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BUREAU OF AIR REGULATION



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.

Answer 1b. 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 NO<sub>x</sub> 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

Mr. Jeffrey F. Koerner

Page 2

November 1, 2002

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,

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

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

Thus, the nitrogen bound % of 0.40 lb/mmbtu 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	$1.51 \times .32 \times 10000/11992 =$	0.400 lb/mmbtu	rate * 97.7 mmbtu/hr =	39.1 lb/hr Nox
wood chips/hr	0.03 %N in fuel	$0.03 \times .32 \times 10000/4500 =$	0.021 lb/mmbtu	rate * 97.7 mmbtu/hr =	2.1 lb/hr Nox
switchgrass/hr	0.73 %N in fuel	$0.73 \times .32 \times 10000/7273 =$	0.321 lb/mmbtu	rate * 97.7 mmbtu/hr =	31.4 lb/hr Nox
sawdust/hr	0.03 %N in fuel	$0.03 \times .32 \times 10000/5593 =$	0.017 lb/mmbtu	rate * 97.7 mmbtu/hr =	1.7 lb/hr Nox
sander dust/hr	0.03 %N in fuel	$0.03 \times .32 \times 10000/5593 =$	0.017 lb/mmbtu	rate * 97.7 mmbtu/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.

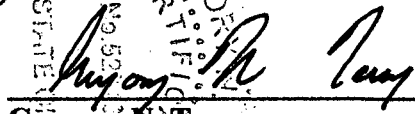
5811900 mmbtu/yr

	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:**

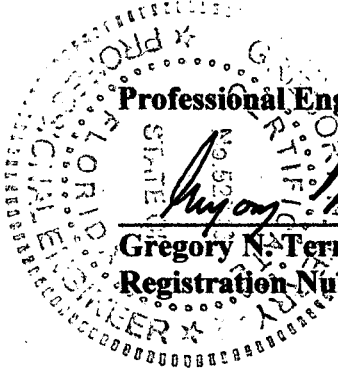


*Gregory N. Terry*

**Gregory N. Terry  
Registration Number: 52786**

*11-1-2002*

**Date**



# 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<sub>2</sub> 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<sub>2</sub> levels, boiler efficiency with wood cofiring was within 0.2-0.4% of boiler efficiency with coal alone. NO<sub>x</sub> 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<sub>2</sub> emissions with wood cofiring would be reduced by approximately the BTU fraction of wood in the fuel. However, in testing, no reduction in SO<sub>2</sub> 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<sub>x</sub> was measured during wood cofiring compared with coal. Figure 11 shows a plot of NO<sub>x</sub>/MMBTU as a function of O<sub>2</sub>. As expected, NO<sub>x</sub> increases with increasing excess air. The curve suggests that NO<sub>x</sub> may be slightly lower with wood cofiring for the same O<sub>2</sub> level, but this difference is probably within data scatter. It can be concluded that for constant O<sub>2</sub>, NO<sub>x</sub> is not increased with wood cofiring.

However, boiler efficiency tests indicated that best efficiency was obtained at high O<sub>2</sub> (4.2%) when cofiring wood. If the unit is cofired with wood at high O<sub>2</sub> to optimize boiler efficiency, then NO<sub>x</sub> 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<sub>2</sub> test, O<sub>2</sub> levels were gradually reduced until CO began to increase. The CO results are plotted in Figure 12 as a function of O<sub>2</sub>. As expected, higher CO levels are experienced at low excess air levels. The curves show that for constant O<sub>2</sub>, 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

- 30 -

# FIGURE 11: NO<sub>x</sub> VS O<sub>2</sub>

## PLANT HAMMOND - 6/92

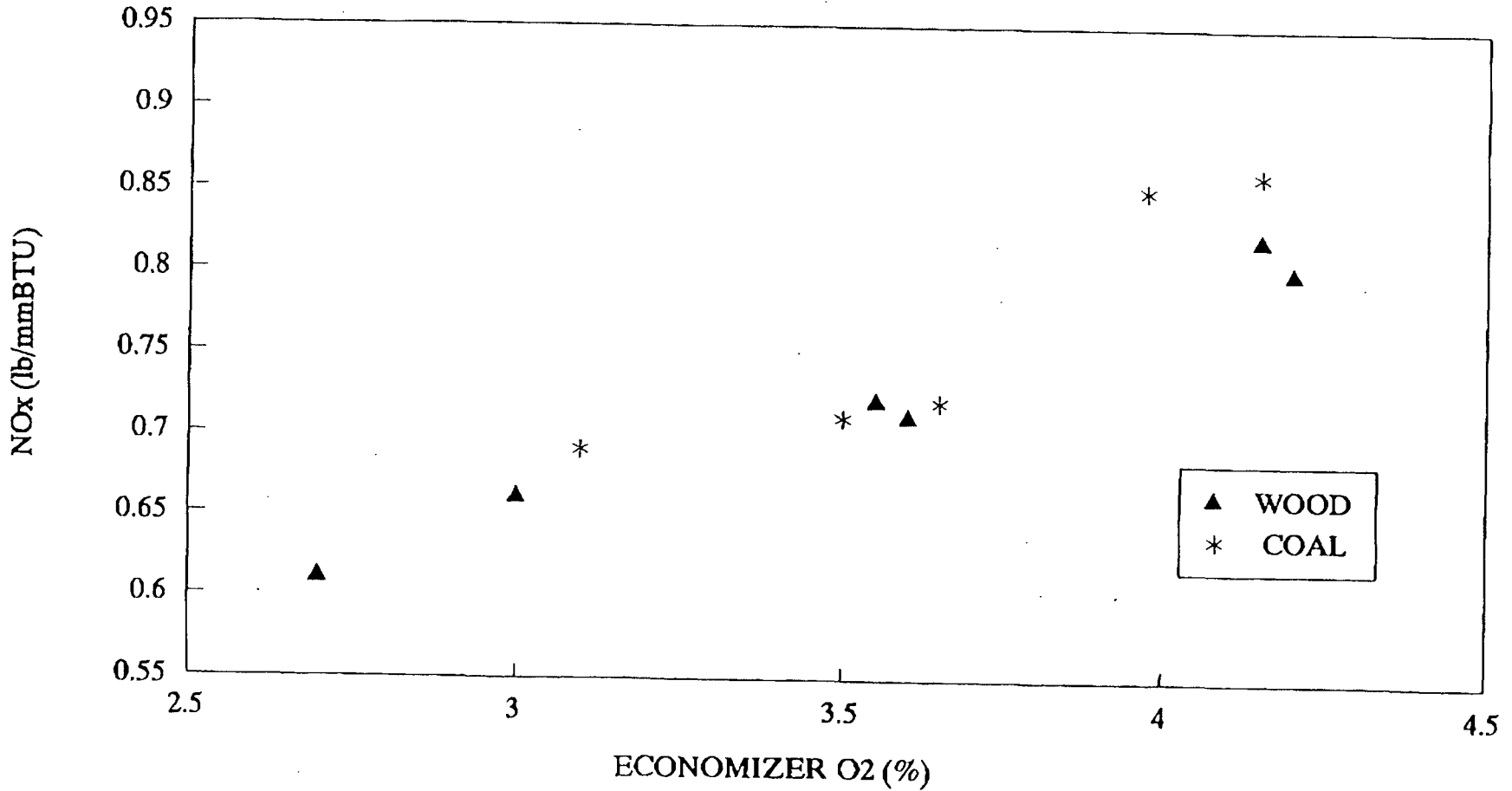
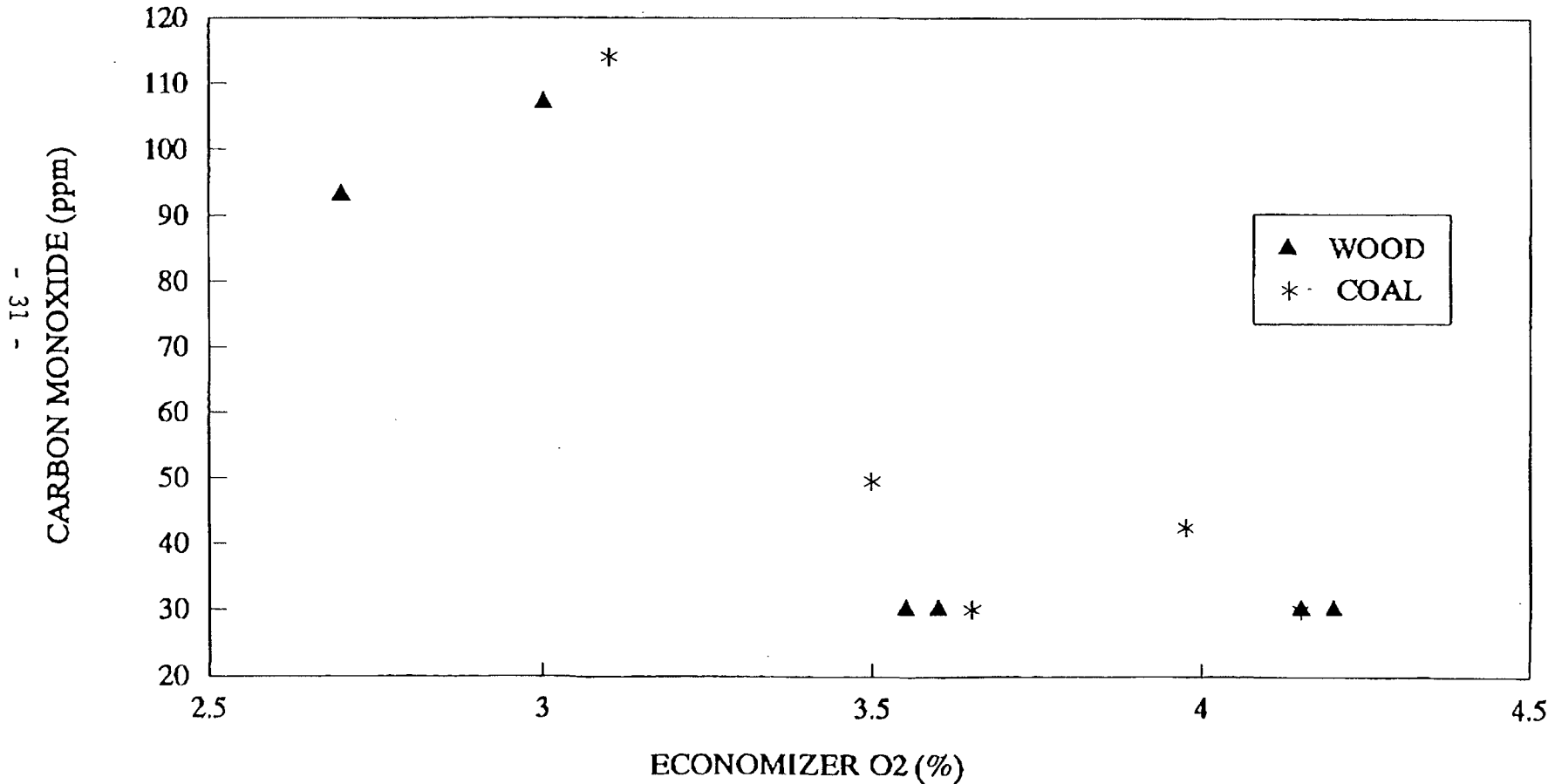
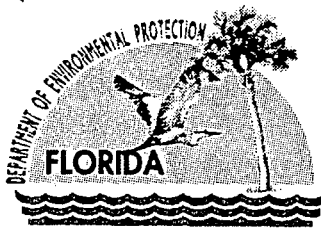


FIGURE 12: CO VS O2  
PLANT HAMMOND - 6/92







Jeb Bush  
Governor

# Department of Environmental Protection

Twin Towers Office Building  
2600 Blair Stone Road  
Tallahassee, Florida 32399-2400

David B. Struhs  
Secretary

October 28, 2002

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. Gene L. Ussery, Jr., Vice President of Power Generation  
Gulf Power  
One Energy Place  
Pensacola, Florida 32520

Re: **Request for Additional Information**  
Project No. 0330045-004-AC  
Crist Units 4 and 5, Biomass Project

Dear Mr. Ussery:

On October 24, 2002, the Department received your request for an air construction permit to authorize the field-testing of "biomass" (wood chips, switchgrass, sawdust and sander dust) in Units 4 and 5 at the Crist Electric Generating Plant. The application is incomplete. In order to continue processing your application, the Department will need the additional information requested below.

1. Your request states that, "Gulf Power believes that no increases in emissions will occur for the testing and use of biomass fuels because the amounts of sulfur, nitrogen, and particulate is lower in biomass than in the coal it will be replacing."
  - a. To support this statement, please provide the following information: lower and higher heating values (Btu/lb), sulfur, nitrogen, ash, moisture, fluorides, lead, and mercury (in terms of percent by weight for all). Compare these values with existing values from coal currently being fired in these units.
  - b. Estimate emissions of carbon monoxide (CO), nitrogen oxides (NO<sub>x</sub>), particulate matter (PM/PM<sub>10</sub>), sulfur dioxide (SO<sub>2</sub>), sulfuric acid mist (SAM), fluorides (F1), lead (Pb), and mercury (Hg). Please provide references for the estimates and report emissions in terms of lb/MMBtu heat input, lb/hour, and tons per year. Compare the annual emissions estimate with the emissions form comparable coal firing. Does the proposed project trigger PSD preconstruction review?
  - c. Please explain the mechanism by which NO<sub>x</sub> emissions will be reduced 3-5%. Is this a 3-5% reduction from actual emissions or from permit allowable emissions? If based on actual emissions, what is the reference for the current coal-fired NO<sub>x</sub> emission rate in terms of lb/MMBtu? What is the averaging period? If NO<sub>x</sub> emissions are expected to decrease, what is expected for CO emissions?
  - d. Units 5 and 6 have electrostatic precipitators (ESP) to control emissions of particulate matter. These units are typically designed for a certain fuel that will produce particles within a known size range and of a given resistivity. Please provide information that shows the particle size range and resistivity from firing the proposed "biomass" fuels is within the original design range of the ESPs. Will there be an increase in particulate matter emissions from firing "biomass"?
2. Historically, the addition of wood and other plant-based materials as fuels for existing coal-fired boilers have caused several problems related to storage, handling, and charging. Please describe how the "biomass" materials will be brought to the site, unloaded, stored at the site, and charged into the units. What additional equipment and measures must be taken to adjust to "biomass" as a new fuel?

*"More Protection, Less Process"*

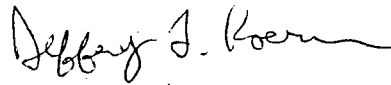
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3. For the ten-month test period, please estimate the total maximum expected firing rates for each fuel (MMBtu per 10 months).

Please provide certification from a Professional Engineer registered in Florida for your initial request and for the additional information requested by the Department [Rule 62-4.050(3), F.A.C.]. The Department notes that your request is to begin field-testing on November 18, 2002. Once the application is complete and if approved, our rules require public notice for such projects with a minimum 14-day public comment period. Please submit the requested additional information as soon as possible so that the Department can attempt to meet your proposed schedule.

The Department will resume processing your application after receipt of the requested information. You are reminded that Rule 62-4.055(1), F.A.C. now requires applicants to respond to requests for information within 90 days or provide a written request for an additional period of time to submit the information. If you have any questions, please contact me at 850/921-9536.

Sincerely,



Jeffery F. Koerner  
New Source Review Section

AAL/jfk

cc: Mr. G. Dwain Waters, Gulf Power  
Ms. Sandra Veazey, NWD Office  
Mr. Gregg Worley, EPA Region 4  
Mr. John Bunyak, NPS

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- Print your name and address on the reverse so that we can return the card to you.
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1. Article Addressed to:

Mr. Gene L. Ussery, Jr.  
 V.P. of Power Generation  
 Gulf Power Corporation  
 One Energy Place  
 Pensacola, FL 32520

2. Article

7001 0320 0001 3692 7744

**COMPLETE THIS SECTION ON DELIVERY**

A. Received by (Please Print Clearly)

J. Garner

B. Date of Delivery

10/30/02

C. Signature

X J. Garner

Agent

Addressee

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Yes

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3. Service Type

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PS Form 3811, July 1999

Domestic Return Receipt

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 City, State, ZIP+4  
 Pensacola, FL 32520

PS Form 3800, January 2001

See Reverse for Instructions

One Energy Place  
Pensacola, Florida 32520

Tel 850.444.6111

RECEIVED

OCT 24 2002

DIVISION OF AIR  
RESOURCES MANAGEMENT



Certified Mail

October 22, 2002

Al L. Linero  
Florida Department of Environmental Protection  
Division of Air Resources Management  
2600 Blair Stone Road  
Mail Station #5510  
Tallahassee, Florida 32399-2400

Dear Mr. Linero:

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

Thank you for meeting with us on October 3, 2002 regarding the Crist Biomass Renewable Energy Project. Enclosed, pursuant to your request is our research study plan outlining the details of the project along with our determination of no emissions increase. A Responsible Official certification statement is also enclosed. Gulf Power hereby requests a construction permit to conduct field testing beginning on November 18, 2002 to determine the feasibility of the long range use of biomass as a fuel.

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,

A handwritten signature in black ink, appearing to read "Dwain Waters".

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