked to high cetane-number diesel fuel known to produce extremely low emissions. To improve the strength of the iron catalysts necessary for the reaction, FETC has used alumina in various forms. With the recent studies, the filtering rates of these catalysts have been improved by an order of magnitude compared to commercially prepared “baseline” catalysts. In addition, FETC researchers continue efforts to filter heavy wax as quickly as it is made, in reactor tests with high diesel and wax yields. The results of this work were presented at the 16th North American Meeting of the Catalysis Society on June 1, 1999, in Boston, Massachusetts.

FETC recently awarded \$5 million to EnerTech Environmental, Inc. to demonstrate the SlurryCarb process, a technology that converts municipal sewage sludge and municipal solid waste into clean renewable fuel that can be co-fired with coal. The new fuel, known as E-Fuel, is a low-sulfur fuel supplement that will produce fewer greenhouse gas emissions than coal when burned. Construction of the up to 100-ton/day “process development facility” will cost a total of \$21 million and will occur over a 27-month period. The SlurryCarb™ process uses varied temperature and pressure conditions to convert sewage sludge and solid waste into E-Fuel, while removing elements (e.g., chlorine) that typically form pollutants during combustion. Specifically, the 10-15 WT percent feed slurry is pressurized above the saturated steam pressure to prevent the slurry from boiling, heated to 570-620 °F, and pumped through the SlurryCarb™ reactor to make E-Fuel. E-Fuel can be burned in a variety of power plant designs, from conventional pulverized coal boilers to more advanced fluidized bed combustors. The system can also be used in industrial settings, such as in cement kilns and paper mills.



STATE INITIATIVES



Technology transfer open house of the SNCR facility in Brilliant, Ohio

The Ohio Coal Development Office, in cooperation with American Electric Power (AEP), Buckeye Power, and DOE, hosted 130 people at an open house at AEP's Cardinal Plant in Brilliant, Ohio in August to highlight a new clean coal technology. The \$6 million, large-scale Selective Non-Catalytic Reduction (SNCR) project, developed by Fuel Tech Inc., is the largest SNCR system constructed in the United States. It is being tested on the 600-MW Cardinal Unit 1. According to AEP Senior Engineer Patrick Malone, this project "shows significant promise in its efforts to cost-effectively reduce nitrogen oxide emissions by 30-35 percent." Additional project goals include ammonia slip at

or below five parts per million, minimal balance-of-plant impacts, and determination of the technical and economic feasibility of the process. Potential benefits of the process include low capital and operating costs, and adaptability with other control technologies. The Development Office cited the importance of coal to Ohio's economy, with more than 90 percent of the state's energy derived from state coal reserves, and noted that the open house underscores the state's commitment to discovering cost-effective, environmentally sound methods for burning "this essential resource."

The State of Illinois has included \$22 million in its Fiscal Year 2000 budget supporting the DOE Low Emission Boiler System (LEBS) Project, adding to a previous allocation of \$3 million for the project. The LEBS project, which is estimated to cost a total of \$127 million, features construction of an 86-MWe proof-of concept test facility to be located at the Turrus Coal Mine in Elkhart, Illinois. In addition to state and federal funding, the balance of the project will be supported by private financing. Construction on this Illinois project is anticipated to start soon, and testing is scheduled to be completed in 2002, after which the plant will produce electricity as an independent power producer for local customers.

The Mississippi Department of Economic and Community Development – Energy Division has reported significant progress on construction of the Red Hills Power Project, an eco-industrial park that will operate both pressurized and non-pressurized circulating fluidized bed combustion systems for a 460-MWe plant. Commercial operation of the energy component of this project, which consists of a joint project between Choctaw Generation Limited Partnership, the Mississippi Lignite Mining Company, and Tennessee Valley Authority, is slated for December 1, 2000. The project managers are continuing to recruit tenants for the Red Hills EcoPlex, a combination energy and industrial park, located in Central Choctaw County, Mississippi. The initial tenant is slated to be a state-of-the-art horticultural greenhouse. Other companies that use fly ash to make roofing tiles and artificial lumber are being solicited. The first industrial tenant should be co-located with the power plant before Red Hills goes on line commercially.

The National Conference of State Legislatures (NCSL) is continuing its efforts to provide information on the ever-changing landscape of utility restructuring. NCSL has prepared a series of reports, "Tax Implications of Electric Industry Restructuring," which address a range of related issues including effects of the changing electric industry on state and local taxes. In addition, NCSL's "The Energy Project," funded through grants and cooperative agreements with DOE's Office of Energy Efficiency, the National Renewable Energy Laboratory, the Energy Foundation, the Joyce-Mertz Gilmore Foundation, and the Pew Charitable Trust, offers formal assistance to state legislators on a variety of energy issues including utility regulation.

NEW FOSSIL ENERGY PUBLICATIONS

- **Topical Report 12 – Advanced Technologies for the Control of Sulfur Dioxide Emissions from Coal-Fired Boilers**, June 1999, available through FETC Library, 3610 Collins Ferry Road, Morgantown, WV 26507-0880, or on web at www.fetc.doe.gov (click on "Other Publications" and then "Topical Reports").
- **Topical Report 13 – Technologies for the Combined Control of Sulfur Dioxide and Nitrogen Oxides Emissions from Coal-Fired Boilers**, May 1999, available through FETC Library, 3610 Collins Ferry Road, Morgantown, WV 26507-0880, or on the web at www.fetc.doe.gov (click on "Other Publications" and then "Topical Reports").
- **Topical Report 14 – Reburning Technologies for the Control of Nitrogen Oxides Emissions from Coal-Fired Boilers**, May 1999, available through FETC Library, 3610 Collins Ferry Road, Morgantown, WV 26507-0880, or on the web at www.fetc.doe.gov (click on "Other Publications" and then "Topical Reports").

**October 11-15, 1999 —
Sixteenth Annual Pittsburgh Coal
Conference: Coal – Energy and
the Environment**

Sponsors: University of
Pittsburgh, with participating
organizations including DOE/
FETC

Location: Pittsburgh, Pennsylvania
Contact: Christine M. Zarnich
Phone: (412) 624-7440
E-mail: zarnich@engrng.pitt.edu

**October 27-28, 1999 —
1999 Advanced PFB
Combustion Workshop**

Sponsors: FETC and the City of
Lakeland

Location: Lakeland, Florida
Contact: Kim Yavorsky
Phone: (412) 386-6044
E-mail: yavorsky@fetc.doe.gov

**November 8-10, 1999 —
Advanced Turbine Systems
Annual Program Review**

Sponsor: DOE-FETC
Location: Pittsburgh, Pennsylvania
Contact: Kim Yavorsky
Phone: (412) 386-6044
E-mail: yavorsky@fetc.doe.gov

**February 8-10, 2000 —
International Conference
On Power Plant Operation,
Efficiency & Environmental
Protection**

Location: India Habitat Centre,
New Delhi, India
Sponsors: National Thermal
Power Corporation (NTPC)
and U.S. Agency for
International Development
(USAID), in association with
DOE-FETC, EPRI and TVA
Contact: Gary Staats
Phone: (412) 386-5741
E-mail: staats@fetc.doe.gov

UPCOMING EVENTS



**March 9-11, 2000 —
Coal Prep India 2000,
International Exhibition
and Conference**

Location: Taj Palace Hotel, New
Delhi, India
Sponsors: Coal Age Magazine,
U.S. Agency for International
Development (USAID), Coal
India, Limited, in association
with DOE-FETC
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CCT COMPENDIUM EXPANDS COVERAGE



In the year and a half since the Department of Energy officially launched the Clean Coal Technology Compendium web site, it has grown from about 75 to over 300 documents and web pages relating to the CCT Program and projects. New documents are being added regularly, strengthening the original intent of the site which is “dedicated to making the maximum use of information derived from the CCT Program.”

The web site features the most recently published: CCT Bibliography, CCT Program Update, Clean Coal Today newsletter, CCT Project Fact Sheets, Topical Reports, and Post Project Assessments, and CCT Project Performance Summary reports (see article on page 5). In addition, the site has a completely reorganized, easy to use bibliography. The contact list of DOE and industry participants has been updated, including updated links to industry web sites. Finally, a system has been introduced whereby new data from ongoing projects is added to the web as soon as it is reported to DOE by the industry participant.

The Compendium site managers have added pages and links intended to increase the visibility of available materials. When logging on to <http://www.lanl.gov/projects/cctc> one can check pages such as “What’s New” for a glimpse of news (*Clean Coal Today* newsletter, information on the recent CCT Conference, and latest releases), or “Welcome to the CCT Compendium.” Other pages, such as the CCT Program and CCT Demonstration Projects, provide brief synopses as well as links to the latest publications, including the CCT Program Update and various CCT project Topical Reports. Another expanded feature is a page with “External Links” that provides links to DOE, general coal sites, U.S. organizations, CCT project participants, and international organizations.

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. A Draft Final Report for Phase 4 has been issued. An extension of the project is being negotiated. (Coosa, GA)

New York State Electric & Gas – *Milliken Clean Coal Technology Demonstration Project.* All testing has been completed. The Draft Final Report has been sent for publication. The project was a complete success. All demonstration goals were met or exceeded. The unit is currently in operation and is scheduled to stay in operation as part of the plant's compliance strategy. (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. Testing at the Milliken site is still ongoing, and final testing is in progress. The final report should be published in early fall 1999. (Ithaca, NY) (Lansing, NY and Rochester, NY)

NOXSO Corporation – *Commercial demonstration of the NOXSO SO₂/NO_x Removal Flue Gas Cleanup System.* Project is on hold pending results of bankruptcy proceedings.

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.* The City of Lakeland continues to negotiate with Foster Wheeler on a turnkey contract. Groundbreaking for Unit 4 is projected for mid-2001 pending completion of DOE's NEPA process and Lakeland Electric's obtaining required state permits. (Lakeland, FL)

Jacksonville Electric Authority (JEA) (formerly York County Energy Partners) – *ACFB Demonstration Project.* In September 1997, DOE signed an agreement with Jacksonville Electric Authority to cost-share refurbishment of the first (Unit 2) of two units at the North Side Generating Station. Construction is planned to begin in October 1999 with operation in early 2002, followed by two years of demonstration. (Jacksonville, FL)

Clean Energy Partners, LP – *Clean Energy Demonstration Project.* Project participants have proposed moving the demonstration to a new site in eastern Kentucky. DOE is conducting a due-diligence survey of this proposed relocation while terms and conditions are being renegotiated with the participant. If this site is approved, DOE will immediately initiate NEPA activities. (site pending)

Sierra Pacific Power Co. – *Piñon Pine IGCC Power Project.* This project is making slow progress achieving integrated operation of all systems. Sierra successfully repaired the damage to the gasifier air tube, gasifier coal feed tube, and refractory on the interior of the gasifier. After solving problems in the filter fines collection system (causing high levels of fines in the hot gas filter), Sierra hopes to achieve full system operation and deliver syngas to the combined cycle power plant. 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 two and-a-half years of successful commercial operation. The gasifier has operated 14,000 hours, and the combustion turbine has operated 15,000 hours producing over 4,500,000 MWh. For the extremely hot month of July 1999, the gasifier was available 80 percent of the time to produce syngas to generate power. (Mulberry, FL)

Wabash River Joint Venture – *Wabash River Coal Gasification Repowering Project.* The syngas and power generation facilities resumed operation in June, after an extended shutdown resulting from a gas turbine failure in March. The facility is operating at near full load to the extent

possible, with the high ambient temperatures experienced this summer derating the combustion turbine. PSI experimented with the newly installed fogger on the gas turbine air inlet, which appears to increase the power by 4-5 MW when the system is in use. A "No Cost" time extension to the cooperative agreement extending the period of performance to January 1, 2000, has been granted. The extension will enable the participants to collect additional data and to improve the availability and capacity of the facility. (West Terre Haute, IN)

Alaska Industrial Development and Export Authority – *Healy Clean Coal Project.* Boiler efficiency, spray dryer absorber, and particulate performance compliance testing have been successfully completed at full load, feeding a blend of run-of-mine and waste coal. Particulate performance compliance testing found average emissions to be 0.0047 lb/10⁶ Btu, well within permit limits of 0.03 lb/10⁶ Btu. Boiler efficiencies of 84 percent at full load and 82 percent at 60 percent load exceeded predicted results. Preliminary results of testing the spray dryer absorber showed emissions to be approximately 50 percent lower than guaranteed levels. A scheduled maintenance outage began in June. During the outage, water lances were installed in boiler walls to eliminate high furnace pressure trips when ash accumulates and falls from furnace walls. Y2K tests were also conducted on control logic systems. A 90-day commercial operation test began in August. (Healy, AK)

Arthur D. Little, Inc. – *Coal-Fueled Diesel Engine Demonstration Project.* The 18-cylinder diesel has been moved into the facility's building. During the installation, the electric generator sustained minor damage when a hoisting clamp slipped. All repairs for the generator have been completed and the engine/generator remounted in June. The DOE design review was completed in June. (Fairbanks, AK)

COAL PROCESSING FOR CLEAN FUELS

Custom Coals International - Self Scrubbing Coal™: An Integrated Approach to Clean Air. In September 1998, the Federal Bankruptcy Court held a hearing on conditions necessary to close the sale between Custom Coals Laurel and Tanoma Energy. Tanoma and the Pennsylvania Department of Environmental Protection were unable to reach agreement on important issues, and Custom Coals' plan for reorganization was determined to be void. In December, C.J. Betters Enterprises of Monaca, Pennsylvania purchased the facility at auction for \$3 million and has reached an agreement with DOE to supply a detailed proposal for continuation of the project. The proposal is expected in September 1999. (Central City, PA; Martin Creek, PA; Richmond, IN; Ashtabula, OH)

Rosebud SynCoal® Partnership - Advanced Coal Conversion Process (ACCP) Demonstration. The Rosebud SynCoal® Project in Colstrip, Montana has processed over 2.1 million tons of raw subbituminous coal. Over 1.4 million tons of SynCoal® has been supplied to customers, including industries (primarily cement and lime plants) and utilities. Rosebud SynCoal® Partnership has completed construction of a Pneumatic SynCoal® Supplemental Fuel Project at Montana Power's Colstrip Unit 2. 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. Rosebud was recently granted a 24-month no-cost time extension to January 2001. (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. The reactor continues to be operated at 235°C, somewhat lower than the design temperature of 250°C. Fresh catalyst additions made to the reactor since early 1999 have increased the catalyst loading to over 151 percent of design without indications of mass transfer limitations. Subsequent on-line withdrawals of spent catalyst and additions of fresh catalyst slurry have been successful in

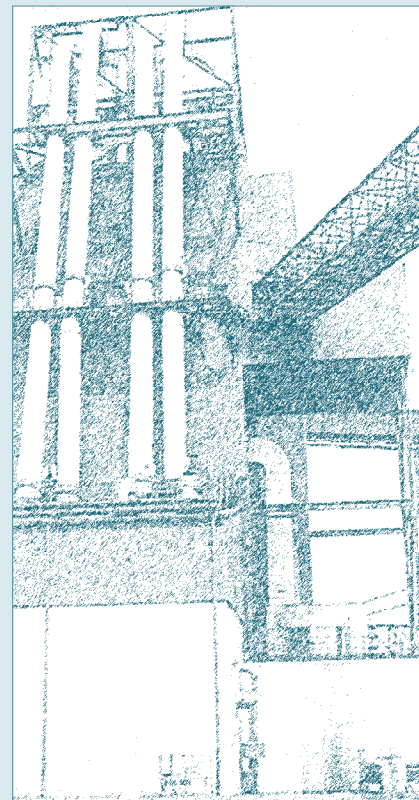
maintaining methanol production rates. During stable test periods, the rate of decline in catalyst activity has met or exceeded the design target of 0.4 percent per day. Since being restarted with fresh catalyst in December 1997, the demonstration facility has operated at greater than 99 percent availability. Since April 1997, over 40 million gallons of methanol have been produced, all of which was accepted by Eastman Chemical Company for use in downstream chemical processes. Catalyst samples have continued to show an increase in arsenic loading; there appears to be a weak correlation between this increased arsenic concentration and the rate of deactivation of the catalyst. A plan to add arsenic removal capacity to the catalyst guard bed system was implemented in June 1999. The level of all potential catalyst poisons will continue to be monitored during the ongoing plant operation. (Kingsport, TN)

INDUSTRIAL APPLICATIONS

Bethlehem Steel Corporation - Blast Furnace Granulated Coal Injection System Project. All testing has been completed and the final report has been submitted and is in review by DOE. Tests have clearly demonstrated that granular coal 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 during this trial and only 19.6 kWh/ton to granulate. Providing granulated coal reduced the cost of power. (Burns Harbor, IN)

CPICOR Management Company, L.L.C. Clean Power From Integrated Coal/Ore Reduction. DOE has conducted a Public Scoping Meeting in Provo, Utah as the first step in 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 Hismelt® 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. Fabrication continues on the new steam reformer test unit that will house the existing 253-tube pulsed combustor for testing. The steam reformer is being fabricated in five major sections that essentially stack on top of each other. Only the topmost section, the dome (which houses two cyclone units for particulate control of the off-gas coming through the steam reformer's fluidized bed) requires additional fabrication. The foundation for the new steam reformer should be ready by late August and the five sections will be erected, with complete assembly expected by early November. Shakedown testing in the new unit is scheduled to start in early December 1999, with CCT Project testing completed at the end of January 2000. During September, the process data as a function of temperature (i.e., gas yields and composition; char yields and composition; emissions; and heat requirement) will be experimentally determined in the existing Process Data Unit using Black Thunder subbituminous coal. (Baltimore, MD)



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