

URBAN WOOD/COAL CO-FIRING IN THE BELLEFIELD BOILERPLANT

QUARTERLY TECHNICAL PROGRESS REPORT

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ABSTRACT

During the third quarter, important preparatory work was continued so that the experimental activities can begin early in the fourth quarter. Authorization was awaited in response to the letter that was submitted to the Allegheny County Health Department (ACHD) seeking an R&D variance for the air permit at the Bellefield Boiler Plant (BBP). Verbal authorizations were received from the Pennsylvania Department of Environmental Protection (PADEP) for R&D variances for solid waste permits at the J. A. Rutter Company (JARC), and Emery Tree Service (ETS). Construction wood was acquired from Thompson Properties and Seven D Corporation. Forty tons of pallet and construction wood were ground to produce BioGrind Wood Chips at JARC and delivered to Mon Valley Transportation Company (MVTC). Five tons of construction wood were milled at ETS and half of the product delivered to MVTC. Discussions were held with BBP and Energy Systems Associates (ESA) about the test program. Material and energy balances on Boiler #1 and a plan for data collection were prepared. Presentations describing the University of Pittsburgh Wood/Coal Co-Firing Program were provided to the Pittsburgh Chapter of the Pennsylvania Society of Professional Engineers, and the Upgraded Coal Interest Group and the Biomass Interest Group (BIG) of the Electric Power Research Institute (EPRI). An article describing the program appeared in the Pittsburgh Post-Gazette. An application was submitted for authorization for a Pennsylvania Switchgrass Energy and Conservation Program.

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INTRODUCTION

This third quarterly technical progress report describes work done during the third three-month period of the University of Pittsburgh's project on "Urban Wood/Coal Co-firing in the Bellefield Boiler Plant."

This report describes the activities of the project team during the reporting period. The principal work has focused upon environmental issues, wood supply, plant operations, analysis, reporting and outside contacts.

EXECUTIVE SUMMARY

During the third quarter, work continued on environmental issues, wood supply, plant operations, analysis and reporting. Several outside contacts were made.

EXPERIMENTAL

During the third quarter of the project, plans continued to be developed for experimental work at the Bellefield Boiler Plant (BBP), which is expected to begin early in the fourth quarter.

RESULTS AND DISCUSSION

Environmental Issues

Authorization was awaited in response to the letter that was submitted to the Allegheny County Health Department (ACHD) seeking an R&D variance for the air permit at the BBP. Verbal authorizations were received from the Pennsylvania Department of Environmental Protection (PADEP) for R&D variances for solid waste “permits-by-rule” at the J. A. Rutter Company (JARC), and Emery Tree Service (ETS).

Wood Supply

JARC ground 40 tons of urban wood waste. The resulting BioGrind Wood Chips were delivered to the Mon Valley Transportation Company (MVTC). ETS milled 5 tons of urban wood waste and delivered half of the resulting products to MVTC.

Plant Operations

Discussions were held with Energy Systems Associates about air monitoring at BBP. Discussions were held with BBP on the timing of the tests. They are currently scheduled for the period of March 19-31.

Analysis

Material and energy balances on Boiler #1 and a plan for data collection were prepared.

Reporting

Presentations were given to the Pittsburgh Chapter of the Pennsylvania Society of Professional Engineers and the Upgraded Coal Interest Group and the Biomass Interest Group of the Electric Power Research Institute. An article describing the program appeared in the Pittsburgh Post-Gazette.

Outside Contacts

An application was submitted to the Pennsylvania State Farm Service Administration office for a Pennsylvania Switchgrass Energy and Conservation Project.

Plan for the Next Quarter

During the fourth quarter from February 16 through May 15, 2001, the processed pallet and construction wood will be blended at MVTC and shipped to the BBP. The test burns will be conducted at BBP and the emissions from Boiler #1 during the test burns will be monitored.

EXPERIMENTAL

Wood/coal cofiring in this project will be conducted at the Bellefield Boiler Plant (BBP) in the Oakland District of Pittsburgh. Two sources of construction wood have been identified. Wood has been collected from both sites. Wood from one site has been tub-ground by J. A. Rutter Company (JARC) of Monroeville, PA. Wood from the second site has been milled by Emery Tree Service (ETS) of Indianola, PA. All of the wood for use at BBP has been delivered to the Mon Valley Transportation Company (MVTC) in Glassport, PA, where it will be blended with coal by personnel from JARC and MVTC early in the fourth quarter of the project and delivered to the boilerplant.

During the third quarter of the project, plans were developed for experimental work, which is expected to be conducted during the fourth quarter.

RESULTS AND DISCUSSION

ENVIRONMENTAL ISSUES

Variances to Permits

A letter was submitted by the University, on behalf of the BBP, to the Allegheny County Health Department (ACHD), requesting an R&D variance to the boilerplant's operating permit for the project. The response from the ACHD was still being awaited at the end of the third quarter of the project.

The Pennsylvania Department of Environmental Protection (PADEP) regulates the operations of J. A. Rutter Company (JARC) and Emery Tree Service (ETS) through a procedure known as "permit by rule." The project team described to the PADEP the general provenance of the construction wood to have been processed at JARC and ETS, and it was notified that oral extensions of the "permit by rule" at both companies had been granted for this project.

The BBP has requested that testing results for air emissions be reported only as percentage differences found with and without co-firing. Doing so will avoid any possibility that the results at BBP during co-firing testing be found to contradict the results that BBP has obtained during past compliance testing.

WOOD SUPPLY

Collection and Grinding

On December 1 JARC ground 35 tons of broken pallets and 5 tons of urban construction wood waste, using a modified method of operation. The construction wood had been collected in mid-November in roll-off containers at a condominium construction site being developed by Thompson Properties. That wood consisted of trim-ends of framing lumber, mixed with about 30% plywood and particleboard. Upon inspection, the product from the modified method of operation contains more fines than anticipated, principally from the particleboard that had been commingled with the trim-ends, but the larger pieces are comprised of far fewer lengthy spears than previous grinds. JARC denotes this new material as "BioGrind Wood Chips." The entire 40 tons of BioGrind Wood Chips were delivered to MVTC in Glassport, PA in mid-December.

During the second quarter of the project, the project team received information from CQ Inc. about Seven D Corporation, a wood truss manufacturer in Tyrone, PA,

which had expressed interest in providing construction wood waste to the University's wood/coal cofiring program. Just before the end of the second quarter, two truck loads of construction wood were delivered to ETS by Seven D Corporation. This wood consisted of trim-ends up to several feet long. On January 23 ETS milled this wood and placed the milled product in rolloffs. One of the rolloffs was delivered to MVTC for use in this project.

Wood-coal blends will be produced at MVTC from both the ground and milled products early in the fourth quarter of the project. The blending will be conducted jointly by personnel from MVTC and JRC.

PLANT OPERATIONS

Discussions with BBP and ESA

The project team continued discussions with Energy Systems Associates (ESA) concerning ESA providing flue gas analysis during the tests at NBP. The five gases, NO, SO₂, CO, O₂ and CO₂, will be analyzed by EPA Methods 10, 3A, 6C and 7E. Particulate sampling will be conducted by EPA Method 17. The sampling will follow the Compliance Test Protocol for BBP that ESA submitted to ACHD in 1996, but with several variations. First, ESA will obtain only two particulate samples per condition. Second, ESA will not obtain coal samples and will use only estimated fuel factors in emissions calculations. Third, this protocol lists five ESA engineers and technicians for the testing and there will only be two involved in the co-fire testing. Fourth, the particulate will likely be collected at the stack since boiler outlet ducts will be used for continuous gaseous sampling. Fifth, SO₂ emissions will be determined through instrument analysis rather than chemical analysis (Method 6C rather than Methods 6 and 8). Sixth, the gaseous sampling will likely be conducted through the four sample ports utilizing three probes per port (with probe lengths based on equal area). Lastly, there will be no assembly of calibration sheets for testing equipment, instrumentation and calibration gases.

Throughout the third quarter of this project, the project team has had an ongoing discussion with BBP as to the timing of the demonstration. A special compliance test is being conducted at BBP as the quarter ends. The BBP expects that test to be completed by mid-March and has scheduled the co-firing demonstration for the period from March 19 through March 31, subject to receipt of the R&D variance from ACHD.

Also throughout the third quarter, Mr. Hongming Li visited the BBP on numerous occasions and engaged in several wide-ranging discussions with ESA to obtain background information for collecting data during the tests and analyzing the system for his masters thesis and the final report of the project. One issue to which he is giving

particular attention is the method to measure the flow of solid fuel to the #1 Boiler, which will be used in the test.

ANALYSIS

Mr. Jun Wang reviewed four articles in the refereed literature describing the effect of cofiring biomass with coal on boiler performance.

Mr. Wang conducted an evaluation of the use of computational fluid dynamics (CFD) and its application to the analysis of wood/coal cofiring. He reviewed the report on the homepage of McDermott Technology Inc., of its special CFD code, COMO WR, which models wood combustion in suspension and on stoker grates.

Mr. Li is developing the plan for data collection and analysis during the testing at the BBP. At the weekly meeting of the project team on January 10 Mr. Li presented the principal reactions occurring in the combustor and a preliminary flowsheet for Boiler #1 and the balance of the plant supporting it. On January 17 Mr. Li presented a detailed generic material balance for Boiler #1 firing coal, using data from the literature. On January 24 Mr. Li presented a framework for detailed generic material and energy balances for Boiler #1 firing coal, using data from the BBP. On January 31 Mr. Li presented detailed generic material and energy balances for Boiler #1 firing coal, using data from the BBP, and a list of data to be collected during each test to enable material and energy balances to be calculated for it. And on February 7 Mr. Li presented a detailed plan for collecting data during each test.

REPORTS AND PRESENTATIONS

Prof. Cobb, the project's Principal Investigator, gave a presentation on the University's Wood/Coal Cofiring Program at the monthly technical meeting of the Pittsburgh Chapter of the Pennsylvania Society of Professional Engineers (PSPE) on January 18.

On January 25 and 26 Prof. Cobb, Prof. Geiger and Mr. Barry attended the meeting of the Upgraded Coal Interest Group of the Electric Power Research Institute (EPRI) at the National Energy Technology Center (NETL) in Pittsburgh, PA. During the roundtable discussion, Dr. Cobb described the current status of the University's Wood/Coal Cofiring Program and the recent application to the U.S. Department of Agriculture for authorization for the Pennsylvania Switchgrass Energy and Conservation Project (PSECP). Mr. Barry reported on his plan to study the use of landfill gas in boilerplants in the Pittsburgh region.

On February 8 and 9 Prof. Cobb, Prof. Geiger and Mr. Barry attended the meeting of the EPRI Biomass Interest Group at the EPRI offices in Washington, DC. During the roundtable discussion, Dr. Cobb described the current status of the University's Wood/Coal Cofiring Program and the recent application to the USDA for authorization for the PSECP.

An article reporting on the milling of the construction wood at ETS and describing the University's Wood/Coal Cofiring Program appeared in the NorthEast Section of the Pittsburgh Post-Gazette on Wednesday, February 14. The article can be seen at:

http://www.post-gazette.com/neighbor_north/20010214nmulcher4.asp

OUTSIDE CONTACTS

Pennsylvania Switchgrass Energy and Conservation Program

In the second quarterly report on this project, it was noted that on October 20 the Farm Service Agency (FSA) of the U.S. Department of Agriculture (USDA) issued Notice CRP-378, "Reviewing and Recommending Applications for Biomass Pilot Projects."

In early December Thomas Stickle, a farmer from Ligonier, PA, who has about 100 acres of Conservation Reserve Program (CRP) land planted in switchgrass, and David Bingham, Chief of the Division of Conservation and Agricultural Technology, Bureau of Plant Industry of the Pennsylvania Department of Agriculture, suggested that the University's wood/coal cofiring program team consider organizing an application for a Pennsylvania Switchgrass Energy and Conservation Project in response to USDA Notice CRP-378.

On December 11 Dr. Cobb and Mr. Elder met in Ligonier with Mr. Stickle. It was agreed to submit an application to organize a project utilizing up to 33,000 CRP acres to produce approximately 130,000 tons of switchgrass per year for cofiring at four fluid-bed boilerplants in Pennsylvania:

Scrubgrass Generating Plant
Cambria CoGen Company
Northhampton Generating Plant
Wheelabrator Frackville Energy Company.

The Tri-County Chapter of Pheasants Forever was contacted and agreed to organize assistance in providing seed and planting support.

An application seeking authorization to develop and implement the project was submitted on December 19 to William Foose, Director, Pennsylvania State FSA Office through the Dominion Center for Environment and Energy at the University of Pittsburgh.

On January 12 a subcommittee of the State Technical Committee of the Pennsylvania State FSA Office reviewed the application and recommended its approval and submission to the U.S. Department of Agriculture. On January 16 the Pennsylvania State FSA Committee reviewed the application and the State Technical Committee recommendation, and enthusiastically supported the project. It cited the tremendous environmental benefits of lower emissions from coal burning through the use of switchgrass, and the prospects for development of a new market for Pennsylvania producers through the use of switchgrass in energy production. A letter to this effect was sent on January 17 to the Deputy Administrator for Farm Programs.

Capitol Boilerplant

In the second quarterly report on this project, it was noted that on October 30 staff members of NETL and Parsons visited the BBP in preparation for a visit to the stoker boilerplant serving the U.S. Capitol.

On November 30 Dr. Cobb participated by speakerphone in a review meeting at NETL in which staff members of NETL and Parsons reviewed the information obtained by their visit to the Capitol boilerplant in early November, their survey of pertinent information in the literature, and evaluations based thereupon. Dr. Cobb was asked to provide information on NO_x emissions at the Pittsburgh Brewing Company, BBP and the NIOSH boilerplant (NBP).

The following NO_x information was provided to NETL:

Pittsburgh Brewing Company – 0.4 lb NO_x/MMBtu
NBP – 0.3 lb NO_x/MMBtu
BBP – 0.25 lb NO_x/MMBtu

According to David Tillman of Foster Wheeler, the percent drop in NO_x from pulverized coal boilers when cofiring wood is 0.75 times the percent wood cofired.

Additional information was provided to NETL about the placement of the Capitol boilerplant high on the list of federally-owned coal-fired boilerplants that the Antares Group has developed for the Federal Energy Management Program (FEMP) as candidates for cofiring. In mid-January the project team provided NETL with Kevin Comer's name and address at the Antares Group, so that NETL might contact him to discuss this further.

Antares Group

In early November Mr. Elder provided Kevin Comer of the Antares Group with information on the project for the briefing book that the Antares Group was preparing for the USDOE. The information included the draft of the two-page briefing that will be placed in the EPRI briefing book, one proceedings paper and two sets of slides from recent presentations. Mr. Comer reciprocated by sending a recent Antares briefing paper on boilerplants at government facilities.

ADMINISTRATIVE ASPECTS

This section provides a note of special actions, the monthly highlights, and a comparison of progress with the milestone chart.

Special Actions

Hongming Li, a MS candidate in the Department of Chemical & Petroleum Engineering at the University of Pittsburgh, was appointed as the Graduate Student Researcher for the project on cofiring of urban wood waste at the NBP.

William P. Barry was appointed in mid-January for eight months as Research Associate for the NBP project.

Forms were requested from NETL in mid-December for clearance for Mr. Li and Mr. Wang to visit NBP and NETL. The forms were received on January 29 and the completed forms were submitted to NETL on January 31. A special activity for both students will be serving as translators for a Chinese delegation due to visit NETL in Fall 2001.

Ten group meetings were held during this quarter to manage the work and discuss the activities of the program team. During these first meetings, assignments were made to members of the program team. Mr. Elder focuses on biomass acquisition, blending and delivery, (2) general operation of the test program and (3) relations with outside contacts. Mr. Wang focuses on boiler system analysis. Mr. Li focuses on data collection during each test and analysis of test results. In addition to this project, the program team during this quarter addressed a wood/coal cofiring demonstration at the NBP, a switchgrass/coal cofiring project, advice to NETL on its consultations to the boilerplant at the U.S. Capitol, and boiler system analysis.

The Chemical and Petroleum Engineering Department has been nominated for a Three Rivers Environmental Award. The BBP and NBP projects have been included in the background and rationale for the award.

Monthly Highlights

Here are the highlights of the first three-month period of the project.

November 15 – December 15, 2000

- to
- A letter requesting a variance to the BBP's air operating permit was sent ACHD.
 - JARC ground 40 tons of pallet and construction wood and delivered it to MVTC.
 - 30 tons of construction wood were collected from Seven D Corporation and delivered to ETS.
 - Information on NO_x levels at various boilerplants was provided to NETL

December 15, 2000 – January 15, 2001

- An application was submitted to the Pennsylvania State FSA Office for a Pennsylvania Switchgrass Energy and Conservation Program.
- Discussions were held with ESA concerning flue gas measurements and data analysis.
- William P. Barry was appointed for eight months as a Research Associate in the Wood/Coal Cofiring Program.

January 15 – February 15, 2001

- 5 tons of construction wood was milled at ETS and half of the milled product was delivered to MVTC.
- Generic material and energy balances and a plan for data collection were prepared.

- The Pennsylvania State FSA office forwarded the application for the PSECP to the USDA.
- A presentation on the University's Wood/Coal Cofiring Program was made to the Pittsburgh Chapter of the PSPE.
- Members of the project team attended meetings of the EPRI Upgraded Coal Interest Group and Biomass Interest Group and briefed the attendees at both meetings on the University's Wood/Coal Cofiring Program.
- An article describing the University's Wood/Coal Cofiring Program appeared in the NorthEast Section of the Pittsburgh Post Gazette on February 14.

Comparison of Progress with Milestone Chart

Task 1: The air quality permit R&D variance has been requested from the ACHD.

Task 2: **Completed** – modified wood chips, closer to those needed for cofiring, have been produced.

Task 3: **Completed** – construction wood has been obtained from two sources.

Task 4: **Completed** – all urban wood waste needed for the project has been processed.

Task 5: The urban processed wood waste has been delivered to MVTC and will be blended early in the next quarter.

Task 6: Optimum wood-coal fuel blends will be determined by tests at BBP during the next quarter.

Task 7: Emissions from BBP during cofiring tests will be measured during the next quarter.

PLAN FOR THE NEXT QUARTER

During the fourth quarter from February 16 through May 15, 2001, the processed pallet and construction wood will be blended at MVTC and shipped to the BBP. The test burns will be conducted at BBP and the emissions from Boiler #1 during the test burns will be monitored.

CONCLUSIONS

Project planning continues to be progressing well. Material and energy balances on Boiler #1 at BBP have been developed and a plan for data collection has been prepared.

Construction wood was acquired from Thompson Properties and Seven D Corporation. Forty tons of wood were ground by JARC to produce BioGrind Wood Chips and delivered to MVTC. Five tons of wood were milled by ETS and delivered to MVTC.

Three presentations have been made. The presentations were given to the Pittsburgh Chapter of PSPE and meetings of the Biomass Interest Group and Upgraded Coal Interest Group of EPRI. An article describing the program appeared in the Pittsburgh Post-Gazette.

Several outside contacts have been made. The project team provided general information on stoker boiler plant operations to staff of NETL and Parsons who were working with the Capitol boilerplant. It also submitted a proposal to the Pennsylvania State FSA office for authorization for the PSECP.

REFERENCES

None.

LIST OF ACRONYMS AND ABBREVIATIONS

ACHD	Allegheny County Health Department
BBP	Bellefield Boiler Plant
CFD	Computational Fluid Dynamics
CRP	Conservation Reserve Program
EPRI	Electric Power Research Institute
ESA	Energy Systems Associates
ETS	Emery Tree Service
FEMP	Federal Energy Management Program
FSA	Farm Service Agency
JARC	J. A. Rutter Company
MVTC	Mon Valley Transportation Company
NBP	NIOSH Boiler Plant
NETL	National Energy Technology Laboratory
NIOSH	National Institute of Occupational Safety and Health
PADEP	Pennsylvania Department of Environmental Protection
PSECP	Pennsylvania Switchgrass Energy and Conservation Project
PSPE	Pennsylvania Society of Professional Engineers
USDA	U.S. Department of Agriculture
USDOE	U.S. Department of Energy