

Reinhold Environmental Ltd.



2010 NO_x-Combustion Round Table & Expo Presentation

February 8 & 9, 2010

Chattanooga, TN

All presentations posted on this website are copyrighted by Reinhold Environmental, Ltd (RE). Any unauthorized downloading, attempts to modify or to incorporate into other presentations, link to other websites, or obtain copies for any other uses than the training of attendees to RE's Conferences is expressly prohibited, unless approved in writing by RE or the original presenter. RE does not assume any liability for the accuracy or contents of any materials contained in this library which were presented and/or created by persons who were not employees of RE.



power generation group

Biomass Conversion Case Study

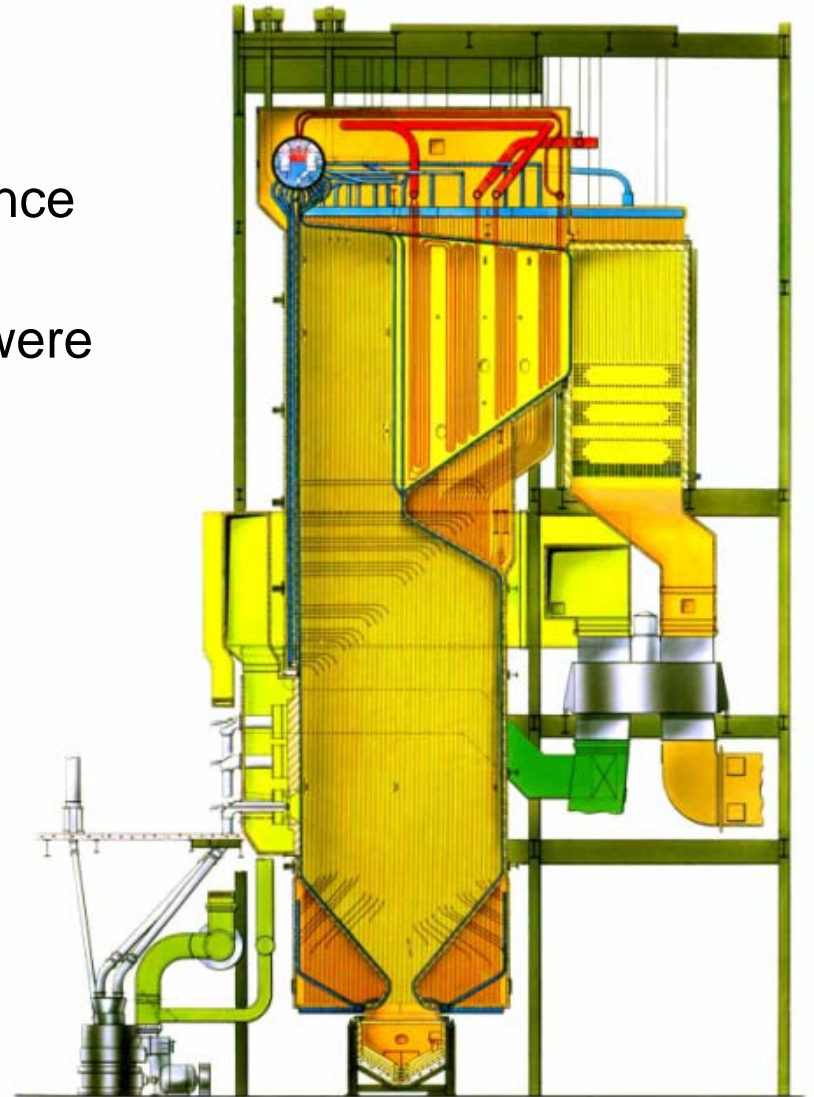


*NO_x – Combustion Round Table & Expo
Chattanooga, TN
February 9, 2010*

Phil McKenzie
BD Manager Biomass Projects

Background

- PC to Biomass/NG conversion study
- Determine max boiler capacity with 50MW (~391,000lb/hr) from biomass and the balance from NG.
- Stoker and BFB combustion technologies were examined.



Design Basis

- Convection Pass Geometry: Original Contract
- Convection Pass Metals: Original Contract
- Biomass Fuel: Standard Biomass Analysis (B&W)
- NG Support Fuel: Standard NG Analysis (B&W)
- Biomass Moisture Range: 35-50% (B&W)
- Original MCR Steam flow: 625 Mlb/hr (Performance Datasheet)
- Steam Flow From Biomass: 391 Mlb/hr (50MW) (Turbine Heat Balance)
- Steam Flow From NG: Balance
- SH Outlet Pressure: 1300 psig (Performance Datasheet)
- SH Outlet Temperature: 950F (Performance Datasheet)
- FW Temperature: 387F - 407F (Turbine heat balance, Performance Datasheet)
- Air Heater Leakage: 10% (Estimated)
- Barometric Pressure: 29.92 inHg (Performance Datasheet)
- Ambient Air Temperature: 80F (Performance Datasheet)

Design Basis

Biomass and NG Design Fuel

input by wt
(%)

		50	50	Biomass Blend			Nat Gas
		Pine	Hardwood				
HHV		9170	8370	8770	5701	4385	21879
moisture %		DRY	DRY	DRY	35	50	0
% by weight	C	55.3	49.7	52.5	34.1	26.3	69.3
	H ₂	5.5	5.4	5.5	3.5	2.7	22.7
	S	0.1	0.1	0.1	0.1	0.1	0.0
	N ₂	0.3	0.2	0.3	0.2	0.1	8.1
	O ₂	37.3	39.3	38.3	24.9	19.2	0.0
	Ash	1.5	5.3	3.4	2.2	1.7	0.0
	Total	100	100	100	100	100	100

		Nat Gas
NOMINAL % by volume	HHV BTU/SCF	1000
	CH4	90
	C2H6	5
	N2	5

Virgin Woody Biomass Capacity Constraints

Biomass capacity can be limited by the following factors:

- Convection pass velocity
 - Low heating value / high moisture fuel results in higher gas flow than PC firing.
- Economizer water outlet temperature
 - Increased flue gas volume raises the economizer water outlet temperature, which can result in steaming and limit the natural circulation of the boiler.
- SH metallurgy
 - Higher gas velocity through the convection pass increases heat transfer and results in higher metal temperatures.
- Hot precipitator (ESP)
 - ESP performance was outside the scope of B&W study.

Biomass Capacity Constraints

Constraints: Stoker VS BFB

- The metallurgy constraint can be alleviated with superheater surface adjustments and materials.
- Both technologies are limited by convection pass velocity:
 - Both technologies are capable of generating 390,900 lb/hr (50MW) from biomass.
 - Stoker biomass maximum capacity: 445,000 lb/hr (71%)
 - BFB biomass maximum capacity: 390,900 lb/hr (63%)

Ancillary Equipment

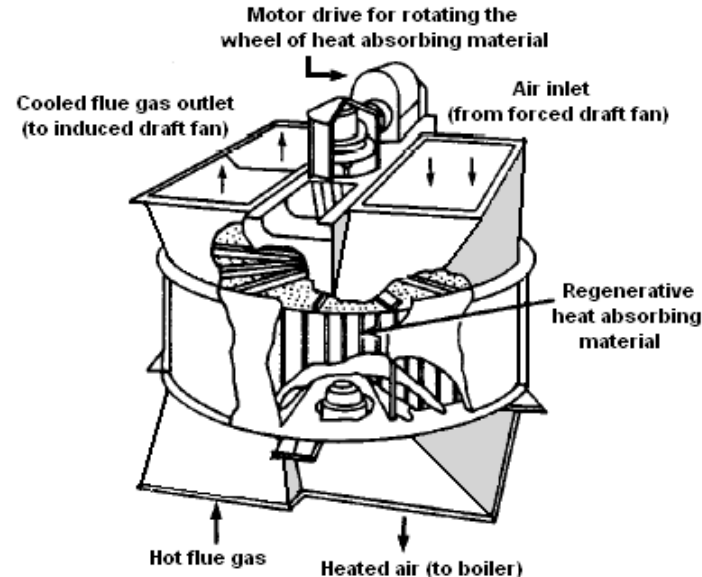
Hot Precipitator

- A hot precipitator was added to the system (by others) in the early 1970's.
- The performance of the hot precipitator was not in the scope of the B&W engineering study. The following factors may affect the precipitator performance:
 - Biomass particulates should be lower than PC firing due to reduced ash content in the fuel source.
 - The flue gas will be a higher moisture content than the original design.
 - The flue gas volume is expected to be less than or equal to the current PC 625,000 lb/hr condition.
 - The flue gas temperature is not expected to exceed the precipitator design of 695F.
 - Char carryover from biomass has more carbon content than PC.
 - The combination of biomass char carryover and tramp air in the precipitator should be addressed.

Ancillary Equipment

Regenerative Air Heater

- A tubular air heater is the B&W standard application for biomass.
- The hot ESP is expected to make reuse of the existing regenerative style air heater possible.

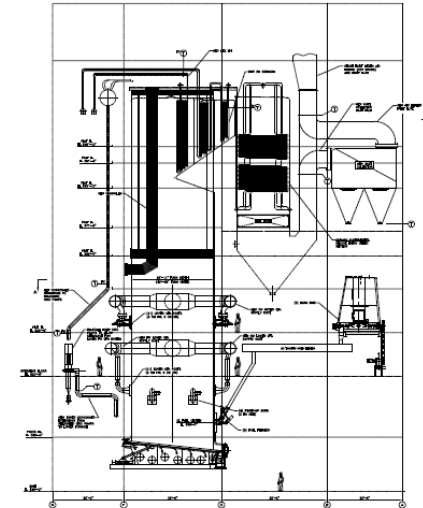
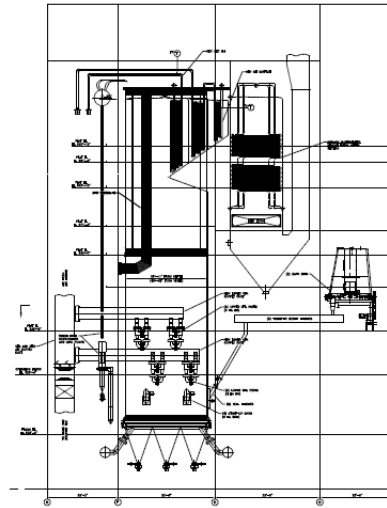


Example Equipment Layouts

Retrofits

BFB retrofit

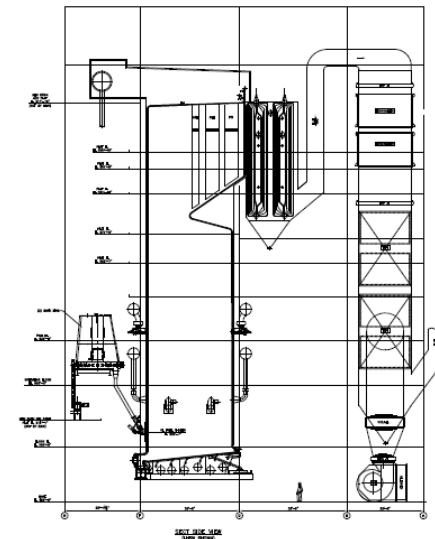
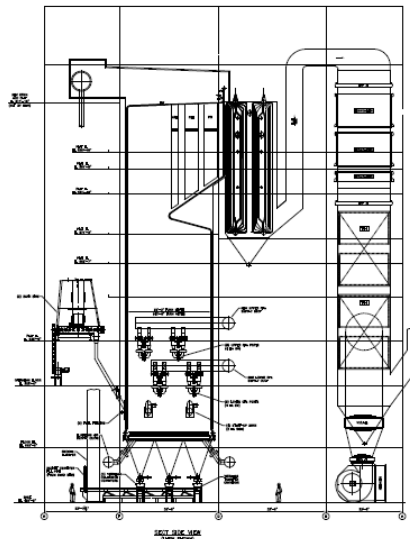
Stoker retrofit



OEM Units

BFB

Stoker



Expected Modifications

	Stoker	BFB
Fuel Handling System (biomass)	New fuel feed system required	
Primary Air Fan - Volume	OK - The PA fan is not needed for Biomass	
Primary Air Fan - Static		
Forced Draft Fan - Volume	OK	
Forced Draft Fan - Static	Booster fan needed (~ +10")	Booster fan needed (~ +30")
Furnace	New Stoker Bottom No digging below grade	New BFB Bottom No digging below grade
Economizer	Add cyclone steam separator Circulation modifications probable	
Large Particle / Spark removal	Possible multiclone collector	Possible LPA screen
Hot Precipitator	Possible modifications, outside B&W scope	
Regenerative Air Heater	OK	
ID Fan - Volume	OK	Possible test block margin infringement depending on FGR tie in point
ID Fan - Static	OK	

Questions and Discussion