Lignite Fuel Enhancement

Quarterly Technical Progress Report:

Period: April 1st, 2006 to June 30th, 2006

DOE Award Number: DE-FC26-04NT41763

Date: July 30th, 2006

Reported by:

Charles Bullinger, P.E.

Senior Principle Engineer /Lignite Fuel Enhancement Project Manager

Great River Energy – Coal Creek Station

2875 Third Street SW

Underwood, North Dakota 58576-9659

Telephone: 701-442-7001

Lignite Fuel Enhancement

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 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 8th quarterly Technical Progress Report for the Lignite Fuel Enhancement Project summarizes activities from April 1st through June 30th of 2006. It summarizes primarily the testing activity during that time period.

Acknowledgement

The authors wish to acknowledge the contributions and support provided by various project managers: Dr. Sai Gollakota (DOE), Matt Coughlin (Barr) Dave Rian (Barr), John Wheeldon (EPRI), Tony Armor (EPRI), Dr. Ed Levy (Lehigh), Dr. Nedad Saranac (Lehigh), and Mark Ness (GRE).

Table of Contents

DISCLAIMER2

ABSTRACT3

ACKNOWLEDGEMENT4

EXECUTIVE REPORT6

PROGRESS:.....6

PROBLEMS ENCOUNTERED:7

PLANS FOR THE NEXT REPORTING PERIOD:8

PROSPECTS FOR FUTURE PROGRESS:9

EXPERIMENTAL APPARATUS:.....10

EXPERIMENTAL & OPERATING DATA:.....10

DATA REDUCTION:.....10

HYPOTHESIS & CONCLUSIONS:.....18

Executive Report

Progress:

The Design Team continued conferencing this quarter, analyzing the early data, and making recommendations based on the results. One team meeting was held at Coal Creek to inspect the dryer and review the operation. By the end of June we had run 100,000 tons of lignite through the dryer.

"Pairs" testing continued this quarter. This is testing of Unit#2 at Coal Creek with seven Pulverizers running "wet" lignite and then that performance and emission data compared to a six "wet" and one "dry" pulverizer operation. Some of that data was included in the last report. Mercury analysis of the segregated material this quarter reveals between 30 to 50 % of the inlet mercury in the segregated mass and 20 to 30% sulfur reduction (see chart below). This quite significant and Dr. Saranac and Mr. Ness had a chance to optimize its operation before capacity testing was begun in June. Some problems with broken inlet airlock gearboxes as a result of material binding them due to liewell screen being out-of-service were rectified. Plant crushers were set tighter and throughput to the dryer was accomplished at 105 ton/hour.

Coal accumulation on the outlet of the 2nd stage was alleviated by air lances however the air pressure in combination with the coal wore a hole into the distribution plate and coal accumulated in the inlet plenum. The distribution plate was repaired and the design team is reviewing modifications to the inlet air distribution that will "sweep" the ledges clean without lances.

Great River Energy and Headwaters met to discuss the Commercialization Plan this quarter. A three tiered approach to utilities was set up and where implementation/marketing is planned. The final marketing strategy/approach is pending final data from the drying system. Discussions with local utilities are ongoing. Inquiries have come from Europe to Australia since the Clearwater Meetings.

Invoices #21 through #23 were completed and forwarded for preliminary review and final DOE approval. The Budget expended through June 30th was \$10,856,518..

Charles Bullinger gave a presentation at the 31st International Clearwater Coal Conference. EPRI continues plans to "sunrise" a Dryer Interest Group in September of 2006.

Problems Encountered:

The drying systems main issues have been with the coal handling system not dryer or baghouse. Liewell pulley, bound air locks, and crusher throughput have all been issues although the dryer has performed and dried to 105 ton/hour. Air distribution improvements will be incorporated in the commercial dryers.

Plans for the next reporting period:

Capacity tests will complete. Some “life” data collected as the dryer continues to run through the summer. DOE project continuation application should be accepted. A “draft” of the Budget Period 1 report should be completed. Budget Period 2 and design of the Commercial System should begin in September.

Prospects for future progress:

The prospects are quite good that all the next Quarter deliverables will be met.

The expectation today, based on preliminary information, is that the project will continue to Phase 2.

Experimental Apparatus:

Details of the dryer and system, P&ID's, schematics, and drawings contain "Limited Rights" information which cannot be disclosed at this particular time.

Experimental & Operating Data:

"Pairs" testing completed and results tabulated. Capacity testing begun.

Dryer in operation: moisture leaving the drying system stack

Data Reduction:

Dryer Performance Testing: Dryer Coal Flow

Prototype Dryer Performance Tests: March - April, 2006

47

Prototype Coal Dryer Performance

Feed rate: 75 tons/hr (14% of total)

Parameter	Feed	Product	Change	
	TM %	TM %	TM % Abs	TM % Rel
Average Total Moisture, TM	36.78	28.55	8.23	22.4
Std. Deviation	1.26	1.00	1.07	
Std. Deviation of the Mean	0.34	0.27	0.30	

Parameter	Feed	Product	Change	
	HHV [BTU/lb]	HHV [BTU/lb]	HHV [BTU/lb]	HHV [%]
Average HHV	6,290	7,043	752	12.0
Std. Deviation	159	121	131	
Std. Deviation of the Mean	43	33	37

48

Dryer Performance Test Data: Total Coal Moisture

50

Unit Performance: Summary

Parameter	Units	Coal Dryer in Service	Coal Dryer Out of Service	Change	Units of Change
Gross Power Output	MW	589	590	NC	
Throttle Steam Temperature	Deg. F	988	989	NC	
Reheat Steam Temperature	Deg. F	1,002	1,002	NC	
SHT Spray Flow	klbs/hr	46	52	-6.4	klbs/hr
Total Coal Flow Rate	klbs/hr	953	972	-2.02	%
Dried Coal	% of Total	14.62	0.00		
Stack Flow Rate	kscfm	1,611	1,626	-0.96	%
Specific Pulverizer Work	kJ/klb	4.09	4.29	-4.65	%
Total Pulverizer Power	kW	4,057	4,206	-3.53	%
NOx Mass Emissions	lb/hr	1,345	1,470	-8.52	%
SOx Mass Emissions	lb/hr	3,618	3,692	-2.00	%
APH 21 Gas Exit Temperature	Deg. F	353	362	-8.6	Deg. F
APH 22 Gas Exit Temperature	Deg. F	368	377	-9.3	Deg. F
Stack Temperature	Deg. F	180	184	-4.2	Deg. F

51

Performance Test Data: Total Coal Flow Rate Reduction

52

Dryer Performance Test Data: Stack Flow Rate

53

Dryer Performance Test Data: Total Pulverizer Power

Prototype Dryer Performance Tests: March-April, 2006

55

Performance Test Results: Boiler Efficiency

61

Performance Test Results: Boiler Efficiency Improvement

62

Performance Test Data: NO_x Emissions

Prototype Dryer Performance Tests: March-April, 2006

63

Performance Test Data: SO₂ Emissions

64

Prototype Coal Dryer Performance

42

Prototype Coal Dryer Performance

Prototype Coal Dryer Performance: March to April, 2006

43

Segregation Stream

44

Hypothesis & Conclusions:

Hypothesis remains the same. We will be able to dry lignite an increment to benefit the performance of and reduce emissions from a coal burning electric power generating station.