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CLEAN COAL TODAY

A Newsletter About Innovative Technologies for Coal Utilization

News Bytes

In addressing participants at the Asia-Pacific Partnership on Clean Development and Climate site visit, on October 30, 2006 (see accompanying article), DOE's Assistant Secretary for Fossil Energy Jeffrey D. Jarrett announced a **major new effort under the Carbon Sequestration Regional Partnerships**. Over $450 million will be provided for a 10-year effort to carry out large-volume sequestration tests in geological formations around the country. Large volume tests are crucial to the deployment of the FutureGen plant, which will produce hydrogen and electricity from a coal-fired power plant, while capturing and sequestering CO_2 emissions. ◆

University of Kentucky's Center for Applied Energy Research has received the **2006 Coal Combustion Products Partnership's (C^2P^2) Special Recognition Award in Innovation**. The award is for pilot-scale

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Inside This Issue

Fossil Energy Participates in Asia-Pacific Partnership

The Department of Energy's Office of Fossil Energy (FE) is co-chairing one, and participating in two other, key task forces under the Asia-Pacific Partnership on Clean Development and Climate (APP), a major public-private effort aimed at accelerating deployment of cleaner, more energy-efficient technologies and practices. Six countries comprise the APP (United States, Australia, China, India, Japan, and the Republic of Korea). These countries are responsible for 49 percent of the world's electricity generation and over 64 percent of the world's coal production. U.S. membership was announced by the White House in June 2005, and the APP inaugural meeting was held in Sydney, Australia, in January 2006.

Michael Morris, AEP Chief Executive Officer, President, and Chairman of the Board, addressed the opening session of the AEP-hosted site visits

According to its Vision Statement, APP has its roots in the World Summit on Sustainable Development, which made clear the need for increased access to affordable, reliable, and cleaner energy throughout the world. The group is to build on existing bilateral and multilateral initiatives — such as the Carbon Sequestration Leadership Forum, and the Asia Pacific Economic Cooperation. It is designed also to be consistent with the United Nations Framework Convention on Climate Change and to complement, but not replace, the Kyoto Protocol. Areas of collaboration are far-ranging, from clean coal and liquefied natural gas, to various renewable sources and energy efficiency methods including building and home construction. The Department of State is the lead federal agency for U.S. participation. A distinctive feature of the APP, however, is private sector participation in order to ensure actual research efforts and projects.

APP has been organized into eight task forces. The Power Generation and Transmission (PG&T) Task Force is co-chaired by FE's Jarad Daniels and Guo Wei of China's National Development and Reform Commission. FE also is represented on the Cleaner Fossil Energy, and Coal Mining Task Forces. Other task forces include Renewable Energy and Distributed Generation, Steel,

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...“APP” continued

Aluminum, Cement, and Buildings and Appliances. The first formal APP activity under the PG&T Task Force (i.e., site visits held during October 30–November 4, 2006) was hosted by American Electric Power with additional support from Southern Company and Tampa Electric Company. AEP, the largest coal burning utility in the Western Hemisphere, is a participant in FutureGen and has committed to building IGCC-based power plants. Over 100 engineers from APP member nations attended the event — which started with a two and-a-half day introductory session at AEP headquarters in Columbus, Ohio. This was followed by site visits and a concluding session back in Columbus, where participants discussed the applicability of what they had learned and suggested next steps for the PG&T Task Force. High-level U.S. government participation included FE Assistant Secretary Jeffrey D. Jarrett, Chairman of the Council on Environmental Quality James L. Connaughton, and Under Secretary of State for Global Affairs Paula J. Dobriansky, who announced that APP member countries have endorsed more than 100 individual projects. Michael Morris, AEP’s Chairman, President, and CEO, opened the event.

EXISTING TECHNOLOGY AND IGCC TRACKS

AEP fostered a hands-on format where participants learned from one another, shared information, and collaborated on how best to address the world’s need to generate electricity from coal while minimizing environmental impacts. Detailed technical discussions were held on techniques for increased efficiency and pollution reduction, such as combustion optimization, and “intelligent” soot blowing. The agenda featured two technology tracks — one focusing on existing coal-fired power generation, specifically efficiency gains and reductions in CO_2 and air emissions; and the other focusing on advanced power generation, especially integrated gasification combined-cycle (IGCC) technologies.

L-R: Gary Thompson, energy production supervisor III at AEP’s Muskingum River Plant, answers questions about control room equipment for APP visitors from China (ZHANG Xingying) and Japan (Yoshitaka OKA)

Over half the representatives participated in the existing technology track, which included tours of two older AEP power plants: the 1,425-MW Muskingum River, and 2,600-MW Gavin plants. AEP has implemented heat rate improvements in its older plants, and will install flue gas desulfurization and selective catalytic reduction on all of its large plants over the next five years. Visitors interacted with AEP personnel to discuss new technologies and best practices for plant equipment including boilers, steam turbines, generators, air heaters, and condensers.

This site visit was well attended by representatives of India, since India, in work supported by USAID and NETL, has seen the attractive payback from even simple and inexpensive improvements to existing plants. AEP shared detailed information on various plant upgrades, including hardware modifications and implementation of better operating and maintenance procedures, as well as detailed plant performance data from both before and after each modification and the associated impact on economic and environmental factors.

Over 40 representatives, many from China, participated in the advanced power generation track, including tours of DOE’s Power Systems Development Facility (Wilsonville, Alabama) operated by Southern Company, to learn about KBR’s transport reactor gasification technology. This technology will be demonstrated by the Southern Company, the Orlando Utilities Commission, and KBR at a new 285-MW coal gasification facility near Orlando, Florida, with support from DOE’s Clean Coal Power Initiative. Later, the group traveled to Polk County, Florida, to visit the Tampa Electric 260-MW IGCC Polk Power Station. That project was co-funded by DOE under the Clean Coal Technology Demonstration Program, and has been in successful commercial operation since 1996. These tours allowed participants to see both air- and oxygen-blown IGCC technologies at large scale. Engineers also met with several IGCC technology providers (General Electric, GTI/Synthesis Energy, Shell, and Siemens) in Columbus to discuss technical and business issues with AEP’s IGCC design team. This design team is working to site AEP’s first commercial IGCC plants for which permit applications have been filed in Meigs County, Ohio, and Mason County, West Virginia. The group also heard from Battelle about the latest developments in carbon capture and storage.

Country Comparison: Total Installed Capacity by Fuel Type

	Australia Installed Capacity (MW)	China Installed Capacity MW)	India Installed Capacity (MW)	Japan Installed Capacity MW)	Korea Installed Capacity (MW)	U.S. Installed Capacity (MW)
Coal	32,038	All fossil fuels 329,483			17,965	338,538
Black coal	24,466		67,790	30,230	16,840	323,419
Brown coal/ lignite	7,572				1,125	15,119
Oil	359		1,201	39,335	6,091	37,970
Gaseous fuel simple-cycle	6,358		11,909	35,295		241,725
Gaseous fuel combined-cycle	2,076			22,838	16,447	193,188
Nuclear		6,836	2,770	47,122	17,716	105,560
Renewables	8,005	105,242		33,543	4,039	118,601
Hydroelectric	7,609		30,942	33,042	3,829	96,955
Other	396		3,811	501	210	21,646

Source: APP Power Generation and Transmission Task Force Action Plan, 2006

CONTINUING RELATIONSHIPS

Possible future activities include additional site visits, both in the U.S. and abroad, peer review studies, workshops, and capacity building approaches on a range of technologies. In terms of specific country activities, ***China*** wants to adjust its power mix and reduce the number of small-scale generators, while improving thermal power plant and end use efficiencies. China Datang Corporation expressed interest in AEP's process optimization for new IGCC projects, including selection of air separation and gasifier technology. China Guodian Corporation proposed site visits to show its plasma ignition technology for pulverized coal (PC)-fired power plants.

Like China, ***India*** wants to build larger plants to realize economies of scale, in addition to retrofitting older plants. India's need for power is such that over the next 30 years, capacity will need to be doubled every 10 years. Investment requirements are estimated at $100 billion over the next five years alone. India believes AEP's methodology could improve efficiencies of under-performing Indian power plants. As a first step, Indian power plants would need to identify benchmarking parameters against which to measure progress in efficiency, economics, and environmental controls. India would also like to update existing units with coal washing, increased carbon controls, and NO_x controls. Specifically, the Tamil Nadu Electricity Board expressed interest in developing formal long-term cooperation with AEP to improve efficiency and reduce the maintenance costs at its existing PC-fired power plants, and to share information on advanced coal-based power generating technologies.

The ***Australian delegation*** showed interest in learning how to apply IGCC technology to their domestic, high-moisture brown coal, which requires drying before gasification. Australian representatives seek higher performance from existing PC-fired power plants, and invited AEP and other APP power companies to help them establish benchmarks.

Japan proposed to lead a Peer Review for the first quarter of 2007. Peer Reviews are recommended throughout the APP action plans as a method of learning "best-of-kind" operation, maintenance, and management practices of similar type coal-fired plants in each APP partner country. Goals would be to build a knowledge base that could be used to increase power generation efficiency, reduce emissions, improve operation and maintenance, and facilitate life extension and retrofits.

The ***Korean delegation*** noted introduction of competition into Korea's electric generating sector, and expects to benefit by cooperating with other APP nations. Lastly, by sharing their experiences, ***U.S.*** utilities can help other APP nations to address environmental concerns common to coal-based utilities, as well as learn from other country's experiences. U.S. involvement in APP is expected to generate global interest in clean coal technologies, and promote the export of clean technologies developed with support of the FE RD&D program.

For more information on APP, including task plans and vision statement, see:

www.asiapacificpartnership.org ■

ADVANCED SEPARATION CONSORTIUM

The Center for Advanced Separation Technologies (CAST) was formed in 2001 under the sponsorship of the U.S. Department of Energy to conduct fundamental research in advanced separation and to develop technologies that can be used to produce coal and minerals in an efficient and environmentally acceptable manner. The CAST consortium consists of seven universities — Virginia Tech, West Virginia University, University of Kentucky, Montana Tech, University of Utah, University of Nevada-Reno, and New Mexico Tech. The consortium brings together a broad range of expertise to solve problems facing the U.S. coal industry and the mining sector in general. At present, a total of 60 research projects are under way.

INNOVATIVE DEWATERING TECHNOLOGIES

One of the most important research activities under way at CAST is the development of new technologies for solid-liquid separation, especially for fine coals. Moisture removal is the most costly aspect of coal preparation. Thermal dryers can effectively reduce moisture, but high capital costs and stringent air quality standards have made that technology impractical for new industrial sites. As a result, coal producers resort to mechanical systems that perform poorly for particles finer than 0.1 mm. Coal fines with high moisture content must be discarded in impoundments, contributing to solid waste disposal problems, possible groundwater contamination, not to mention the lost energy value. In the U.S., approximately 2 billion tons of fine coal have been discarded in abandoned ponds and 500 to 800 million tons in active ponds. U.S. coal producers continue to discard 30 to 40 million tons of fresh coal fines into ponds each year.

To address this problem, researchers at CAST have developed novel dewatering aids that can substantially improve the removal of surface moisture from fine coal during vacuum filtration. A commercial demonstration of this innovative dewatering technology is currently underway by Beard Technologies, Inc. Shakedown testing began in November 2006 at the Pinnacle reclaim plant installed next to a large impoundment in Wyoming County, West Virginia. The plant will be one of the few to recover coal from waste impoundments without the benefit of tax credits provided under Section 29 of the Internal Revenue Code. These tax credits were authorized in the Crude Oil Windfall Profit Tax Act of 1980, which was designed to encourage production of synthetic fuels from non-conventional sources. A deep ***cone thickener*** has been installed to hold the coal fines and eliminate the need for a waste impoundment. If the project is successful, technology is expected to be replicated in other impoundments.

CAST is testing other promising technologies such as a ***hyperbaric filter centrifuge***, which employs both gas pressure and centrifugal force to efficiently remove water from fine coal. Tests conducted to date with a small-scale pilot unit demonstrate that the new technology can reduce the moisture content of fine coal by 30–50 percent compared to currently available dewatering methods. Further tests are under way to see how different coal samples respond to this new technology. A licensing agreement has been signed with Decanter Machine Inc., the largest manufacturer of centrifuges in the United States. The company is planning to develop a production-scale prototype that can be tested in the coal industry.

Work is also under way at CAST to develop the ***hyperbaric horizontal belt filter*** (HHBF) technology. Construction of a pilot-scale test unit at Virginia Tech has been completed, and preliminary tests show that moisture can be reduced to less than 10 percent. In addition, the ***flocculant injection*** system developed by CAST is already in use by many coal companies to minimize the loss of fine coal associated with screen-bowl centrifuges, a dewatering technology already in use.

REMOVAL OF MERCURY AND OTHER IMPURITIES

The U.S. EPA issued the Clean Air Mercury Rule (CAMR) on March 15, 2005, which created performance standards and established permanent declining caps from the current annual 48 tons of mercury emission to 15 tons by 2018 from coal fired power plants. In order to meet this challenge, CAST has developed a ***metallic filter*** that can remove over 90 percent of mercury from the gaseous effluents discharged from a power plant. The filters were tested at a coal-fired power plant in eastern Montana. The results showed that the metallic filters removed more than 90 percent of the mercury from the power plant gas stream. The spent filter can be regenerated and reused.

Other CAST research projects have focused on improving the removal of unwanted impurities (*e.g.*, clay, sulfur, mercury, and other toxic elements) from coal, while helping the minerals industry

remain competitive. A joint Krebs Engineers-CAST project resulted in the development of a ***novel hydrocyclone*** that can efficiently remove clay (slimes) from fine coal. The same technology can also be used for processing other minerals. For example, laboratory experiments show that improved desliming can improve recovery of downstream potash by 4–6 percent. Adoption of these new technologies being developed at CAST will help the U.S. minerals industry remain competitive with imported minerals, and in doing so, retain U.S. jobs.

OTHER RESEARCH

CAST also is carrying out important work in the areas of solids-solids separation, modeling, sensors and controls, and chemical-biological separation. The bulk of the coal being cleaned today is coarse and treated by density-based separation processes. To monitor performance of these separators and maximize the efficiency of cleaning coarse coal, CAST researchers have developed ***electronic density tracers*** that make use of recent advances in transponder technology. Typically, density tracers are plastic blocks of known densities that are added to a feed stream, collected manually from product streams, and counted to determine the efficiency of separation — a process that is cumbersome and potentially inaccurate. Therefore, a new method has been developed in which the tracer is tagged with a transponder so that the destination of each tracer can be monitored electronically. The new technique has been tested successfully, and Precision Testing Laboratory of Beckley, West Virginia, has commercialization plans.

CAST research staff conduct tests of a new hyperbaric filter centrifuge developed to improve fine coal dewatering

In the area of modeling, CAST members have developed a mathematical model to describe the ***flotation process***, which is the most versatile solid-solid separation process used in both the coal and minerals industries. The model is based on first principles so that it has predictive and diagnostic capabilities. In another project, a computational fluid dynamic simulation technique has been used to design optimal flotation machines. This project is co-funded by Dorr-Oliver EIMCO. In addition, surface forces acting between two macroscopic surfaces immersed in water have been measured using the atomic force microscope and the surface force apparatus. The results show that an attractive force that is stronger and longer-ranged than the van der Waals force is present between hydrophobic surfaces immersed in water. Although its origin is not yet known, the ***hydrophobic force*** may play an important role in separating the hydrophobic energy minerals (coal, oil, bitumen, and kerogen) from hydrophilic minerals (including clay and silica). ■

... "News Bytes" continued

field tests and ash by-product evaluations at Ghent, Kentucky, under the Clean Coal Power Initiative (CCPI) Advanced Multi-Product Coal Utilization By-Product Processing Plant project. The C^2P^2 program is a cooperative effort of the U.S. Environmental Protection Agency, American Coal Ash Association, Utility Solid Waste Activities Group, U.S. Department of Energy, and U.S. Federal Highway Administration. ◆

On November 30, 2006, DOE announced the **award of $1 billion in tax credits to nine companies**, to bring about rapid deployment of advanced coal-based power generation and gasification technologies. These tax incentives are provided under the Energy Policy Act of 2005. ◆

DOE has published a **Notice of Availability for a Draft Environmental Impact Statement for Western Greenbrier Co-Production Demonstration Project**, a CCPI project. A public hearing is scheduled for early January and written comments must be received, or postmarked, by January 18, 2007 (fax 412-285-4403). A public hearing on a Draft EIS for another CCPI project — the Demonstration of a 285-MW Coal-Base Transport Gasifier — was held in Orlando, Florida, in September 2006. The Final EIS for that project is nearing completion. ■

MESABA NEXT-GENERATION IGCC PLANT

Through a U.S. Department of Energy (DOE) cooperative agreement awarded June 1, 2006, MEP-I LLC (a wholly-owned project company of Minnetonka-based Excelsior Energy) plans to demonstrate a next-generation integrated gasification-combined cycle (IGCC) electric power generating plant, the Mesaba Energy Project. The 606-MWe plant (the first of two similarly sized plants envisioned by project sponsors) will feature next-generation ConocoPhillips E-Gas™ technology first tested at the DOE-funded Wabash River Coal Gasification Repowering Project. Mesaba will benefit from recommendations of an industry panel applying the Value Improving Practices process to Wabash cost and performance results. The project will be twice the size of Wabash, while demonstrating better efficiency, reliability, and pollutant control. The $2.16 billion project ($36 million federal cost-share) will be located in the Iron Range region north of Duluth, Minnesota. Mesaba is one of four projects selected under Round II of the Clean Coal Power Initiative.

The overriding Mesaba objective is to develop a standard, replicable design configuration for a large, feedstock-flexible IGCC plant. The design would be based on sound cost data so that potential developers would have the best financial information possible, and would thus be more likely to develop commercial size plants. Technical goals are ambitious: gasifier system operational availability of 90 percent or better; fuel flexibility including bituminous and sub-bituminous coals, or a petcoke blend; a design heat rate of 8,600 Btu/kWh using bituminous coal; and improved environmental controls extending to mercury and carbon dioxide (CO_2). The E-Gas™ process captures approximately 80 percent of the chemical energy in the feedstock. The heat recovery system captures up to an additional 15 percent of the feedstock energy in the form of steam, for a total feedstock conversion to useful energy of up to 95 percent.

EARLY PROGRESS

The project definition and development phase is moving forward. Conceptual design and associated optimization studies have been completed. More detailed engineering and design have been initiated, as have discussions with an engineering, procurement, and construction contractor (a consortium of Fluor Enterprises, ConocoPhillips, and Siemens), as preparatory to a turnkey arrangement. The DOE is providing 50 percent cost-share of the $44.5 million pre-construction costs. The construction phase is expected to begin in April 2008. DOE will not cost-share project construction, but will provide $13.8 million (24.5 percent) of the $56.4 million required for operational demonstration, expected to begin in early 2012. DOE also may provide a loan guarantee pursuant to the Energy Policy Act of 2005 to cover a portion of the private sector financing of the project.

Permitting for the project is also moving forward, and a joint DOE-State of Minnesota draft Environmental Impact Statement is to be issued in early 2007. Public environmental scoping meetings were held by DOE in October 2005, while the state held separate scoping meetings in August 2006. Minnesota requires evaluation of two alternative sites for the project. Itasca County is the site preferred by the sponsors, with St. Louis County as the secondary site. A request for a long-term Power Purchase Agreement (PPA) was submitted to the Minnesota Public Utilities Commission (MPUC) in December 2005, and a decision is expected by October 2007. The PPA application includes requests for a large electric power generating plant site permit and routing permits for a high voltage transmission line and natural gas pipeline. Air and water-related permit applications have also been filed.

THE E-GAS™ PROCESS

Mesaba is a logical follow-on to the successful, though smaller scale and less complex, 262-MWe(net) Wabash project. Mesaba will deploy substantial technology advancements in gasification, fuel flexibility, and air separation. A key element of the project is the multiple train gasification island, with an advanced full-slurry quench, oxygen-blown, continuous-slagging two-stage entrained-flow ConocoPhillips E-Gas™ gasifier. The gasifier converts carbonaceous feedstock to synthesis gas and a glassy vitrified inert slag resembling coarse sand. This technology is more advanced than that used at the Wabash facility, which incorporated only a single train and partial slurry-quench design. The unique two-stage gasifier increases efficiencies, and provides feedstock mixing.

The advanced Air Separation Unit (ASU) configuration is first of its kind in the United States. It provides combustion turbine air integration, extracting turbine bleed air to reduce the parasitic load of the main ASU air compressor, thereby increas-

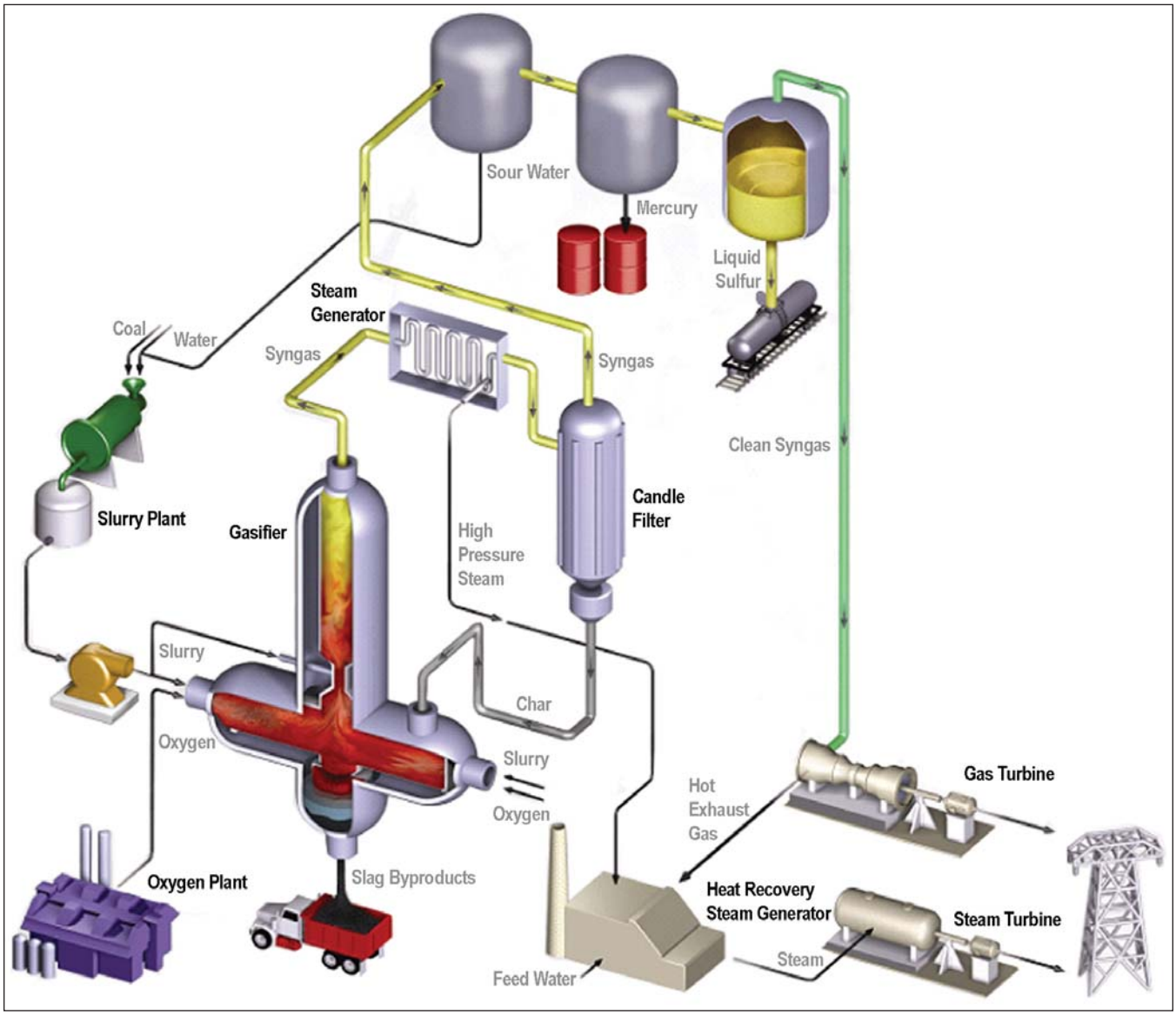
ing net plant output and reducing capital cost. The configuration will also provide for nitrogen dilution by recycling nitrogen extracted from air entering the ASU for combustion turbine injection to reduce formation of nitrogen oxides through reduced combustor flame temperature and time combustion gases remain at elevated temperatures.

PROCESS DETAILS

The process begins with feedstock acceptance and storage, and slurry preparation. The feedstock is slurried with water and injected, along with oxygen from ASU, into the first-stage gasifier. The multiple train gasification island contains three gasifier trains (the third is a spare), slag handling, synthesis gas cooling, gas cleanup, and synthesis gas conditioning. In the first-stage gasifier, the feedstock undergoes a partial oxidation reaction to form synthesis gas composed of hydrogen, carbon monoxide, carbon dioxide, and methane. The high temperature and pressure ensure the complete conversion of all feedstock, and traps the inorganic ash and metals as molten slag. The slag — which has various uses in the construction industry — falls through a tap hole in the bottom of the first stage into a water quench.

Raw hot syngas from the first-stage then flows upward into the second-stage gasifier, where it is quenched with more slurry injected without need for additional oxygen. This second slurry stream is volatilized in an endothermic reaction with the synthesis gas to increase the energy content of the gas. The raw synthesis gas exiting the second-stage gasifier is cooled in a unique steam genera-

See "Mesaba" on page 9...



Simplified diagram of Mesaba system (does not show multiple trains)

INTERNATIONAL INITIATIVES

U.S.-INDIA ENERGY DIALOGUE COLLABORATES ON COAL

Under auspices of the U.S.-India Energy Dialogue launched by U.S. Secretary of Energy Samuel W. Bodman, and India's Deputy Planning Commissioner, Dr. Montek Singh Ahluwalia in May 2005, the U.S. DOE Office of Fossil Energy (FE) and the Indian Government have established a Coal Working Group (CWG) and are carrying out a work plan to cooperate in a number of clean coal areas. India is the world's third largest coal producer, and is committed to a significant expansion of coal production and coal-based power generation over the next decade. The CWG is assisting India in deploying coal cleaning technologies and practices that can improve the economics and efficiencies of processing India's high-ash coal. The CWG is chaired by FE's Assistant Secretary Jeffrey D. Jarrett, and co-chaired by Additional Secretary S.P. Seth of India's Ministry of Coal. Areas of proposed collaboration include underground coal gasification, coal cleaning, methane capture from active and abandoned coal mines, sustainable mining practices, and improved mine health and safety.

Technical exchanges are an important tactic in the work plan. In October 2006, FE and the National Energy Technology Laboratory led a delegation from Coal India Limited on a tour of several underground and surface coal mines in Colorado, Utah, and Wyoming. The trip focused on observing U.S. methodologies, and consulting with U.S. experts on suitable methods to extract coal from thick, steep, multiple gassy underground seams that are common in India, while attaining high coal yield during the extraction process. Overburden slope stability during surface mining was another topic that was of particular interest. The visitors consulted with mining experts at each site regarding engineering planning and modeling, geological conditions, environmental issues, costing, operation details, and equipment specifications. Several best practices and opportunities for improvement in India were identified.

FE Assistant Secretary Jeffrey Jarrett and India's Ministry of Coal former Additional Secretary Pradeep Kumar sign the Energy Dialogue Coal Work Plan

The CWG also is sponsoring workshops. The Underground Coal Gasification Workshop, sponsored jointly by DOE/FE, Lawrence Livermore National Laboratory, and India's Ministry of Coal, was held in Kolkata, India from November 12–15, 2006. Underground coal gasification (UCG) is considered a potential technology to economically access energy resources from deep or unmineable coal seams, while producing synthesis gas for power generation, synthetic liquid fuels, natural gas, or other chemicals. The combination of UCG with CO_2 sequestration offers important economic and environmental benefits. Nearly 100 decision makers from government, industry, research institutions, and academia from the United States, India, China, Japan and Australia participated in the workshop.

As a joint activity of CWG and the Asia Pacific Partnership, DOE/FE is planning a "Workshop on Enhancing the Use of Washed Coal in India" to be held in New Delhi, India in Spring 2007. Coal preparation services

and equipment represent a major export market for the United States. Funding also has been provided to FE by DOE's Clean Energy Technology Export Program and the Department of State for conducting an economic analysis of coal beneficiation. Coal cleaning has been shown to increase efficiency in burning Indian coals. Washing also reduces bulk, which lowers rail transportation costs. Air emissions and solid waste quantities have been reduced as well.

In 2007, FE in cooperation with Indian counterparts will continue implementing the actions outlined in the work plan, and coordinate these Energy Dialogue activities with related actions being pursued under the Asia-Pacific Partnership on Clean Development and Climate (see article, page 1). In addition, the next formal meeting of the CWG will be hosted by the United States. ■

Six Indian engineers and two FE representatives visit Twentymile Coal Mine near Steamboat Springs, Colorado. Indian visitors are all from subsidiaries of Coal India Ltd. L to R: Morgan Mosser (FE/NETL), Subir Das, Asok Roy, Craig Zamuda (FE), Rajesh Gupta, Anil Rana, A.K. Singh, and S. Chandraseklar

..."Mesaba" continued

tor system to produce high-pressure saturated steam in a fire-tube boiler that is much smaller and less costly than traditional power plant steam generators. This high-quality steam is supplied to the Heat Recovery Steam Generator (HRSG). After cooling, the entrained dry particulate removal process — consisting of a cyclone and candle filter — recycles the char back to the first-stage gasifier. This consolidates the solids in one stream as a slag exiting the first-stage. This simple dry system, which maximizes carbon conversion with 99.9 percent reliability, is significantly more efficient than the wet-scrubbing systems employed by other technologies, removing more particulates and avoiding black-water problems which lead to equipment wear.

Next, chlorides, mercury, and sulfur contaminants are removed from the synthesis gas stream in a series of chemical processes. Mercury is captured in a carbon bed for disposal in approved sites. Sulfur compounds are recovered and converted to elemental sulfur for sale in agricultural and other markets. Unlike most technologies that vent tail gas from the sulfur recovery unit to an incinerator, the E-Gas™ process recycles all unconverted gases to the second-stage gasifier, resulting in 99 percent sulfur recovery.

The desulfurized hydrogen-rich "sweet gas" then is heated, moisturized, and piped to the power block as fuel for the combustion turbines. Hot exhaust gas from the combustion turbines is supplied to the HRSG to superheat additional steam which is added to the steam provided by the fire-tube boiler. This is fed to the steam turbine. Spent steam and condensate is returned to the HRSG for superheating. ■

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Comments are welcome and may be submitted to the Editor.

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 Cooperative Agreement has expired. The Draft Final Report is in progress. (Fairbanks, AK and Beloit, WI)

PPII Status

Otter Tail Power Company – *Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector (AHPC) Technology.* The project has been completed. The Final Report has been submitted and approved. (Big Stone City, SD)

Sunflower Electric Power Corp. – *Demonstration of a 360-MWe Integrated Combustion Optimization System.* Due to larger than anticipated costs for installation of new low-NO_x burners and overfire air systems, Sunflower has withdrawn the continuation application to DOE for proceeding to Phase III Budget Period 2 of the project, and DOE has accepted Sunflower's withdrawal position. The project is now in closeout. A final report has been received and approved. (Garden City, KS)

Universal Aggregates, LLC – *Commercial Demonstration of the Manufactured Aggregate Processing Technology Utilizing Spray Dryer Ash.* The Cooperative Agreement for this project was scheduled to end on December 31, 2006. Universal Aggregates continues to make equipment modifications to improve throughput capacity and continuous run time of the plant. Although full-capacity operation has not yet been achieved, the plant has shipped finished product to its distributor and this material has been accepted and utilized by concrete block manufacturers. (King George, VA)

CONSOL Energy Inc. – *Greenidge Multi-Pollutant Control Project.* 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; activated carbon injection for mercury control; and a baghouse for particulate 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. Construction of the integrated multi-pollutant control system at the coal-fired, AES Greenidge 107-MW Unit 4 in Dresden, NY, has been completed. System startup and commissioning is under way and was expected to be completed by the end of December 2006. A continuation request to move to Budget Period 2 of the project, Operations and Testing, has been received and is being evaluated. (Dresden, NY)

CCPI Status

MEP-I LLC (Excelsior Energy Inc.) – *Mesaba Energy Project.* Excelsior's application for pre-construction 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. A draft Environmental Impact Statement (EIS), prepared by DOE in cooperation with the Minnesota Department of Commerce and the MPUC and intended to fulfill the requirements of both the Federal and State environmental review processes, is expected to be available in early 2007. The MPUC is also considering Excelsior's petition for approval of a 603-MWe power purchase agreement with Northern States Power, per the Minnesota Innovative Energy Project and Clean Energy Technology statutes. 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 NOx reduction goal of 5 percent along with improvements in cyclone stability. NeuCo has shown that by using their SCR Optimization module, they are reducing 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 release of CombustionOpt, 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 analytics. (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) is evaluating ash byproducts separated in pilot scale field tests at the 2,200-MW Ghent Generating Station. The ultra-fine ash (smaller than 5 μm), when used at 20 percent level in concrete, outperformed typical ash by achieving up to 107 percent of control strength in 28 days. These tests were conducted using a Ken-

tucky Transportation Pavement Mix Design. In the tests performed using Kentucky Transportation Cabinet High Performance Mix Design, the ultra-fine ash outperformed the control formulation in strength. Tests were also performed by varying the ultra-fine ash substitution levels in concrete from 5 percent to 35 percent. These tests showed that, although higher substitution levels (*e.g.*, 35 percent) delay early strength development, the control strength was surpassed after 28 days. Lower substitution levels (5 percent to 10 percent) provided both early and long term strength. (Ghent, Carroll County, KY)

We Energies – *TOXECON™ Retrofit for Mercury and Multi-Pollutant Control.* This project is currently in the operations phase. We Energies is addressing balance of plant issues and performing parametric and optimization testing. Hot glowing embers were previously found in the baghouse hoppers. As a result, We Energies reduced the temperature set point for the hopper heaters and empties the hoppers more frequently, which appears to have addressed the problem. Laboratory tests confirm spontaneous combustion of the activated carbon follows the Frank-Kamenetskii model. We Energies is modifying the materials handling system used to unload the storage silo containing spent sorbent and flyash, because operation of this system results in dust emissions. Parametric testing of the Norit DARCO-Hg powdered activated carbon has been completed, and testing of the Norti DARCO-Hg-LH bromindated, powdered activated carbon is on going. Optimization testing to determine the effect of bag cleaning cycles on mercury emission control is being performed. The TOXECON™ project has continued to successfully demonstrate, under full scale power plant conditions, reliable mercury continuous emission monitors (CEM). (Marquette, MI)

Western Greenbrier Co-Generation, LLC – *Western Greenbrier Co-Production (WGC) Demonstration Project.* WGC continues to work to develop key project areas including the waste coal resource plan, coal upgrading processes, and arrangements for sale of power to support a public tax-exempt bond sale to fund the project. The preliminary process design is completed. DOE approved a modification to the Cooperative Agreement to extend Phase 1 by 6 months, (from October 31, 2006 to April 30, 2007). The Draft Environmental Impact Statement (EIS) was completed, approved, and made available for public review. The EPA and DOE Notices of Availability for the document were published in the Federal Register on December 1st and 4th, respectively. A public hearing will be held in Rainelle, WV, on Thursday evening, January 4, 2007. The public comment period for the draft will end on January 18, 2007. (Rainelle, WV)

Great River Energy (GRE) – *Lignite Fuel Enhancement.* GRE has initiated design of a full-scale dryer system in Budget Period 2. In this period, GRE will be constructing two full-scale dryers, which can supply 50 percent of the coal needed for a 546-MW unit. The design activities relating to the following areas have been initiated: coal handling section, detailed design and construction schedule, crusher area layout drawings, naming conventions, air flowsheets, and water flowsheets. Since March 2006, GRE has operated the first coal dryer, and processed more than 210,000 tons of lignite coal. Lignite moisture content was reduced from about 38.5 percent to 29.5 percent, and the dried coal was supplied to the 546-MW Unit 2 at the Coal Creek Station. (Underwood, ND)

Pegasus Technologies – *Mercury Specie and Multi-Pollutant Control.* The cooperative agreement was signed in April 2006. Budget period 1 is progressing with installation of sensors and other neural-network data acquisition and control software and hardware. The project will 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 at the project host site in Jewitt, Texas. The Pegasus technology provides plant operators the ability to assess detailed plant operating parameters which affect mercury capture efficiency as well as overall heat rate, and 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 will begin in October 2008. (Jewett, TX)

Southern Company Services, Inc. – *Demonstration of a 285-MW Coal-Based Transport Gasifier.* Work is continuing on preparing the comprehensive Front End Engineering Design (FEED) package. The Final Environmental Impact Statement (EIS) was scheduled to be issued in late 2006 or early 2007. (Orlando, FL) ■

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