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Pensacola, Florida 32520

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BUREAU OF AIR REGULATION

GULF POWER
A SOUTHERN COMPANY

Certified Mail

November 1, 2002

Jeffrey F. Koerner
Florida Department of Environmental Protection
Division of Air Resources Management
2600 Blair Stone Road
Mail Station #5510
Tallahassee, Florida 32399-2400

Dear Mr. Koerner:

RE: CRIST ELECTRIC GENERATING PLANT
BIOMASS PROJECT
PERMIT No: 0330045-001-AV

Thank you for the quick response to our request dated October 22, 2002 regarding the use of biomass at Plant Crist. Please find below our response to your request for additional information received October 29, 2002. Also attached is the required certification seal by a professional engineer for this project. Please let me know if you have additional questions regarding our test burning of this fuel.

Answer 1a. The attached Excel worksheet contains the available analyses for biomass fuels and an ultimate fuel analysis of Galatia coal (main fuel supplier for Crist). Please note that the biomass fuels contain no (added) chemicals or chemical treatments. The lower and higher heating values for these fuels were not available, therefore only an estimated heating value is given for each fuel.

Answer1b. Emission estimates are included in the attached Excel worksheet for the requested pollutants. Included is a conservative annual estimate of emissions as compared to the utilization of coal. Crist Units 4 and 5 are capable of accommodating biomass fuels thus this is not a NSR-PSD preconstruction review.

Answer 1c. The potential for NOx reduction is solely based on the amount of fuel bound nitrogen. Wood chips and other biomass contain less nitrogen per mmbtu (heat input value) than coal. The data suggest nitrogen oxides may be reduced by up to 9.5% based on the amount of fuel bound nitrogen in biomass. A conservative number is 3-5 % reduction. Carbon monoxide is not expected to increase from the use of biomass because of the small amounts (<10%) and due to the overall design of a coal fired boiler

Included to support these statements are excerpts from a biomass study conducted at Plant Hammond (Georgia Power) in 1992.

Answer 1d. Units 4 and 5 have hot side and cold side electrostatic precipitators having a collection efficiency greater than 99.9%. These units are designed for a full range of resistivity allowing the unit to burn a wide range of fuels as noted by its easy fuel switch to low sulfur coal in 1993 for acid rain compliance.

Answer #2. No additional equipment or measures must be taken to adjust to biomass as an alternative fuel. The biomass will be brought to the facility by truck, unloaded with existing equipment, and stored at existing storage facilities. The biomass will be charged through the existing pulverizers and fuel delivery system for combustion in the boilers.

Answer #3. The Crist Biomass Renewable Energy Project outlines a schedule of up to 30 days of testing for each proposed biomass fuel over a 10 months period. The estimated amount of each fuel is as follows: 7816 tons of wood chips; 4836 tons of switchgrass; 6288 tons of sawdust; and 6288 tons of sander dust.

If you have any questions regarding this project or the protocol development for the Crist Biomass Renewable Energy Project, please call me at (850) 444.6527.

Sincerely,

Dwain Waters Q.E.P.

G. Dwain Waters, Q.E.P.
Air Quality Programs Supervisor

cc: w/att: Jim. Vick, Gulf Power Company
Charles Howton, Gulf Power Company
Wright, Terry, Gulf Power Company
John Dominey, Gulf Power Company
Danny Herrin, Southern Company Services
Gary Perko, Hopping, Green & Sams
Ms. Sandra Veazey, FDEP Northwest District Office, Pensacola, Florida

BIOMASS WORKSHEET

Fuel	btu/lb	Moisture %	Ash %	Sulfur %	Nitrogen %	F ppm	Pb ppm	Hg ppm
Coal	11992	11.34	6.68	1.35	1.51	78	27.6	0.09
Wood Chips	4500	50	0.5	0.05	0.03	0	7.5	0
Switchgrass	7273	11.47	3.94	0.12	0.73	35.4	0.44	0.011
Sawdust	5593	35.65	1.85	0.02	0.03	1	0	0.02
Sander dust	5593	35.65	1.85	0.02	0.03	1	0	0.02

whereas:				
Ton of coal = 2000 lbs =	23.984 mmbtu			
thus: equal wood products are:				
wood chips =	4500 btu/lb	or	2.665	factor greater than coal
switchgrass =	7273 btu/lb	or	1.649	factor greater than coal
sawdust =	5593 btu/lb	or	2.144	factor greater than coal
sander dust =	5593 btu/lb	or	2.144	factor greater than coal
In other words, it will take	5329.7778 lbs of wood chips to replace equal heat input of 1 ton of coal(2.665* 2000).			

Baseline capacity for Crist Unit 4 or 5	
100% rated capacity of Unit 4 & 5 is 977 mmbtu/hr each.	
10% of fuel = 97.7 mmbtu/hr or	8147.0981 lbs of coal per hour

Material balance calculation		8147.09807	lbs of coal
wood chips:	F17*8147 lbs =	21711	lbs of wood chips to replace 10% heat input in Unit 4
switchgrass:	F18*8147 lbs =	13433	lbs of switchgrass to replace 10% heat input in Unit 4
sawdust:	F18*8147 lbs =	17468	lbs of sawdust to replace 10% heat input in Unit 4
sander dust:	F18*8147 lbs =	17468	lbs of sander dust to replace 10% heat input in Unit 4

Hourly emission estimates for coal and biomass fuels (equal to 10% heat input)

Sulfur Dioxide per hour (AP- 42 Factor)

coal emissions/hr	38*0.95*1.35*(8147/2000) tons coal =	198.5 lbs or	0.0993 tons of SO2 @ rate =	2.03198 lb/mmbtu
wood chips/hr	38*0.95*0.05*(21711/2000) tons chips =	19.6 lbs or	0.0098 tons of SO2 @ rate =	0.200556 lb/mmbtu
switchgrass/hr	38*0.95*0.12*(13433/2000) tons grass =	29.1 lbs or	0.0145 tons of SO2 @ rate =	0.297814 lb/mmbtu
sawdust/hr	38*0.95*0.02*(17468/2000) tons sawdust =	6.3 lbs or	0.0032 tons of SO2 @ rate =	0.064545 lb/mmbtu
sander dust/hr	38*0.95*0.02*(17468/2000) tons sander =	6.3 lbs or	0.0032 tons of SO2 @ rate =	0.064545 lb/mmbtu

Nitrogen Oxide per hour

Uncontrolled Nox emissions on Unit 4 & 5 are approximately 0.67 lb/mbtu

However, Unit 4 & 5 have Low Nox Burner Tips which reduce emissions to 0.40 lb/mbtu (CEM data)

Thus, the nitrogen bound % of 0.40 lb/mbtu is approximately equal to about 32% of the total fuel bound nitrogen converted to Nox.

Using this % of conversion of fuel bound nitrogen the following estimates are made for wood derived fuel:

coal emissions/hr	1.51 %N in fuel	1.51*.32*10000/11992 =	0.400 lb/mmbtu	rate * 97.7 mbtu/hr =	39.1 lb/hr Nox
wood chips/hr	0.03 %N in fuel	0.03*.32*10000/4500 =	0.021 lb/mmbtu	rate * 97.7 mbtu/hr =	2.1 lb/hr Nox
switchgrass/hr	0.73 %N in fuel	0.73*.32*10000/7273 =	0.321 lb/mmbtu	rate * 97.7 mbtu/hr =	31.4 lb/hr Nox
sawdust/hr	0.03 %N in fuel	0.03*.32*10000/5593 =	0.017 lb/mmbtu	rate * 97.7 mbtu/hr =	1.7 lb/hr Nox
sander dust/hr	0.03 %N in fuel	0.03*.32*10000/5593 =	0.017 lb/mmbtu	rate * 97.7 mbtu/hr =	1.7 lb/hr Nox

Particulate Matter per hour

Unit 4 & 5 have ESP @ approximately 99.9% efficiency

coal emissions based on AP-42 factor	0.08*Ash%	6.68 * tons fuel/hr =	2.18 lbs/hr or	0.022 lb/mmbtu
wood chips based on AP-42 factor	0.08*Ash%	0.5 * tons fuel/hr =	0.43 lbs/hr or	0.004 lb/mmbtu
switchgrass based on AP-42 factor	0.08*Ash%	3.94 * tons fuel/hr =	2.12 lbs/hr or	0.022 lb/mmbtu
sawdust based on AP-42 factor	0.08*Ash%	1.85 * tons fuel/hr =	1.29 lbs/hr or	0.013 lb/mmbtu
sander dust based on AP-42 factor	0.08*Ash%	1.85 * tons fuel/hr =	1.29 lbs/hr or	0.013 lb/mmbtu

Particulate Matter 10 per hour

Unit 4 & 5 have ESP @ approximately 99.9% efficiency

coal emissions based on AP-42 factor	0.05*Ash%	6.68 * tons fuel/hr =	1.36 lbs/hr or	0.014 lb/mmbtu
wood chips based on AP-42 factor	0.05*Ash%	0.5 * tons fuel/hr =	0.27 lbs/hr or	0.003 lb/mmbtu
switchgrass based on AP-42 factor	0.05*Ash%	3.94 * tons fuel/hr =	1.32 lbs/hr or	0.014 lb/mmbtu
sawdust based on AP-42 factor	0.05*Ash%	1.85 * tons fuel/hr =	0.81 lbs/hr or	0.008 lb/mmbtu
sander dust based on AP-42 factor	0.05*Ash%	1.85 * tons fuel/hr =	0.81 lbs/hr or	0.008 lb/mmbtu

Continued: Hourly emission estimates for coal and biomass fuels (equal to 10% heat input)

Fluorides (assumes 90% conversion of F to HF) tons of fuel * 2000/ton*ppmF* 1E-6*1.054lbHF/lbF * .90 = lbs HF emitted

coal emissions/hr	4.07355	78 *1E-6*1.054 * .90=	0.60 lbs/hr	HF	or	0.0062 lb/mmbtu
wood chips/hr	10.85556	0 *1E-6*1.054 * .90=	0.00 lbs/hr	HF	or	0.0000 lb/mmbtu
switchgrass/hr	6.71662	35.4 *1E-6*1.054 * .90=	0.45 lbs/hr	HF	or	0.0046 lb/mmbtu
sawdust/hr	8.73413	1 *1E-6*1.054 * .90=	0.02 lbs/hr	HF	or	0.0002 lb/mmbtu
sander dust/hr	8.73413	1 *1E-6*1.054 * .90=	0.02 lbs/hr	HF	or	0.0002 lb/mmbtu

Lead (EPRI Emissions Handbook) Pb lbs/ton of coal'=3.4*(0.1*(ppmPb/Ash %*100))^0.8*2000*btu/lb/10^12

coal emissions/hr	0.0016 lb/ton	or	0.0065 lb/hr	or	6.7E-05 lb/mmbtu
wood chips/hr	0.0017 lb/ton	or	0.0183 lb/hr	or	1.9E-04 lb/mmbtu
switchgrass/hr	0.0001 lb/ton	or	0.0004 lb/hr	or	3.7E-06 lb/mmbtu
sawdust/hr	0.0000 lb/ton	or	0.0000 lb/hr	or	0.0E+00 lb/mmbtu
sander dust/hr	0.0000 lb/ton	or	0.0000 lb/hr	or	0.0E+00 lb/mmbtu

Mercury (EPRI Emissions Handbook) Hg lbs= tons coal * 2000/lb/ton * ppm Hg/10^6*(.70)

coal emissions/hr	0.0005 lb/hr	or	5.3E-06 lb/mmbtu
wood chips/hr	0.0000 lb/hr	or	0.0E+00 lb/mmbtu
switchgrass/hr	0.0001 lb/hr	or	1.1E-06 lb/mmbtu
sawdust/hr	0.0002 lb/hr	or	2.5E-06 lb/mmbtu
sander dust/hr	0.0002 lb/hr	or	2.5E-06 lb/mmbtu

Sulfuric Acid Mist (Southern Research) H2SO4 lbs = 3063* 008*.25* SO2 tons)

coal emissions/hr	0.6081 lb/hr	or	0.0062 lb/mmbtu
wood chips/hr	0.0600 lb/hr	or	0.0006 lb/mmbtu
switchgrass/hr	0.0891 lb/hr	or	0.0009 lb/mmbtu
sawdust/hr	0.0193 lb/hr	or	0.0002 lb/mmbtu
sander dust/hr	0.0193 lb/hr	or	0.0002 lb/mmbtu

Carbon Monoxide (CO) AP-42 Factor for Coal is 0.50/ton (Southern research shows CO the same or lower when co-firing wood at Hammond (report attached)

coal emissions/hr	4.07355 tons coal =	2.04 lbs CO	or	0.021 lb/mmbtu
wood chips/hr	97.700 mmbtu chips	2.04 lbs CO	or	0.021 lb/mmbtu
switchgrass/hr	97.700 mmbtu grass	2.04 lbs CO	or	0.021 lb/mmbtu
sawdust/hr	97.700 mmbtu sawd	2.04 lbs CO	or	0.021 lb/mmbtu
sander dust/hr	97.700 mmbtu sander	2.04 lbs CO	or	0.021 lb/mmbtu

Conservative Hourly Comparison of Emissions for Unit 4 or 5 (lb/hr)

Emissions based on maximum emission rate for Units 4 or 5 = 977 mmbtu/hr

	Coal	Coal+ Wood Chips	Coal + Switchgrass	Coal+ Sawdust or Sander Dust
SO2	1985.2	1806.3	1815.8	1793.0
Nox	390.8	353.8	383.1	353.4
Particulate	21.8	20.0	21.7	20.9
PM 10	13.6	12.5	13.6	13.1
HF	6.0	5.4	5.9	5.4
Pb	0.1	0.1	0.1	0.1
Hg	0.005	0.005	0.005	0.005
H2SO4	6.081	5.533	5.562	5.492
CO	20.368	20.368	20.368	20.368

Conservative Annual Comparison of Emissions for Unit 4

Emissions based on calendar year 2000 heat input. 4374919 mmbtu/yr

	Coal	Coal+ Wood Chips	Coal + Switchgrass	Coal+ Sawdust or Sander Dust
SO2	4444.9	4044.3	4065.5	4014.5
NOx	875.0	792.2	857.7	791.2
Particulate	48.7	44.8	48.6	46.8
PM-10	30.5	28.0	30.4	29.2
HF	13.5	12.1	13.2	12.2
Pb	0.1	0.2	0.1	0.1
Hg	0.01	0.01	0.01	0.01
H2SO4	13.61	12.39	12.45	12.30
CO	45.60	45.60	45.60	45.60

Conservative Annual Comparison of Emissions for Unit 5

Emissions based on calendar year 2000 heat input. 5811900 mmbtu/yr

	Coal	Coal+ Wood Chips	Coal + Switchgrass	Coal+ Sawdust or Sander Dust
SO2	5904.8	4058.7	4086.9	4019.1
NOx	1162.4	793.7	880.8	792.5
Particulate	64.7	45.2	50.2	45.2
PM-10	40.5	28.2	31.4	27.4
HF	17.9	12.1	13.5	12.1
Pb	0.2	0.2	0.1	0.1
Hg	0.02	0.01	0.01	0.01
H2SO4	18.09	12.43	12.52	12.31
CO	60.58	47.10	47.10	47.10

CRIST UNITS 4 & 5 BIOMASS BURNING DEVELOPMENTAL PROJECT AND SCHEDULE CERTIFICATION BY PROFESSIONAL ENGINEER

"I, the undersigned, am a registered professional engineer in the state of Florida and hereby certify to the best of my knowledge that all information submitted for the construction permit to development protocols for the use of biomass fuels at the Crist Electric Generating Plant is true, accurate and complete. "

Professional Engineer Signature:

Gregory N. Terry
Registration Number: 52786

11-1-2002
Date

[illegible]

[illegible]

[illegible]

[illegible]

Southern Company - Coal Quality Database

Ultimate Analysis –

Crist and Smith- Galatia coal from Illinois Basin

Total Records Found 10

As Rec'd

Ash (% by wt)	6.68 ± 0.50 (Nondet: 0) (N/A: 0) (Med/Max/Min: 6.60/7.46/5.90)
HOC (BTU/lb)	11992 ± 109 (Nondet: 0) (N/A: 0) (Med/Max/Min: 12026/12129/11830)
Sulfur (% by wt)	1.35 ± 0.21 (Nondet: 0) (N/A: 0) (Med/Max/Min: 1.44/1.61/1.07)
C (% by wt)	68.43 ± 1.42 (Nondet: 0) (N/A: 0) (Med/Max/Min: 68.09/70.46/66.41)
H (% by wt)	4.37 ± 0.14 (Nondet: 0) (N/A: 0) (Med/Max/Min: 4.38/4.58/4.17)
N (% by wt)	1.51 ± 0.06 (Nondet: 0) (N/A: 0) (Med/Max/Min: 1.50/1.59/1.40)
O (% by wt)	6.33 ± 1.17 (Nondet: 0) (N/A: 0) (Med/Max/Min: 6.78/7.55/4.59)
Vol (% by wt)	30.44 ± 1.57 (Nondet: 0) (N/A: 0) (Med/Max/Min: 30.34/32.78/28.41)
Fixed C (% by wt)	49.86 ± 3.21 (Nondet: 0) (N/A: 0) (Med/Max/Min: 50.55/53.73/44.78)
Total Moisture (% by wt)	11.34 ± 0.59 (Nondet: 0) (N/A: 0) (Med/Max/Min: 11.35/11.98/10.29)

Dry Basis

Ash (% by wt)	7.53 ± 0.55 (Nondet: 0) (N/A: 0) (Med/Max/Min: 7.40/8.41/6.70)
HOC (BTU/lb)	13526 ± 106 (Nondet: 0) (N/A: 0) (Med/Max/Min: 13504/13664/13345)
Sulfur (% by wt)	1.52 ± 0.23 (Nondet: 0) (N/A: 0) (Med/Max/Min: 1.62/1.79/1.21)
C (% by wt)	77.18 ± 1.42 (Nondet: 0) (N/A: 0) (Med/Max/Min: 77.06/79.45/75.42)
H (% by wt)	4.93 ± 0.13 (Nondet: 0) (N/A: 0) (Med/Max/Min: 4.92/5.12/4.73)
N (% by wt)	1.70 ± 0.07 (Nondet: 0) (N/A: 0) (Med/Max/Min: 1.69/1.79/1.58)
O (% by wt)	7.14 ± 1.34 (Nondet: 0) (N/A: 0) (Med/Max/Min: 7.66/8.58/5.18)
Vol (% by wt)	34.33 ± 1.67 (Nondet: 0) (N/A: 0) (Med/Max/Min: 34.06/36.95/32.21)
Fixed C (% by wt)	56.25 ± 3.80 (Nondet: 0) (N/A: 0) (Med/Max/Min: 57.22/60.58/50.00)

Southern Company - Coal Quality Database

Total Records Found 10

Trace Elements – Statistics

Crist & Smith – Galatia coal from Illinois Basin

As Rec'd Basis

As (mg/kg)	18.8 ± 7.7 (Nondet: 0) (N/A: 0) (Med/Max/Min: 16.4/38.9/12.4)
Ba (mg/kg)	24.13 ± 5.78 (Nondet: 0) (N/A: 0) (Med/Max/Min: 22.50/32.00/15.00)
Be (mg/kg)	1.1 ± 0.2 (Nondet: 0) (N/A: 0) (Med/Max/Min: 1.1/1.5/0.8)
B (mg/kg)	N/A ± N/A (Nondet: 0) (N/A: 0) (Med/Max/Min: N/A/N/A/N/A)
Cd (mg/kg)	0.13 ± 0.05 (Nondet: 0) (N/A: 0) (Med/Max/Min: 0.13/0.22/0.06)
Cl (mg/kg)	3042 ± 188 (Nondet: 0) (N/A: 0) (Med/Max/Min: 2994/3361/2794)
Co (mg/kg)	5.5 ± 1.0 (Nondet: 0) (N/A: 0) (Med/Max/Min: 5.5/6.8/3.5)
Cr (mg/kg)	10 ± 2 (Nondet: 0) (N/A: 0) (Med/Max/Min: 10/13/7)
Cu (mg/kg)	8 ± 2 (Nondet: 0) (N/A: 0) (Med/Max/Min: 7/11/3)
F (mg/kg)	78 ± 64 (Nondet: 0) (N/A: 0) (Med/Max/Min: 72/248/19)
Hg (mg/kg)	0.09 ± 0.03 (Nondet: 0) (N/A: 0) (Med/Max/Min: 0.10/0.12/0.00)
Li (mg/kg)	N/A ± N/A (Nondet: 0) (N/A: 0) (Med/Max/Min: N/A/N/A/N/A)
Mg (% by wt)	0.04 ± 0.00 (Nondet: 0) (N/A: 0) (Med/Max/Min: 0.04/0.05/0.04)
Mn (mg/kg)	11 ± 5 (Nondet: 0) (N/A: 0) (Med/Max/Min: 9/19/6)
Mo (mg/kg)	N/A ± N/A (Nondet: 0) (N/A: 0) (Med/Max/Min: N/A/N/A/N/A)
Na (% by wt)	0.07 ± 0.01 (Nondet: 0) (N/A: 0) (Med/Max/Min: 0.07/0.08/0.05)
Ni (mg/kg)	16 ± 3 (Nondet: 0) (N/A: 0) (Med/Max/Min: 16/19/10)
Pb (mg/kg)	27.6 ± 4.4 (Nondet: 0) (N/A: 0) (Med/Max/Min: 27.4/34.9/21.0)
Sb (mg/kg)	0.61 ± 0.27 (Nondet: 1) (N/A: 0) (Med/Max/Min: 0.65/1.00/0.05)
Se (mg/kg)	0.35 ± 0.22 (Nondet: 5) (N/A: 0) (Med/Max/Min: 0.21/0.70/0.20)
Sr (mg/kg)	N/A ± N/A (Nondet: 0) (N/A: 0) (Med/Max/Min: N/A/N/A/N/A)
V (mg/kg)	19 ± 4 (Nondet: 0) (N/A: 0) (Med/Max/Min: 18/24/11)
Zn (mg/kg)	30 ± 7 (Nondet: 0) (N/A: 0) (Med/Max/Min: 29/44/19)
Total Moisture (% by wt)	11.34 ± 0.59 (Nondet: 0) (N/A: 0) (Med/Max/Min: 11.35/11.98/10.29)

COFIRING OF WOOD WASTE WITH COAL AT PLANT HAMMOND UNIT 1 OF GEORGIA POWER COMPANY

D. M. Boylan

M. T. Newton

P. K. Vitta

E. V. Gunter

Southern Company Services, Inc.
Birmingham, AL

September, 1992

EXECUTIVE SUMMARY

During the period June 15-19, 1992, tests were conducted at Georgia Power Company's Plant Hammond Unit 1 to determine the impact of cofiring wood waste with coal on plant performance. Test data were obtained to determine the effect of wood on mill, precipitator, boiler efficiency, and stack gas emissions.

The wood waste was a mixture of tree trimming waste and sawdust. The wood waste had been processed in a tub grinder with 2" screen. A total of 140 tons wood waste was burned.

Eleven performance tests were conducted. Baseline tests were conducted at low, high and medium O_2 levels with coal as fuel. Boiler efficiency, mill performance, and particulate and gaseous emissions were measured. Baseline testing was followed with tests of wood-coal cofiring. Two compositions of wood-coal mixture were prepared and burned over two days, repeating the test procedure of the baseline tests. All tests were conducted at full load. Wood percentage in the fuel ranged between 9.7 and 13.5%, with an average for the cofire tests of 11.5% (all percentages by weight).

Test results indicated that Plant Hammond Unit 1 could successfully fire wood-coal mixtures for concentrations up to 13% (by weight - 7.5% by heating input) without significant problems. Based on the test results, this wood percentage is close to the maximum which could be fired without dropping load. In approximately eighteen hours of wood operation, only one partial feeder blockage was observed, and this problem cleared itself. Opacity was observed to increase with wood cofiring, the cause of which is presently unexplained. At medium and high O_2 levels, boiler efficiency with wood cofiring was within 0.2-0.4% of boiler efficiency with coal alone. NOx emissions with wood were about the same or slightly less than with coal firing. Sulfur emissions theoretically should have been 6-7% lower with wood cofiring. This decrease was not observed because of fluctuations in the coal sulfur content. Mill power increased with wood cofiring, and mill vibration was slightly higher. Mill fineness was slightly affected, as the wood particles did not grind as small as the coal particles.

The report describes the tests in detail, including a discussion and summary of test results and recommendations for further study.

INTRODUCTION AND OBJECTIVES

Disposal of wood waste is a growing potential problem for the Southern Company and its customers. Forest products based industry is an important part of the economy in the Southeast. Paper industry, sawmills, and furniture companies are extensive in this area, and they generate large quantities of wood waste. Tree trimming and transmission line access clearing also result in large quantities of waste. The cost of disposing of wood wastes has been rising rapidly in the past few years and is expected to rise further as many of the land fills are expected to be closed to wood wastes.

The wood waste has potential for use as fuel. One option under consideration is to cofire quantities of wood waste with coal in existing coal fired power plant boilers. At several Southern Company plants, various forms of customer wood waste (predominantly sander dust) are being burned.

Questions remain, however, regarding the impact of cofiring wood waste on the performance and efficiency of the power plant, particularly as the percentage of wood waste cofiring increases. An economic assessment of wood waste cofiring requires information regarding the impact of wood on the plant emissions, efficiency, and reliability and maintenance. In November, 1991, SCS and GPC conducted short tests on Plant Mitchell Unit 1 to investigate the impact of wood on a CE unit. This unit was and with wood cofiring. The results are shown in Figures 7-10. For these tests, heat absorbed in the superheater was about the same for both fuels. The wood mixture had higher absorption in the reheater and economizer and less in the boiler compared with coal.

However, these results are affected by operation of the gas recirculation system. When wood was initially introduced into the furnace in Test 4, the unit experienced a decrease in superheater temperature. This superheat temperature drop may have resulted from higher volatility in the wood producing more intense flame in the boiler. In order to prevent dropping load, gas recirculation fans were activated to increase superheat temperature. The resulting higher gas flow then reduced boiler residence time and increased heat transfer in the convective sections of the unit.

Flue Gas Emissions

The wood waste material has a very low sulfur content (0.2% compared with coal at 1.7%), so it was expected that the SO_2 emissions with wood cofiring would be reduced by approximately the BTU fraction of wood in the fuel. However, in testing, no reduction in SO_2 lb/MMBTU was measured. Fuel analysis indicates, however, that the coal for Tests 1, 2 and 3 has slightly lower sulfur content than the coal which was mixed with the wood. This conclusion is supported by the sulfur level of Test 9. Test 9 was a coal alone test, conducted between the wood tests, for which the coal was about 10% higher in sulfur content than the mixed fuel. From the fuel analyses, it is calculated that the cofiring of wood reduced the sulfur emissions by about 5-6%.

Only a small or no reduction in NO_x was measured during wood cofiring compared with coal. Figure 11 shows a plot of NOx/MMBTU as a function of O_2. As expected, NOx increases with increasing excess air. The curve suggests that NOx may be slightly lower with wood cofiring for the same O_2 level, but this difference is probably within data scatter. It can be concluded that for constant O_2, NOx is not increased with wood cofiring.

However, boiler efficiency tests indicated that best efficiency was obtained at high O_2 (4.2%) when cofiring wood. If the unit is cofired with wood at high O_2 to optimize boiler efficiency, then NOx emissions will be higher with wood cofiring than with coal alone.

Carbon monoxide measurements were made to determine air settings for the two fuels for the lowest excess air condition. For the low O_2 test, O_2 levels were gradually reduced until CO began to increase. The CO results are plotted in Figure 12 as a function of O_2. As expected, higher CO levels are experienced at low excess air levels. The curves show that for constant O_2, within the range of data scatter, approximately no difference in CO emissions was observed between coal alone and wood cofiring.

Mill Performance

One of the concerns of firing bark and wood waste directly in the pulverized coal furnace is the pulverizers themselves. Concern has been expressed regarding the effectiveness of the mills in grinding the fibrous material, and the effect of wood on plugging mill passages. Plant Hammond is served by four ball-in-race mills.

Figure 13 shows the mill outlet samples screening results for all tests. Mill outlet samples were taken from each mill in an "as operated" mode. No particular mill settings were sought beyond those required to maintain test load with the particular fuel. The fineness results indicate that the fineness of the product is only slightly reduced when cofiring wood in these mills. On average, 2.5% less material passes the 200 mesh screen, most of the difference showing up on the 100 mesh and some on the 60 mesh screens. BTU analyses were performed on the screen fractions to determine the percentage of wood in each fraction. The results indicate that approximately 80% of the material caught on the 60 mesh screen is wood. Forty to fifty percent of the 100 mesh screening is wood, while the finer material is about 8-10% wood. Therefore, approximately 85-90% of the wood is ground finer than 100 mesh in the mills. About 70% of the wood passes the 200 mesh screen. These results

FIGURE 11: NOx VS O2

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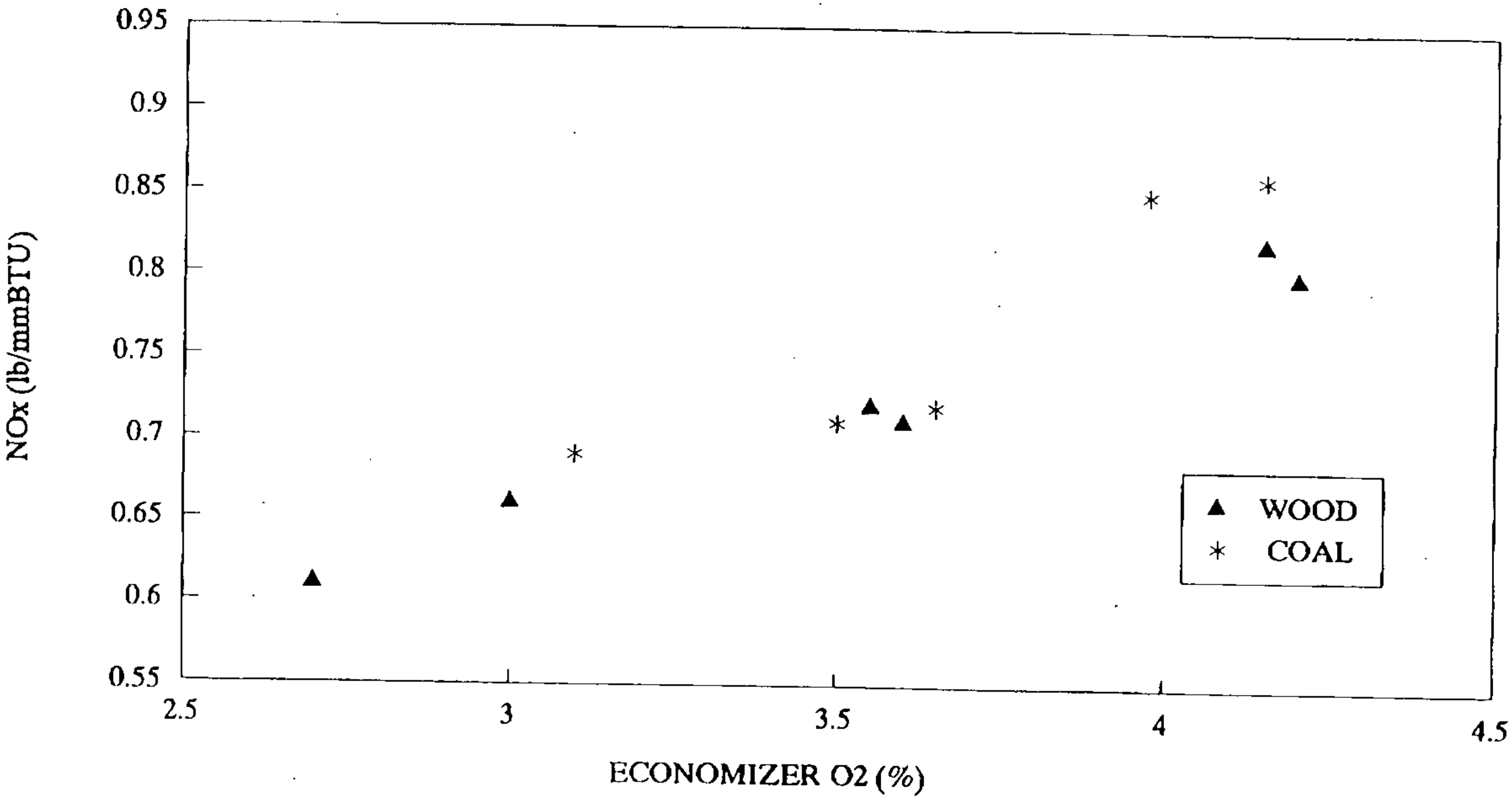

FIGURE 12: CO VS O2

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