

**DESIGNING AN OPPORTUNITY FUEL WITH BIOMASS AND  
TIRE-DERIVED FUEL FOR COFIRING AT WILLOW ISLAND  
GENERATING STATION AND COFIRING SAWDUST WITH  
COAL AT ALBRIGHT GENERATING STATION**

**Type of Report: Quarterly**

Report Period Start Date: October 1, 2003

Report Period End Date: December 31, 2003

Principal Authors: K. Payette and D. Tillman

Date of Report Issue: January 2004

USDOE Award Number: DE-FC26-00NT40894

**Name and Address of Submitting Organization:**

Allegheny Energy Supply Co., LLC.  
4350 Northern Pike  
Monroeville PA 15146-2841

## **DISCLAIMER**

“This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability of responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.”

## **ABSTRACT**

During the period October 1, 2003 – December 31, 2003, Allegheny Energy Supply Co., LLC (Allegheny) continued with demonstration operations at the Willow Island Generating Station and improvements to the Albright Generating Station cofiring systems. The demonstration operations at Willow Island were designed to document integration of biomass cofiring into commercial operations, including evaluating new sources of biomass supply. The Albright improvements were designed to increase the resource base for the projects, and to address issues that came up during the first year of operations. This report summarizes the activities associated with the Designer Opportunity Fuel program, and demonstrations at Willow Island and Albright Generating Stations.

## TABLE OF CONTENTS

	<u>Page</u>
<b>Type of Report: Quarterly .....</b>	i
<b>DISCLAIMER.....</b>	ii
<b>ABSTRACT .....</b>	iii
<b>LIST OF GRAPHICAL MATERIALS .....</b>	v
<b>INTRODUCTION.....</b>	vi
The Willow Island Demonstration.....	vi
The Albright Demonstration.....	vii
The Combined Results.....	viii
<b>EXECUTIVE SUMMARY .....</b>	ix
<b>EXPERIMENTAL.....</b>	10
<b>RESULTS AND DISCUSSION .....</b>	11
Results at Willow Island .....	11
Results at the Albright Demonstration.....	11
<b>CONCLUSION: Expected Technical Progress During the 14<sup>th</sup> Quarter.....</b>	12
<b>REFERENCES .....</b>	13
<b>APPENDIX: Paper at Pittsburgh Coal Conference.....</b>	<b>Error! Bookmark not defined.</b>

## LIST OF GRAPHICAL MATERIALS

	<u>Page</u>
None	

## INTRODUCTION

Cofiring—the firing of two dissimilar fuels at the same time in the same boiler—has been proposed for using biomass in coal-fired utility boilers. In practice, this cofiring introduces a family of technologies rather than a single technology. The family of technologies includes blending the fuels on the coal pile or coal belt, and feeding them simultaneously to any processing (e.g., crushing and/or milling) systems on their way to the boiler; preparing the biofuels separately from the coal and introducing them into the boiler in a manner that does not impact fossil fuel delivery; or converting the solid biofuels to some other fuel form (e.g., producer gas) for firing in a coal-fired or natural gas-fired installation. The Allegheny project is designed to demonstrate both direct combustion approaches to cofiring.

### The Willow Island Demonstration

Allegheny Energy Supply, LLC is demonstrating blending wood waste and tire-derived fuel to create a new opportunity fuel for cofiring in cyclone boilers, and integrating this fuel combination with a separated overfire air system for maximum NO<sub>x</sub> management. This project also is demonstrating the use of biomass-TDF blends to reduce SO<sub>2</sub> and fossil CO<sub>2</sub> emissions along with trace metal emissions. The demonstration is occurring at Willow Island Generating Station Boiler #2. It is a 188-MW<sub>e</sub> cyclone boiler operated in a pressurized mode and equipped with a “hot side” electrostatic precipitator (ESP). This demonstration, located in Willow Island, WV, has numerous unique features to significantly advance cofiring technology. Allegheny Energy, using Foster Wheeler Development Corporation, has completed a feasibility study for the project and has moved into Phase II—construction and operation of the demonstration system.

Cofiring of wood wastes with coal has been demonstrated as an effective means for using biomass in cyclone boilers; demonstrations have occurred at the Allen Fossil Plant of TVA, the Michigan City Generating Station of NIPSCO, and the Bailly Generating Station (BGS) of NIPSCO. In these demonstrations, NO<sub>x</sub>, SO<sub>2</sub>, and fossil-based CO<sub>2</sub> emissions reductions occurred. In each case, the volatility of the wood waste created the mechanism for NO<sub>x</sub> reduction, while the use of a sulfur-free fuel reduced SO<sub>2</sub> emissions. Testing at BGS opened a new area of investigation: designing blends of opportunity fuels to optimize the impacts of cofiring. At BGS, urban wood waste is mixed with petroleum coke at a specified blend to optimize NO<sub>x</sub> emissions management while accomplishing the goals of fossil CO<sub>2</sub> emissions reductions. The NO<sub>x</sub> emissions reductions at BGS are ~30 percent when firing the designed opportunity fuel blend.

The Willow Island demonstration blends sawdust with TDF to create a new opportunity fuel for cofiring in a cyclone boiler equipped with a separated overfire air system. This demonstration evaluates the creation of a second opportunity fuel blend that has potential to maximize NO<sub>x</sub> emissions reductions from the combustion process. At the same time, SO<sub>2</sub> emissions are reduced along with fossil CO<sub>2</sub> emissions and heavy metal emissions. The Willow Island plant “hot-side” ESP requires the use of a sodium additive to enhance the resistivity of the flyash particles. This demonstration examines the potential of biofuel cofiring to obviate the need for such additives in the control of particulates and opacity—capitalizing upon the potassium and sodium content of the biomass ash.

The demonstration program involves utilizing the sawdust- TDF-coal blend for maximum impact in the cyclone combustion process. It is estimated that the project can fire at least 10 percent wood waste, along with about 10 percent TDF in the project.

While this demonstration involves integrating past successful programs, it provides a significant enhancement of cofiring and the use of biomass. If successful, it will be the first demonstration where cofiring has been explicitly integrated into an overall NO<sub>x</sub> control strategy as a significant contributor. Further, if successful, it provides a means for cyclone boiler owners and operators to consider NO<sub>x</sub> management strategies other than end-of-pipe solutions or expensive fossil-based combustion strategies to achieve compliance with current and proposed regulations.

Further, this will be the first cofiring demonstration where the boiler is equipped with a “hot side” electrostatic precipitator—an ESP installed between the economizer and the air heater rather than after the air heater. Such “hot side” ESP’s conventionally use sodium additives to improve the resistivity of the flyash and enhance its capture. Biomass, with its concentrations of potassium and sodium, has some potential to reduce or eliminate the need for such additives. This demonstration will address that condition and, as a consequence, advance the use of cofiring in coal-fired boilers.

## **The Albright Demonstration**

The Albright Generating Station demonstration provides a means for comparing the NO<sub>x</sub> reduction results obtained at Willow Island Generating Station—in a cyclone boiler—to those that can be obtained in a pulverized coal boiler. The Albright Generating Station Boiler #3 is a 140 MW<sub>e</sub> boiler, comparable in capacity to the Willow Island boiler. It burns a similar eastern bituminous coal. Of critical importance, the Albright boiler is equipped with a low-NO<sub>x</sub> firing system including a separated overfire air system.

The Electric Power Research Institute (EPRI) has developed a demonstration of sawdust cofiring in a PC boiler at the Seward Generating Station. A favorable biomass fuel supply potential and the favorable technology potential has led Allegheny to decide to relocate the cofiring demonstration to the Albright Generating Station. The relocation of the separate injection demonstration from Seward Generating Station to Albright provides

opportunities to extend the knowledge base concerning cofiring—capitalizing upon the configuration of Albright Boiler #3. Specifically cofiring has not been applied to a generating station equipped with low NO<sub>x</sub> firing separated overfire air system. In relocating the demonstration from Seward to Albright, Allegheny Energy and USDOE have capitalized upon such an opportunity.

## **The Combined Results**

The combination of the Willow Island demonstration at the cyclone boiler and the comparative data developed at the Albright demonstration in a tangentially-fired pulverized coal boiler will provide definitive data concerning the emissions reduction potential of biomass cofiring in units already equipped with low NO<sub>x</sub> firing systems. As such, these data will help define the potential, and limits, of biomass cofiring as an emissions reduction strategy. At the same time these demonstrations will provide a means for evaluating biomass cofiring as a cost-effective strategy for voluntary fossil CO<sub>2</sub> emissions reductions. Finally these projects will demonstrate additional environmental benefits of cofiring.

## **EXECUTIVE SUMMARY**

The Fourteenth Quarter of the USDOE-Allegheny Energy Supply Co., LLC (Allegheny) Cooperative Agreement, October 1, 2003 through December 31, 2003, was characterized by demonstration operations at the Willow Island site and continuous improvement at the Albright cofiring site. Technical work that proceeded during the twelfth quarter of the cooperative agreement included the following:

- At Willow Island Generating Station, cofiring continued with both biomass and TDF.
- Allegheny, after evaluating the sawdust supply for the Albright Generating Station and determining the need for an oversized material grinder, completed detailed engineering and procurement for the installation of a new grinder. The grinder selected was a 2-stage grinder, to be installed at the discharge of the oversized particles from the screen. The grinder was delivered by Industrial Biomass, Inc., and, after evaluation, was augmented by a dust management system. The dust management system was delivered to the site very late in the quarter.
- Progress anticipated for the fifteenth quarter of this cooperative agreement—January 1, 2004 through March 31, 2004—includes completion of the demonstration phase of the Willow Island project, installation of the 2-stage grinder at Albright, and the completion of additional testing at the Albright Generating Station. This quarter will see the start of the final report. Progress will include initiation of activities associated with preparation of the final project report..

## **EXPERIMENTAL**

Does not apply

## **RESULTS AND DISCUSSION**

Overall results include significant operational testing at Willow Island, and the initiation of modifications to the Albright Generating Station Cofiring System.

### **Results at Willow Island**

During the fourth quarter of 2003, the 14<sup>th</sup> quarter of the project, Willow Island received and burned over 560 tons of biomass for cofiring. Year-to-date totals for biomass consumption were about 3,000 tons of sawdust. Additionally, Willow Island received and burned TDF in the fourth quarter of 2003. Attempts were made to perform 10 percent cofiring testing, however these were not completed due to plant equipment issues.

The testing that was completed during the 14<sup>th</sup> Quarter of the project, then, reinforced previously experienced operational outcomes (see Report 40894R10). Willow Island continues to demonstrate the utility of cofiring sawdust in a cyclone boiler.

### **Results at the Albright Demonstration**

During the 14<sup>th</sup> quarter, Industrial Biomass fabricated a dust management system for the 2-stage grinder and, in late December, supplied virtually all of the components of that dust management system to the site.

## **CONCLUSION: Expected Technical Progress During the 15<sup>th</sup> Quarter**

Allegheny Energy will complete its cofiring testing during the fourteenth project quarter. The fifteenth project quarter, from January 1, 2004 through March 31, 2004 is expected to see the following progress, as shown in Table 1.

**Table 1. Anticipated Progress at Willow Island and Albright Demonstration Sites**

<b>Progress at Willow Island</b>	<b>Progress at Albright</b>
Implementation of 10 percent sawdust cofiring testing at the site	Completion of the dust management system and complete installation of the grinding system
Completion of the testing	Resumption and completion of cofiring testing
Start of the final report	Start of the final report

## **REFERENCES**

None