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CLEAN COAL TODAY

A Newsletter About Innovative Technologies for Coal Utilization

News Bytes

The Office of Fossil Energy is proceeding with the third round of the Clean Coal Power Initiative (CCPI). A Notice of Intent to issue a Funding Opportunity Announcement (FOA) was issued on May 23, 2007 (see Fossil Energy *Techline* of same date). The next step is issuance of a Draft FOA, followed by a Final FOA later this summer. CCPI Round 3 specifically targets advanced coal-based systems that capture and separate CO_2 for sequestration and beneficial reuse. Applications would be due in early 2008. Once released, the Draft FOA will be at http://www.grants.gov and http://e-center.doe.gov ◆

DOE held four well-attended public meetings in June 2007 on the FutureGen Draft Environmental Impact Statement, prepared in accordance with the National Environmental Policy Act (NEPA). Meetings were held in Odessa and Heart of Brazos, Texas; and Mattoon and Tuscola, Illinois. Feedback generally was supportive

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Regional Partnerships Lead U.S. Carbon Sequestration Efforts

With its rich history of steel making and coal mining, together with environmental quality improvement, Pittsburgh, Pennsylvania provided the backdrop for the Sixth Annual Conference on Carbon Capture & Sequestration. The event served as a reminder of the importance of coal for U.S. energy needs and security. The conference took place May 7–10, 2007, and marked its first trip to "coal country" since its inception in 2001. The firm of Exchange Monitor Publications and Forums organized the conference for the U.S. Department of Energy's Office of Fossil Energy (FE). With growing interest over the last six years, a record number of attendees (over 700) was testimony to the increasing relevance of carbon sequestration technology, and its regional implementation through FE's Carbon Sequestration Regional Partnerships initiative.

Acting ASFE Thomas D. Shope addresses Sequestration Conference

During the Conference, the Regional Partnerships provided a snapshot of progress on characterization efforts and field validation tests. In his opening remarks, Acting Assistant Secretary for Fossil Energy (ASFE) Thomas D. Shope noted that these tests are vital to providing the necessary knowledge base for, and gaining public acceptance of, carbon capture and storage so that the technology can continue to make unwavering progress. The seven Partnerships involve more than 350 organizations (state agencies, universities, environmental groups, and private companies) and span 41 states, two Indian nations, and four Canadian provinces.

The Partnerships initiative is built on the recognition that geographical differences in fossil fuel/energy use and CO_2 storage sinks across North America will dictate varying approaches to carbon sequestration. The first ***characterization phase*** (2003–2005) identified regional opportunities and developed frameworks to validate and deploy technologies. Computers models were developed to match CO_2 sources and sinks (depleted oil and natural gas fields, unmineable coal seams, and deep saline formations). A product of

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... *"Regional" continued*

this activity is the *Carbon Sequestration Atlas of the United States and Canada*, including storage capacity estimates (see Table 1). The benefits of CO_2 storage include potential recovery of natural gas (63 trillion cubic feet from coal seams) and oil (16 billion barrels). Such enhanced recovery efforts will help offset the costs of developing infrastructure to capture and transport CO_2 from sources to geological sinks.

The ***validation phase*** — 25 geological and 11 terrestrial small-scale sequestration field tests — began in 2005 and is to last until 2009. Geologic field tests are exploring CO_2 storage in depleted oil and natural gas fields, saline formations, and unmineable coal seams, while terrestrial field tests are investigating modified forest and agricultural practices to promote additional carbon uptake in trees, soils, and other vegetation. Measurement technologies are being employed to monitor the fate of the stored CO_2 and to satisfy compliance requirements associated with emerging greenhouse gas registries and carbon markets. In addition to field testing, Partnerships continue to characterize regional sequestration opportunities, maintain regional geographic information systems (GIS) and decision support systems (DSS); permit field projects through the regulatory agencies; and implement public outreach and educational activities in their respective communities.

BIG SKY CARBON SEQUESTRATION PARTNERSHIP (Big Sky), led by Montana State University

MIDWEST GEOLOGIC SEQUESTRATION CONSORTIUM (MGSC), led by Illinois State Geological Survey

MIDWEST REGIONAL CARBON SEQUESTRATION PARTNERSHIP (MRCSP), led by Battelle Memorial Institute

PLAINS CO_2 REDUCTION PARTNERSHIP (PCOR), led by the Energy and Environmental Research Center.

SOUTHEAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP (SECARB), led by the Southern States Energy Board

SOUTHWEST REGIONAL PARTNERSHIP ON CARBON SEQUESTRATION (SWP), led by the New Mexico Institute of Mining and Technology

WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP (WESTCARB), led by the California Energy Commission

Contacts:
www.netl.doe.gov/technologies/carbon_seq/partnerships/contacts.html

FIELD TESTING

Validation Phase projects include 10 ***enhanced oil recovery/enhanced gas recovery (EOR/EGR)*** field tests in progress in Alberta Canada, California, Illinois, Mississippi, North Dakota, Texas, and Utah. Synergies are achieved by coupling sequestration with EOR/EGR. Much geologic information is already available, as is the infrastructure. A structure cap is essentially assured.

Prior to the field testing, MGSC's "Huff 'n Puff" field test, the Owens No. 1 well at the Loudon Oil Field, produced only 2 barrels of oil a day. Following injection of CO_2, production jumped to nearly 8 bpd before leveling off at 4 bpd. Another project is employing post-audit modeling analysis from data gathered in over 30 years of EOR operation at SACROC, in the Permian Basin.

MGSC's Huff 'n Puff Owens No. 1 Well Site

Modeling results are being applied to a nearby and geologically similar field at Claytonville, in anticipation of EOR injection there. Another oil field project, PCOR's Zama Field Test, serves the triple purpose of CO_2 sequestration, hydrogen sulfide (H_2S) disposal, and EOR. This project is recognized and endorsed by the Carbon Sequestration Leadership Forum.

The Partnerships also are applying lessons learned from EOR/EGR operations to sequestration in ***unmineable coal seams***. Many coals contain large quantities of methane adsorbed on the coal surfaces. Tests show that CO_2 is more strongly adsorbed on coal surfaces than on methane, so can be used to displace the methane. Thus, injecting CO_2 into unmineable coal seams can accomplish both CO_2 sequestration and enhanced coal bed methane (ECBM) production, *and* produce a saleable product to help offset the cost of CO_2 sequestration. Five such field tests are under way in Alabama, Illinois, New Mexico, North Dakota, Virginia, and West Virginia. One project, SWP's San Juan Basin ECBM Sequestration Test, will desalinate the excessive water produced by ECBM and use it for irrigation and forest restoration, forming a combined ECBM-terrestrial sequestration project.

Saline formations are the focus of 10 field tests. The estimated CO_2

Table 1. Geologic CO_2 Storage Capacity Estimates (Gigatons of CO_2)

Partnership	Saline		Unmineable Coal Seams		Oil and Natural Gas Fields	Total	
	Low	High	Low	High		Low	High
Big Sky	271	1,085	-	-	0.8	275	1,086
MGSC	29	115	2.3	3.3	0.4	32	119
MRCSP	47	189	0.7	1.0	2.5	121	121
PCOR	97	97	8	8	19.6	125	125
SECARB	360	1,440	57.4	82.1	32.4	450	1,555
SWP	18	64	0.9	2.3	21.4	40	88
WESTCARB	97	388	86.8	86.8	5.3	81	309
Total	**919**	**3,378**	**156.1**	**183.5**	**82.4**	**1,157.6**	**3,643.9**

Source: *Carbon Sequestration Atlas of the United States and Canada* http://www.netl.doe.gov/publications/carbon_seq/atlas/index.html

storage capacity of saline formations is larger than that of other sources. Few such projects exist, so field tests will provide crucial information on such vital parameters as formation porosity, permeability, and the chemistry of formation fluids. Also important is the speed at which CO_2 can be injected without over-pressurizing the formation and its migration over time, or adversely affecting its interaction with formation fluids and minerals. Field tests are under way in Arizona, California, Illinois, Kentucky, Michigan, Mississippi, Ohio, and Utah. SECARB's Gulf Coast Project, SWP's Aneth Field Project, and WESTCARB's Rosetta Project are "stacked" storage projects where existing EOR/EGR operations overlay the target saline formation. This allows the sharing of seismic data, infrastructure, and joint regulatory permitting. Most of the saline field tests are still in early stages of development, with a few having completed seismic surveys and injection well drilling. MRCSP's Appalachian Basin field test completed a seismic survey in July 2006, and an 8,000 foot test well in January 2007. Another project — Big Sky's basalt field test — offers an unusual repository for CO_2. Basalt formations have high potential for mineral trapping of CO_2, and Big Sky is examining mineralization rates.

The Partnerships also are engaged in 11 terrestrial sequestration projects consistent with regional ecosystems. Projects involve changes in agricultural and forest land management practices, adopting conservation technologies such as no-till farming, converting marginal croplands to grasslands and forests, establishing vegetation on mined soil, restoring wetlands, and careful selection of plant species. Still others are focused on reclaiming damaged mine lands, and using produced water for irrigation and land remediation. Other projects are focusing on reforestation of degraded lands and altering land management practices on rangelands and agricultural lands to increase soil carbon uptake. Several unique projects include PCOR's wetland restoration activities in the Prairie Pothole Region. This project will result in value-added products such as carbon credits, wetlands credits, and improved water quality and wildlife habitat. WESTCARB's forest fuel management activities will reduce large episodic CO_2 releases from catastrophic wildfires, while Big Sky's cropland and rangeland activities will result in best management practices handbooks for farmers and ranchers.

Following a highly successful characterization phase, the Regional Partnerships have accomplished much during the first two years of the Validation Phase. The geologic projects cover a wide range of strata. Terrestrial projects are also regionally appropriate. The Partnerships are poised to greatly increase the carbon sequestration knowledge base and complete the groundwork necessary for large-scale tests envisioned for the ***deployment phase***, scheduled for Fiscal Year 2008.

Scaling up the size and duration of projects is vital to resolving key operational issues. The deployment phase will be implemented in three stages. First will be site selection and characterization, NEPA compliance and permitting, and infrastructure development. Actual CO_2 injection and monitoring will follow in the second phase. The third phase will include site closure and post-injection monitoring/analyses. ■

Big Sky's cropland field test could result in value-added products for farmers, such as increased soil fertility and crop productivity, and carbon credits

PROGRESS IN TWO MAJOR CCPI PROJECTS

Two projects under the U.S. Department of Energy (DOE)-sponsored Clean Coal Power Initiative have made significant progress in demonstrating new technologies to remove mercury from coal and enhance use of low-Btu lignite coals while increasing energy efficiency. The Wisconsin Electric Power Company (We Energies) is demonstrating the TOXECON™ mercury control process at its Presque Isle Power Plant near Marquette, Michigan, while Great River Energy (GRE) is showing the viability of lignite fuel enhancement at its Coal Creek Station in Underwood, North Dakota. Both projects were awarded in 2004 under Round I of the Clean Coal Power Initiative. Elsewhere in the program, six projects are in various phases of planning or operation. Plans for a third round under the CCPI were announced on May 23, 2007 (see News Bytes on page 1).

WE ENERGIES TOXECON™

TOXECON™ is an EPRI patented process that integrates a mercury (Hg), particulate matter, SO_2, and NO_X emissions control system, while maintaining a marketable quality fly ash. Specific project goals include 90 percent mercury removal and 100 percent fly ash utilization. TOXECON™, with injection of powdered activated carbon (PAC) downstream of the electrostatic precipitator (ESP) and use of a baghouse, is the cleanest mercury control technology available for hot-side ESP plants. The U.S. hot-side market for this technology is estimated at 42 GW. We Energies is teaming with ADA-ES, Inc., Cummins & Barnard, Inc., Wheelabrator, Thermo Fisher Scientific, and EPRI to carry out the TOXECON™ project at three 90-MW units using Powder River Basin coal.

Presque Isle TOXECON™ plant

In the TOXECON™ process, PAC is injected downstream of the hot-side ESP and upstream of the baghouse. Temperatures in the ESP are so high that PAC would be ineffective if injected there. At the tail end of the process, a baghouse provides additional particulate removal and increased contact time for the sorbents. TOXECON's™ high air-to-cloth ratio (a parameter representing gas velocity through the bags) in the baghouse leads to lower capital investment costs while allowing design flexibility for ancillary equipment selection. Outage time also can be reduced with the TOXECON™ system since the downstream system can be built, installed, and checked while the ESP is in full operation.

A significant milestone was met during January 2007 after 48 consecutive days where mercury removal exceeded 90 percent using DARCO® Hg and Hg-LH sorbents. In addition, baseline baghouse testing achieved 99.6 percent particulate removal. The air-to-cloth (A/C) ratio in the baghouse was studied to determine whether varying ratios would affect baghouse design. Tests thus far show A/C ratio has no effect on mercury removal over the range of 5 to 6 ft/min. The absence of A/C ratio constraint in this range would allow more design flexibility with ancillary equipment.

During the fourth quarter of 2006, tests were performed to determine the effect of baghouse cleaning frequency on mercury removal efficiency (by adjusting the baghouse differential pressure (ΔP) control set point). The greater the ΔP across the baghouse filter bags, the thicker the dust layer on the bags. This affects the time dust has contact with the gases, which was suspected to influence mercury removal efficiency since the dust layer contains significant amounts of PAC. For these tests, the set point was reduced by increments of 0.5 inches of H_2O from 6.5 inches of H_2O down to 5.0 inches of H_2O. The data showed that at lower flue gas temperatures (<320 °F) there was little difference in mercury removal between the four set points. This allows for more frequent cleaning, lower pressure drop, and reduced auxiliary power requirements, while maintaining high mercury removal efficiency. At higher temperatures, mercury removal was significantly affected by pressure drop settings.

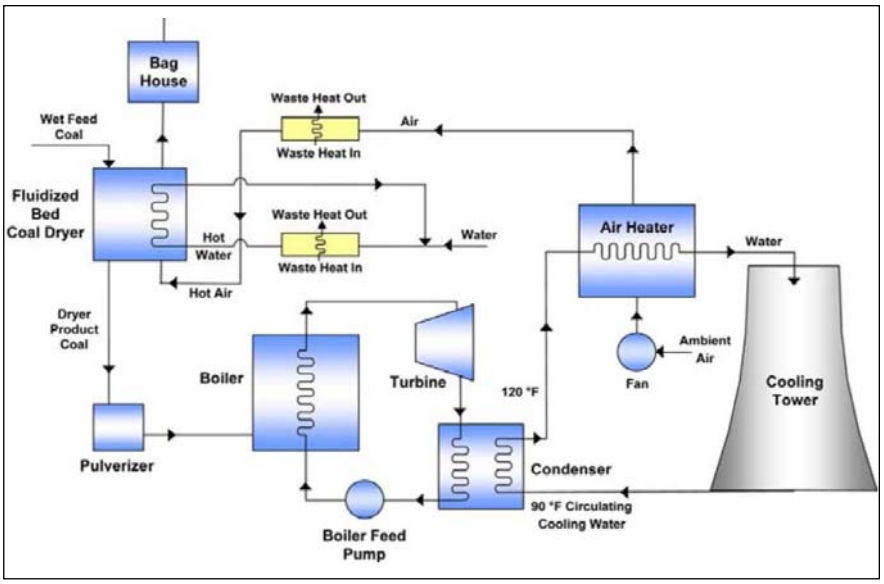
Balance of plant functions outside the emissions control system also provided valuable lessons, and commercialization decisions can turn on such issues. During initial operation, for example, undesired high carbon ash combustion in the hoppers forced a delay in the testing after several weeks of continued PAC injection. Working with industry, We Energies, DOE, and team members have identified the cause of PAC/ash ignition/combustion in the hoppers, and developed preliminary guidelines for the safe operation of hoppers. Issues with the ash silo dust emissions and

wet mixing of the PAC/ash mixture from the baghouse were similarly resolved, as were excessive dust emission during unloading of the ash silos.

Mercury continuous emissions monitoring operation has been successful, with over a year of operation. Preliminary field tests show that the Thermo Fisher device passed U.S. Environmental Protection Agency Performance Specification 12A Compliance Testing. Additional Relative Accuracy Test Audit (RATA) testing will be performed in FY2007, and the TOXECON™ demonstration is scheduled to end in March 2009. Between now and then, work will include: additional RATA testing, tests on fabric filter performance and durability in the PAC environment, NO_X and SO_2 control using Trona injection, and ash-mercury management.

LIGNITE FUEL ENHANCEMENT

Another important and award-winning CCPI project has been ongoing since July 2004 and is scheduled to be completed in December 2008. GRE is demonstrating moisture reduction of low-rank lignite coal (higher heating value of 6,200 Btu/lb), to increase its energy value so that less coal is required to produce an equivalent amount of electricity with fewer emissions. The project is being conducted at Unit 2, one of two 546-MW lignite-fueled units at GRE's Coal Creek Station in Underwood, North Dakota. DOE is to provide $13.5 million of the $31.5 million project cost. Project participants include Barr Engineering Company, Heyl & Patterson, EPRI, and Lehigh University, with Falkirk Mining Company providing the lignite coal.



Schematic of the Lignite Fuel Enhancement process

The Lignite Fuel Enhancement System uses waste heat from the power plant to reduce moisture content in the lignite (now 38 percent) to 30 percent, before feeding the lignite into the boiler. This waste heat utilization represents significant energy savings, since typically 45 percent of the fuel heat input to a conventional pulverized coal-fired power plant is lost in the condenser hot water, and another 20 percent is lost in the stack gas.

In Phase I, which ended in August 2006, a 115-ton/hr prototype dryer was designed, constructed, and tested to process up to one-fourth of the coal now fed to Unit 2. The partially dried coal was fed to one of the seven pulverizers normally in use. Following this success, GRE designed four full-scale (135-ton/hr) dryers needed for full-power operation of Unit 2. These would have throughput capacity 20 percent higher than the prototype. Construction of this full-scale dryer system is in progress. Separately, and as evidence of promising results thus far, GRE announced plans to equip Unit 1 (not part of the CCPI project) with the dryer technology, applying lessons to be learned as work on Unit 2 progresses (see Fossil Energy *Techline*, June 6, 2007).

The dryer is a two-stage fluidized bed in a single vessel, using fluidized-bed mixing, segregation, and drying characteristics. The full boiler dryer system uses plant cooling water and flue gas as the major heating medium. Water drawn from the cooling tower captures heat from the steam condenser in the boiler circuit, raising the temperature to about 120 °F. The heated water is routed to an air heater before returning to the plant cooling water circuit. Ambient air is heated in the air heater and subsequently used as the fluidizing media in the fluidized-bed dryer to provide heat along with hot water. A two-stage dryer is used to enhance heat transfer.

During prototype testing, coal is dried to varying moisture levels to measure the effect of coal drying on plant performance. The dryer optimum operating conditions and the effects of partially dried coal on the unit performance were determined from a series of paired performance tests (with and without dryer) under

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DOE STUDIES ON COAL-TO-LIQUIDS

The U.S. DOE Office of Fossil Energy (FE) National Energy Technology Laboratory (NETL) has issued reports that examine the feasibility of coal-to-liquids (CTL) facilities, both the general and the site-specific. The reports are part of a NETL/FE effort to provide guidance for R&D efforts in view of growing interest in CTL fuels by government agencies, the private sector, and Congress. FE has funded some CTL projects while accomplishing complementary goals of the Hydrogen from Coal Program and the Clean Coal Power Initiative.

NETL performed separate studies for a commercial-scale CTL plant (50,000 bpd), a small-scale plant (10,000 bpd), and a site-specific (Healy, Alaska) plant (14,640 bpd) that would produce diesel fuel, naphtha, and electricity. Commercial-scale CTL plants using high-Btu Midwestern bituminous coal represent promising economic opportunities depending on the price of crude oil (the base case tied to a crude oil price of $61/bbl provides a 19.8% return on investment (ROI)). The small-scale plant would be a less promising opportunity — while the total plant cost is reduced, it would not achieve the economies of scale that apply to CTL plants (ROI about 12% below the base case). The Alaska CTL plant would supply niche markets for petroleum products in Alaska, and would consider using the CO_2 produced for Enhanced Oil Recovery (EOR) or Enhanced Coal Bed Methane (ECBM) applications. Published studies are available at www.netl.doe.gov/energy-analyses/ref-shelf.html/.

Following Congressional directives in EPAct 2005, the U.S. Department of Defense (DoD) has been investigating uses of Fischer-Tropsch (F-T) fuels. Motivating forces are domestic availability and related security implications, increasing price of conventional fuels, the potential to lower tailpipe emissions, and use for a wide range of military systems. The Secretary of the U.S. Air Force issued a directive to test and certify

Table 1: Coal-to-Liquids Plants Under Consideration in the United States

Project Lead	Project Partners	Location	Feedstock	Status	Capacity	Cost
American Clean Coal Fuels	None cited	Oakland, IL	Bituminous/ Biomass	Feasibility	25,000 bpd	N/A
Synfuels Inc.	GE, Haldor-Topsoe, NACC, ExxonMobil	Ascension Parish, LA	Lignite	Feasibility	N/A	$5 billion
DKRW Advanced Fuels	Rentech, GE	Medicine Bow, WY	Bituminous	Design (2011)	13,000 bpd	$1.4 billion
DKRW Advanced Fuels	Rentech, GE, Bull Mountain Land Co.	Roundup, MT	Sub-bituminous/ Lignite	Feasibility	22,000 bpd	$1–5 billion
AIDEA	ANRTL, CPC	Cook Inlet, AK	Sub-bituminous	Feasibility	80,000 bpd	$5–8 billion
Mingo County	Rentech	WV	Bituminous	Feasibility	20,000 bpd	$2 billion
WMPI	Sasol, Shell, DOE	Gilberton, PA	Anthracite Culm	Design	5,000 bpd	$612 million
Rentech/Peabody	N/A	MT	Sub-bituminous/ Lignite	Feasibility	10,000–30,000 bpd	N/A
Rentech/Peabody	N/A	Southern IL, Southwest IN, Western KY	Bituminous	Feasibility	10,000–30,000 bpd	N/A
Rentech*	Kiewit Energy Co., WorleyParsons	East Dubuque, IL	Bituminous	Construction (2010)	1,800 bpd*	$800 million
Rentech	Adams County	Natchez, MS	Coal/Petcoke	Feasibility	10,000 bpd	$650–750 million
Baard Energy	AMEC Paragon	Wellsville, OH	Sub-bituminous/ Lignite	Feasibility	35,000 bpd	$4 billion
Headwaters	Hopi Tribe	AZ	Bituminous	Feasibility	10,000–50,000 bpd	N/A
Headwaters	NACC, GRE, Falkirk	ND	Lignite	Feasibility	40,000 bpd	$3.6 billion

*will co-produce fertilizer

F-T fuels, with the goal of procuring 50% of jet fuel requirements by 2016 from domestic resources. F-T fuels are being tested as a source of energy for today's military and commercial equipment, and for use in new technologies such as scram jets, rockets, fuel cells, and advanced turbine engines. The DoD development plan calls for using its infrastructure and authority to define standards, certify, test, and employ F-T fuels. As the world's largest institutional oil consumer, DoD is uniquely positioned to act as a catalyst for private industry to develop, distribute, and use F-T fuels. The commercial aviation industry formed a consortium to work with DoD and DOE to pursue alternative fuels. This Commercial Aviation Alternative Fuels Initiative has facilitated funding for projects that complement U.S. Air Force activities.

Congress is considering various CTL proposals, while the private sector is capitalizing on interest in F-T fuels by building pilot plants and performing feasibility studies for proposed plants. A wide variety of proposals call for domestic plants using all grades of coal (and biomass) ranging in size from pilot (1,800 barrels/day (bpd)) to commercial (50,000–80,000 bpd). CTL pilot projects in operation include the 10-15 bpd Rentech facility in Colorado, and Headwaters Incorporated's 30 bpd plant in New Jersey.

The private sector has joined together in the Coal-to-Liquids Coalition (www.futurecoalfuels.org/) (CTLC). Entities including Sasol, Rentech, DKRW, Baard Energy, Headwaters, and many others are jointly promoting legislation to aid a CTL industry in the United States. Recently, the Southern States Energy Board joined the CTLC.

Internationally, the Sasol plant in South Africa is the largest operational CTL plant, producing 150,000 bpd. Under construction in China are Shehua's 20,000 bpd (initially) plant, Lu'an Group's 3,000–4,000 bpd plant, and Yankuang's 40,000–180,000 bpd plant. China also has several projects in the planning stages: Sasol JV's two 80,000 bpd plants, Shell-Shenhua's 70,000–80,000 bpd plant, and Headwaters/UK Race Investment 70,000–80,000 bpd plant. Elsewhere, Pertamina/Accelon has an approximately 76,000 bpd plant under construction in Indonesia. In the Philippines, Headwaters has a 50,000 bpd facility in planning. Australia has two plants under consideration: Alton Resources plc, Jacobs Consultancy, and MineConsult are joining in a 45,000 bpd plant, while Anglo American/Shell is planning a 60,000 bpd facility. In New Zealand L&M group is planning a 50,000 bpd facility. ■

... "CCPI" continued

carefully controlled conditions. Because the prototype dryer supplied only 14 percent of the coal that would be supplied to the full-scale unit, moisture reduction was just 1.1 percent. However, this translated into a boiler efficiency increase of 0.5 percent, a stack flow rate decrease of 0.7 percent, and a pulverizer power consumption decrease of 3.3 percent. As for emissions, NO_x fell by 7.5 percent, mercury and CO_2 by 0.5 percent, and heat rate decreased by 0.5 percent. In prototype dryer tests, the segregated stream from the first stage was found to contain sulfur- and mercury-enriched components. Separating the segregated stream further reduces emissions in full-scale demonstration.

In terms of full-scale demonstration (Phase 2), design has been completed and dryer fabrication began in April 2007. The four-dryer integrated system, expected to be installed in March 2008, should meet the complete fuel needs of the 546-MW Unit 2, processing 3.75 million tons of raw coal per year. Operating data will be collected through 2008, after which the unit is expected to operate as an integral part of the utility's power grid.

Together, the We Energies and Great River Energy CCPI projects are helping to move forward this important demonstration program for advanced clean coal technologies. Watch for reports on all of these projects in future issues of *Clean Coal Today*. ■

... "News Bytes" continued

of locating the FutureGen plant in each of the given locales. ◆

In other NEPA-related activities, DOE in April 2007 signed a Record of Decision for SCS's Demonstration of a 285-MW Coal-Based Transport Gasifier in Orlando, Florida. The project was awarded under Round 1 of the CCPI, and now can proceed with detailed design activities. ◆

The U.S. Departments of Treasury and Energy have released new Advanced Coal Project Tax Credit Applications for 2007–2008. Applications for DOE certification are due to DOE by October 31, 2007. The credits are authorized under the Energy Policy Act of 2005 (see Fossil Energy *Techline* June 7, 2007). ◆

INTERNATIONAL INITIATIVES

CSLF CAPACITY BUILDING WORKSHOP

Emerging economy member countries of the Carbon Sequestration Leadership Forum (CSLF) are key partners in one international effort to address greenhouse gas emissions, through refinement and development of carbon capture and storage technologies. At the same time, some of the countries have signaled concerns that limited technological capabilities and financial resources hamper their ability to participate fully in CSLF activities and to host projects. Subsequently, capacity building has become a CSLF focus, including training efforts in RD&D and project implementation.

The first Capacity Building Workshop for Emerging Economies, organized by the CSLF Capacity Building Task Force, was held in Pittsburgh, Pennsylvania, May 7, 10, and 11, 2007. The event attracted 48 participants from Brazil (15), Colombia (1), India (15), Mexico (3), South Africa (10), and Saudi Arabia (4). The workshop was held in conjunction with the 6th Carbon Capture and Sequestration Conference (May 8–10, 2007) to give participants an unparalleled opportunity to learn about carbon capture and storage (CCS), and hear about the latest developments from world experts. In addition to providing an overview of carbon management issues and an update on international CCS projects, the workshop covered such topics as capture costs, economics, and financing; risk management; measuring, mitigation, and verification; and legal and regulatory frameworks. The workshop syllabus/agenda — expected to be a model for further training — was developed by NETL staff and international CCS experts with a high degree of input from the CSLF emerging economies as to their specific needs. Participants emphasized the current lack of a CCS knowledge base in emerging economies, and insufficient identification of potential sequestration sites. Lack of appropriate legal and regulatory frameworks was also a concern.

NETL Director Carl O. Bauer and Dr. Malti Goel

Several of the delegation members also participated in a panel discussion at the sequestration conference, entitled "Capacity Building Needs and Potential Ways to Meet Those Needs in Emerging Economies." The panel was co-chaired by Justin (Judd) R. Swift, Deputy Assistant Secretary for International Affairs, Office of Fossil Energy, and Chair of the CSLF's Capacity Building Task Force. Co-Chair was Dr. Malti Goel, Advisor in the Indian Ministry of Science & Technology and also Vice-Chair of CSLF Technical Group.

The final day of the workshop, held at the NETL Pittsburgh campus after the sequestration conference, included a tour of NETL's R&D facilities, and provided an opportunity for the participants to interact with NETL's researchers involved in cutting-edge CCS R&D.

NETL OFFICIALS MEET WITH BRAZILIAN REPRESENTATIVES

Over the past decade, several organizations in the Brazilian public and private energy sector have been in regular contact with the National Energy Technology Laboratory discussing areas of mutual interest, especially clean coal technologies to make use of the country's high-ash subbituminous coal resources. According to the last survey 25 years ago, coal resources total more than 32 billion metric tons in two southern Brazilian states

— 87 percent of the resources are in Rio Grande do Sul and 13 percent are in Santa Catarina. Development of the coal sector has stalled in recent decades, but is believed to be essential to Brazilian energy security.

In April, a delegation from Santa Catarina visited NETL to discuss potential collaboration. The delegation was headed by the State Governor, the Honorable L. H. da Silveira. Among the accompanying officials were two State Delegates, Clésio Salvaro and Valmir Comin; as well as Fernando Zancan, President of the Brazilian Coal Association (BCA) and Executive Director of the Santa Catarina Coal Producers Association (SIECESC). The Government of Santa Catarina plans to support local industry initiatives related to clean coal technologies and carbon capture and storage. The BCA also is planning to establish a R&D laboratory in Santa Catarina in association with SIECESC. The laboratory would focus on coal gasification and carbon capture and sequestration.

Subsequent to the April meeting, NETL Director Carl Bauer met with a group from Brazil on the sidelines of the Carbon Sequestration Leadership Forum (CSLF) Capacity Building Workshop and 6th Carbon Capture and Sequestration Conference held in Pittsburgh on May 7–11, 2007 (see cover article). Present at the meeting were Thais Murce Mendes and Paulo Cesar Cunha from Petrobras, and Dr. J. Marcelo Ketzer from the Pontifical Catholic University (PUC) of Rio Grande do Sul. Petrobras is a 53-year-old Brazilian quasi state-owned company, which is now in the process of becoming an integrated energy company. It had a net revenue of US$81.5 billion in 2006 and expects to invest US$87.1 billion in infrastructure in the 2007–2011 period.

Brazilian delegation visits NETL. Left to right: Santa Catarina Governor Luiz Henrique da Silveira; NETL's Dr. Ralph A. Carabetta; Santa Catarina legislators Clésio Salvaro and Valmir Comin; Santa Catarina Executive Secretary for International Affairs Vinicius Lummertz Silva, and Fernando Zancan, President of the Brazilian Coal Association and Executive Manager of Santa Catarina's Coal Producers Association

At this meeting, discussions with NETL centered on Petrobras and PUC interest in carbon capture and storage technologies. Brazil is an active member of the Carbon Sequestration Leadership Forum. In April 2006, at a meeting of the CSLF Joint Policy and Technical Group, Petrobras announced establishment of the Petrobras Carbon Sequestration Network for R&D, a laboratory infrastructure and education center to be run in cooperation with PUC. The 2006–2008 budget is US$6 million for the center, located in Porto Alegre, in the State of Rio Grande do Sul. In terms of commercial projects, PETROBRAS has been injecting CO_2 for enhanced oil recovery in wells in Bahia since 1987, with accumulated CO_2 injection of over 1 million tons. The company also has projects in CO_2 separation and capture, CO_2 storage, industrial residue carbonation, and carbon fixation into biomass.

The meeting resulted in tentative agreement for exchange visits between the countries. Brazilian scientists could work with U.S. experts in NETL's facilities, and NETL staff could travel to Brazil to conduct lectures, workshops, or other capacity building exercises. Other organizations, including NETL's R&D partners (university, private sector companies, and other national laboratories) may be brought into the cooperation later. Discussions are continuing on possible U.S.-Brazil cooperation. These efforts support DOE's efforts to promote deployment of clean coal and carbon capture and sequestration technologies in key countries that produce and use coal. ■

ACTIVE CCT DEMONSTRATION, PPII, AND CCPI PROJECT STATUS

CCT DEMONSTRATION STATUS

Kentucky Pioneer Energy (KPE), LLC – *Kentucky Pioneer Energy Project*. The Cooperative Agreement has expired. The Draft Final Report is in progress. (Trapp, KY and West Terre Haute, IN)

TIAX, LLC (formerly Arthur D. Little, Inc.) – *Clean Coal Diesel Project.* The Post Project Assessment is being developed. (Fairbanks, AK and Beloit, WI)

PPII STATUS

Universal Aggregates, LLC – *Commercial Demonstration of the Manufactured Aggregate Processing Technology Utilizing Spray Dryer Ash.* The Cooperative Agreement for this project expired on December 31, 2006. Universal Aggregates continues to make equipment modifications to improve throughput capacity and to extend the continuous run time of the plant. Their project team is preparing a Final Report. The plant is producing and selling lightweight aggregate to the concrete block industry. (King George, VA)

CONSOL Energy Inc. – *Greenidge Multi-Pollutant Control Project.* Construction of the integrated multi-pollutant control system at the coal-fired, AES Greenidge 107-MW Unit 4 in Dresden, NY, has been completed. Startup, commissioning, and performance testing are currently under way. Initial test results indicate that the targeted emissions reductions are being achieved. This project includes a unique hybrid selective non-catalytic reduction (SNCR) and in-duct selective catalytic reduction (SCR) system for NO_X reduction; a circulating fluidized bed dry scrubber for SO_2, SO_3, and acid gas reduction; and activated carbon injection for mercury control. This combination of technologies will demonstrate advanced emissions control at a lower cost than traditional retrofits at a plant of this size and age. (Dresden, NY)

CCPI STATUS

MEP-I LLC (Excelsior Energy Inc.) – *Mesaba Energy Project.* Excelsior's application for pre-construction site permits continues through the State approval process. The application included requests for a large electric power generating plant site permit and routing permits for a high voltage transmission line and natural gas pipeline. Also included was Excelsior's request for air- and water-related permits. The Draft Environmental Impact Statement, prepared by DOE in cooperation with the Minnesota Department of Commerce, is intended to fulfill the requirements of both the Federal and State environmental review processes. The document is expected to be available this summer. The Minnesota Public Utilities Commission (MPUC) is also considering Excelsior's petition for approval of a Power Purchase Agreement (PPA) with Northern States Power (*i.e.*, Xcel Energy), per the Minnesota Innovative Energy Project and Clean Energy Technology statutes. The MPUC is expected to rule on the PPA this summer. Excelsior is coordinating with the U.S. Army Corps of Engineers in regard to the wetlands permit process. The Project Definition and Development phase runs through April 2008. (Itasca & St. Louis Counties, MN)

NeuCo, Inc. – *Integrated Optimization Software.* The project at Dynegy's Baldwin Energy Complex has completed the planned efforts in Budget Period 1 within budget and on schedule. The Combustion Optimization module achieved the NO_X reduction goal of 5 percent along with improvements in cyclone stability. NeuCo has shown that its SCR Optimization module reduces ammonia consumption by 18 percent. NeuCo has installed the Sootblowing Optimization module on two separate units, with and without an intelligent sootblowing control system. This dual approach allows NeuCo to address a wide range of sootblowing issues. The latest releases of Combustion-Opt, SCR-Opt, and PerformanceOpt provide a variety of enhancements that were designed to make each of the optimizers less of a "black box." All three optimizers now support advanced functionality for real-time analysis. In May, Baldwin Energy Complex hosted a plant tour and discussion designed to demonstrate the use and the benefits of the optimizers. Over 100 people, representing about 50 fossil fuel power generators, attended this event. (Baldwin, IL)

University of Kentucky Research Foundation – *Advanced Multi-Product Coal Utilization By-Product Processing Plant.* University of Kentucky's Center for Applied Energy Research (CAER) withdrew from the project on March 31, 2007. CAER did not proceed further on this project because of lack of private cost share for detailed design and construction. A Final Report has been prepared. (Ghent, Carroll County, KY)

We Energies – *TOXECON™ Retrofit for Mercury and Multi-Pollutant Control.* The project is currently in the operational phase. A significant milestone was achieved early this year when mercury removal was above 90% for 48 consecutive days. The air-to-cloth (A/C) ratio (parameter that represents the gas velocity through the bags) in the baghouse had no effect on the level of mercury removal over the range of approximately 5–6 ft/min. Tests also were performed to determine the effect of baghouse cleaning frequency by adjusting the baghouse differential pressure (ΔP) control set point. The data showed that at lower flue gas temperatures (< 320 °F) there was little difference in mercury removal with respect to baghouse pressure drop

over normal operating range. This allows for more frequent cleaning, lower pressure drop, and reduced auxiliary power requirements while maintaining high mercury removal efficiency. Trona injection testing for multi-pollutant control is scheduled for August 2007. The TOXECON™ project has continued to successfully demonstrate, under full-scale power plant conditions, reliable mercury continuous emissions monitoring (CEM) (see article, page 4). (Marquette, MI)

Western Greenbrier Co-Generation, LLC – *Western Greenbrier Co-Production (WGC) Demonstration Project.* The preliminary process design is completed. WGC continues to work to finalize key project areas including the plant engineering/procurement/construction, and operations and maintenance contracts. Arrangements for sale of power to support a public tax-exempt bond sale to fund the project are in progress. The West Virginia Air Quality Board approved the WGC Air Permit in March 2007. The Final Environmental Impact Statement is expected to be released later this summer, followed by the Record of Decision. (Rainelle, WV)

Great River Energy (GRE) – *Lignite Fuel Enhancement.* In Budget Period 2, GRE initiated site preparation activities for the construction of two full-scale dryers. An order has been placed for the fabrication of the dryers. Detailed specifications for auxiliary equipment are being developed (see article, page 4). (Underwood, ND)

Pegasus Technologies – *Mercury Specie and Multi-Pollutant Control.* The project is in the construction/design phase. Sensors and other neural-network data acquisition features are being installed. Software configurations and control algorithms are also being designed and installed. Pegasus was granted a 5-month no-cost extension of budget period 1, from May to October 2007. The project objective is to demonstrate non-intrusive advanced sensors and neural network-based optimization and control technologies for enhanced mercury and multi-pollutant control on an 890-MW tangentially fired boiler. The Pegasus technology provides neural network optimization control. It also provides plant operators the ability to assess detailed plant operating parameters that affect mercury capture efficiency, overall heat rate, particulate removal and flue gas desulfurization efficiencies. The technology, once demonstrated, should have broad application to existing coal fired boilers and improve quality of saleable by-products such as fly ash. Performance testing is scheduled to begin in October 2008. (Jewett, TX)

Southern Company Services, Inc. – *Demonstration of a 285-MW Coal-Based Transport Gasifier.* The project has transitioned to Budget Period 2, which entails detailed engineering, equipment procurement, and construction. Orders are being placed for long-lead time equipment. An underground utility investigation for the plant site has been completed and interferences have been identified. SCS construction is expected to mobilize at the plant site in September/October to begin site preparation. (Orlando, FL) ■

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