

CLEAN COAL TODAY

A NEWSLETTER ABOUT INNOVATIVE TECHNOLOGIES FOR COAL UTILIZATION

PROJECT NEWS BYTES

The **Advanced Coal Conversion Process (ACCP)** Clean Coal Technology Demonstration Project being demonstrated by **Rosebud SynCoal Partnership** at Colstrip, Montana was recently granted a six-month no-cost time extension to install and test a supplemental SynCoal® firing system at Colstrip Unit 2, and to allow DOE and Rosebud to evaluate a Cooperative Agreement restructuring proposed by Rosebud last year. Pilot scale unit stabilization testing will be done during this extension.

The ACCP facility was part of the Utility-Coal Facility Tours for the “Western Coal Resources & Markets: Focus Montana” conference, which was held from June 17-19, 1998, in Billings, Montana.

In May 1998, the Assistant Secretary for Fossil Energy approved the continuation and completion of the
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HEALY CLEAN COAL PROJECT PROVIDES POWER & ENVIRONMENTAL BENEFITS

In June 1998, the Healy Clean Coal Project (HCCP) reported achieving a critical milestone — satisfying stringent NO_x and SO₂ emissions requirements on run-of-mine coal near one of the most pristine areas of the world. Environmental compliance testing, done to satisfy terms of the air permit, showed the plant to be well within compliance levels with emissions of 0.26 lb/MMBtu of NO_x and 0.01 lb/MMBtu of SO₂ for run-of-mine coal. In fact, it is one of the cleanest coal burning plants now operating in the United States and the world. Located just four miles from the world-famous Denali National Park and Preserve, HCCP is demonstrating advanced SO₂ and NO_x control technologies at a new 50-MWe power plant in Healy, Alaska.



Golden Valley Electric Association is adding capacity with a 50-MWe slagging combustor unit using 65% waste coal.

The HCCP team is led by the project sponsor, the Alaska Industrial Development and Export Authority (AIDEA). AIDEA, a public corporation of the State of Alaska, was established to create and retain quality jobs in Alaska and diversify Alaska’s economy. The total cost of HCCP is \$242 million, with the U.S. Department of Energy providing 48 percent (\$117 million) while AIDEA provides 52 percent (\$124 million).

The Healy Clean Coal Project is located adjacent to Golden Valley Electric Association’s (GVEA’s) existing 25-MWe Healy Unit #1 pulverized coal power plant. The Fairbanks utility will operate the HCCP and pay for power generation under a power sales agreement. Forty new permanent jobs have been created as a result of the plant. Run-of-mine coal, blended with up to 65 percent waste coal, comes from the nearby Usibelli mine. Waste coal improves project economics by reducing the net cost of electricity while minimizing landfill requirements.

HCCP was selected under Round III of DOE’s Clean Coal Technology Program in 1989. After a lengthy permitting and engineering design process to ensure the protection of Denali National Park, general construction began

See “Healy” on page 2...

...Healy continued

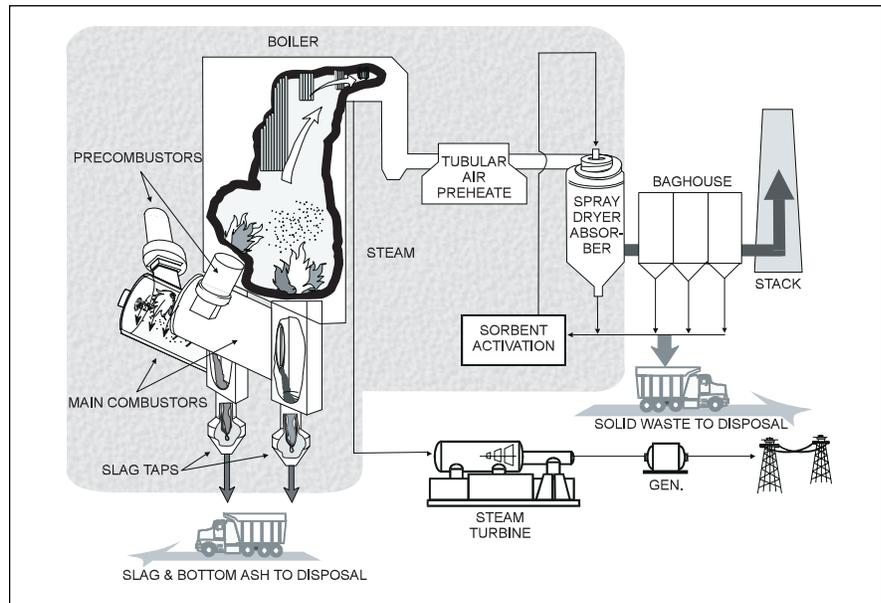
in May, 1995. In addition to intrinsic environmental advantages of the technologies being demonstrated, a Memorandum of Agreement (MOA) between AIDEA, GVEA, DOE, and the National Park Service provides further protection. Low-NO_x burners, designed by Foster Wheeler, were installed at Healy Unit #1 as a result of the MOA and as a permit condition. The MOA also requires duct injection of sorbent to reduce annual SO₂ emissions from Unit #1 by 25 percent.

Commissioning and some start-up activities began in July 1997, and final construction was completed in November 1997. HCCP began test firing and formal shakedown of the combustors using coal in January 1998. As the demonstration testing continued, environmental control systems were sequentially brought on line and integrated with HCCP operations.

TECHNOLOGY

HCCP integrates an advanced slagging combustion system (twin 310MMBtu/hr combustors) designed by TRW with an innovative sorbent injection and spray dryer/baghouse system, provided by Babcock & Wilcox (B&W) who acquired Joy Environmental Technologies. The HCCP technology has the demonstration goal to reduce NO_x levels to as little as 0.2 lb/MMBtu while removing over 90 percent SO₂ in order to meet or exceed current New Source Performance Standards (NSPS). Virtually all fly ash particles are removed before the flue gases are released to the atmosphere, with particulate emissions of less than 0.02 lb/MMBtu.

In a slagging combustor, coal is burned at sufficiently high temperatures to allow about 80 percent of the ash-forming mineral matter to be



removed as molten slag. By carefully controlling temperatures and air/fuel stoichiometry, TRW's novel slagging combustor limits the formation of both thermal and fuel NO_x as compared to conventional systems.

TRW's novel slagging combustion approach utilizes a coal-fired precombustor to increase the air inlet temperature to optimize slagging performance in the main combustor, where over 60-75 percent of the coal is burned. During this two-stage combustion, control of air/fuel stoichiometry results in very low-NO_x emissions before overfire air is injected to complete carbon burnout.

The combustor also employs limestone injection for first-stage SO₂ control. Most of the pulverizing limestone fed into the combustor is flash calcined in the boiler. The residue flash calcined material (FCM) is removed in a baghouse system. A small part of the FCM (a benign by-product) may be sold for commercial applications, but most is slurried and atomized through the spray dryer absorber/dry scrubber system to remove more SO₂. SO₂ is further removed from the flue gas by reacting with the dry FCM on the baghouse

filters. Thus, HCCP utilizes three distinct zones of SO₂ control using the slagging combustor, spray dryer, and baghouse, while employing humidification, to achieve high levels of control, even for low-sulfur coals.

The HCCP balance-of-plant includes a conventional boiler and turbine supplied by Foster Wheeler Energy Corporation and Sumitomo Corporation of America, respectively, along with a distributed control system and continuous emissions monitoring system.

The HCCP will use a nominal 1,000 tons per day of subbituminous coal. The run-of-mine coal has a heating value of about 7,800 Btu/lb and typically contains about 0.17 percent sulfur, 26 percent moisture, and 8 percent ash. The combustion efficiency, afforded by the cyclonic mixing of fuel and air and the high temperatures attained, enables use of low energy density fuels.

PERFORMANCE

Recently, HCCP completed a test run of 18 consecutive days on run-of-mine coal at full load without a trip or a shutdown. During the demonstration, operations have gone relatively

smoothly, with most of the difficulties associated with ancillary equipment. The demonstration has targeted various modifications to the precombustor to improve slag removal (eliminate blockages, or plugging) and HCCP performance, particularly for operations on the higher ash content waste coal blends. HCCP also has been operating at 55 MWe, slightly above the original 50 MWe (nominal) capacity.

HCCP is scheduled to complete parametric evaluation of the slagging combustor and spray dryer/baghouse systems along with a 90-day commercial acceptance test. This parametric testing includes variation in HCCP load, limestone injection rates, and an evaluation of three run-of-mine and waste coal blends. In January 1999, HCCP is scheduled for two 90-day duration tests to address optimized system performance and operating cost. HCCP will collect operational data for 3-½ years, with 2 years of data being provided at no cost to DOE.

ENVIRONMENTAL MONITORING

Aggressive visibility and air quality monitoring programs are being implemented by the project participants as well as the U.S. National Park Service to track ambient concentrations

of SO₂, NO_x, and PM₁₀ and assess potential impacts at Denali National Park, where annual mean concentrations are about 10-30 times less than that of EPA's National Ambient Air Quality Standards (NAAQS). Under the MOA, visibility monitoring equipment was installed at the Denali National Park's Visitors Center and at a location near Healy. Future plans include an educational exhibit at the visitors center that would highlight HCCP and enable visitors to learn how clean coal technologies can produce clean power while protecting the environment.

The power output from the combined GVEA Healy Unit #1 and HCCP is three times that of the older Healy Unit #1 facility alone. The combined emissions reduction from *both* units is expected to result in only an 8 percent increase (depending on demand and unit availability) in annual emissions on a tonnage basis. Based on the demonstration testing to-date, annual emissions from the two plants may be significantly lower per megawatt than those from the old, uncontrolled Healy Unit #1.

Based on promising results to date, HCCP technology has potential for other utility and large industrial boilers in new and retrofit applications. It also is helping to open new markets for Alaska's abundant coal resources.

...News Bytes continued

clean coal project "**Self-Scrubbing Coal™: An Integrated Approach to Clean Air,**" with a new participant, **Laurel Energy L.P.**, an affiliate of **Tanoma Energy, Inc.**, of Latrobe, Pennsylvania. Continuation of the project will allow production and combustion testing of both Carefree™ and Self-Scrubbing™ coals, using the DOE patented Micro-Mag process. Laurel Energy L.P. is in the process of purchasing the assets of Custom Coals Laurel (the original participant), which is in bankruptcy. The purchase will include the 500-ton-per-hour Laurel Coal Processing Facility near Central City, Pennsylvania, site of the Clean Coal Technology Project.

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UPCOMING EVENTS

October 16, 1998 — *Power Quality Workshop*

Location: St. Louis, MO

Sponsor: DOE/FETC, Institute of Electronics and Electrical Engineers,
U.S. Fuel Cell Council

Contact: FETC (304)285-4747

December 1-4, 1998 — *Air Quality: Mercury, Trace Elements, and Particulate Matter Conference*

Location: Tysons Corner, VA

Sponsor: Energy & Environmental Research Center, U.S. EPA, DOE/FETC

Contact: Energy & Environmental Research Center (701)777-3119

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web site: www.eerc.und.nodak.edu

COAL BIOMASS CO-FIRING EFFORT GAINS MOMENTUM

DOE/FE's efforts toward a balanced portfolio of power generation technologies that can reduce emissions while sustaining energy growth include pioneer efforts in biomass-coal co-firing/reburning technologies. These technologies, where biomass typically constitutes 2-15 percent of the heat input, have potential to add capacity and achieve SO₂/NO_x regulatory compliance. Most importantly, they offer promise to reduce greenhouse gases in that biomass is renewable, and unburned hydrocarbons normally produced by in-field burning of biomass wastes are avoided, as is landfill methane. FE's co-firing activities, sometimes in conjunction with DOE's Office of Energy Efficiency (EE), have been driven largely by the interests of coal-fired utilities in having a "hedge" against possible future climate change regulations or renewable energy portfolio standards contained in deregulation legislation. Other utility motives are establishing green pricing programs, addressing industrial waste problems, and assisting farmers with evaluating energy crops in high-soil erosion areas.

Large existing coal-fired boilers offer economic and efficiency advantages over the smaller boilers where biomass would be burned by itself. Biomass has low heating value, high moisture, and low density, and can only be used locally due to transportation costs. Two major milestones show the extent to which the biomass co-firing program has advanced since its inception four years ago — a multi-year program cost-shared by FE and the Electric Power Research Institute (EPRI) will start long-term demonstrations this Fall in utility boilers co-firing various biomass types with coal, and a new effort will begin to support novel concepts in coal/biomass fuel handling.

FE PROGRAM

Although some utility co-firing is practiced in the U.S. and abroad, establishing long term reliability and improving economics through process optimization are still significant needs. Major issues, which the FE program addresses, include biomass fuel handling equipment and fireside impacts, such as carbon burn-out, ash fouling, ash disposal, and NO_x behavior. Retrofit costs are site specific and vary significantly. FE recognizes that a decision to pursue biomass co-firing rests with coal-fired utilities, and the co-firing must offer benefits when compared to other coal technologies. Co-firing must compete in the realm of coal-fired boilers, unlike renewables which compete only with each other.

FE has worked with stakeholders including DOE/EE/Biomass Power Program, U.S. Department of Agriculture (USDA) and USDA Forest Service, Coalition of Northeastern Governors which administers DOE's Northeast Regional Biomass Energy Program, and EPRI, to help plan, fund, and conduct projects. Inputs from numerous state organizations, universities, utilities, private sector firms, and industry trade groups have been essential.

A workshop in June 1995, organized by FE, Sandia National Laboratories-Livermore (SNL), and the National Renewable Energy Laboratory (NREL), brought together 16 organizations, including 5 utilities, to prioritize research needs. Since the workshop, a number of activities have been initiated to address technical and commercialization issues.

Coordinated Co-firing R&D – Researchers at FETC, SNL, and NREL are conducting a 3-year project, with EE support, to evaluate combustion behavior and synergies. For example, coal sulfur has been experimentally shown to have the potential to temper the troublesome chloride corrosion associated with some biomass fuels, while a novel physical reaction model was developed to explain how large biomass particles of up to ¼-inch diameter could achieve long residence times and successfully burn out in some utility pulverized coal boilers.

Utility Demonstrations – Through a multi-year FE/EPRI Cooperative Agreement with over 50 percent industry cost sharing, 5 U.S. utilities have successfully conducted demonstration tests in 7 boilers of different scales and configurations (wall, tangential, cyclone) while co-firing various energy crops and waste biomass fuels using various fuel handling/injection schemes.

Long-term demonstrations, which also involve EE, are scheduled to begin in the fall of 1998 at the General Public Utilities Seward Station and the Northern Indiana Public Service Company (NIPSCO) Bailly Station. The Seward project includes sawdust and utility generated wood co-firing in a 32-MWe wall-fired boiler using a separate biomass injection system. The Bailly project includes blends of clean urban wood waste, petroleum coke, and coal in a 160-MWe cyclone-fired boiler that features the advanced scrubber that was successfully demonstrated in the Pure Air on the Lake Project under the DOE Clean Coal Technology (CCT) Program.

Advanced Biomass Reburning – Through an FE Cooperative Agreement, Energy and Environmental Research (EER) Corporation is evaluating advanced biomass reburning

with the potential for over 90 percent NO_x removal by the use of promoting agents. Data show that biomass reburning may be an attractive, low-cost option to address Title IV NO_x requirements, and possibly more stringent NO_x requirements from EPA's 22-State Implementation Plan (SIP) Call for ozone nonattainment regions.

This advanced reburn technology was originally developed and funded by FE to build upon conventional reburning technologies that have been successfully demonstrated in the DOE CCT Program. The EER biomass reburning project involves Niagara Mohawk Power Company, Antares Corporation, and FE researchers, with funding from the USDA Phase II Small Business Innovative Research Program.

Stoker Co-firing – The University of Pittsburgh is conducting urban waste wood resource assessments for industrial stoker boilers, involving coal brokers, wood recyclers, boiler owners, and various government organizations, with funding from the USDA Forest Service and support from FE researchers. A successful demonstration test of shredded pellet co-firing was completed in 1997 at the Pittsburgh Brewing Company.

Advanced Power Systems Development – With EE funding, FETC in-house researchers are examining advanced turbine system combustion issues with biomass-derived syngas. In related projects, FE researchers have begun wood cogas-ification tests in a pilot-scale pressurized fluidized-bed gasifier/hot-gas cleanup facility, while FETC and NREL are conducting life cycle assessments for biomass gasification. These activities will help support FE's initiative to develop high-efficiency, near-zero emissions coal-based "Vision 21" EnergyPlexes that can be both fuel-flexible and allow for co-production of power and fuels/chemicals.

Advanced Coal/Biomass Fuel Handling – An FE solicitation recently resulted in awards for four projects that will support novel concepts in waste coal/biomass fuel preparation for co-firing applications. (See "Clean Fuels Awards" on page 6.)

In a separate effort, through Cooperative Research and Development Agreements with industry (e.g., HiMicro, Inc.) and EE support, FE researchers are helping to evaluate prototype mills for biomass and coal processing, including co-pulverization, and mills that are used in other industries.

International Activities – With funding from International Energy Agency Coal Research, FE completed a comprehensive review in 1996 to document biomass and waste co-firing commercial experiences in the U.S. and abroad. The U.S. Agency for International Development (USAID) and FE also are investigating the precommercial development of bagasse projects in India.

Industry Consortium – FE has recently supported an industry-led R&D consortium that will sponsor research to expand utilization of novel coal combustion by-products, including ash from biomass co-firing.

Co-firing is considerably more complex than stand alone renewable generation, since two fuels are combined in one plant, and requires plant operators to alter practices. Coal-fired power plants face different challenges than renewables, which are seen as "green," but which are relied on much less for power generation. These include environmental regulations, deregulation and the need to reliably supply large volumes of baseload power.



Biomass handling system facility at TVA's Colbert Station



Coal waste wood co-firing at NIPSCO Michigan City Station



Woodwaste handling at NIPSCO Michigan City Station



CLEAN FUELS AWARDS



On August 12, 1998, DOE Office of Fossil Energy announced the selection of nine research projects for innovative concepts for producing clean fuels and feedstocks from coal. These selections were made under the "Solid Fuels and Feedstocks Grand Challenges" Program Research and Development Announcement. The solicitation was announced in March, 1998, and 30 proposals were received.

Four of the selected projects will develop advanced technologies for the recovery of carbon from waste coal fines and ash impoundments, while four projects will develop advanced biomass/solid waste/coal fuels for utilization in coal-fired boilers. One project will develop an advanced cleaning process for the pre-combustion removal of mercury from coal. Once the selected projects complete contract negotiations, the projects will begin a Phase I research and development program, which will last up to 18 months with DOE providing \$300,000 to \$600,000. This cost-shared program requires the industrial participant to provide at least 20 percent proposer cost sharing. After Phase I, a down-selection will occur for a Phase II effort to scale up technologies and address proof-of-concept testing. Awards selected under Phase II could result in 500,000 to \$1 million of DOE funding for projects up to 3 years in length with a minimum proposer cost-share of 50 percent.

The selected Phase I projects and their sponsors are:

- ◆ *Ultrasonically-Enhanced Dense-Medium Cycloning for Fine Coal and Coal Refuse Impoundment Materials - Pennsylvania State University, University Park, PA* - Develop advanced separation technology based on the application of ultrasonic energy to scrub clays from the surfaces of particles for the improved cleaning and recovery of coal from waste ponds using dense-medium magnetite cyclones.
- ◆ *Development and Demonstration of Integrated Carbon Recovery Systems from Fine Coal Processing Waste - Southern Illinois University, Carbondale, IL* - Develop new/improved density-based and surface-based fine-coal cleaning devices and fine-coal dewatering techniques to improve the recovery, economics, and marketing of fines from coal preparation plants and waste coal ponds.
- ◆ *Advanced Carbon Recovery/Dewatering Systems Development - Virginia Polytechnic Institute and State University, Blacksburg, VA* - Develop innovative fine-coal dewatering technologies to improve the handling and economics of fine coal recovery and utilization systems from coal preparation plants and coal ponds.
- ◆ *A Technology for the Recovery of High Quality Fuel and Adsorbent Carbons from Coal Burning Utility Ash Ponds and Landfills - University of Kentucky Research Foundation, Lexington, KY* - Develop separation processes to recover carbon from power plant fly ash for use either as a fuel or as a high-quality carbon adsorbent. The technology also produces high-quality, salable fly ash from previously unmarketable material.
- ◆ *A Low-Cost and High-Quality Solid Fuel from Biomass and Coal Fines - Altex Technologies Corporation, Santa Clara, CA* - Develop an integrated dewatering and extrusion device for pelletizing biomass and coal feedstocks using processed sewage sludge as a binder and sealer in order to produce pellets with superior transportability and handling characteristics for combustion in coal-fired boilers.
- ◆ *Production of New Biomass/Waste-Containing Solid Fuels - CQ Inc., Homer City, PA* - Develop a novel die for pellet mills that facilitates dewatering and produces strong, weather-proof, composite pellet fuels, from different combinations of biomass, waste, and coal feedstocks, for various coal combustion applications. The technology is an extension of the commercial E-Fuel technology developed by CQ Inc.
- ◆ *Compacting Biomass and Municipal Solid Wastes to Form an Upgraded Fuel - University of Missouri, Columbia, MO* - Develop a novel rotary press for dewatering and compacting biomass feedstocks into biomass logs for cofiring in various coal combustion applications. The technology is an adaptation of the coal log technology developed by the University of Missouri.
- ◆ *New Solid Fuels from Coal and Biomass Waste - McDermott Technology, Inc., Alliance, OH* - Develop drying and pelletizing technologies for municipal sewage sludge and paper sludge, both with and without coal addition, to produce pellets for cofiring in a cyclone boiler. Any toxics present in the sludges become encased in the slag produced by the cyclone boiler.
- ◆ *Removal of Selected Hazardous Air Pollutant Precursors by Dry Magnetic Separation - EXPORTech Company, Inc., New Kensington, PA* - Develop technology for the pre-combustion removal of mercury using dry magnetic separation on pulverizer recycle streams at pulverized-coal power plants. The process technology is applicable to both cleaned and uncleaned coals and removes mercury via its association with pyrite that is liberated during pulverization.

ADVANCED COAL-BASED POWER AND ENVIRONMENTAL SYSTEMS '98 CONFERENCE

— LOOKING TO THE FUTURE —

The U.S. Department of Energy, Federal Energy Technology Center (FETC) hosted the Advanced Coal-Based Power and Environmental Systems '98 Conference, July 21-23, 1998, in Morgantown, West Virginia. About 300 persons attended the conference representing every region of the United States and several other countries.

The conference provided a forum for industry representatives, government regulators, scientists, engineers, and other interested parties to: (1) share the results of FE-sponsored research and development projects related to advanced power generation and environmental systems; (2) learn about cooperative industrial-government research and development opportunities (CRADAs) with FETC; and 3) discuss the direction of future research and development for a competitive energy market in the coming millennium.

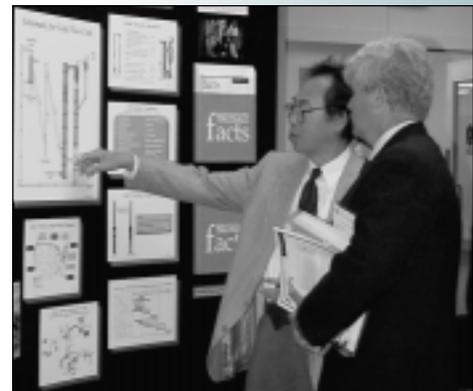
At the opening session, FETC Director Rita A. Bajura presented an overview of research and development activities required to bring advanced power systems into the marketplace of the 21st century. The Director noted that fossil fuels will continue to be the dominant global energy source for the foreseeable future, but industry must respond to tightening environmental regulations. Information on cost, performance, and the environmental implications of CO₂ capture is a critical need.

The keynote address was given by J. Gordon Hurst, Executive Vice President and Chief Operating Officer of the Southern Indiana Gas and Electric Company (SIGECO), who stressed the importance of partnership in solving energy problems. He noted that industry representatives, government regulators, and technology developers must work together to meet the challenges and opportunities of a changing energy market.

Joseph P. Strakey, Associate Director of the Office of Power Systems Product Management at FETC, outlined Vision 21 - Advanced Power Plants for the 21st Century. This DOE program will require new configurations of power generation systems to obtain the maximum amount of energy possible from coal, while achieving near-zero emissions and producing high-value products from waste streams.

After the opening session, industrial and academic researchers and developers, along with FETC scientists and engineers, presented research results at sessions for Advanced Power Systems; IGCC Gas Cleaning, Recovery, Separation, and Advanced Gasification; Particulate Control; By-Product Utilization; Environment Control Technology; and Global Climate Change. Two poster sessions were also held for Combustion and Environmental Control, and Hot Gas Cleanup.

The conference showcased advances made in all aspects of advanced coal-based power and environmental systems. It also defined the direction that future research must take as we move toward the new millennium.



NEW COAL STAKEHOLDER: COAL UTILIZATION RESEARCH COUNCIL

COAL UTILIZATION RESEARCH COUNCIL

The Coal Utilization Research Council (CURC) is an ad hoc, not-for-profit organization of coal producers, coal users, equipment manufacturers, engineering service providers, and other entities involved in the use of coal. The CURC members advocate effective, collaborative partnerships between government and industry in order to pursue technology research and development programs. They also support programs to facilitate the early commercial introduction of cost-effective, efficient, and environmentally compatible coal-based technologies.

Organized in late 1996, CURC reflects the growing concern of industry over dramatic decreases in government funding and awareness of the need to continue research and development of coal-based technologies. This decrease in government-supported R&D was accompanied by a realization that ever more stringent environmental requirements were being demanded of those who use coal. Most important, there was a realization that more stringent environmental requirements could not be met cost-effectively with current know-how. Less R&D funding and more stringent environmental requirements could result in a future where coal — the nation's most abundant fossil fuel resource — would have a minimal role in meeting future energy needs.

The CURC focuses upon *utilization* rather than *production* of coal. To that end, CURC membership has developed a mutually-agreed upon vision for the future use of coal to achieve its appropriate place in the energy mix. The group works with related associations to support and disseminate this vision of coal and coal technology development.

Through the collaboration of industry experts over the course of several months, CURC has produced a "Coal Technology Roadmap" that is intended to guide technology research and development efforts toward certain goals. In the near term (2005 to 2010) the Roadmap sets forth a series of suggested technology initiatives that might enable coal to compete with natural gas from the standpoint of both price to the consumer and impact upon the environment. The Roadmap also proposes several technology options (to be developed in the 2020 timeframe) that would greatly increase the efficiency by which coal is converted to useful energy. Further, during this timeframe, technologies must be developed so that there are *de minimis* emissions, including CO₂, resulting from the use of coal. The Roadmap contemplates development of technologies that are evolutionary, and builds upon the existing technology base (e.g. improved coal gasification) as well as revolutionary technologies (e.g. coal gasification in combination with fuel cells or hybrid coal plants that use combinations of gasification and pressurized fluidized-bed technologies).

CURC also is considering a set of proposed financial and tax incentives designed to encourage the early utilization of advanced coal-based technologies. This set of possible incentives was developed in recognition of the fact that entities that wish to use new technologies are exposed to greater risks than those intending to use conventional technologies to accomplish the same job. This applies equally to coal-based technologies that produce liquids, gases, or

solid products from coal. In addition, the electric generation industry is in the throes of a major restructuring. Competition and the uncertainties attendant with the initial phases of restructuring are not conducive to the assumption of technology risk-taking. As a result, the great technology advances made through the U.S. Department of Energy's Clean Coal Technology Demonstration Program stand at risk unless the means are found to encourage risk-taking.

CURC's agenda for the future is to introduce policy makers and others to the elements of the Roadmap and to encourage its adoption as a guide to future decisions on coal-based R&D. This is regarded as a dynamic process, and thus the Roadmap technologies and goals may change as new discoveries are made. In addition, CURC will look to government and encourage policy makers to consider providing forms of risk-sharing that will encourage the use of new technologies.

Working with other organizations that have similar views and missions relative to coal, the Coal Utilization Research Council intends to become a forceful advocate for developing the technology base to use the coal resources that are so abundant throughout the world.

This guest piece was submitted by Mr. Ben Yamagata, Director of the Coal Utilization Research Council. The Council is one of several key stakeholders in DOE's coal technology programs. Other key stakeholders will present their views in upcoming issues. For additional information, contact the CURC at: 1080 Thomas Jefferson St., NW, Washington, DC 20007-3877

INTERNATIONAL INITIATIVES

SOUTH AFRICA PROJECT RECOGNIZED FOR CONTRIBUTING TO GHG REDUCTION



DOE receives a photograph of the first ECO Housing Project. L to R: John Hindman (SAIC), Douglas Guy (PEER Africa), Art Bladwin (DOE/FETC), and Mark Freeman (DOE/FETC).

In July 1998, PEER Africa Consultants, a subsidiary of a U.S. civil engineering firm, and the International Institute for Energy Conservation (IIEC) were officially recognized under the United Nations Framework Convention on Climate Change as an official “Activities Implemented Jointly” (or “JI”) project. This is the first project in Africa, continuing work on energy-efficient housing for which the U.S. DOE Office of Fossil Energy (FE) provided technical support.

The approved project of 6,000 energy-efficient Ecohomes in Guguletu township near Cape Town is projected to reduce over 55,000 tons/year of CO₂. The project builds upon PEER’s energy-efficient housing project in Kutlwanong township, where the first 200 of a total of 2,000 Ecohouses have been completed.

At Kutlwanong and another South African township (Qalabotjha), an FE engineer surveyed 138 houses to document high-polluting stoves and assess intervention measures, including the integration of improved stoves and fuels inside energy-efficient houses (see *Clean Coal Today*, Summer 1998 issue). FE surveys showed high levels of indoor air pollution, especially carbon monoxide, that were consistent with chronic health problems reported by residents, and illustrated that simple measures could be successful in educating residents about mitigating stove hazards. As a result of the FE surveys, PEER Africa catalyzed an important Indoor Air Quality Workshop in March 1998, sponsored by IIEC with U.S. Agency for International Development funding, in order to assess possible remedies through the government and private sector. In addition, PEER Africa is now planning a comprehensive stove intervention/replacement program.

PEER Africa’s energy-efficient houses are being built for as little as \$3,500, and compare favorably with more expensive houses built on a large scale over a 5-year period as part of South Africa’s National Reconstruction and Development Program. In June 1998, PEER Africa provided FE’s Fossil Energy Technology Center with a certificate of appreciation from community leaders in Kutlwanong and a photo of the 200 completed houses. In addition to USAID, IIEC, and FE, other organizations that have worked with PEER include DOE’s Office of Diversity and Economic Impact, DOE’s Golden Operations Office, the Republic of South Africa’s Department of Minerals and Energy, and various public and private groups under the Gore-Mbeki Binational Commission.

CCTs TO BE EVALUATED FOR PHILIPPINES PALAWAN PROVINCE



This summer, a DOE Office of Fossil Energy (FE) representative visited the Philippines to discuss potential application of clean coal technologies to the Palawan Province, an environmentally pristine area where all generation is currently oil-fired and 70 percent of the near-one million population live in isolated communities without power. Meetings have been conducted under the auspices of the Philippine Center for Sustainable Development, which was funded by the U.S.-Asian Environmental Partnership (a U.S. State Department program). The

Center is a collaborative international institute started last year by a California-based consortium led by California State University in Hayward and the Philippines’ De La Salle University in Manila. The initial effort in Palawan, largely supported by local funding, will be a pilot program of modeling and economic analysis on the role of advanced clean technologies, including clean coal, in the energy mix.

The Center’s team comprises representatives from FE, De La Salle University, California State University, Lawrence Livermore National Laboratory, and the University of California at Santa Barbara and at Davis. If the Palawan effort is successful, a national model would be developed with the Philippines’ Ministry of Energy for other rural communities. Funding for that effort would be expected to come from a variety of international and local

sources. The model also may be applicable to other Asian countries that are seeking a mix of energy generation to cope with growing economic demand while addressing climate change concerns.

Some 20 percent of Philippine power generation is coal-fired, with the remainder oil-fired. Oil is expected to be phased out, with new generation coming from natural gas and a combination of clean coal and renewables.

INTERNATIONAL NEWS BYTES

A U.S. DOE Office of Coal & Power Systems (OC&PS) exhibit generated a high level of interest at the recent **PowerGen Europe Conference and Exhibition**, held in Milan, Italy on June 9-11, 1998. The conference highlighted the latest in technology innovations and business opportunities for power generation to an international audience interested in the global marketplace. Some 400 people from over a dozen countries stopped by the OC&PS booth, showing particular interest in the progress of the Clean Coal Technology Program and as R&D activities. Technologies eliciting the most interest were advanced environmental controls, fluidized-bed combustion, and integrated gasification combined cycle (IGCC), with many questions about progress of the Tampa Electric and Piñon Pine IGCC projects. Many of the Eastern European representatives were interested in technologies such as flue gas cleanup. In coal R&D, most questions dealt with coal liquefaction, advanced turbines, and the Power Systems Development Facility at Wilsonville. Overall, OC&PS participation at the PowerGen Exhibition complemented the efforts of the U.S. State Department and Department of Commerce, which also exhibited at the event, offering international exposure to a wide range of innovative U.S. technologies.

In July 1998, a representative from U.S. DOE's Office of Fossil Energy took part in the Executive Committee meeting in Oxford, U.K., under the **International Energy Agency's Multiphase Flow Science Agreement**. Participating countries include the U.K., Norway, Canada, Australia, Mexico and U.S. The U.S. has been the Operating Agent for the Agreement (and headed the successful Granular Flow Advanced Research Objective) since its inception in 1987 but is transferring responsibility to the U.K. The agreement coordinates the exchange of complementary research task results in a range of research programs to improve understanding of the behavior and properties of multi-phase flow phenomena associated with obtaining energy from coal, oil, and gas.

RESEARCH & DEVELOPMENT NEWS

 The U.S. DOE, Office of Fossil Energy (FE) announced that it will participate in an **Interagency Working Group** to help formulate and coordinate the national PM_{2.5} research program. This activity stems from FE's participation in a recent workshop sponsored by the U.S. Environmental Protection Agency and the North American Research Strategy for Tropospheric Ozone at Chapel Hill, North Carolina, that focused on identifying key components and design parameters for a comprehensive national program to characterize ambient particulate matter and important co-pollutants. This work will augment FE's current work with EPA on PM_{2.5} in the Upper Ohio River Valley Region (see article in Summer issue of *Clean Coal Today*). Earlier this year, FE signed two cooperative agreements with the Energy and Environmental Research Center to focus on DOE initiatives to help industry comply with evolving regulation of hazardous air pollutants, in particular mercury and PM_{2.5}, and with international agreements and national goals on global climate change. This \$31.2 million jointly-sponsored research program will assist technology development, demonstration, and commercialization in the U.S. energy industry.

 An FE representative made a presentation on the application of **Ion-Electron Conducting Membranes** at the recent 5th International Conference on Inorganic Membranes, in Nagoya, Japan. Some 230 participants from 23 countries attended the conference. As developed under FE's RD&D programs, these membranes could be applied to DOE's energy and environmental technology development programs, including power generation, fuels production, and phased transition to a hydrogen economy. Participants considered U.S. efforts in membrane technology to be quite advanced.

 **CONSOL Inc.** will be designing, building, and conducting operational testing at a facility that will produce aggregate materials for road construction from scrubber sludge and other wastes from coal-fired power plant facilities. Under a \$1 million grant from FE, CONSOL hopes to prove the technical feasibility of this waste-to-product process, which may provide a major outlet for coal-fired power plant waste nationwide.

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 received and is being reviewed. (Coosa, GA)

New York State Electric & Gas – *Milliken Clean Coal Technology Demonstration Project.* High-sulfur (4%) coal testing began in May 1998. Reports on ESP performance and LNCF-3 testing have been completed. (Lansing, NY)

New York State Electric & Gas – *Micronized Coal Reburning Demonstration for NO_x Control.* Preliminary testing was performed at the Milliken demonstration unit in early February 1998. Short-run tests showed that NO_x could be reduced an additional 35-40%. Further testing with different LNCF III primary and overfired air settings was expected to begin in September 1998. Long-term testing at Kodak was concluded in July 1998. (Lansing, NY and Rochester, NY)

NOXSO Corporation – *Commercial Demonstration of the NOXSO SO₂/NO_x Removal Flue Gas Cleanup System.* Discussions are ongoing with a major utility to re-site this project. (Site pending)

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.* These projects have been restructured and re-sited to Lakeland, Florida. The City of Lakeland continues to negotiate with Foster Wheeler on the turnkey contract. (Lakeland, FL)

Jacksonville Electric Authority (formerly York County Energy Partners) – *ACFB Demonstration Project.* On September 29, 1997, DOE signed an agreement with Jacksonville Electric Authority to cost-share refurbishment of the first (Unit 2) of two units at North Side Generating Station. Capital cost of repowering Unit 2 is \$309 million, of

which DOE's cost-share is \$74.7 million, or 24%. Construction is planned to begin in March 1999, with operation in early 2002, and two years of operations. Activities are underway to draft an Environmental Impact Statement. (Jacksonville, FL)

Clean Energy Partners, L.P. – *Clean Energy Demonstration Project.* Clean Energy Partners (CEP) has recommended moving the Project to an existing power plant site in southern Illinois. CEP is completing the due diligence for a 260-MWe IGCC plant with an option on a second train on the same site. CEP has formed a site-specific Project Team that includes the new host. DOE is reviewing the various options for re-siting this project. (Site pending.)

Sierra Pacific Power Co. – *Piñon Pine IGCC Power Project.* The primary gasifier has had many smooth startups and shutdowns for making high quality syngas. However, Sierra Pacific continues to have difficulty maintaining stable operation of the entire fully integrated gasification island. The primary issue has been with small quantities of solids removed by the hot gas filter system; they have been more difficult to convey and combust than anticipated thus inhibiting stable production of syngas. The plant continues to operate in the gas combined cycle mode. (Reno, NV)

Tampa Electric Co. – *Tampa Electric Integrated Gasification Combined-Cycle Project.* Between January and March 1998, the unit was in operation 1,600 hours and operated on syngas 94% of the time. The unit is currently undergoing a maintenance outage and was scheduled to return to operation in June 1998. (Mulberry, FL)

Wabash River Joint Venture – *Wabash River Coal Gasification Repowering Project.* Cinergy Corp., through its Indiana based operating company, PSI Energy Inc., Plainfield, Indiana, has reached an agreement to purchase its contract with Houston-based Dynegy Inc. for coal gasification services at the Wabash plant. Dynegy's ownership of the facility and the technology is not affected by this contractual agreement with Cinergy. Dynegy, in conjunction with Cinergy and the Department of Energy, will explore alternatives that will enable the Wabash facility to continue operating as a syngas facility. (West Terre Haute, IN)

Alaska Industrial Development and Export Authority – *Healy Clean Coal Project.* In June 1998, environmental compliance testing was performed at full load of 62 MW (gross) with run-of-mine subbituminous coal. Under these conditions, the permit required emissions to be less than 0.35 lb per million Btu for nitrogen oxides and less than 0.10 lb per million Btu for sulfur dioxide. Nitrogen oxide emissions of 0.26 lb per million Btu and sulfur dioxide emissions of 0.01 lb per million Btu were attained during the testing. The stringent sulfur dioxide emission level required by the permit is significantly lower than the 1.2 lb per million Btu limit established by the New Source Performance Standards (NSPS). The Healy Clean Coal Project also completed a test run of 18 consecutive days at full load without a trip or a shutdown. Entrained combustor characterization testing at full load, in conjunction with the NO_x and SO₂ reduction system tuning and trimming, is continuing. The Demonstration Test Program is comprised of performance guarantee tests, environmental compliance tests, major system characterization tests, and integrated commercial operating tests. (Healy, AK)

Arthur D. Little, Inc. – *Coal-Fueled Diesel Engine Demonstration Project.* A 60% design review was held at the University of Alaska. The project is on schedule for delivery of the 18-cylinder coal-diesel engine in November 1998. (Fairbanks, AK)

COAL PROCESSING FOR CLEAN FUELS

Custom Coals International/Tamoma Coal Sales, Inc. – *Self-Scrubbing Coal™: An Integrated Approach to Clean Air.* Tanoma Coal Sales, Inc., under the name of Laurel Energy L.P., of Latrobe, Pennsylvania, has offered to buy the site and continue the project. DOE conditionally approved the continuation and completion of the project on May 18, 1998. Negotiations on the final project outcome are continuing. (Central City, PA; Martin Creek, PA; Richmond, IN; Ashtabula, OH).

Rosebud SynCoal® Partnership – *Advanced Coal Conversion Process (ACCP) Demonstration.* The ACCP facility continues to process raw subbituminous coal, producing over 1.3 million tons of SynCoal® product to date. Nearly 1.3 million tons has been supplied to customers, including industries (primarily cement and lime plants) and

utilities. Rosebud SynCoal Partnership has signed a letter agreement with Montana Power Company's Colstrip Unit No. 2 to design, install, commission and operate a pneumatic injection system for Colstrip Unit No. 2. The pneumatic injection system would inject SynCoal® product on a steady basis to Colstrip Unit No. 2. A six-month no cost-time extension was granted in August 1998. (Colstrip, MT)

Air Products Liquid Phase Conversion Company, L.P. – *Liquid Phase Methanol Process Demonstration Project.* The LPMEOH™ Process Demonstration Facility completed a 24-day period of continuous, stable operation on coal-derived synthesis gas this summer at a lower reactor temperature of 235°C. The design reactor temperature is 250°C. Over this operational period, the rate of decline in catalyst activity was a favorable 0.2 percent per day. Fresh catalyst additions have been made to the reactor to increase the catalyst concentration in the

slurry to the design loading of 40 weight percent. Process variable studies are currently underway. Since being restarted with fresh catalyst in December 1997, the demonstration facility has operated at greater than 99 percent availability. The LPMEOH™ Process Demonstration Facility has produced over 21 million gallons of methanol since its startup in April 1997, all of which was accepted by Eastman Chemical Company for use in downstream chemical processes. (Kingsport, TN)

INDUSTRIAL APPLICATIONS

Bethlehem Steel Corporation – *Blast Furnace Granulated Coal Injection System Project.* The “Pulverized Coal Trial” was initiated in April as planned. During the entire month of May, operating personnel struggled to keep the coal conveying lines open to the tuyeres. The instability of the furnace operation and the variable coal flow caused the trial to be suspended on June 1,

1998. During June the operation of both furnaces returned to more normal operating conditions and the process was stabilized, and the furnace was returned to granulated coal on June 6. The “Pulverized Coal Trial” data is currently being evaluated. The Sanborn coal, a Colorado “B” seam coal, has been selected for “Western Coal Trial.” A “No-Cost” time extension which extended the period of performance of the agreement from July 26, 1998, to September 30, 1999, was granted. (Burns Harbor, IN)

CPICOR™ Management Company, L.L.C. – *Clean Power From Integrated Coal/Ore Reduction.* CPICOR™ has recommended the incorporation of the HIs melt® direct iron reduction technology in this Project. HIs melt® is an Australian-developed technology and is licensed by Rio Tinto. This technology has been shown to be applicable to a wide range of coals and ores. DOE is evaluating the impacts of incorporating this technology. (Vineyard, UT)

FE ORGANIZES SEPARATIONS WORKSHOP FOR VISION 21 SYSTEMS



Realizing the ambitious goal of “Vision 21,” FE’s new approach to 21st century energy production, requires significant advances in materials technology, especially materials for separations processes. Vision 21 envisions generating efficiencies of greater than 60 percent using coal; thermal efficiencies of 85-90 percent; near-zero emissions of traditional pollutants; and zero net CO₂ emissions using efficiency improvements and carbon sequestration. Several technologies are embedded in yet-to-be-defined configurations, and materials for separations systems will be critical to all of these element alternatives. These include gas-gas separations such as the

separation of hydrogen from synthesis gas or from carbon dioxide; air separation to produce oxygen; and gas-solid separation devices (i.e., hot-gas filters). Therefore, a “Gas Separations Workshop for Vision 21 Systems” was planned as the centerpiece of this year’s FE Materials Program Annual Contractor/Program Review, held in early summer.

Nearly 100 representatives from government, academia, domestic and international research organizations, and U. S. industry met in Knoxville to discuss the highest priority materials development needs for Vision 21 systems. Professor William Fulkerson, who served on the President’s Committee of Advisors on Science and Technology (PCAST), and who was charged with preparing the fossil energy portion of the PCAST report, led off the workshop by laying out the challenges that coal faces if it is to remain a viable energy resource for the United States. The Director of FE’s Office of Advanced Research then presented Vision 21 as the Department of Energy’s R&D strategy for addressing these challenges. Representatives from companies working on Vision 21 technologies then provided the commercial perspective for the separations processes and materials that will be required to achieve these Vision 21 objectives.

To request copies of proceedings for this year’s FE Materials Program Contractor/Program Review, as well as a summary of the results of the Separations Workshop, contact Fred Glaser at 301-903-2786 or e-mail your request to fred.glaser@hq.doe.gov.

