

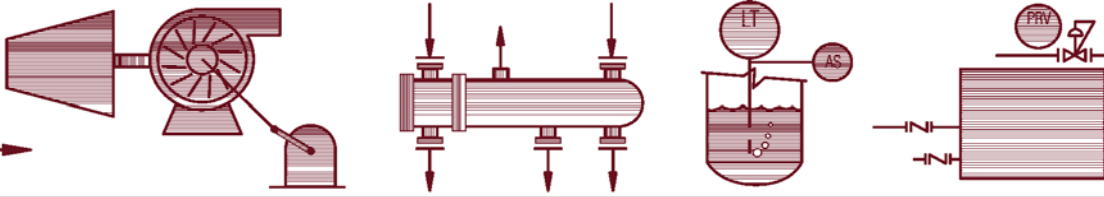
# ENERGY SOURCE

A Newsletter published by

## ESI

The Steam and Power *SPECIAL FORCES*®

Winter 2006



# FLY ASH CARBON BURN-OUT

*What are you doing with your Fly Ash?*

*By: William L. Reeves, P.E., President, ESI*

*Lisa I. Cooper, Vice-President, PMI*

*S. Frank Kirkconnell, P.E., Vice-President and General Manager, PMI*

**P**rogress Materials, Inc. (PMI), a subsidiary of Progress Energy, developed the patented Carbon Burn-Out (CBO)<sup>TM</sup> technology to provide a cost-effective, reliable method of reducing fly ash carbon content to produce an admixture with consistent performance desired by the concrete admixture marketplace. The CBO process uses a specially designed, fluidized bed to substantially complete the carbon combustion begun in the power plant boiler. The fluidized bed is nearly ideal for providing optimal residence time, temperature, and oxygen content for combustion of fine particle, low heating value, non-volatile fly ash “fuel”. It is also ideal to handle the environmental challenges of today and the future.

ESI Inc. of Tennessee took the process parameters developed by PMI and, working with PMI, designed and produced the required information to construct the first facility. ESI was the engineer and provided construction management services for the first commercial carbon burn-out (CBO) facility built in the United States. To date, two full-scale commercial Fly Ash Carbon Burn-Out Facilities are in operation, and two more facilities are under construction.

## **Carbon Burn-Out Process & Technology**

Referring to the CBO Process Schematic on the following page, the process is described first by following the ash and then, separately, the air. High-carbon ash (feed ash) is pneumatically conveyed from the power plant’s existing silo(s) to the CBO feed ash silo. From there, feed ash is continuously metered into the fluid bed combustor (FBC) where most of the carbon fraction is combusted. The ash from the FBC is then pneumatically transported through the gas/product (G/P) cooler. The ash is typically cooled by bypassing a portion of the power plant’s condensate stream and directing this bypass stream to the G/P cooler. The heat picked up in the G/P cooler can be used to increase the efficiency of the power plant. The cooled FBC exhaust gas and low-carbon fly ash stream is separated in the fabric filter dust collector. The low carbon ash (product ash) is pneumatically conveyed to the storage and load-out area where it is sent to market.

## **ENERGY SOURCE**

The *ENERGY SOURCE* is published quarterly for customers, employees, and friends of ESI Inc. of Tennessee.

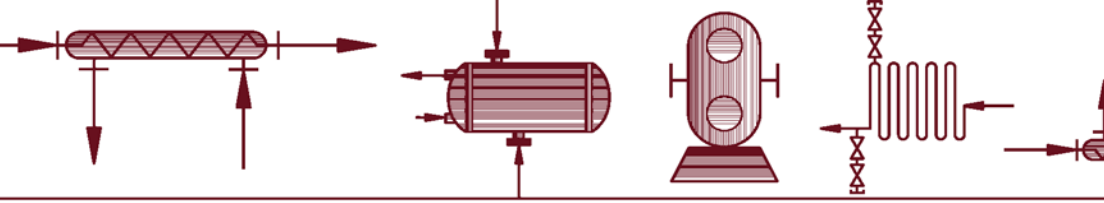
ESI is the Steam and Power *SPECIAL FORCES*<sup>®</sup> providing clients with innovative, cost-effective, and environmentally-friendly solutions.

If you have any suggestions or comments about the newsletter feel free to call us at 770-427-6200 or e-mail us at [energysource@esitenn.com](mailto:energysource@esitenn.com).

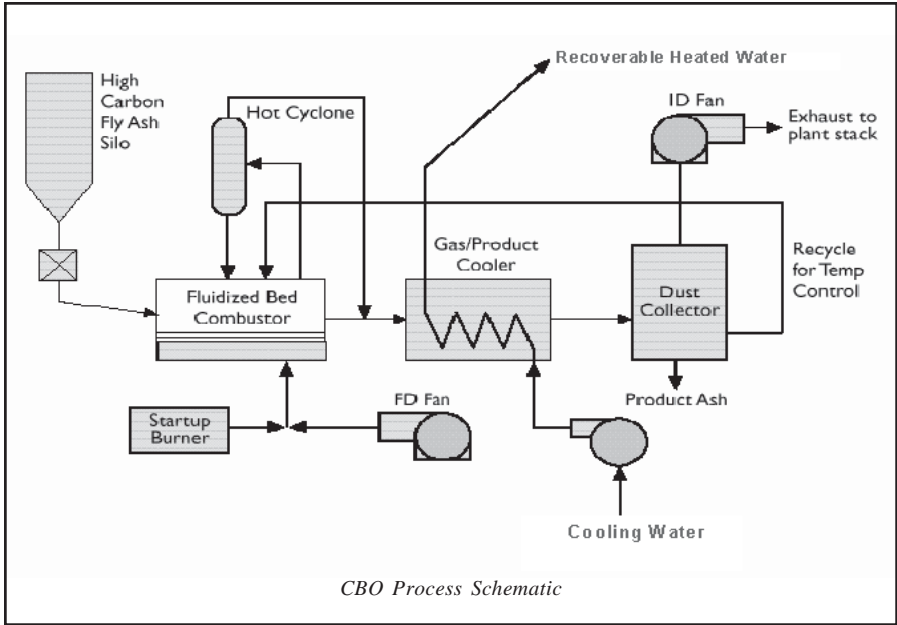
**Deanna White**  
Managing Editor

Combustion air from the FD fan enters the FBC via a start-up burner. This burner is used only during start-up to bring the bed to auto-ignition temperature, where combustion of the carbon in the feed ash provides the heat required to self-sustain the combustion process. The combustion air fluidizes the bed and provides oxygen for combustion of the fly ash carbon. The FBC exhaust gas is cleaned of carryover ash in the hot cyclones. From the hot cyclones, FBC exhaust gas flows through the G/P cooler. The “cooled” FBC exhaust gas is cleaned of the low-carbon ash in the fabric filter dust collector. The FBC exhaust gas flows through the ID fan and out to the utility boiler tie-in point.

*Continued on Page 2*



**FLYASH CARBON BURN-OUT...** *Continued from Page 1*



**South Carolina Electric & Gas CBO Facility**

The first full-scale Carbon Burn-Out plant was constructed at the Wateree Station of South Carolina Electric & Gas (SCE&G). Wateree is a two-unit, 772 MW plant located southeast of Columbia, SC. The Wateree CBO was designed and constructed as a turnkey facility by PMI, with detail design performed by ESI. The Wateree CBO facility began commercial operation in January 1999. A summary overview of that installation follows.



Referring to the photo on the left, the fluid bed combustor is within the tower at right-center. The heat exchanger is the inverted “U” in the center, and the product ash/flue gas separation takes place in the tower at left-center. FD and ID fans are behind the heat exchanger, as is the condensate pump and piping system. The CBO Control Room is just beyond the right border.

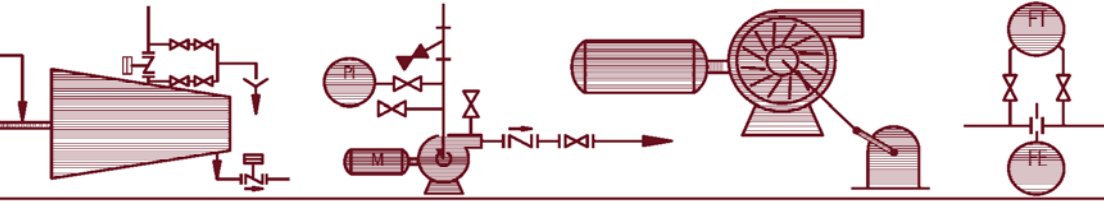
The CBO site at Wateree Station requires minimal duct runs while maintaining open access to all existing power plant systems. The ash product storage and load-out system is about 400 feet behind the photographer.

**CBO Experience to Date**

Two people per shift perform CBO plant operations, including quality control on the product ash being shipped. The Wateree CBO has been able to exceed its design capacity. Feed ash LOI to the CBO has varied significantly at times, while product ash has been consistent.

The Wateree CBO fly ash product is finer in particle size than the high-carbon feed ash, and is finer than the low-carbon fly ash produced by the Wateree units before

*Continued on Page 4*



## ESI Bulletin Board

### ENVIRONMENTAL UPDATE

#### **MACT Deadline December 2007**

Are you Ready?  
If not - you better get started!  
Call Jay Garrett with ESI today  
to discuss your options.  
E-mail: [info@esitenn.com](mailto:info@esitenn.com)  
Phone: 770-427-6200

### OPERATOR TRAINING

#### **Are Your Operators Properly Trained?**

ESI is currently training the operating staff at the Dominion Power Plant in Salem, MA. The Power Plant consists of two 80 MW coal-fired boilers, one 147 MW coal-fired boiler, and one 438 MW fuel oil-fired boiler. The comprehensive operator training program includes training on each piece of equipment including:

- Role of the equipment in overall power plant operation.
- Operational theory
- Start-up and shutdown procedures including why certain steps are critical
- Daily operating procedures including why certain steps are so important
- Specific critical do's and don'ts both in the daily operation and during emergencies

This training program was customized for this Dominion Power Plant. A customized Operator Training Program could save your company a great deal of time, money, and could potentially mitigate losses from improper operation of the facility's powerhouse. If you are interested in discussing training for your operators, please contact Jay Garrett at 770-427-6200 or [info@esitenn.com](mailto:info@esitenn.com).

### ARE NATURAL GAS PRICES KILLING YOU?

"The Reason Why Natural Gas SHOULD NOT Be Your Fuel Of Choice!", presented in the Fall 2005 issue of the *ENERGY SOURCE*, had a tremendous response. If you missed it, please visit the News & Events Section of our website at [www.esitenn.com](http://www.esitenn.com). This article discussed the current and long-term supply and demand problems which have led to unprecedented prices for natural gas. Based on the natural gas futures, it doesn't appear that prices are going down anytime soon. Have you considered switching to solid fuel? Following is a fuel cost comparison to consider:

#### **Annual Fuel Costs:**

**Natural Gas -  
\$12.1 million**

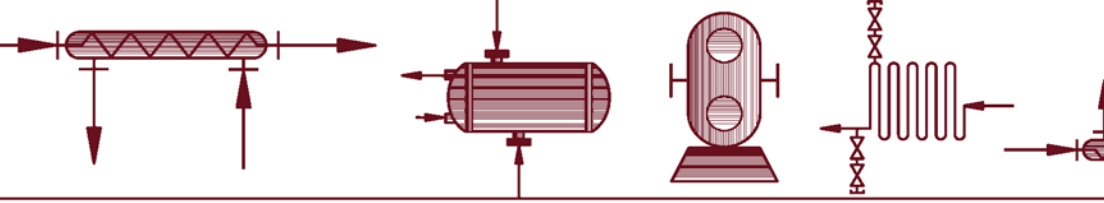
**Coal -  
\$4.9 million**

**Woodwaste -  
\$3.8 million**

This comparison is based on a steam load of 150,000 pph at 150 psig, operating 8,400 hours per year. If you would like to discuss the economic viability of converting your energy production from natural gas, contact Jay Garrett or Bill Reeves with ESI today!

E-mail: [info@esitenn.com](mailto:info@esitenn.com)  
Phone: 770-427-6200

**Contact ESI's STEAM & POWER SPECIAL FORCES®  
Today at 770-427-6200 or [info@esitenn.com](mailto:info@esitenn.com).**



**FLY ASH CARBON BURN-OUT...** *Continued from Page 2*



*Month 1 - Initial site preparation and foundation work underway.*



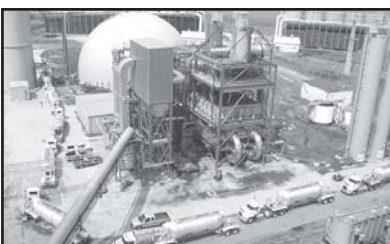
*Month 3 - Fluidized Bed Combustor (FBC) erection completed. FBC tower steel topped out. 16,000-ton ash product storage dome inflated.*



*Month 6 - Baghouse, feed and recycle silo installed. Load-out silo topped out. Ductwork pre-fabricated and ready for installation.*



*Month 9 - Ductwork installed, electrical and control system installation continue.*



*Month 12 - On the first day of operation, 34 trucks arrived to transport this low-carbon fly ash to market where it is used as an additive product for concrete.*

the low NO<sub>x</sub> burner conversion. The CBO product fly ash shows no signs of agglomeration or other detrimental properties. The fly ash has performed very well in the concrete marketplace and is viewed as a premium product.

Recovery of heat from CBO Wateree and application back to the turbine cycle in the power plant has functioned well, improving overall efficiency of the power plant.

**Santee Cooper Winyah Generating Station CBO Facility**

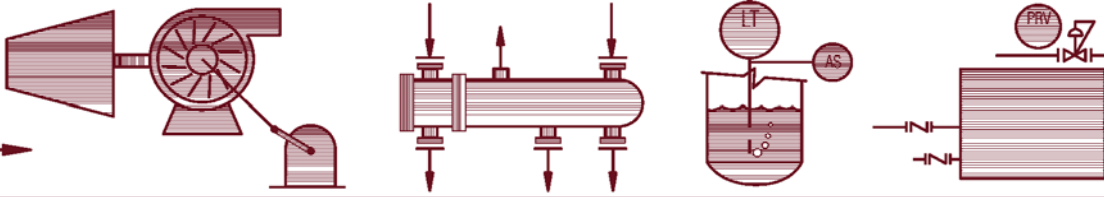
A second Carbon Burn-Out facility was constructed at the Winyah Station of Santee Cooper located in Georgetown, SC. Please see the photographs to review the construction sequence. The Winyah Generating Station has four units, with a total capacity of approximately 1155 MW. The Winyah CBO was designed and constructed by ESI with the assistance of PMI who was responsible for their patented process technology. The Winyah CBO was placed into commercial operation in 2002.

The CBO facility bypasses a portion of the condensate system and returns recovered heat from the residual carbon combustion process back to the Winyah station. The flue gas ducting and condensate piping is arranged so that the CBO plant can operate while connected to either Unit 3 or Unit 4 (one at a time). This flexibility allows CBO operations to continue even when an outage condition exists on one of the boilers. A product ash storage dome with approximately 16,000 tons of capacity was included in the project to provide flexibility for the ash marketer. Fly ash is reclaimed from the dome and routed to a single 1,000-ton load-out silo with dual dustless load-out spouts.

**Second Unit Design Enhancements – Winyah CBO**

Among the design enhancements incorporated in the Winyah facility were improved feed ash blending capabilities and improvements in combustion efficiency within the FBC. The overall height of the facility was reduced slightly. All of these improvements favor an even more economical means of using this technology.

*Continued on Page 5*



**FLY ASH CARBON BURN-OUT...** *Continued from Page 4*



*CBO Tower at the Northeast Carbon Burn-Out Facility.*



*Product Storage Dome at the Northeast Carbon Burn-Out Facility.*

**CBO Facilities Under Construction**

ESI and PMI are currently constructing two new Carbon Burn-Out facilities. One facility will be located in the Northeast and one will be in the Mid-Atlantic. Both will be in operation in 2006.

**CBO Project Parameters**

ESI and PMI are actively evaluating other facilities for the deployment of this technology throughout the United States. Contact Jay Garrett with ESI at [jgarrett@esitenn.com](mailto:jgarrett@esitenn.com) or 770-427-6200 to discuss any details related to this innovative, environmentally friendly, proven ash technology.

**Summary**

Carbon Burn-Out has proven effective and efficient in producing a consistent, very high quality fly ash that the market demands. Both the Wateree and the Winyah CBO plants have demonstrated the ability to produce a consistent low LOI product from a range of feedstock carbon contents and sources.

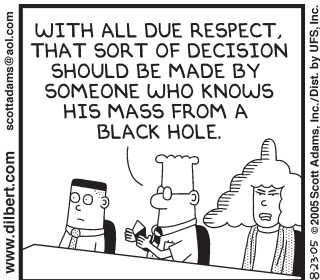
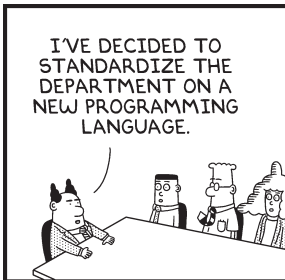
# Just A Reminder

ESI has extensive experience combusting a wide range of solid fuels including:

- Coal
- TDF
- Woodwaste
- Agricultural By-Products
- Paper Mill Sludge
- "Plant Opportunity Fuels"

Please visit the Project Case Studies Section of our website @ [www.esitenn.com](http://www.esitenn.com) to see some of the projects ESI has performed or contact ESI at 770-427-6200 or [info@esitenn.com](mailto:info@esitenn.com) for more information.

**Call ESI for all your Steam & Power Needs!**



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