Biomass Reburning – Modeling/Engineering Studies

Quarterly Report No. 7 for Period

April 1 –June 30, 1999

Prepared by:

Vladimir Zamansky and Michael Booth

July 30, 1999

DOE Contract No. DE-FC26-97FT97270

Submitted by:

Energy and Environmental Research Corporation

18 Mason, Irvine, CA 92618

Disclaimer

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or 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

This project is designed to develop engineering and modeling tools for a family of NO_x control technologies utilizing biomass as a reburning fuel. During the seventh reporting period (April 1 –June 30, 1999), no information was received at EER on scheduled FETC R&D group's project activities. EER activities were on hold due to the pending purchase of the Niagara Mohawk's Dunkirk Station, a target demonstration site in this program, and then by the actual purchase of the Station by NRG. This report includes information about the current project status, recently submitted to NRG for soliciting their interest to proceed with biomass reburn demonstration, and notes on alternative demonstrative partners.

Table of Contents

<u>Section</u>	<u>Page</u>
Abstract	3
1.0 Biomass Reburn at Niagara Mohawk: Discussion Notes.....	5
2.0 Exploration of Alternative Demonstration Partners.....	8

1.0 Biomass Reburn at Niagara Mohawk: Discussion Notes

The work scheduled in this project on biomass reburning system design issues specific to Niagara Mohawk's Dunkirk Station, the target demonstration site, was suspended, first due to the pending purchase of the station by NRG, then by the actual purchase, itself. With Niagara Mohawk's Research and Development Department no longer responsible for the project, the decision as to whether to move forward with the reburning project became NRG's. Their initial response was to make no decision.

Recently, however, EER has been informed that NRG has decided to proceed with the biomass cofiring project. An NRG official has expressed an interest in exploring the possibility of moving on into the reburning project. This issue will be pursued by EER as promptly as possible. Information presented below was recently submitted to NRG for updating them on technology and project issues.

TECHNOLOGY BACKGROUND

Reburning is a NO_x control technology that reduces NO_x by injecting fuel into the upper furnace above the main burners, sufficient to produce a slightly fuel rich zone. The primary combustion region of the boiler, is typically operated with slightly lower than normal excess air, while overfire air is injected in a "burnout zone" such that all of the reburn fuel and residual combustibles are completely burned out. Reductions in NO_x due to conventional reburning technologies can range between 58-77%.

Natural gas is currently the reburn fuel of choice, but micronized coal, oil and Orimulsion® have also been used as the reburn fuel in some boiler applications. Energy and Environmental Research Corporation (EER) has already placed such systems in service on various coal-fired power plants. EER believes that there may be some distinct advantages to the use of pulverized biomass as a reburn fuel. For example, pilot scale experimental testing has shown that furniture waste can have comparable NO_x reduction performance to natural gas at reburn heat input rates up to 15%, while biomass is much less expensive than natural gas. EER has also developed an

advanced biomass reburning technology that utilizes additives and has achieved 70-90% NO_x control in pilot scale experiments. Using biomass as a reburn fuel will however require the use of specific biomass receiving, handling, and processing equipment be at the plant. It is also anticipated that the biomass feedstock will need to be reduced to a particle size smaller than that typically used for co-firing, with the exact size requirements depending upon the characteristics of specific fuels and boiler applications.

PROJECT BACKGROUND

The biomass reburn project is the result of several awards made to EER by USDA and DOE FETC to study the use of biomass as a reburn fuel. Other project partners have included Niagara Mohawk, the FETC R&D group, and the ANTARES group. Phase I of the project was completed in 1997 and demonstrated the technical and economic feasibility of the concept.

Phase II (October 1997 –October 1999, with total funding of \$470K) is currently in progress. To date, promising results have been obtained via process modeling and combustion testing in a 1 MMBtu/hr test facility. Based upon the results, the project team is ready to conduct a technical feasibility and economic analysis for a specific site. In particular, project plans call for the development of conceptual designs for a particular reburn application, the performance modeling studies to evaluate thermal impacts and to determine specific particle size requirements, and a comparison of the economics for biomass cofiring and biomass reburning. Biomass reburning will be of specific value to power generators with the current capability to co-fire biomass since the processing and handling equipment for a reburn system will share some common components, but can be configured to deliver additional NO_x control benefits (50-90% depending on process conditions).

Phase II is expected to culminate in the development of specific equipment lists and economic figures for a biomass reburning demonstration (Phase III). In this final stage of Phase II, the project team needs to work directly with a potential host demonstration site. Prior to asset transfer to NRG, Niagara Mohawk had identified the Dunkirk Station as the target demonstration

site and agreed to provide \$30K Phase II cofunding (\$15.4K in-kind labor and \$15.6K for services by the ANTARES group). Due to the transition process, the project has been on hold since January 1999. For timely completion of the project, the team urgently needs NGR's confirmation that Dunkirk Station may still be considered as the demonstration site.

PHASE III DEMONSTRATION

Phase III will require that the knowledge gained in the previous efforts be applied to a full scale facility. The project team has identified several manufacturers of equipment that is capable of sizing material to the required specification. Although there are different host site possibilities, Dunkirk Station is an attractive choice for the following reasons:

- as part of a separate DOE project, the station will be retrofitted with the capacity to receive, process, and co-fire biomass fuels;
- a dedicated supply of suitable biomass material has already been identified; and
- the project team is already familiar with the equipment planned for the station cofiring retrofit and has performed a preliminary economic analysis of the system.

Funding for Phase III is still undecided, but it is expected that a 50/50 cost share split between federal and private funding sources will be required. Private sources could include in-kind engineering/management labor or equipment. Federal funding is expected to pay for outside engineering/consulting costs and at least some of the capital outlays required for retrofit (boiler modification, micronizing equipment). The final details of the costs and funding for Phase III will depend on the site selected and the demonstration test matrix. However, a preliminary cost estimate is provided below:

Equipment/Installation	\$0.9M	including lease of micronizing equipment, boiler modifications, and additional piping, duct work and blowers.
Engineering	\$0.2M	
Testing/Modeling	\$0.4M	
Project Management/Admin	<u>\$0.2M</u>	
Total	\$1.7M	

2.0 Exploration of Alternative Demonstrative Partners

In the interim between learning of the pending sale and receiving NRG's indication of interest, EER has also initiated exploratory talks with other groups that could be interested in biomass reburning. One opportunity is Weyerhaeuser, which, like other firms in the forest products industry, has a spreader stoker system with NO_x emissions higher than wanted by the regulatory authorities. With a ready surplus of biomass at little or no cost, forest products companies could find considerable synergism with biomass reburn projects - if they need the NO_x control. The environmental department of the state of Wisconsin, for example, has indicated to EER that it would favor the use of biomass-driven NO_x control at forest company sites in that state. Elsewhere, methane deNO_x has been applied to a forest products spreader stoker system. Assuming technical issues associated with the use of a biomass reburning fuel on such systems can be circumvented or resolved, the absence of a fuel price differential could make biomass reburning a more palatable approach for the host company than gas reburning or other technologies with incremental operating costs. For its part, Weyerhaeuser corporate management has expressed a willingness to commit the time of one or more of their staff to explore the possibility further in a face-to-face meeting with EER and DOE.

EER has uncovered an additional demonstration opportunity at a power company for whom it has performed recently a NO_x technology evaluation. Here, the company currently cofires PDF (process derived fuel) with coal and, when needed, natural gas. It has expressed an interest in exploring the possibility of installing a reburning system that could be fired with either natural gas or PDF. At issue is whether PDF, which is made largely from refuse, could be treated as biomass. EER would appreciate DOE's views on this possibility.