Consumer Products Division
P.O. Box 919
Palatka, FL 32178-0919
(386) 325-2001

November 14, 2006

RECEIVED
NOV 16 2006
BUREAU OF AIR REGULATION

Jeffery F. Koerner, Air Permitting North Section
Bureau of Air Regulation
Florida Department of Environmental Protection
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Re: Modification of the No. 4 Recovery Boiler, No. 4 Lime Kiln and No. 4 Combination Boiler
Project No. 1070005-038-AC/PSD-FL-380

Response to Request for Information No. 2

Dear Mr. Koerner:

On October 27th, Georgia-Pacific received your second request for additional information regarding this project. Our responses are below and in the attachments to this letter. For ease of following GP's responses we have repeated the FDEP's questions prior to the answers.

1. **Describe the methods that will be used to monitor the heat input rate to the No. 4 combination boiler for fuel oil firing and for bark/wood firing (i.e., oil flow meter, steam production rate with thermal efficiency, periodic sampling and analysis of bark/wood, record keeping, etc.).**

   Answer: GP monitors the rate, the temperature and the pressure of the steam produced in the No. 4CB. Based on these values we calculate the "heat input necessary" to produce this level of steam (in MMBTU/HR). The #4 Combination Boiler has an efficiency of 66%, so the calculated "Necessary Heat Input" is divided by 0.66 to obtain the "actual total heat input" (in MMBTU/HR). GP measures the usage rate for fuel oil and uses that value to calculate the heat input from oil in MMBTU/HR (the calculation is fuel oil flow in gallons per hour times 0.15 MMBTU / Gallon = MMBTU / HR from oil). The heat input from fuel oil is subtracted from the "actual total heat input" to obtain the "heat input associated with burning bark" (in MMBTU/HR). The "heat input associated with burning bark" value is divided by the heat input value of bark (4750 BTU/LB) to quantify the amount of bark burned (tons/hour).

   A calculation summary is shown in **Attachment A**.

   These calculations are performed automatically by the Powerhouse Process Control Computer System and the instantaneous results are displayed on the Powerhouse control room screen for the operators to monitor and control. During stack testing and for compliance reporting, GP takes the fuel oil and bark usage values from the Powerhouse computer system and, using the heat input values for the fuels as listed above, GP calculates the hourly heat input value for the No. 4CB for each of the required three runs. The values for the three runs are then averaged and the 3-hour average value is used to determine the "allowed rate" (adding 10% if the tests were done at less than 90% of maximum) until the next set of tests is completed.

2. **In Attachment E, the particulate matter removal efficiency for the ESP on the No. 5 power boiler (No. 5PB) is listed as 40-65%. Is this only for particulate matter removal when firing fuel oil? Provide the general specifications for the recently modified ESP for the No. 5 power boiler (i.e., number of fields, T-R sets, acfm, cleaning mechanism, cleaning cycle, etc.)**

   Answer: The No. 5PB precipitator removal efficiency of 40-65% is based on particulate removal when burning fuel oil and with two ESP fields in operation. The general specifications of the No. 5 Power Boiler ESP are shown in **Attachment B**. This attachment also shows the general specifications of the No. 4 Combination Boiler (No. 4CB) precipitator as the ESP's are of similar design. The No. 5 PB ESP is proposed to be part of the future No. 4CB emissions control system and in its upgraded state it will help the No. 4CB achieve the efficiencies shown below in the response to Question. No. 3.

3. **Will the ESP for the No. 5 power boiler be used for the No. 4 combination boiler project? What are the preliminary design parameters for firing bark/wood (inlet loading, outlet loading, removal efficiency etc.)?**

   Answer: Yes, it is GP's intent to use the No. 5PB precipitator for the No. 4 CB and to build a new ESP for the No. 5PB. The preliminary design parameters for the No. 4CB ESP project are as follows: Air Flow = 317,000 acfm, Maximum Temperature = 500 °F, Moisture = 20%, Inlet Loading = 1.4 gr/dscf; Outlet Loading = 0.016 gr/dscf; PM Removal Efficiency = 98.9%.

4. **If a new ESP will be added for the No. 5 power boiler, provide: the general specifications (i.e., number of fields, T-R sets, acfm, cleaning mechanism, cleaning cycle, inlet loading, outlet loading, removal efficiency, etc.) and the pertinent application pages.**

   Answer: A new ESP will be added for the No. 5PB. The specifications will be very similar to those shown in **Attachment B** (i.e. when the No. 4CB / No. 5PB project is completed, there will be three very similar in design ESPs with three fields in each ESP – two of the ESPs will serve the No. 4CB and one ESP will serve the No. 5PB).

   The preliminary design parameters for the No. 5PB ESP are as follows: Air Flow = 250,000 acfm, Maximum Temperature = 500 °F, Moisture = 20%, Inlet Loading = 0.08 gr/dscf; Outlet Loading = 0.02 gr/dscf; PM Removal Efficiency = 75.0% (based on two field operation).

   Pertinent application pages are included in **Attachment C** and this response is sealed by the PE of record, Mr. David Buff. Final design and construction information will be provided to the DEP after installation.

5. **Provide the final configuration for controlling particulate matter from the No. 4 combination boiler. If used, will the existing ESP for the No. 5 power boiler be installed parallel to, or in series with, the existing ESP for the No. 4 combination boiler? Will both existing stacks be used? If not, provide the stack configurations.**

   Answer: It is GP's intent to split the flow from the No. 4CB and direct half of the stack gas flow (about 160,000 acfm) to the existing No. 4CB ESP and about half of the flow to the existing No. 5PB ESP. It should be noted that this flow rate (160,000 acfm) is about 73% of the current gas flow rate to the existing No. 4CB ESP. Current plans call for using the existing stacks to service the existing ESP's and to build a new stack for the new ESP to be installed on the No. 5PB.

6. **Attachment GP-EU1-I1 is the revised process flow diagram, which clearly shows flue gas recirculation for the No. 4 combination boiler. Is flue gas recirculation currently installed on the No. 4 combination boiler? Will flue gas recirculation be installed on the No. 4 combination boiler for this project? What is the design flue gas recirculation rate (%) and the corresponding NOx reduction?**

   Answer: Attachment GP-EU1-I1 represents the flow diagram for the future No. 4 Combination Boiler. It inadvertently indicated that FGR would be used in the future. This is not the case, and the flow diagram has been revised and is included in **Attachment D.** FGR is not currently installed on the boiler. FGR was evaluated for the No. 4 CB, and was ruled out as BACT.

7. **For the similar boilers identified in the response (Camas, Washington and Monticello, Mississippi), provide any available stack test data (CO, NOx, SO_2 and VOC) when firing natural gas with bark/wood and when firing only bark/wood.**

   Answer: The GP mills at Camas and Monticello have provided the following data: **(in lbs/MMBTU)**. There is no data for firing "bark only". Note that the Camas Mill mixes its bark with primary solids from its wastewater clarifier and burns the resulting mixture.

	CO	**NOx**	**SO_2**	**VOC**
Camas (gas & bark & solids)	**0.027**	**0.18**	**0.059**	**<0.001**
Camas (bark & solids –some gas)	**0.29**	**0.18**	**0.002**	**0.016**
Monticello (gas & bark)	**0.56**	**0.18**	**0.016**	**0.015**
(Monticello- 24% gas / 76% bark - based on heat input)				
NCASI Factors for bark	**0.6**	**0.22**	**0.025**	**0.017**

Neither of these facilities burns No. 6 Fuel Oil or NCG/SOG gases in their bark boilers as does the Palatka Mill. It would therefore be inappropriate to compare the Camas / Monticello emission rates with the Palatka emission rates.

8. **Please provide the Fuel Tech guarantee for SNCR as well as Georgia-Pacific's request for bid on an SNCR system.**

   Answer: This information is provided at **Attachment E.**

9. **You provided an additional SO_2 modeling analysis for No. 4 recovery boiler during startup. Provide the rationale for this modeling analysis. Also, verify the hourly emissions rates used in the modeling analyses. It appears that the original "109.9 lb/hour" was used in the analysis of the 24-hour average.**

   Answer: - The purpose of the SO_2 modeling analysis for the No. 4 RB during startup was to demonstrate that the Florida AAQS for SO_22 would not be exceeded during startup conditions for the Boiler. The underlying reason for the modeling was to obtain higher permitted emission limits for SO_2 during startup, since the draft permit for the No. 4 RB had imposed SO_2 emission limits during startup which were reflective of normal operation of the boiler. Since fuel oil usage and SO_2 emissions will be higher during such periods, and flue gas flow rates and temperatures lower than normal operation, a concern existed that startup emissions could pose an AAQS problem. However, the modeling analysis demonstrated that RB start up impacts were within the AAQS.

Regarding the SO_2 AAQS modeling analysis for normal operation of the No. 4 RB, we concur that the 24-hour averaging time modeling incorrectly used an SO_2 emission rate of 109.9 lb/hr. The correct emission rate should have been 292.8 lb/hr (100 ppmvd), as shown in Attachment I, Table I-1 of the September letter. The revised modeling has been completed, and the results are provided in revised Table I-4 which is included in **Attachment F.**

GP modeled start up SO_2 emissions based on fuel oil flow rates of 80 gpm (3 hour) and 40 gpm (24 hour) that would equate to stack SO_2 emissions in the range of 300 to 600 ppmvd at 8% O_2. Based upon the results of the modeling, Georgia-Pacific believes that the Department should approve different SO_2 limits for the Recovery Boiler when the boiler is burning: (1) Black Liquor and Black Liquor/fuel oil and (2) when the boiler is burning only fuel oil. For Scenario No. 1 the applicable limit would be 100 ppmvd SO_2 at 8% O_2 as a 24 hour rolling average. However, for Scenario No. 2 the compliance limit would be that GP burn fuel oil containing sulfur at less than or equal to 2.35% and that the RB not exceed the 10% capacity factor limit for burning fossil fuel.

Note that GP would still agree to meet the 12.0 ppmvd at 8% O_2 12-month rolling average limit for SO_2 emissions from the Recovery Boiler.

10. **In Attachment I, see Table I-6 titled, "SO_2 Class I Impacts in the Okefenokee". The 24-hour second highest values in the table do not match the modeling results submitted. Modeling results (2001) show a 24-hour second highest value of 4.14 ug/m^3 at receptor 5 instead of 3.99 ug/m^3 at receptor 15. Also, modeling results (2003) show a 24-hour second highest value of 2.25 ug/m^3 at receptor 30, instead of 2.16 ug/m^3 at receptor 43. Verify the information and correct as necessary.**

    Answer: Table I-6 has been revised to match the modeling results and the revised table is included in **Attachment G.**

11. **In Question No. 1 of RAI-#1** the Department asked for test data documentation for the 60% removal efficiency values that GP uses for the NCG prescrubbers. At the time we answered the request, GP could not locate any efficiency data regarding these scrubbers. However, such data was located and is included in **Attachment H.** The data shows that at a 100 gpm scrubber flow, the removal efficiency of TRS in both the Batch and Continuous Prescrubbers is about 65%.

12. The start up time for the #4 Recovery Boiler can range from 8 to 16 hours based upon whether it is coming out of a cold outage or a "warm off-line" event. GP requests the department to approve a start up / excess emissions time period of 12 hours for the #4RB.

As needed, application updates and information are included in the attachments as indicated throughout this response report. If you have any questions regarding this response, please contact Michael Curtis at 386-329-0918.

I, the undersigned, am the responsible official of the source for which this document is being submitted. I hereby certify, based on the information and belief formed after reasonable inquiry, that the statements made and the data contained in this document are true, accurate, and complete.

Sincerely,
Keith Wahoske
Keith W. Wahoske, Vice-President
Palatka Operations

cc: David Buff, P.E., Golder
T. Champion, T. Wyles, S. Matchett, M. Curtis - GP
Mr. Christopher Kirts, P.E. - FLDEP

LIST OF ATTACHMENTS

ATTACHMENT A (Q-1)

Calculation sheet – bark burning in No. 4CB

ATTACHMENT B (Q- 2 & 4)

General Specifications – ESP's – No. 5PB and No. 4CB

ATTACHMENT C (Q-4)

Application pages – No. 5PB ESP; PE Seal Form – Mr. David Buff

ATTACHMENT D (Q-6)

Revised process Flow Diagram – GP-EU1 – I1

ATTACHMENT E (Q-8)

Fuel Tech RFP and Fuel Tech SNCR proposal

ATTACHMENT F (Q-9)

Revised Table I - 4

ATTACHMENT G (Q-10)

Revised Table I - 6

ATTACHMENT H (Q-11)

Batch and Continuous prescrubber TRS removal efficiency data

ATTACHMENT A (Q-1)

Calculation sheet – bark burning in No. 4CB

Bark Calculation:

$$\text{Steam}\left(\frac{\text{Btu}}{\text{day}}\right) - \text{Oil}\left(\frac{\text{Btu}}{\text{Day}}\right) = \text{Bark}\left(\frac{\text{Btu}}{\text{day}}\right)$$

$$\text{Steam}^{\text{ Equiv}}\left(\frac{T}{HR}\right)_{\text{Bark}} - \text{Oil}^{\text{ Equiv}}\left(T/HR\right)_{\text{Bark}} = \text{Bark}\left(T/HR\right)$$

$$\underline{\text{Steam}^{\text{ Equiv}}\left(T/HR\right)_{\text{Bark}}}$$

$$= \left(\text{Steam Flow } \frac{\text{k lb}}{HR}\right)\left(\frac{1000\text{ lb}}{1\text{ k lb}}\right)\left(\frac{1440\text{ Btu}}{\text{lb}_{\text{steam}}}\right)\left(\frac{\text{lb bark}}{4750\text{ Btu}}\right)\left(\frac{1\,T}{2000\text{ lb}_{\text{Bark}}}\right)$$

$$= \left(\text{Steam Flow } \frac{\text{klb}}{HR}\right)(0.1516)$$

$$\underline{\text{Oil}^{\text{ Equiv}}\left(T/HR\right)_{\text{Bark}}}$$

$$= \left(\text{Oil Flow } \frac{\text{Klb}}{HR}\right)\left(\frac{1000\text{ lb}}{1\text{ klb}}\right)\left(\frac{\text{gal}}{7.888\text{ lb}_{\text{oil}}}\right)\left(\frac{150{,}000\text{ Btu}}{1\text{ gal}}\right)(0.66)\left(\frac{\text{lb Bark}}{4750\text{ Btu}}\right)\left(\frac{1\,T}{2000}\right.$$

$$= \left(\text{Oil Flow } \frac{\text{klb}}{HR}\right)(1.322)$$

$$\boxed{\text{Bark}\left(T/HR\right) = \left(\text{Steam Flow } \frac{\text{klb}}{HR}\right)(0.1516) - \left(\text{Oil Flow } \frac{\text{Klb}}{HR}\right)(1.322)}$$

ATTACHMENT B (Q- 2 & 4)

General Specifications – ESP's – No. 5PB and No. 4CB

NO. 4 COMBINATION BOILER & NO. 5 POWER BOILER

PRECIPITATOR SPECIFICATIONS

1.1 The existing Research-Cottrell electrostatic precipitators are two (2) stand alone chambers. They are three (3) fields long in the direction of gas flow. (The chambers are identical except the No. 5PB chamber has an empty inlet field). The precipitators are a single wall design with a penthouse and hopper bottom. Hoppers are "V" shaped, chamber wide and field long. Each hopper has a screw conveyor feeding collected material to a cross conveyor through rotary valves.

1.2 The precipitator operates under positive pressure. The boiler's induced draft fan is located upstream of the precipitator.

1.3 Collecting plates are Research-Cottrell Opzel single sheet plates. Discharge electrodes are rigid mast Research-Cottrell tab scalloped Duratrodes. There are six (6) Duratrodes in the direction of gas flow in each field. Each of the fields has twenty (20) gas passages with twelve (12) inch spacing. The collecting plates are forty-one feet (41′) high by eleven feet two inches (11′ 2″) long in the direction of gas flow.

1.4 The No. 4CB chamber has a total forty nine (49) rappers: twelve (12) collecting plate rappers per field, six (6) leading end and six (6) trailing end, three (3) discharge electrode rappers per field, and two (2) inlet and, two (2) outlet distribution plate rappers. Rappers are top mounted Magnetic Impulse Gravity Impact (MIGI) rappers.

The No. 5PB chamber has thirty four (34) MIGI rappers. It is missing the fifteen (15) rappers on the empty inlet field (this field was installed in October 2006).

1.5 The fields are individually energized by five (5) transformer/rectifier (T/R) sets (six now that the new field was added to the No. 5PB ESP). Each T/R is connected full wave through a single output bushing. The power supply is 480 volts, 60 Hz, 3 Ph.

T/R Set Ratings

Vac	Iac	kV	Idc	kVA
480	84	55	500	38.6

1.6 The discharge electrode support bushings are housed in a heated penthouse.

1.7 Each outlet plenum supports its own stack.

1.8 The precipitator chambers are not covered by a weather enclosure.

1.9 Rapper controls are BHA SQ300 controls. The precipitator controls are linked to the plant distributed control system and can be monitored from the powerhouse control room. The precipitator controls operate independently. Programming changes are done locally at the precipitator control panels located in the precipitator roof motor control center.

ATTACHMENT B - continued

NO. 5 POWER BOILER NEW PRECIPITATOR SPECIFICATIONS

1.10 New Equipment

1.10.1 Install a complete new ESP with three fields for the PB5 precipitator. This will include but not limited to all collecting plates, discharge electrodes, upper and lower high tension frames, rappers, and all associated support and spacing hardware. Lower high tension frames shall be equipped with anti-sway insulators.

1.10.2 Independent T/R set and controls for the new ESP on the No. 5 PB. Controls shall match existing BHA SQ300 controls.

1.10.3 All electrical equipment, components, and wiring down stream of the Purchaser supplied breakers in a Purchaser supplied motor control center for the new T/R set.

1.10.4 New inlet duct and transition sections to incorporate the PB5 ESP and discharge to a new stack.

1.10.5 Thermal insulation with stainless steel lagging for any new or modified duct work. Lagging pattern to match existing lagging.

1.10.6 A modification of the safety interlock system to incorporate the new T/R set.

ATTACHMENT C (Q-4)

Application pages – No. 5PB ESP; PE Seal Form – Mr. David Buff

ATTACHMENT GP-EU1-I3

DETAILED CONTROL EQUIPMENT INFORMATION
NEW ESP FOR NO. 5 POWER BOILER
(preliminary)

The No. 5 Power Boiler will be equipped with a new electrostatic precipitator (ESP) for particulate control. Preliminary design information for the ESP is presented below.

Parameter	**Electrostatic Precipitator**
Manufacturer	To be determined
No. of Chambers	1
No. of Fields	3
Gas Flowrate (acfm)	250,000
Flue Gas Temperature (oF)- max	500
No. of Transformer/Rectifier Sets	3
Primary Voltage (V,ac)	0-480
Secondary Voltage (kV,dc)	0-55
Primary Current (A,ac)	0-100
Secondary Current (mA,dc)	0-500
Inlet Dust Loading (normal)	0.044 gr/acf; 0.17 lb/MMBtu
Outlet Dust Loading (normal)	0.011 gr/acf; 0.043 lb/MMBtu
Inlet Dust Loading (sootblowing)	0.13 gr/acf; 0.51 lb/MMBtu
Outlet Dust Loading (sootblowing)	0.033 gr/acf; 0.13 lb/MMBtu
Control Efficiency (%)	75% (minimum)

APPLICATION INFORMATION

Professional Engineer Certification

1. Professional Engineer Name: **David A. Buff**
   Registration Number: **19011**
2. Professional Engineer Mailing Address:
   Organization/Firm: **Golder Associates Inc.****
   Street Address: **6241 NW 23rd Street, Suite 500**
   City: **Gainesville** State: **FL** Zip Code: **32653**
3. Professional Engineer Telephone Numbers:
   Telephone: **(352) 336-5600** ext.**545** Fax: **(352) 336-6603**
4. Professional Engineer Email Address: **dbuff@golder.com**
5. Professional Engineer Statement:

I, the undersigned, hereby certify, except as particularly noted herein, that:*

(1) To the best of my knowledge, there is reasonable assurance that the air pollutant emissions unit(s) and the air pollution control equipment described in this application for air permit, when properly operated and maintained, will comply with all applicable standards for control of air pollutant emissions found in the Florida Statutes and rules of the Department of Environmental Protection; and

(2) To the best of my knowledge, any emission estimates reported or relied on in this application are true, accurate, and complete and are either based upon reasonable techniques available for calculating emissions or, for emission estimates of hazardous air pollutants not regulated for an emissions unit addressed in this application, based solely upon the materials, information and calculations submitted with this application.

(3) If the purpose of this application is to obtain a Title V air operation permit (check here ☐, if so), I further certify that each emissions unit described in this application for air permit, when properly operated and maintained, will comply with the applicable requirements identified in this application to which the unit is subject, except those emissions units for which a compliance plan and schedule is submitted with this application.

(4) If the purpose of this application is to obtain an air construction permit (check here ☒, if so) or concurrently process and obtain an air construction permit and a Title V air operation permit revision or renewal for one or more proposed new or modified emissions units (check here ☐, if so), I further certify that the engineering features of each such emissions unit described in this application have been designed or examined by me or individuals under my direct supervision and found to be in conformity with sound engineering principles applicable to the control of emissions of the air pollutants characterized in this application.

(5) If the purpose of this application is to obtain an initial air operation permit or operation permit revision or renewal for one or more newly constructed or modified emissions units (check here ☐, if so), I further certify that, with the exception of any changes detailed as part of this application, each such emissions unit has been constructed or modified in substantial accordance with the information given in the corresponding application for air construction permit and with all provisions contained in such permit.

David A. Buff
Signature

11/9/06
Date

(seal)

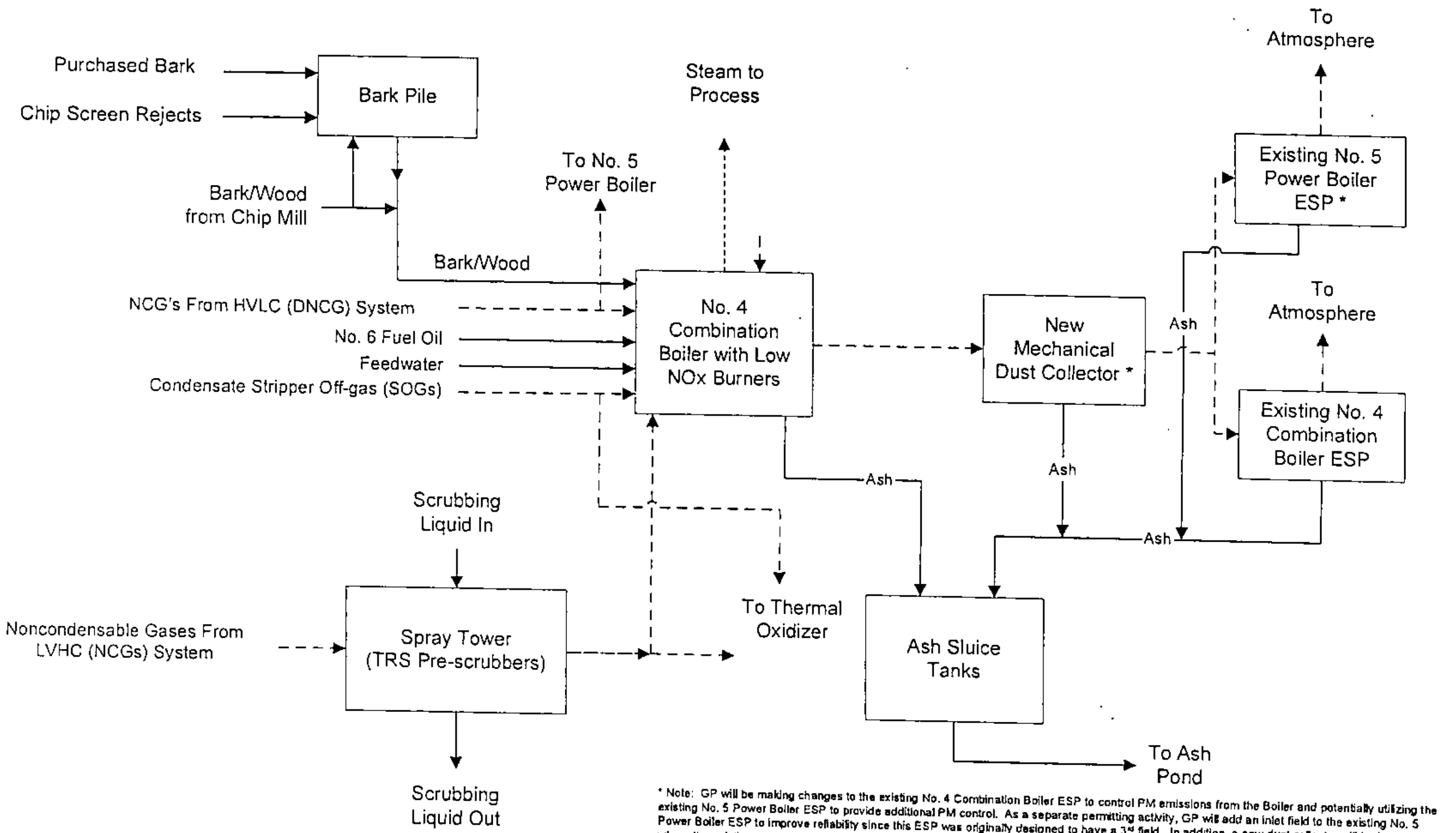
* Attach any exception to certification statement.

** Board of Professional Engineers Certificate of Authorization #00001670

ATTACHMENT D (Q-6)

Revised process Flow Diagram – GP-EU1 – I1

053-7627



* Note: GP will be making changes to the existing No. 4 Combination Boiler ESP to control PM emissions from the Boiler and potentially utilizing the existing No. 5 Power Boiler ESP to provide additional PM control. As a separate permitting activity, GP will add an inlet field to the existing No. 5 Power Boiler ESP to improve reliability since this ESP was originally designed to have a 3rd field. In addition, a new dust collector will be installed where the existing secondary and tertiary collectors are and the primary dust collector will be abandoned. The existing hopper will either be bypassed with new ductwork or gutted and used to remove heavy particulate.

Attachment C
Process Flow Diagram
No. 4 Combination Boiler
Georgia-Pacific Palatka Mill

Process Flow Legend

Solid/Liquid ——→
Gas - - - - →
Steam ········→

Filename: 4.4 0100/4.1/110706/GP-EU1-I1_rev2.VSD
Date: 11/07/06

Golder Associates

ATTACHMENT E (Q-8)

Fuel Tech RFP and Fuel Tech SNCR proposal

Dwg # ~~[illegible]~~
B+W 21879 F-4 6/12/64

FUEL TECH®
Technology for a renewed environment™

Combustion Unit Survey
NOxOUT® SNCR Budgetary Information

Company Name: **Georgia-Pacific Corp**	Date Submitted: **1/12/04**
Customer Reference: **Palatka, FL Mill Combination #4 Boiler**	Date Required: **ASAP**

Location of Facility: **Palatka, FL (40 miles east of Gainesville, FL)**

Type of Combustion Unit (i.e., Turbine, Boiler, Heater, Incinerator, Furnace, etc.):
Boiler burning bark, clean woodwaste, No. 6 Fuel Oil, natural gas, Non condensable gases

~~Furnace Dimensions~~, Cross Sectional x Height or Length (ft), Provide Drawings If Available:
See attached drawings Need from Plant 20'x20'x45' (to nose arch)

Current Emissions Controls (i.e., LNB, OFA, etc):
ESP for particulate control

Primary Fuel: **Bark & Clean woodwaste**	Secondary Fuel: **No. 6 Fuel Oil (2.35% S or less)**	Tertiary Fuel: **Natural gas**

Heating Value, Primary Fuel (Btu/ lb): 4750 **~~4,500~~ Btu/lb bark/wet woodwaste**	Heating Value, Secondary Fuel (Btu/ lb): oil 18500
Electrical Area Classification other than NEMA4:	Indoor/ Outdoor Installation: Boiler is outdoors
Control Room Interface Required? (Y / N)	Turnkey Quote Required? (Y / N) **Just for SNCR system**
New Unit or Retrofit? Used boiler	Additional Comments:

Please complete the chart below with as much information as possible representing the expected operating conditions.

	Primary Fuel (Bark and Wood)/oil			Secondary Fuel (No. 6 Fuel Oil)		
Maximum Continuous Rating %	100	75	50	100	75	50
Heat Input (mmBtu/ hr)						
Operating Hours @ % Load (hrs)	8,760			8,760		
Gas Temperature @ inlet to superheater (°F)	1,400			---		
Flue Gas Flow Rate lb/hr @ 229 °F leaving economizer				---		
Existing Baseline NOx x☐ #/mmBtu ☐ Dry ☐ Uncorrected ☐ ppm (dry) ☐ Wet ☐ Corrected to Ref O_2						
Desired Target NOx x☐ #/mmBtu ☐ Dry x☐ Uncorrected ☐ ppm (dry) ☐ Wet ☐ Corrected to Ref O_2				---		
Existing O_2 (%, dry)						
Reference or Corrected O_2 (%, dry)						
Moisture Content (%)	30-35 % mixed			---		
Existing CO (ppm, in-furnace) lb/MM Btu				---		
Existing SO_2 (ppm) lb/MM Btu						
Existing HCl or Cl_2 (ppm)	---			---		

FUEL TECH®

Technology for a renewed environment™

Proposal No. 04-B-008, Rev 2
NOxOUT® SNCR & NOxOUT Cascade®
NOx Reduction System Options

For

Golder Associates, Inc.
Gainesville, Florida
Project No. 0537627-0200

Georgia-Pacific Corporation
Palatka, FL Mill
No. 4 Combination Fuel Boiler

February 22, 2006

PROPOSAL SUMMARY

In support of efforts underway at Golder Associates and G-P to identify and evaluate post-combustion NOx reduction alternatives for the No. 4 Combination Boiler at the Palatka Mill, Fuel Tech, Inc. (FTI) is pleased to submit our revised budgetary proposal covering the design, supply, fabrication, delivery, personnel training and commissioning of NOxOUT® NOx reduction system options. These NOx reduction options include NOxOUT® SNCR Selective Non-catalytic NOx Reduction and our hybrid SNCR/SCR NOx reduction process, NOxOUT Cascade®.

In our Revision 1 proposal dated January 5, 2006, four (4) SNCR performance cases were presented for the potential combinations of fuel fired in this boiler. As noted in that proposal, NOx reduction via SNCR is limited by a number of factors, such as boiler design, combustion byproducts, upper furnace flue gas temperature, flue gas velocity and residence time available to the SNCR process, furnace access for reagent distribution purposes, sulfur content of the fuel being fired, flue gas temperature at the outlet of the air preheater, and the concentration of ammonia slip that can be tolerated for the specific application. Some of these factors individually affect SNCR NOx reduction performance and others can have a combined influence on the SNCR process – sulfur content and ammonia slip are factors that must be considered in combination when evaluating SNCR performance.

The SNCR performance cases, restated in this Revision, highlight the challenges that the post-combustion conditions present to the SNCR. For this application these challenges, among others, include relatively high CO and the need to control NH3 slip in order to limit the potential formation of ammonium bisulfate (ABS). In order to control ammonia slip, urea must be injected at a higher than ideal temperature – we call this "right side of the slope" injection – which has a direct impact on chemical utilization and NOx reduction performance. The CO present in the flue gas at the point of injection effectively shortens the residence time for the SNCR process reactions, thereby placing an additional restriction on the potential for NOx reduction. If the controlled NOx emissions target is lower than what can be achieved via SNCR or a specific compliance scenario requires lower emissions from this boiler, the SNCR process can be combined with a downstream catalyst to further reduce the NOx emission rate and the ammonia present at the stack.

If the urea reagent is injected at a higher elevation in the furnace (still within the effective temperature window) and the chemical is released at a lower temperature, the SNCR process is operated at a higher point on the process efficiency curve and chemical utilization is greatly improved. Ammonia slip increases when SNCR is operated under these conditions, but the additional slip serves as the reagent for the NOx reduction achieved downstream in the SCR catalyst.

PROPOSAL SUMMARY continued...

Assuming NOx reduction levels of 85-90% are not required, there are other benefits to this approach as compared to a conventional SCR system, including:

- NOx reduction required from the SCR is reduced which relaxes the restrictions on the inlet conditions, such as NH3:NOx distribution, temperature distribution, and flue gas velocity distribution, and
- The treatment length in the catalyst bed (catalyst volume requirements) can be reduced which has an impact on overall pressure drop, catalyst replacement costs, and total weight of the SCR system.

Because the average velocity of the flue gas entering the SCR reactor must be controlled to the level required by the application and the guarantees offered by the catalyst vendor, the cross-sectional area of the duct which houses the SCR reactor is the same for either approach.

Generally speaking, NOx reduction via the NOxOUT Cascade process can be cost-effective when the catalyst can be installed within the confines of the existing ductwork where the cross-sectional area can be expanded to slow the flue gas down to the velocity dictated by the catalyst vendor. When extensive ductwork or structural modifications are required to provide the necessary process conditions, the added cost can be prohibitive.

NOx Reduction Control Options

Depending on the controlled NOx emission rate required for this project, FTI has provided an option for a conventional NOxOUT® SNCR system. By the term "conventional" SNCR we are referring to SNCR that employs multiple levels of wall-mounted injectors. The theory (and practice) behind using multiple levels of injection and a feed-forward/feedback control loop that tracks boiler operation and NOx reduction performance, is that the injector level(s) in-service will change automatically with the boiler load (steam flow) and accompanying shifts in the effective "temperature window" for the SNCR process. For base-loaded operation, the flow of concentrated urea would be biased between these levels or possibly directed to only the upper elevation if this provides the best NOx reduction performance and NH3 slip control.

Some the guidelines for these automatic shifts in injector operation (as a function of steam flow or fuel firing rate) will be defined during the modeling phase of the project and the remainder will be determined at the time of system startup and optimization. Flow rates and atomization pressures for each injector that correspond to specific load and firing conditions are programmed into the PLC or DCS control tables.

PROPOSAL SUMMARY continued...

One way to open up the effective temperature window for a given application is to move injectors up out of the upper furnace and into the convection pass. Standard injectors in the upper furnace produce relatively large droplets of water-encapsulated, atomized urea. The NOxOUT SNCR process relies on the targeted injection and momentum of these droplets to carry the urea, which eventually is converted into gas-phase ammonia, into predetermined areas of the furnace where the NH3 molecules will react selectively with NOx. Relatively speaking, these droplets are large and they require a certain amount of residence time to evaporate before the ammonia is released and they finally come into contact with the ammonia molecules – this is the point in time at which the selective reaction occurs. Any ammonia that leaves the process boundary unreacted will show up downstream as ammonia slip, and because this unreacted ammonia can combine to form undesirable byproducts, this is the limiting factor for the SNCR process.

As our preliminary design for this application indicates, these standard wall injectors can generally achieve a higher level of SNCR NOx reduction if the chemical is released at a lower temperature. For the hybrid system in this particular case, the SNCR NOx reduction would improve nominally from 30-35 percent to as much as 50 percent, and using a downstream catalyst to absorb the increased level of ammonia slip would result in an overall NOx reduction is excess of 70%. The SNCR and Cascade performance details for each firing scenario are included in the Process Design Tables that follow this section of our proposal.

TECHNOLOGY OVERVIEW: NOxOUT® SNCR Process Description

NOxOUT® SNCR is a patented in-furnace, post-combustion NOx reduction technology that relies on the finely controlled distribution of urea to effect a selective reaction of gas-phase ammonia with NOx within a specific temperature region in the upper furnace. The urea is delivered and stored as a 50% aqueous solution that is continuously circulated through the stainless steel SNCR system piping loop. Using plant service water, a metering module located near the injection elevation further dilutes the reagent to a predetermined concentration and precisely controls the flow of diluted reagent to distribution modules located at each injection elevation. The distribution modules provide the final control of diluted reagent and atomizing (plant) air being delivered to each injector, where droplet size and trajectory for each injector have been determined through advanced computer modeling. The final spray characteristics and flow rate of diluted reagent for each injector are fine-tuned during system optimization and startup to correspond to specific boiler operating loads and NOx concentrations.

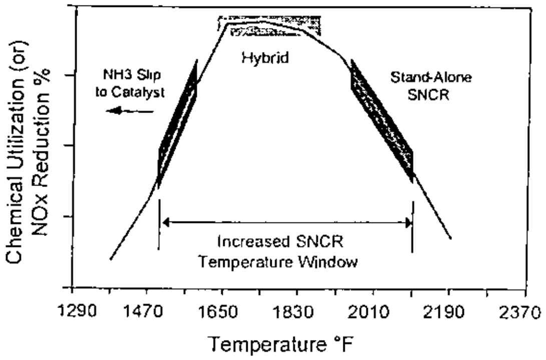
PROPOSAL SUMMARY continued...

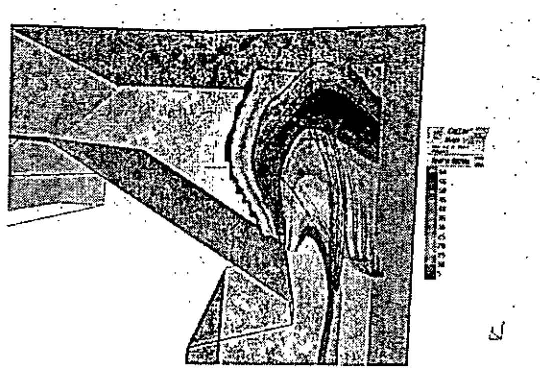
Using feedback NOx emission signals from the CEMS (if available) and these optimized settings, the SNCR system runs in the background under the control of an on-board Allen-Bradley SLC 500 Series PLC (DH+ or Ethernet) and is transparent to the other plant operations. The NOxOUT system information will be available to the operators on a control room computer display or can be tied directly into the plant Distributive Control System if one is available.

TECHNOLOGY OVERVIEW: NOxOUT Cascade® Process Description

Within the NOxOUT Cascade Process are two proven NOx reduction technologies. The first of these is the NOxOUT® SNCR Process which utilizes a stabilized aqueous urea solution that will react with NOx under the appropriate conditions to produce elemental nitrogen, water vapor and trace amounts of carbon dioxide. One of the limiting factors for NOxOUT® SNCR has been the amount of ammonia slip that is allowed to occur. Once the ammonia slip maximum is reached in the system design phase, work towards further NOx reduction must cease if that additional NOx reduction would result in the ammonia slip limit being exceeded. NOxOUT® SNCR has addressed this concern by utilizing what is known as "right side of the slope" injection technology which helps to minimize the amount of ammonia produced while providing significant levels of NOx reduction.

As illustrated by the graph below and the accompanying snapshot from one of our process models, SNCR NOx reduction efficiency and chemical utilization are improved by releasing the chemical at a lower temperature. A controlled, higher concentration of NH3 slip is directed to the SCR catalyst where the ammonia is absorbed and an incremental increase in NOx reduction performance can be achieved. Considerable work indicates that the most cost-effective level for NOxOUT Cascade occurs when the NOxOUT® SNCR component is maximized for NOx reduction.





PROPOSAL SUMMARY continued...

Conventional SCR technology requires the injection of ammonia, either aqueous or anhydrous, into the flue gas prior to the flue gas passing over the surface of a catalyst that is specifically designed to encourage the reduction of NOx. This requires tightly controlled reactor inlet conditions and the maintenance and operation of equipment especially designed to handle and feed the ammonia reagent. The ammonia handling equipment typically consists of a pressure vessel for storage, an evaporator or vaporizer to convert the ammonia to a gaseous phase, a compressor or blower, and an ammonia injection grid. The utility requirements for this equipment generally are high since the evaporator operates at a high temperature and the blower must move very large volumes of gas.

Other related costs with ammonia storage and handling systems include the process safety management and communications requirements established by the Occupational Safety and Health Administration. These regulations require annual reporting of any stored highly hazardous chemicals and annual studies of personal safety and environmental concerns to protect neighboring communities in the event of an accidental release. The NOxOUT Cascade System has incorporated the positive features of the SCR by utilizing a catalyst to further reduce NOx emissions from the NOxOUT® SNCR system but has eliminated all ammonia handling requirements so that the expenses and safety and environmental concerns are removed.

The NOxOUT® SNCR Process for this hybrid system approach is designed to generate a higher, controlled level of ammonia slip from the SNCR process boundary that will become thoroughly mixed in the flue gas. This process-managed ammonia slip then becomes the reducing agent for the reactions that occur in the SCR reactor as the flue gas passes over the catalyst surface. The ammonia that is present will react with the available NOx, further reducing the outlet NOx emissions and the concentration of unreacted ammonia leaving the reactor vessel.

In addition to eliminating the need to store and handle highly hazardous chemicals, the NOxOUT Cascade Process requires a shorter treatment length than would be required by a standalone SCR to achieve the same overall level of NOx reduction. With the NOxOUT Cascade System, a high percentage of NOx is reduced by the NOxOUT® SNCR process, leaving the SCR portion to add only incremental NOx reduction and absorption of the higher level of ammonia slip from the SNCR process. Although the volume of flue gas and the inlet area required for the SCR reactor are the same, the reduced workload on the SCR portion translates into a shorter treatment length and a smaller reactor vessel, lower pressure drop for the system, and fewer constraints on the SCR inlet conditions. In many cases, fan replacements can be avoided along with the costs of a complete system draft analysis. In addition, catalyst replacement costs may be reduced significantly since the volume of catalyst exposed to contaminants in the flue gas is reduced.

PROPOSAL SUMMARY continued...

FTI Scope of Supply

The Fuel Tech Equipment Scope of Supply detailed in this proposal includes:

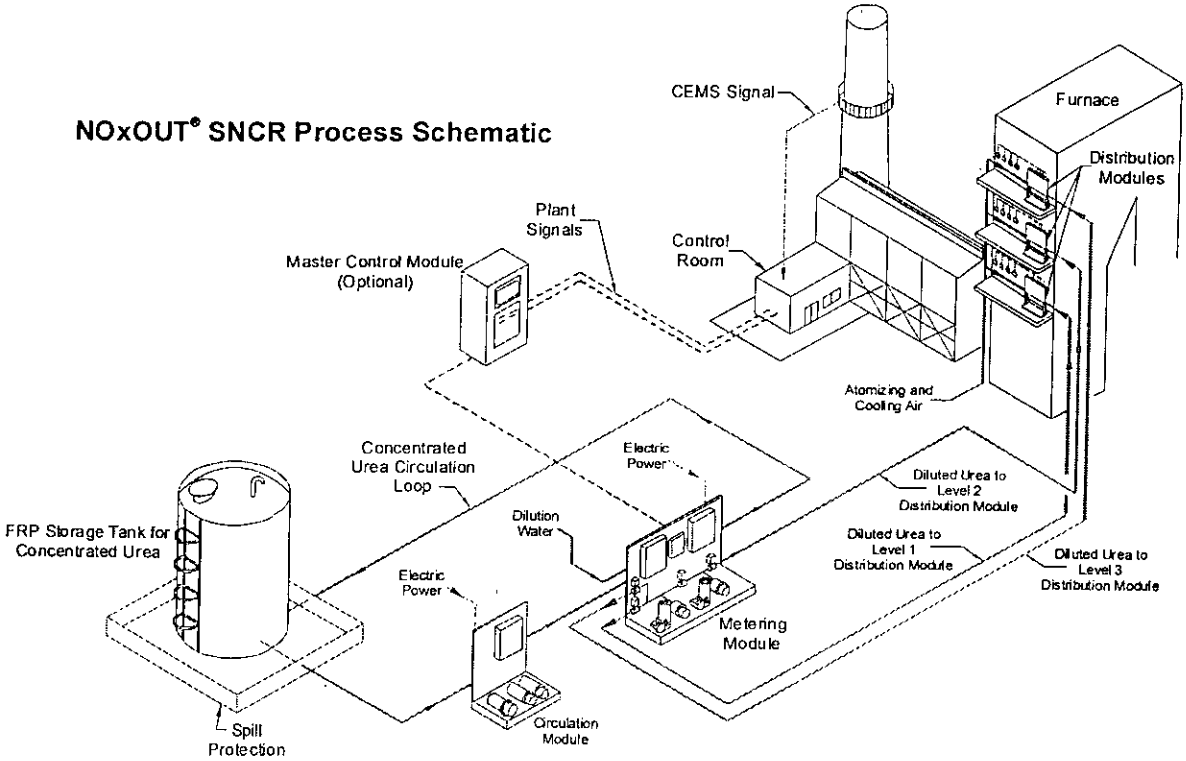
- One (1) double-wall FRP reagent storage tank with all required appurtenances,
- One (1) reagent circulation module to provide a continuous flow of the reagent to the circulation loop piping – the temperature of the concentrated reagent must be maintained at a sufficient level to minimize the potential for crystallization, generally requiring that this loop be heat traced and possibly insulated,
- Multiple-level, Independent Level Control (ILC) Metering module with an on-board water boost pump (WBP) to control the reagent and dilution water flow rates and deliver a consistent urea droplet concentration to the distribution modules and injectors, and
- Distribution modules to provide fine, individual control of the diluted and atomized reagent being delivered into the boiler via the wall-mounted injectors.

Descriptions of the individuals components identified in the FTI Equipment Scope of Supply summaries, including the module descriptions, estimated module weights and dimensions, are provided later in this Proposal. Expected system utility requirements such as dilution water flow rates, atomizing/cooling air flow rates, and electric power consumption also are provided.

PROPOSAL SUMMARY
(Continued...)

The proposed equipment for this project would be configured very closely to what is illustrated below in the SNCR Process Schematic, with the exception that the SNCR system would have only two (2) levels of urea injection.

NOxOUT® SNCR Process Schematic



PROCESS DESIGN TABLE – NOxOUT SNCR

B&W Combination Fuel Boiler No. 4

Design Case		**Bark & Oil**	**Bark, Oil, NCG**	**Bark, Oil, NCG, SOG**	**Oil**
October 2005 Testing		**No. 2**	**No. 5**	**No. 6**	**No. 7**
Furnace Design		Stoker	Stoker	Stoker	Stoker
Maximum Heat Input	(MMBtu/hr)	455.0	438.0	397.0	373.0
Uncontrolled NOx	(lb/MMBtu)	0.240	0.210	0.260	0.280
	(lb/hr)	109.2	92.0	103.2	104.4
SNCR NOx Reduction	(%)	35.0%	30.0%	35.0%	25.0%
Controlled NOx	(lb/MMBtu)	0.156	0.147	0.169	0.210
	(lb/hr)	71.0	64.4	67.1	78.3
NOx Removed	(lb/hr)	38.2	27.6	36.1	26.1
Expected Temperature At Bullnose Elevation	(°F)	1700-1800	1750-1850	1750-1850	1950-2050
Expected NOxOUT® A Consumption @ Load	(gph)	17	15	16	14
Average NH^3 Slip As Measured @ Stack	(ppmvdu)	15	15	15	5
In-furnace CO Limit At Bullnose Elevation	(ppm)	250	250	250	100
Reagent Distribution Strategy	Level 1	6	6	6	6
	Level 2	3	3	3	3

Process Design Comments

* The high sulfur content in the fuel for the oil firing case requires that allowable NH3 slip be reduced to limit the potential formation of ammonium bisulfate, thereby limiting the SNCR NOx reduction that can be achieved.

** The preliminary design calls for retract mechanisms on the six (6) lower (Level 1) injectors. The position of the upper (Level 2) level injectors would be fixed.

PROCESS DESIGN TABLE – NOxOUT CASCADE

B&W Combination Fuel Boiler No. 4

Design Case		Bark & Oil	Bark, Oil, NCG	Bark, Oil, NCG, SOG	Oil
October 2005 Testing		No. 2	No. 5	No. 6	No. 7
Furnace Design		Stoker	Stoker	Stoker	Stoker
Maximum Heat Input	(MMBtu/hr)	455.0	438.0	397.0	373.0
Uncontrolled NOx	(lb/MMBtu)	0.240	0.210	0.260	0.280
	(lb/hr)	109.2	92.0	103.2	104.4
SNCR NOx Reduction	(%)	50.0%	40.0%	50.0%	35.0%
Controlled NOx	(lb/MMBtu)	0.120	0.126	0.130	0.182
	(lb/hr)	54.6	55.2	51.6	67.9
NOx Removed	(lb/hr)	54.6	36.8	51.6	36.6
SCR NOx Reduction	(%)	44.4%	29.9%	35.7%	7.9%
Controlled NOx	(lb/MMBtu)	0.067	0.088	0.084	0.168
	(lb/hr)	30.4	38.7	33.2	62.5
NOx Removed	(lb/hr)	24.2	16.5	18.4	5.4
Overall NOx Reduction	**(%)**	**72.2%**	**57.9%**	**67.9%**	**40.1%**
Expected Temperature At Bullnose Elevation	(°F)	1700-1800	1750-1850	1750-1850	1950-2050
Expected NOxOUT® A Consumption @ Load	(gph)	35.2	22.7	33.3	21.4
Average NH^3 Slip As Measured @ Stack	(ppmvdu)	5	5	5	5
In-furnace CO Limit At Bullnose Elevation	(ppm)	250	250	250	100
Reagent Distribution Strategy	Level 1	6	6	6	6
	Level 2	3	3	3	3

Process Design Comments

- A static mixing device will be required to produce the inlet conditions dictated by the catalyst vendor.

- NGC and SOG flows are given under acfm conditions. For Test 5, the total GHI is 438 MMBtu/hr. Since the bark flow and oil flow are known (and their HHV is known as well) the GHI from NGC can be back-calculated and from that the scfm. It is assumed that SOG (which is methanol vapor) acts exactly like NGC. Since the oxygen content was not provided, the amount of excess air was increased to about 55% so that the flue gas flow would match the provided 135,000 dscfm. For Test 7, where oil is the only fuel, a more typical amount of excess air (~25%) was used.

FTI EQUIPMENT SCOPE OF SUPPLY SUMMARY

	G-P Palatka No. 4 Combination Boiler	
NOxOUT Design Option	NOxOUT® SNCR	NOxOUT Cascade ®
10,000 gallon FRP Storage Tank	1	1
SLP3-C Circulation Module	1	1
FRP Circulation Module Enclosure	1	1
PV1001 Chemical Circulation Control	1	1
	Urea & Dilution Water Metering	
SLP3-MS-ILC Metering Module	1	1
	Diluted Urea & Atomizing/Cooling Air Distribution Lower Level of Wall Injectors	
SLP3-D-6 Distribution Module	1	1
Wall-mounted Injector with Automatic Retract	6	6
Retract Control Panel	1	1
	Diluted Urea & Atomizing/Cooling Air Distribution Middle Upper Level of Wall Injectors	
SLP3-D-3 Distribution Module	1	1
Wall-mounted, Fixed Position Injector	3	3
Retract Control Panel	Not Required	Not Required
	Diluted Urea & Atomizing/Cooling Air Distribution Upper Level of Injection – Multiple Nozzle Lances	
Catalyst – Plate, Corrugated or Honeycomb Design	Not Applicable	121 m^3
Acoustic Cleaning Device	Not Applicable	12
SCR Reactor Design, Cold Flow Modeling, and Engrg	Not Applicable	LOT
SCR Reactor Ductwork, Structural Support, Civil	Not Applicable	Not Included
	Additional Equipment and Services	
Optical Pyrometer Temperature Monitor	1	1
PLC Controls & Interface Support	1	1

FUEL TECH EQUIPMENT SCOPE OF SUPPLY

FRP NOxOUT®A UREA STORAGE TANK

Made of Fiberglass Reinforced Plastic (FRP) with Premium Grade Vinylester Resin. Fabricated per ASTM D3299-88 where applicable, 1.5 Specific Gravity, heating package to maintain 80°F, site specific variables include seismic zone, wind load, snow load, and temperature variance.

Also includes heat trace and insulation with thermostat control, level transmitter, manway, vent, internal downpipe, external fill pipe, thermocouple, ladder, hold down and lifting lugs, FRP flanges for inlet and outlet, and fill and circulation line valves for suction isolation, drain, and return control.
10,000 Gallon Capacity: 10' OD × 17' SS × 18" OAH; Approx. Empty Weight: 2,400 lbs.
Reference FTI Drawing C-1

SLP3-C CIRCULATION MODULE

The Circulation Module is designed for the continuous circulation and heating of the NOxOUT® A chemical and the supplied feed of the reagent into the Metering Module(s). The NOxOUT® tank level indication and alarms will be mounted on this module adjacent to the local control panel.

The Circulation Module includes: Complete assembly and testing, local control panel (NEMA 4X), redundant SS centrifugal pumps with auto switch, TEFC motors, motor starters, stainless steel skid with basin, 3 kW electric heater, duplex strainer for chemical, flow sensor and indicator for NOxOUT® A reagent, reagent temperature indicator, tank level indication, and all necessary SS components, piping, (Schedule 40 socket welded), and fittings.
Typical size: (4"W × 7'L × 6'H); Approximate Weight: 1,500 lbs.
Reference FTI Drawing D-1

PCV1001 CHEMICAL CIRCULATION CONTROL

The pressure control loop regulates the NOxOUT urea pressure for the High Flow Delivery Module supply to the Metering Modules in order to maintain the proper flow rate and pressure. This valve station maintains a sufficient chemical pressure upstream of the Metering Modules to allow for proper maintenance of the NOxOUT urea flow. Each valve station, specifically sized for the application, is a pre-fabricated piping spool piece consisting of a stainless steel pressure control valve, manual bypass valve, pressure transmitter, local pressure indicator, isolation valves, stainless steel piping, fittings, etc.
Reference FTI Drawing J-7

FUEL TECH EQUIPMENT SCOPE OF SUPPLY

(Continued...)

CIRCULATION MODULE ENCLOSURE

Fuel Tech provides Switzer 9000 Series modular enclosures to house certain system modules. The enclosures are constructed of fiberglass reinforced isopthalic plastic resin and molded-in color gel coat with ultraviolet inhibitors. Each building is specifically designed for the individual application with reinforced walls and flooring. Lifting lugs and structural design and analysis is performed where needed.

The enclosure includes the pre-installed Circulation Module, two (2) large service doors, heater, electrical outlets, lighting, electrical breaker panel with circuits and transformer specifically sized for application, and steel flooring system. All utility connections will be made to exterior of the enclosure.
Reference FTI Drawing A-22, J-9

SLP3-MS-ILC METERING MODULE

This module is designed for Independent Level Control, which permits a biasing of the chemical to each injection level that is in operation. The Metering Module provides flow and pressure control for the fluids used in the NOxOUT® Process – NOxOUT® A Urea and Dilution Water. The water supply will be adjusted, via a regulator, to a set pressure that will allow for proper flow to each Distribution Module. The corresponding flow of NOxOUT® A is then fed, by use of a metering pump and a digital indicating controller, into the dilution water discharge line and through a static mixer. A water/boost pump is supplied to power the mixed chemical up to each injector level at the proper pressures and flow rates. The local control panel on this module can operate in local or remote. In the remote mode the FTI-supplied PLC can automatically feed the optimized amount of NOxOUT® A reagent water pressure through the use of a 4-20 mA signal. Automatic flush of the system is also provided to clear chemical from the lines prior to shutdown.

Also includes complete assembly and testing, two (2) local control panels with PLC (NEMA 4X), three (3) SS metering pumps with AC motors and drive controllers, three (3) turbine/boost pumps with TEFC motors and motor starters, stainless steel skids with basin, three (3) static mixers, three (3) magnetic flow meters with digital indicating controllers to electronically indicate and control the precise chemical flow, three (3) magnetic flow meters, pressure control valves, pressure transmitters and indicator for controlling water flows, motor operated ball valves for chemical and water inlet, duplex strainer for water, air pressure switch, regulators for water inlet chemical calibration columns, and all necessary components, SS Schedule 40 socket-welded piping, SS butt-welded tubing, and fittings.
Typical Size: 4' W × 12' L × 6.5' H – Approximate Weight: 3,000 lbs.
Reference FTI Drawing E-4

FUEL TECH EQUIPMENT SCOPE OF SUPPLY
(Continued...)

SLP3-D-X DISTRIBUTION MODULE

The Distribution Modules are placed just prior to the injectors (typically at the same elevation) and are used as a guide and check for proper injector performance. Air for atomization and cooling is introduced through this module. One panel is supplied for each injector. They are grouped and pipe-manifolded together for ease of installation.

Also includes the necessary panels per module. Complete assembly and testing, flow and pressure indication with regulators for chemical and atomizing air. Each panel will be mounted to a freestanding stainless steel base and a pipe-manifold assembled for easy flow accessibility.
Typical Size: (SLP3-D-6) 2' W × 6.6' L x 6' H; Approximate weight: 600 lbs.
Typical Size: (SLP3-D-3) 2' W × 3.3' L x 6' H; Approximate weight: 300 lbs.
Reference FTI Drawing F-1, F-2

SLP3-I-NFTL INJECTOR ASSEMBLY

The urea injector assemblies are installed at the furnace elevation determined by our process modeling with each appropriately sized and characterized for proper flows and pressures required to achieve the necessary NOx reductions. The injectors are constructed entirely of 316L stainless steel. The nozzle tip is a ceramic-coated 316L stainless steel. The cooling shield is typically 3/4" Inconel tubing or 316 stainless steel with ceramic coating (0.750" OD and 0.065" wall thickness). The inner atomization tube is typically 3/8" tubing with an adapter to accept different injector tips, with a standard length of 2.5 feet.

Each assembly includes Fuel Tech air atomized injector, adapter for insertion adjustment, coupler to attach to boiler support, quick-connects and 6' long steel-braided flex hoses for both the chemical and atomizing air connections.
Reference FTI Drawing G-1

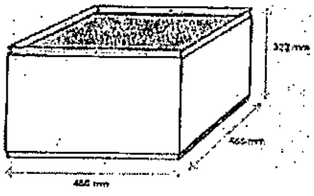
FUEL TECH EQUIPMENT SCOPE OF SUPPLY
(Continued...)

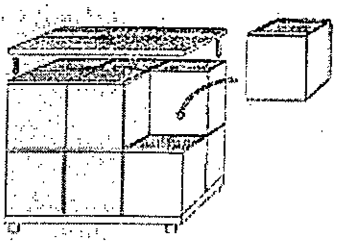
CATALYST for SCR PORTION of HYBRID

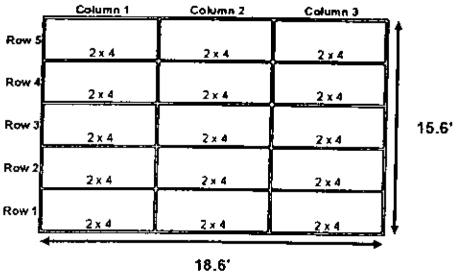
The proposed catalyst features a corrugated, fiber reinforced titanium dioxide (TiO_2) carrier. The carrier is impregnated with the active components: vanadium pentoxide (V_2O_5) and tungsten trioxide (WO_3). The catalyst is shaped to a monolithic structure with a large number of parallel channels. This catalyst design provides a highly porous structure with a large surface area and an ensuing large number of active sites. Some of the benefits of the proposed catalyst are:

- A high NOx removal level with minimum ammonia slip
- A low activity towards SO_2 oxidation, minimizing the risk of fouling downstream equipment
- A high poison resistance ensuring a long and stable service life
- A substantially lower weight than for conventional plate or extruded catalysts, allowing a fast response to changes in operation

The proposed catalyst layout consists is a two layer design comprised of individual catalyst "cassettes" (left) assembled to form a module like that show below in the center picture. The picture (below, center) shows a typical arrangement for each layer. The Loading Diagram (below, right) illustrates a design that consists of fifteen modules each having a total of eight (8) cassettes: four wide by two deep.







	Column 1	Column 2	Column 3
Row 5	2 x 4	2 x 4	2 x 4
Row 4	2 x 4	2 x 4	2 x 4
Row 3	2 x 4	2 x 4	2 x 4
Row 2	2 x 4	2 x 4	2 x 4
Row 1	2 x 4	2 x 4	2 x 4

Specific requirements for this project would follow at a later date.

FUEL TECH SCOPE OF SUPPLY
(Continued...)

ACOUSTIC CLEANING SYSTEM

Acoustic cleaners are pneumatically operated horns that produce low frequency, high-energy sound waves. The sound waves fracture particulate deposits that have bonded to mechanical parts and other surfaces in the SCR system. As opposed to other methods of cleaning, sound waves generated by acoustic horns do not cause structural damage and have proven to be effective in the harshest operating environments.

The acoustic cleaners are operated in a semi-aggressive sequence to minimize the potential for ash buildup in the catalyst. Each horn generally is sounded for a period of ten (10) seconds every ten (10) minutes. This operating sequence has proven to be the optimum program for cleaning coal fly ash.

Acoustic cleaners have only one moving part, a titanium diaphragm. The diaphragm is housed in the sound generator of the acoustic horn. This diaphragm is cut from a square piece of titanium, stress relieved and machined on both sides to ensure uniform thickness and maximum diaphragm life.

The bell section of the acoustic cleaner is fabricated using stainless steel – this is the only portion of the acoustic cleaner that is inserted into the flue gas stream. The remaining bell sections and sound generator are machined cast pieces that are painted for corrosion protection.

TEMPERATURE MONITORING SYSTEM

The temperature monitoring system supplied by Fuel Tech is an optical pyrometer designed to continuously monitor the furnace flue gas temperature. The temperature monitor senses the visible light from the ash particles to determine the flue gas temperature. Temperature readings are not biased by unit wall temperatures and can provide temperature readings for units firing coal, wood waste, municipal solid waste, refuse derived fuels, heavy oil or any other fuel which produce glowing particles during combustion.

The temperature sensed by the monitor will be utilized in determining the proper zone of injection for the NOxOUT process. By properly selecting the zone of injection based on flue gas temperature, the NOxOUT process can be optimized with regard to NOx reduction, chemical flows, and ammonia slip. This temperature control signal allows the Fuel Tech engineers to optimize the system operation and provide the best available SNCR system. The temperature monitor will require the following utilities and connections in order to be installed and operate properly:

FUEL TECH SCOPE OF SUPPLY

(Continued...)

- 3" threaded pipe nipple extending 4-6 inches outside the boiler wall
- 110 VAC power
- 60 to 80 psig plant air
- Structural support of the unit (approximately 100 lbs)

Reference FTI Drawing G-11 and G-15

CONTROL ROOM INTERFACE

Control of the ILC Metering Module is facilitated by a PLC-based control system utilizing an Allen-Bradley SLC 500 Series, DH+ or Ethernet. In addition to local control, the PLC can control the entire NOx reduction process. This is accomplished by routing to the PLC the required boiler parameters such as NOx, Oxygen, and Boiler Load. The PLC is programmed during the initial phases of the equipment construction and then tuned during the start-up testing to react to specific unit conditions.

Operator interface at the Metering Module is handled by an Allen-Bradley PanelView 550 (or 1000). This unit is a digital display which acts as the operator's window to unit operation and control. From the PanelView, the operator can monitor all of the system performance as well as control the system and adjust the automatic operation at the various load conditions. This is accomplished through the use of the display screen and the integrated keypad.

FUEL TECH SCOPE OF SUPPLY
(Continued...)

ENGINEERING

Fuel Tech will provide Project and Process Engineering and the following drawings and information:

- P&IDs
- Skid Arrangements
- Foundation Loads
- Interface Drawings
- Injector Locations
- Electrical Drawings and Bill of Materials
- Pump Performance Curves

ENGINEERING SERVICES

- Computational Fluid Dynamics and Kinetic Modeling
- SCR Reactor Design and Flow Modeling for Cascade Option
- Project Engineering
- Start-up and Optimization Service (20 Man-days for SNCR, 40 Man-days for Hybrid)
- Operation and Maintenance Manuals (5)

SCOPE OF SUPPLY BY OTHERS

1. Installation of Fuel Tech, Inc. Supplied Equipment.
2. Interconnecting Piping and Wiring of Fuel Tech, Inc. Supplied Equipment.
3. Tank Foundation and Structural Support for System Modules.
4. SCR Reactor Vessel Ductwork and Structural Steel Modifications.
5. Static Mixing Device.
6. NOxOUT System Utility Estimates.

Summary of Estimated Utilities NOxOUT SNCR	Plant Air (scfm)	Instrument Air (scfm)	Reagent Flow (gph)	Dilution Water Flow (gph)	Cooling Water Flow (gpm)	480V Power (kW)	220V Power (kW)	110V Power (kW)
Bark and Oil	111	36	17	523	0	66	3	1.75
Bark, Oil, and NCG	111	36	15	525	0	66	3	1.75
Bark, Oil, NCG, and SOG	111	36	16	524	0	66	3	1.75
Oil	111	36	14	526	0	66	3	1.75
	Note 1	Note 2	Note 3	Note 4		Note 5		

Note 1: These "worst-case" estimates assume that all nine (9) injectors are in service, each using 12 scfm of plant air for urea atomization and injector tip cooling. If the lower level of injectors are not required under certain firing conditions, they will be retracted automatically and the flow through these six (6) injectors will be reduced to approximately 3 scfm each for cooling.

Note 2: These estimates include 35 scfm required to cool the temperature monitor optics and one (1) scfm for the Metering Module control valve.

Note 3: These estimates assume full load operation with this of diluted urea being distributed amongst all injectors that are in service.

Note 4: These estimates are based on the assumption that the total flow (concentrated urea + dilution water) per injector is one (1) gpm. The actual consumption rate will depend on the number of injectors in service at a given load and firing condition

Note 5: This estimate assumes that power will be fed into the step-down transformer located in the Circulation Module enclosure and distributed as needed to serve the system components in the enclosure as well as the rest of the SNCR system.

Summary of Estimated Utilities NOxOUT Options	Plant Air (scfm)	Instrument Air (scfm)	Reagent Flow (gph)	Dilution Water Flow (gph)	Cooling Water Flow (gpm)	480V Power (kW)	220V Power (kW)	110V Power (kW)
NOxOUT SNCR (Test 2)	111	36	17	533	0	66	3	1.75
NOxOUT Cascade (Test 2)	111	36	35	525	0	66	3	1.75
	Note 1	Note 2	Note 3	Note 4		Note 5		

7. Chemical Supply: NOxOUT® Quality Licensed Reagent (50% Solution).
8. Implement Control Logic Schemes into Plant Controls System.
9. NOx, Ammonia, and CO Monitoring Equipment, if Required.
10. Required Penetrations for Injector Wall Sleeves and Mounting.
11. Asbestos Abatement, if Required.
12. System Performance Testing.
13. Spare Parts.

FUEL TECH, INC. STANDARD TERMS AND CONDITIONS

For the Engineering, Equipment, and Services identified in this proposal, we quote the following budgetary prices, FOB Jobsite:

NOxOUT® SNCR	Eight Hundred and Seventy-five Thousand Dollars	$875,000.00
NOxOUT Cascade®	Two Million, Nine Hundred Thousand Dollars	$2,900,000.00

Price includes the stated number of start-up and optimization services man-days per unit, with travel and living expenses included. Please see our Field Service Pricing Schedule, Exhibit C1, dated January 2006, for per diem service rates.

TERMS OF PAYMENT

10%	Upon receipt of Letter of Intent, Purchase Order, or Contract
20%	Upon submittal of Drawings to the Buyer for Approval
20%	Upon Buyer's release for equipment fabrication
10%	Upon submittal of Certified Drawings to the Buyer
30%	Upon date of shipment of equipment, or thirty days after notification to buyer that equipment is ready to ship, whichever occurs first.
10%	After successful completion of acceptance test or six (6) months after receipt of equipment, whichever occurs first.

All invoices are payable net thirty (30) days from invoice date. Buyer shall pay interest at the rate of ten percent (10%) per annum on all overdue amounts. Buyer shall pay all Sales Tax, Use Tax, Excise Tax, or other similar taxes.

EXHIBIT C3
FUEL TECH, INC. STANDARD TERMS AND CONDITIONS

These terms and conditions shall be part of the attached proposal and shall become part of the contract entered into between FUEL TECH, INC. (Fuel Tech), and the Buyer. Deviations from these terms and conditions must be agreed to in a writing signed by Fuel Tech and the Buyer. Fuel Tech hereby gives notice of its objection to any different or additional terms or conditions unless such different or additional terms or conditions are agreed to in a writing signed by Fuel Tech and Buyer.

1. TERMS OF PAYMENT:
All invoices are payable net thirty (30) days from date of invoice. Buyer shall pay interest at the rate of ten percent (10%) per annum on all overdue amounts. Buyer shall pay all sales tax, use tax, excise tax, or other similar taxes.

2. DELAYS:
If shipments are delayed by Buyer, payment shall be due on and warranty coverage shall begin to run from thirty days after the original shipment date specified in the contract or thirty (30) days after notification to Buyer that equipment is ready to ship, whichever is earlier. Risk of loss shall pass to Buyer at the time that equipment is identified, and any costs caused by such delay shall be borne by Buyer.

If shipments are delayed by Buyer, Fuel Tech will ship the equipment no later than sixty (60) days after initial notification to the Buyer that the equipment is ready for shipment. Buyer agrees either (1) to provide Fuel Tech an appropriate "ship to" address and to accept delivery or (2) pay reasonable storage charges for the equipment beginning sixty (60) days after initial notification to Buyer that equipment is ready to ship.

3. PERFORMANCE GUARANTEE:
Buyer warrants that the operating conditions of the Unit are those specified in the Process Design Table. Buyer is solely responsible for the accuracy of that operating condition information, and all performance guarantees and equipment warranties granted by Fuel Tech shall be void if that operating condition information is inaccurate or is not met. All performance guarantees and equipment warranties are conditioned on Buyer timely providing all of the equipment, materials, chemicals, utilities, and services that it has agreed to provide, on operating the Unit within the operating conditions specified in the Process Design Table, and on using reagent of license grade quality in the operation of the Unit.

EXHIBIT C3
FUEL TECH, INC. STANDARD TERMS AND CONDITIONS

4. EQUIPMENT WARRANTY:
Fuel Tech warrants that the equipment it provides shall be free from defects in design, workmanship, and material at the time the equipment is delivered and for a period of twelve (12) months after initial operation, or eighteen (18) months from shipment of equipment, whichever occurs first. Fuel Tech does not warrant wear parts such as injection tips, cooling shields, pump diaphragms, check valves, solenoids, pump impellers, pump wear rings, pump seals, valve packing, and valve seats.

All warranties made by the manufacturer of the equipment (if that manufacturer is any entity other than Fuel Tech) shall be assigned by Fuel Tech to the Buyer, if such assignment is permissible by law and contract. Warranty coverage starts at shipment of equipment or thirty (30) days after notification to Buyer that equipment is ready to ship.

5. DISCLAIMER OF WARRANTIES:
Fuel Tech warrants its equipment and the performance of its equipment solely in accordance with the equipment warranty and performance guarantee contained in this proposal and makes no other representations or warranties of any other kind, express or implied, by fact or by law. All warranties other than those specifically set forth in this proposal are expressly disclaimed. **FUEL TECH SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, AND DISLCAIMS THE IMPLIED WARRANTY OF MERCHANTABILITY, THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, AND ANY OTHER IMPLIED WARRANTIES OF DESIGN, CAPACITY, OR PERFORMANCE RELATING TO THE EQUIPMENT.**

6. LIMITATION OF LIABILITY:
Buyer's sole remedy under the equipment warranty and the performance guarantee shall be to allow Fuel Tech, at Fuel Tech's option, either to repair, replace, or supplement the equipment to meet the performance guarantee, or, in the event that those options are not feasible, to remove the Equipment and refund the contract price to Buyer. NOTWITHSTANDING ANYTHING TO THE CONTRARY, FUEL TECH'S TOTAL LIMIT OF LIABILITY ON ANY CLAIM, WHETHER FOR BREACH OF CONTRACT, BREACH OF WARRANTY, TORT, NEGLIGENCE, STRICT LIABILITY, OR ANY OTHER LEGAL THEORY, FOR ANY LOSS OR DAMAGE ARISING OUT OF, OR CONNECTED TO, OR RESULTING FROM THIS AGREEMENT, INCLUDING WITHOUT LIMITATION AMOUNTS INCURRED BY FUEL TECH OR BUYER IN ATTEMPTING TO REPAIR, REPLACE, OR SUPPLEMENT THE EQUIPMENT OR MEET THE PERFORMANCE GUARANTEE, SHALL BE LIMITED TO THE CONTRACT PRICE TO BE PAID BY BUYER PURSUANT TO THE CONTRACT.

EXHIBIT C3
FUEL TECH, INC. STANDARD TERMS AND CONDITIONS

7. EXCLUSION OF CONSEQUENTIAL DAMAGES:
NOTWITHSTANDING ANYTHING TO THE CONTRARY, IN NO EVENT SHALL FUEL TECH BE LIABLE FOR ANY INDIRECT, CONSEQUENTIAL, INCIDENTAL, SPECIAL, OR PUNITIVE DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF CAPITAL, LOSS OF REVENUES, LOSS OF PROFITS, LOSS OF ANTICIPATORY PROFITS, LOSS OF BUSINESS OPPORTUNITY, DAMAGE TO EQUIPMENT OR FACILITIES, COST OF SUBSTITUTE NOx REDUCTION SYSTEMS, DOWNTIME COSTS, GOVERNMENT FINES, OR CLAIMS OF CUSTOMERS, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

8. RESPONSIBILITY FOR THIRD PARTIES
Buyer shall at all times be responsible for the acts and omissions of its subcontractors and of any other third parties hired or retained or contracted by Buyer to perform work or provide equipment related to the system provided by Fuel Tech, including but not limited to third party design, systems integration, equipment tie-in, or process design changes. Fuel Tech shall have no responsibility for ensuring the accuracy of any such work or the performance of any equipment provided by subcontractors or third parties hired or retained or contracted by Buyer, and Buyer assumes all liability for any such work or equipment and for any failures in Fuel Tech's equipment caused by any such subcontractors or third parties hired or retained or contracted by Buyer. Buyer agrees to indemnify, hold harmless, and defend Fuel Tech from any claims, losses, damages, injuries, or failures caused by any such subcontractors or third parties.

9. CONFIDENTIALITY:
Buyer agrees that it shall hold Confidential Information received from Fuel Tech in the strictest confidence, shall not use the Confidential Information for its own benefit except as necessary to fulfill the terms of the agreement between the parties, shall disclose the Confidential Information only to employees, agents, or representatives who have a need to know the Confidential Information, shall not disclose the Confidential Information to any third party, shall not copy the Confidential Information, shall not disassemble, decompile, or otherwise reverse engineer the Confidential Information and any inventions, processes, or products disclosed by Fuel Tech, and, in preventing disclosure of Confidential Information to third parties, shall use the same degree of care as for its own information of similar importance, but no less than reasonable care.

10. LICENSE AGREEMENT AND OTHER TERMS:

Sale is subject to agreement on other terms and conditions, including a Sale of Equipment with License Agreement.

EXHIBIT C3
FUEL TECH, INC. STANDARD TERMS AND CONDITIONS

11. INDEMNIFICATION:
Each Party shall defend, indemnify, and hold harmless the other Party and its employees, agents, and representatives from any claims, liabilities, lawsuits, costs, losses, or damages that arise out of or result from any negligent or willful acts or omissions of the indemnifying Party's employees, agents, or representatives. Where such claims, liabilities, lawsuits, costs, losses, or damages are the result of the joint or concurrent negligence or willful misconduct of the Parties or their respective agents, employees, representatives, subcontractors, or any third party, each Party's duty of indemnification shall be in the same proportion that the negligence or willful misconduct of such Party, its agents, employees, representatives, or subcontractors contributed thereto. The Party entitled to indemnity under this Agreement shall promptly notify the indemnifying Party of any indemnifiable claim, liability, lawsuit, cost, loss, or damage. The Party responsible for indemnification under this Agreement shall conduct and control the defense of the indemnified claim, liability, lawsuit, cost, loss, or damage. The Parties shall use their best efforts to cooperate in all aspects of the defense of any such claim, liability, lawsuit, cost, loss, or damage. The indemnifying Party shall not be bound by any compromise or settlement made without its prior written consent.

12. FORCE MAJEURE
The Parties shall be excused from liability for delays in manufacture, delivery, or performance due to any events beyond the reasonable control of the Parties, including but not limited to acts of God, war, national defense requirements, riot, sabotage, governmental law, ordinance, rule, or regulation (whether valid or invalid), orders of injunction, explosion, strikes, concerted acts of workers, fire, flood, storm, failure of or accidents involving either Party's plant, or shortage of or inability to obtain necessary labor, raw materials, or transportation ("Force Majeure"). Any delay in the performance by either party under this Agreement shall be excused if and to the extent the delay is caused by the occurrence of a Force Majeure, provided that the affected party shall promptly give written notice to the other party of the occurrence of a Force Majeure, specifying the nature of the delay, and the probable extent of the delay, if determinable.

Following the receipt of any written notice of the occurrence of a Force Majeure, the parties shall immediately attempt to determine what fair and reasonable extension for the time of performance may be necessary. The parties agree to use reasonable commercial efforts to mitigate the effects of events of Force Majeure.

No liabilities of any party that arose before the occurrence of the Force Majeure event shall be excused except to the extent affected by such subsequent Force Majeure.

EXHIBIT C3

FUEL TECH, INC. STANDARD TERMS AND CONDITIONS

13. GOVERNING LAW

This Agreement shall be governed by and interpreted in accordance with the laws of the State of Illinois, excluding its choice of laws rules. The parties shall attempt to settle any disputes, controversies, or claims arising out of this Agreement through consultation and negotiation in good faith and in a spirit of mutual cooperation. If those attempts fail, then any dispute, controversy or claim shall be submitted first to a mutually acceptable neutral advisor for mediation. Neither party may unreasonably withhold acceptance of a neutral advisor. The selection of the neutral advisor must be made within forty-five (45) days after written notice by one party demanding mediation, and the mediation must be held within six months after the initial demand for it. By mutual agreement, however, the parties may postpone mediation until they have each completed some specified but limited discovery about the dispute, controversy, or claim. The cost of mediation shall be equally shared between the parties. Any dispute that the parties cannot resolve through mediation within six (6) months after the initial demand for it may then be submitted to a state or federal court of competent jurisdiction within the State of Illinois for resolution. The use of mediation shall not be construed (under such doctrines as laches, waiver, or estoppel) to have adversely affected any party's ability to pursue its legal remedies, and nothing in this provision shall prevent any party from resorting to judicial proceedings if good faith efforts to resolve a dispute under these procedures have been unsuccessful or interim resort to a court is necessary to prevent serious and irreparable injury to any party or others.

14. ENTIRE AGREEMENT

This Exhibit C3 and the Fuel Tech Proposal attached to it constitute the entire agreement between the parties and can be modified only in writing signed by authorized representatives of each of the parties.

FUEL TECH®

Technology for a renewed environment™

Proposal No. 04-B-008, Rev 2
NOxOUT® SNCR & NOxOUT Cascade®
NOx Reduction System Options

For

Golder Associates, Inc.
Gainesville, Florida
Project No. 0537627-0200

Georgia-Pacific Corporation
Palatka, FL Mill
No. 4 Combination Fuel Boiler

February 22, 2006

PROPOSAL SUMMARY

In support of efforts underway at Golder Associates and G-P to identify and evaluate post-combustion NOx reduction alternatives for the No. 4 Combination Boiler at the Palatka Mill, Fuel Tech, Inc. (FTI) is pleased to submit our revised budgetary proposal covering the design, supply, fabrication, delivery, personnel training and commissioning of NOxOUT® NOx reduction system options. These NOx reduction options include NOxOUT® SNCR Selective Non-catalytic NOx Reduction and our hybrid SNCR/SCR NOx reduction process, NOxOUT Cascade®.

In our Revision 1 proposal dated January 5, 2006, four (4) SNCR performance cases were presented for the potential combinations of fuel fired in this boiler. As noted in that proposal, NOx reduction via SNCR is limited by a number of factors, such as boiler design, combustion byproducts, upper furnace flue gas temperature, flue gas velocity and residence time available to the SNCR process, furnace access for reagent distribution purposes, sulfur content of the fuel being fired, flue gas temperature at the outlet of the air preheater, and the concentration of ammonia slip that can be tolerated for the specific application. Some of these factors individually affect SNCR NOx reduction performance and others can have a combined influence on the SNCR process – sulfur content and ammonia slip are factors that must be considered in combination when evaluating SNCR performance.

The SNCR performance cases, restated in this Revision, highlight the challenges that the post-combustion conditions present to the SNCR. For this application these challenges, among others, include relatively high CO and the need to control NH3 slip in order to limit the potential formation of ammonium bisulfate (ABS). In order to control ammonia slip, urea must be injected at a higher than ideal temperature – we call this "right side of the slope" injection – which has a direct impact on chemical utilization and NOx reduction performance. The CO present in the flue gas at the point of injection effectively shortens the residence time for the SNCR process reactions, thereby placing an additional restriction on the potential for NOx reduction. If the controlled NOx emissions target is lower than what can be achieved via SNCR or a specific compliance scenario requires lower emissions from this boiler, the SNCR process can be combined with a downstream catalyst to further reduce the NOx emission rate and the ammonia present at the stack.

If the urea reagent is injected at a higher elevation in the furnace (still within the effective temperature window) and the chemical is released at a lower temperature, the SNCR process is operated at a higher point on the process efficiency curve and chemical utilization is greatly improved. Ammonia slip increases when SNCR is operated under these conditions, but the additional slip serves as the reagent for the NOx reduction achieved downstream in the SCR catalyst.

PROPOSAL SUMMARY continued...

Assuming NOx reduction levels of 85-90% are not required, there are other benefits to this approach as compared to a conventional SCR system, including:

- NOx reduction required from the SCR is reduced which relaxes the restrictions on the inlet conditions, such as NH3:NOx distribution, temperature distribution, and flue gas velocity distribution, and
- The treatment length in the catalyst bed (catalyst volume requirements) can be reduced which has an impact on overall pressure drop, catalyst replacement costs, and total weight of the SCR system.

Because the average velocity of the flue gas entering the SCR reactor must be controlled to the level required by the application and the guarantees offered by the catalyst vendor, the cross-sectional area of the duct which houses the SCR reactor is the same for either approach.

Generally speaking, NOx reduction via the NOxOUT Cascade process can be cost-effective when the catalyst can be installed within the confines of the existing ductwork where the cross-sectional area can be expanded to slow the flue gas down to the velocity dictated by the catalyst vendor. When extensive ductwork or structural modifications are required to provide the necessary process conditions, the added cost can be prohibitive.

NOx Reduction Control Options

Depending on the controlled NOx emission rate required for this project, FTI has provided an option for a conventional NOxOUT® SNCR system. By the term "conventional" SNCR we are referring to SNCR that employs multiple levels of wall-mounted injectors. The theory (and practice) behind using multiple levels of injection and a feed-forward/feedback control loop that tracks boiler operation and NOx reduction performance, is that the injector level(s) in-service will change automatically with the boiler load (steam flow) and accompanying shifts in the effective "temperature window" for the SNCR process. For base-loaded operation, the flow of concentrated urea would be biased between these levels or possibly directed to only the upper elevation if this provides the best NOx reduction performance and NH3 slip control.

Some the guidelines for these automatic shifts in injector operation (as a function of steam flow or fuel firing rate) will be defined during the modeling phase of the project and the remainder will be determined at the time of system startup and optimization. Flow rates and atomization pressures for each injector that correspond to specific load and firing conditions are programmed into the PLC or DCS control tables.

PROPOSAL SUMMARY continued...

One way to open up the effective temperature window for a given application is to move injectors up out of the upper furnace and into the convection pass. Standard injectors in the upper furnace produce relatively large droplets of water-encapsulated, atomized urea. The NOxOUT SNCR process relies on the targeted injection and momentum of these droplets to carry the urea, which eventually is converted into gas-phase ammonia, into predetermined areas of the furnace where the NH3 molecules will react selectively with NOx. Relatively speaking, these droplets are large and they require a certain amount of residence time to evaporate before the ammonia is released and they finally come into contact with the ammonia molecules – this is the point in time at which the selective reaction occurs. Any ammonia that leaves the process boundary unreacted will show up downstream as ammonia slip, and because this unreacted ammonia can combine to form undesirable byproducts, this is the limiting factor for the SNCR process.

As our preliminary design for this application indicates, these standard wall injectors can generally achieve a higher level of SNCR NOx reduction if the chemical is released at a lower temperature. For the hybrid system in this particular case, the SNCR NOx reduction would improve nominally from 30-35 percent to as much as 50 percent, and using a downstream catalyst to absorb the increased level of ammonia slip would result in an overall NOx reduction is excess of 70%. The SNCR and Cascade performance details for each firing scenario are included in the Process Design Tables that follow this section of our proposal.

TECHNOLOGY OVERVIEW: NOxOUT® SNCR Process Description

NOxOUT® SNCR is a patented in-furnace, post-combustion NOx reduction technology that relies on the finely controlled distribution of urea to effect a selective reaction of gas-phase ammonia with NOx within a specific temperature region in the upper furnace. The urea is delivered and stored as a 50% aqueous solution that is continuously circulated through the stainless steel SNCR system piping loop. Using plant service water, a metering module located near the injection elevation further dilutes the reagent to a predetermined concentration and precisely controls the flow of diluted reagent to distribution modules located at each injection elevation. The distribution modules provide the final control of diluted reagent and atomizing (plant) air being delivered to each injector, where droplet size and trajectory for each injector have been determined through advanced computer modeling. The final spray characteristics and flow rate of diluted reagent for each injector are fine-tuned during system optimization and startup to correspond to specific boiler operating loads and NOx concentrations.

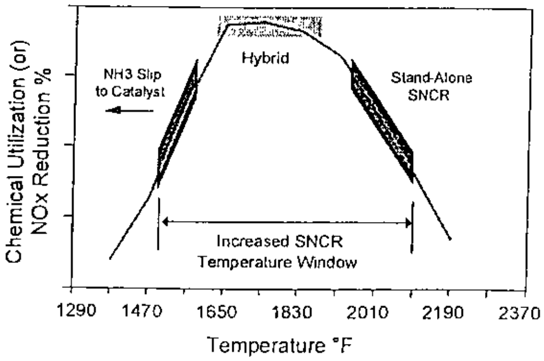
PROPOSAL SUMMARY continued...

Using feedback NOx emission signals from the CEMS (if available) and these optimized settings, the SNCR system runs in the background under the control of an on-board Allen-Bradley SLC 500 Series PLC (DH+ or Ethernet) and is transparent to the other plant operations. The NOxOUT system information will be available to the operators on a control room computer display or can be tied directly into the plant Distributive Control System if one is available.

TECHNOLOGY OVERVIEW: NOxOUT Cascade® Process Description

Within the NOxOUT Cascade Process are two proven NOx reduction technologies. The first of these is the NOxOUT® SNCR Process which utilizes a stabilized aqueous urea solution that will react with NOx under the appropriate conditions to produce elemental nitrogen, water vapor and trace amounts of carbon dioxide. One of the limiting factors for NOxOUT® SNCR has been the amount of ammonia slip that is allowed to occur. Once the ammonia slip maximum is reached in the system design phase, work towards further NOx reduction must cease if that additional NOx reduction would result in the ammonia slip limit being exceeded. NOxOUT® SNCR has addressed this concern by utilizing what is known as "right side of the slope" injection technology which helps to minimize the amount of ammonia produced while providing significant levels of NOx reduction.

As illustrated by the graph below and the accompanying snapshot from one of our process models, SNCR NOx reduction efficiency and chemical utilization are improved by releasing the chemical at a lower temperature. A controlled, higher concentration of NH_3 slip is directed to the SCR catalyst where the ammonia is absorbed and an incremental increase in NOx reduction performance can be achieved. Considerable work indicates that the most cost-effective level for NOxOUT Cascade occurs when the NOxOUT® SNCR component is maximized for NOx reduction.



PROPOSAL SUMMARY continued...

Conventional SCR technology requires the injection of ammonia, either aqueous or anhydrous, into the flue gas prior to the flue gas passing over the surface of a catalyst that is specifically designed to encourage the reduction of NOx. This requires tightly controlled reactor inlet conditions and the maintenance and operation of equipment especially designed to handle and feed the ammonia reagent. The ammonia handling equipment typically consists of a pressure vessel for storage, an evaporator or vaporizer to convert the ammonia to a gaseous phase, a compressor or blower, and an ammonia injection grid. The utility requirements for this equipment generally are high since the evaporator operates at a high temperature and the blower must move very large volumes of gas.

Other related costs with ammonia storage and handling systems include the process safety management and communications requirements established by the Occupational Safety and Health Administration. These regulations require annual reporting of any stored highly hazardous chemicals and annual studies of personal safety and environmental concerns to protect neighboring communities in the event of an accidental release. The NOxOUT Cascade System has incorporated the positive features of the SCR by utilizing a catalyst to further reduce NOx emissions from the NOxOUT® SNCR system but has eliminated all ammonia handling requirements so that the expenses and safety and environmental concerns are removed.

The NOxOUT® SNCR Process for this hybrid system approach is designed to generate a higher, controlled level of ammonia slip from the SNCR process boundary that will become thoroughly mixed in the flue gas. This process-managed ammonia slip then becomes the reducing agent for the reactions that occur in the SCR reactor as the flue gas passes over the catalyst surface. The ammonia that is present will react with the available NOx, further reducing the outlet NOx emissions and the concentration of unreacted ammonia leaving the reactor vessel.

In addition to eliminating the need to store and handle highly hazardous chemicals, the NOxOUT Cascade Process requires a shorter treatment length than would be required by a standalone SCR to achieve the same overall level of NOx reduction. With the NOxOUT Cascade System, a high percentage of NOx is reduced by the NOxOUT® SNCR process, leaving the SCR portion to add only incremental NOx reduction and absorption of the higher level of ammonia slip from the SNCR process. Although the volume of flue gas and the inlet area required for the SCR reactor are the same, the reduced workload on the SCR portion translates into a shorter treatment length and a smaller reactor vessel, lower pressure drop for the system, and fewer constraints on the SCR inlet conditions. In many cases, fan replacements can be avoided along with the costs of a complete system draft analysis. In addition, catalyst replacement costs may be reduced significantly since the volume of catalyst exposed to contaminants in the flue gas is reduced.

PROPOSAL SUMMARY continued...

FTI Scope of Supply

The Fuel Tech Equipment Scope of Supply detailed in this proposal includes:

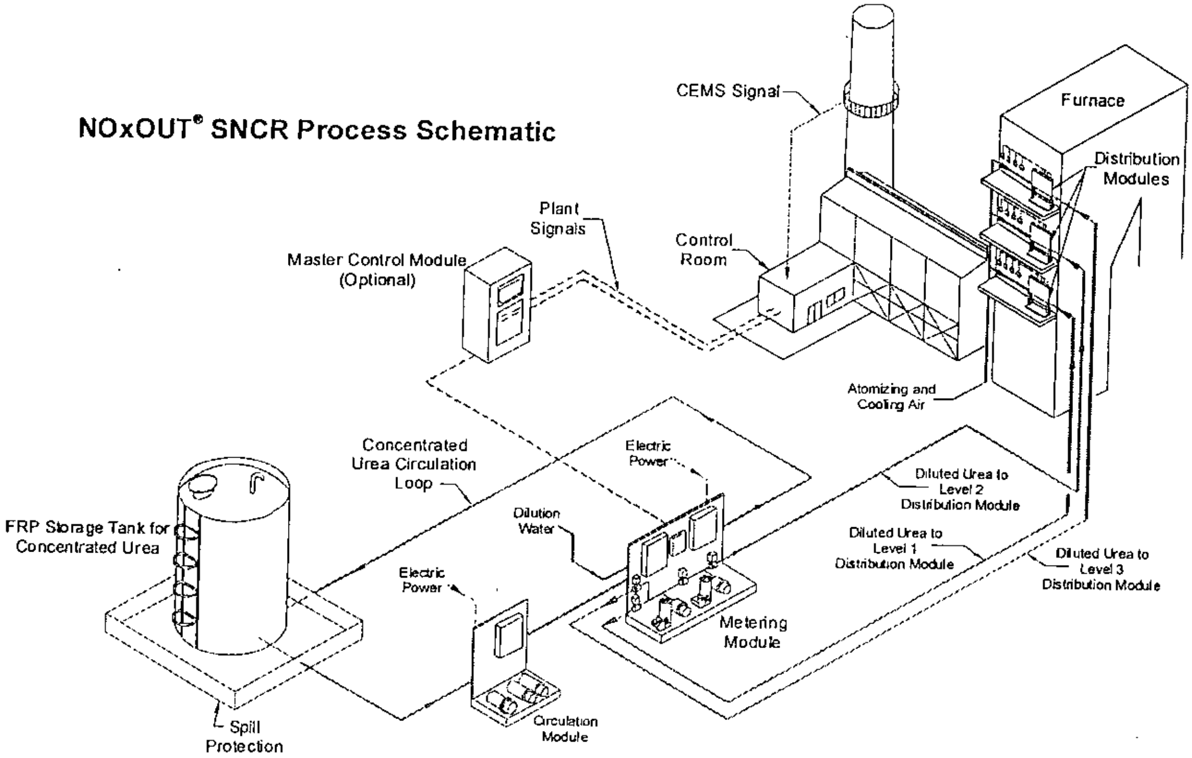
- One (1) double-wall FRP reagent storage tank with all required appurtenances,
- One (1) reagent circulation module to provide a continuous flow of the reagent to the circulation loop piping – the temperature of the concentrated reagent must be maintained at a sufficient level to minimize the potential for crystallization, generally requiring that this loop be heat traced and possibly insulated,
- Multiple-level, Independent Level Control (ILC) Metering module with an on-board water boost pump (WBP) to control the reagent and dilution water flow rates and deliver a consistent urea droplet concentration to the distribution modules and injectors, and
- Distribution modules to provide fine, individual control of the diluted and atomized reagent being delivered into the boiler via the wall-mounted injectors.

Descriptions of the individuals components identified in the FTI Equipment Scope of Supply summaries, including the module descriptions, estimated module weights and dimensions, are provided later in this Proposal. Expected system utility requirements such as dilution water flow rates, atomizing/cooling air flow rates, and electric power consumption also are provided.

PROPOSAL SUMMARY
(Continued...)

The proposed equipment for this project would be configured very closely to what is illustrated below in the SNCR Process Schematic, with the exception that the SNCR system would have only two (2) levels of urea injection.

NOxOUT® SNCR Process Schematic



PROCESS DESIGN TABLE – NOxOUT SNCR

B&W Combination Fuel Boiler No. 4

Design Case		**Bark & Oil**	**Bark, Oil, NCG**	**Bark, Oil, NCG, SOG**	**Oil**
October 2005 Testing		**No. 2**	**No. 5**	**No. 6**	**No. 7**
Furnace Design		Stoker	Stoker	Stoker	Stoker
Maximum Heat Input	(MMBtu/hr)	455.0	438.0	397.0	373.0
Uncontrolled NOx	(lb/MMBtu)	0.240	0.210	0.260	0.280
	(lb/hr)	109.2	92.0	103.2	104.4
SNCR NOx Reduction	(%)	35.0%	30.0%	35.0%	25.0%
Controlled NOx	(lb/MMBtu)	0.156	0.147	0.169	0.210
	(lb/hr)	71.0	64.4	67.1	78.3
NOx Removed	(lb/hr)	38.2	27.6	36.1	26.1
Expected Temperature At Bullnose Elevation	(°F)	1700-1800	1750-1850	1750-1850	1950-2050
Expected NOxOUT® A Consumption @ Load	(gph)	17	15	16	14
Average NH^3 Slip As Measured @ Stack	(ppmvdu)	15	15	15	5
In-furnace CO Limit At Bullnose Elevation	(ppm)	250	250	250	100
Reagent Distribution Strategy	Level 1	6	6	6	6
	Level 2	3	3	3	3

Process Design Comments

* The high sulfur content in the fuel for the oil firing case requires that allowable NH3 slip be reduced to limit the potential formation of ammonium bisulfate, thereby limiting the SNCR NOx reduction that can be achieved.

** The preliminary design calls for retract mechanisms on the six (6) lower (Level 1) injectors. The position of the upper (Level 2) level injectors would be fixed.

PROCESS DESIGN TABLE – NOxOUT CASCADE

B&W Combination Fuel Boiler No. 4

Design Case		Bark & Oil	Bark, Oil, NCG	Bark, Oil, NCG, SOG	Oil
October 2005 Testing		No. 2	No. 5	No. 6	No. 7
Furnace Design		Stoker	Stoker	Stoker	Stoker
Maximum Heat Input	(MMBtu/hr)	455.0	438.0	397.0	373.0
Uncontrolled NOx	(lb/MMBtu)	0.240	0.210	0.260	0.280
	(lb/hr)	109.2	92.0	103.2	104.4
SNCR NOx Reduction	(%)	50.0%	40.0%	50.0%	35.0%
Controlled NOx	(lb/MMBtu)	0.120	0.126	0.130	0.182
	(lb/hr)	54.6	55.2	51.6	67.9
NOx Removed	(lb/hr)	54.6	36.8	51.6	36.6
SCR NOx Reduction	(%)	44.4%	29.9%	35.7%	7.9%
Controlled NOx	(lb/MMBtu)	0.067	0.088	0.084	0.168
	(lb/hr)	30.4	38.7	33.2	62.5
NOx Removed	(lb/hr)	24.2	16.5	18.4	5.4
Overall NOx Reduction	**(%)**	**72.2%**	**57.9%**	**67.9%**	**40.1%**
Expected Temperature At Bullnose Elevation	(°F)	1700-1800	1750-1850	1750-1850	1950-2050
Expected NOxOUT® A Consumption @ Load	(gph)	35.2	22.7	33.3	21.4
Average NH^3 Slip As Measured @ Stack	(ppmvdu)	5	5	5	5
In-furnace CO Limit At Bullnose Elevation	(ppm)	250	250	250	100
Reagent Distribution Strategy	Level 1	6	6	6	6
	Level 2	3	3	3	3

Process Design Comments

* A static mixing device will be required to produce the inlet conditions dictated by the catalyst vendor.

* NGC and SOG flows are given under acfm conditions. For Test 5, the total GHI is 438 MMBtu/hr. Since the bark flow and oil flow are known (and their HHV is known as well) the GHI from NGC can be back-calculated and from that the scfm. It is assumed that SOG (which is methanol vapor) acts exactly like NGC. Since the oxygen content was not provided, the amount of excess air was increased to about 55% so that the flue gas flow would match the provided 135,000 dscfm. For Test 7, where oil is the only fuel, a more typical amount of excess air (~25%) was used.

ATTACHMENT F (Q-9)

Revised Table I - 4

TABLE I-6
MAXIMUM SO_2 IMPACTS PREDICTED FOR COMPARISON TO THE SO_2 PSD CLASS I INCREMENTS AT THE OKEFENOKEE NWA

Averaging Time/Rank	Maximum Concentration[a] ($\mu g/m^3$)	Receptor Location LCC Coordinates (km) X	Receptor Location LCC Coordinates (km) Y	Time Period (YYMMDDHH)	PSD Class I Increment ($\mu g/m^3$)
Annual					
Highest	0.00[b]	NA	NA	NA	2
	0.00	NA	NA	NA	
	0.00	NA	NA	NA	
24-Hour					
Second-highest	4.14	1,422.472	-926.620	01112924	5
	2.44	1,397.157	-930.757	02010924	
	2.25	1,397.157	-930.757	03111824	
3-Hour					
Second-highest	19.1	1,422.472	-926.620	01121221	25
	16.8	1,416.891	-912.442	02021006	
	24.4	1,419.983	-921.368	03112312	

Note: YYMMDDHH = Year, Month, Day, Hour Ending
LCC = Lambert Conic Conformal
NA = Not Applicable

[a] Based on the CALPUFF model using 3 years of CALMET meteorological data for 2001, 2002, and 2003, 4-km Florida domain.

[b] A "0.00" impact means that the predicted concentration was zero or less. The CALPUFF model does not print a negative concentration.

ATTACHMENT G (Q-10)

Revised Table I - 6

TABLE I-4
MAXIMUM PREDICTED SO_2 IMPACTS FOR COMPARISON TO THE FLORIDA AAQS

Averaging Time and Rank	Concentrations (µg/m³)[a]			Receptor Location UTM Coordinates (m)		Time Period (YYMMDDHH)	Florida Ambient Air Quality Standards (µg/m³)
	Total (c=a+b)	Modeled Source (a)	Background[b] (b)	East	North		
Highest Annual							
	27.7	21.7	6	434741	3283275	01123124	60
	25.9	19.9	6	434741	3283275	02123124	
	28.1	22.1	6	434629	3283191	03123124	
	26.6	20.6	6	434741	3283275	04123124	
	27.7	21.7	6	434704	3283247	05123124	
HSH 24-Hour							
	182	148	34	434704	3283247	01012024	260
	197	163	34	434554	3283135	02010724	
	193	159	34	434666	3283219	03121724	
	169	135	34	434704	3283247	04040224	
	183	149	34	434704	3283247	05122624	
HSH 3-Hour							
	637	509	128	434666	3283219	01011215	1,300
	642	514	128	434592	3283163	02022712	
	575	447	128	434666	3283219	03042618	
	640	512	128	434629	3283191	04041415	
	642	514	128	434629	3283191	05042718	

Note: YYMMDDHH = Year, Month, Day, Hour Ending.
HSH = Highest, second-highest
AAQS = Ambient Air Quality Standards

[a] Concentrations are based on highest concentrations predicted using AERMOD with five years of meteorological data from 2001 to 2005 of surface and upper air data from the National Weather Service station at Jacksonville International Airport as received from the FDEP.

[b] Background concentrations are highest mean and HSH 24-and 3-hour concentrations, measured during 2004 and 2005 from Palatka monitoring station 12-107-1008.

ATTACHMENT H (Q-11)

Batch and Continuous prescrubber TRS removal efficiency data

NCG/TRS SYSTEM CONTROL EQUIPMENT EFFICIENCIES

PRE-SCRUBBERS

Date	Time	System	Inlet, ppm	Outlet, ppm	Efficiency	Flow, gpm
05/28	1650-1720	Continuous	47500	17450	63%	80
	1720-1750		15600	8900	43%	80
	1758-1808		49900	22950	54%	80
05/29	1145-1215		274500	139520	49%	100
	1218-1248		215250	141180	50%	100
	1249-1319		274710	154240	55%	100
07/11/02	1344-1404	Continuous	281250	106100	62%	100
	1404-1420		284450	112040	61%	100
	1420-1435		303200	93440	69%	100
	Average				64%	
05/28	1530-1555	Batch	3761	1933	49%	80
	1555-1615		3987	1975	50%	80
	1615-1645		961	431	55%	80
05/29	0948-1012		16290	7260	55%	107
	1018-1048		64580	19030	71%	107
	1055-1125		35700	12120	66%	104
	Average				64%	106
07/05/02	1335-1405		76500	29400	62%	100
	1405-1445		70800	25000	65%	100
	1445-1515		166500	45920	72%	100
	Average				66%	100

Notes: 05/29, batch scrubber flow was 107 gpm 1055-1115 and 97 gpm 1115-1125.
Found some nozzle pluggage in continuous scrubber after 05/29 test.

SO_2 SCRUBBER AT ISLAND

Date	Time	Inlet, ppm	Outlet, ppm	Efficiency	Flow, gpm	PH
05/30	1357-1457	1742	3	99.8%	420	8.1
	1457-1557	1563	3	99.8%	419	7.9

CME

Date	Time	Inlet, ppm	Outlet, ppm	Inlet, #hr	Outlet, lb/hr	Efficiency ppm/#/hr
05/30		18	3	1.04	0.15	83/86%
		--	24	--	1.44	--
		47	18	2.70	0.98	62/64%

Experienced scrubber problems

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Keith Wahoske
eorgia-Pacific
O. Box 919
215 CR 216
Palatka, FL 32177

FedEx Express

E

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Account#: S *********

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SHIP TO: (850)413-9198 BILL SENDER

Jeffrey Koerner
FL Dept of Environmental Protection
2600 Blair Stone Road

Tallahassee, FL 323992400

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Department of
Environmental Protection

Jeb Bush
Governor

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

Colleen M. Castille
Secretary

October 27, 2006

{Sent by Electronic Mail - Return Receipt Requested}

Mr. Keith Wahoske, Vice President of Palatka Operations
Georgia-Pacific, Palatka Mill
P.O. Box 919
Palatka, Florida 32178-0919

Re: Modification of the No. 4 Recovery Boiler, No. 4 Lime Kiln and No. 4 Combination Boiler
Project No. 1070005-038-AC/PSD-FL-380

Dear Mr. Wahoske:

On September 27th, the Department received your response to our request for additional information regarding this project. Based on our review of this information, the application remains incomplete. In order to continue processing your application, the Department will need the additional information requested below. Should your response to any of the items below require new calculations, please submit the new calculations, assumptions, reference material and appropriate revised pages of the application form.

No. 4 Combination Boiler and No. 5 Power Boiler

1. Describe the methods that will be used to monitor the heat input rate to the No. 4 combination boiler for fuel oil firing and for bark/wood firing (i.e., oil flow meter, steam production rate with thermal efficiency, periodic sampling and analysis of bark/wood, record keeping, etc.).
2. In Attachment E, the particulate matter removal efficiency for the ESP on the No. 5 power boiler is listed as 40-65%. Is this only for particulate matter removal when firing fuel oil? Provide the general specifications for the recently modified ESP for the No. 5 power boiler (i.e., number of fields, T-R sets, acfm, cleaning mechanism, cleaning cycle, etc.)
3. Will the ESP for the No. 5 power boiler be used for the No. 4 combination boiler project? What are the preliminary design parameters for firing bark/wood (inlet loading, outlet loading, removal efficiency, etc.)?
4. If a new ESP will be added for the No. 5 power boiler, provide: the general specifications (i.e., number of fields, T-R sets, acfm, cleaning mechanism, cleaning cycle, inlet loading, outlet loading, removal efficiency, etc.) and the pertinent application pages.
5. Provide the final configuration for controlling particulate matter from the No. 4 combination boiler. If used, will the existing ESP for the No. 5 power boiler be installed parallel to, or in series with, the existing ESP for the No. 4 combination boiler? Will both existing stacks be used? If not, provide the stack configurations.
6. Attachment GP-EU1-11 is the revised process flow diagram, which clearly shows flue gas recirculation for the No. 4 combination boiler. Is flue gas recirculation currently installed on the No. 4 combination boiler? Will flue gas recirculation be installed on the No. 4 combination boiler for this project? What is the design flue gas recirculation rate (%) and the corresponding NOx reduction?

"More Protection, Less Process"

7. For the similar boilers identified in the response (Camas, Washington and Monticello, Mississippi), provide any available stack test data (CO, NOx, SO_2 and VOC) when firing natural gas with bark/wood and when firing only bark/wood.
8. Please provide the Fuel Tech guarantee for SNCR as well as Georgia-Pacific's request for bid on an SNCR system.

No. 4 Recovery Boiler

9. You provided an additional SO_2 modeling analysis for No. 4 recovery boiler during startup. Provide the rationale for this modeling analysis. Also, verify the hourly emissions rates used in the modeling analyses. It appears that the original "109.9 lb/hour" was used in the analysis of the 24-hour average.
10. In Attachment I, see Table I-6 titled, "SO_2 Class I Impacts in the Okefenokee". The 24-hour second highest values in the table do not match the modeling results submitted. Modeling results (2001) show a 24-hour second highest value of 4.14 ug/m^3 at receptor 5 instead of 3.99 ug/m^3 at receptor 15. Also, modeling results (2003) show a 24-hour second highest value of 2.25 ug/m^3 at receptor 30, instead of 2.16 ug/m^3 at receptor 43. Verify the information and correct as necessary.

Also, representatives from the Bureau of Air Regulation met with representatives from Georgia-Pacific on October 26th. In addition to identifying the above items, we also discussed the following: except for CO emissions, the No. 4 combination boiler project may not result in any increases over baseline emissions; consideration of flexible startup conditions for the No. 4 recovery boiler when firing 100% fuel oil; problems with installing a gas flow meter on the No. 4 recovery boiler due to the proximity of the existing fan and stack; modification of the existing ESP on the No. 5 power boiler; proposed installation of a new ESP for the No. 5 power boiler; and use of the recently modified ESP for the No. 5 power boiler as part of the control system for the No. 4 combination boiler. Some or all of these issues may be addressed in your response to this request for additional information.

The Department will resume processing your application after receipt of the requested information. Rule 62-4.050(3), F.A.C. requires that all applications for a Department permit must be certified by a professional engineer registered in the State of Florida. This requirement also applies to responses to Department requests for additional information of an engineering nature. For any material changes to the application, please include a new certification statement by the authorized representative or responsible official. You are reminded that Rule 62-4.055(1), F.A.C. 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 regarding this request, please call Bruce Mitchell at 850/413-9198 or me at 850/921-9536.

Sincerely,

Jeffery F. Koerner

Jeffery F. Koerner, Air Permitting North Section
Bureau of Air Regulation

JFK/bm

cc: Mr. Keith Wahoske, Georgia-Pacific (keith.wahoske@gapac.com)
Ms. Myra J. Carpenter, Georgia-Pacific (myra.carpenter@gapac.com)
Mr. Mike Curtis, Georgia-Pacific (michael.curtis@gapac.com)
Mr. David Buff, Golder Associates Inc. (dave_buff@golder.com)
Mr. Chris Kirts, NED Office (kirts_c@dep.state.fl.us)
Mr. Gregg Worley, U.S. EPA, Region 4 (worley.gregg@epamail.epa.gov)
Mr. John Bunyak, NPS (john_bunyak@nps.gov)

GND

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P. Adams
DIRECTOR OFFICE STE 23
111 S MAGNOLIA DR
TALLAHASSEE, FL 32301
UNITED STATES Phone: 850-921-9505

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LAKEWOOD, CO 80228
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