WRBA 45th Annual Meeting

Red Lion Hotel on the River
Portland Oregon
March 12th 2013

Bob Morrow
Detroit Stoker Company

I'm excited for the one day of the year when green's meaning shifts from saving the environment to polluting our major organs.

someecards

Detroit Stoker Company

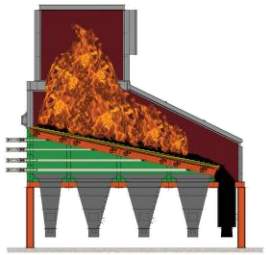
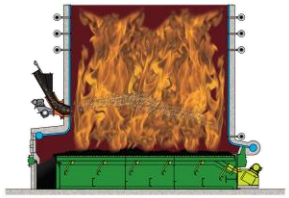
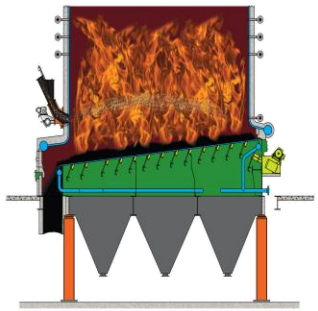
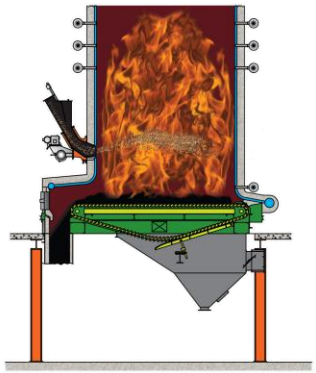
- Administration, Sales, Engineering & Manufacturing in Monroe, Michigan
- 40 Million $US Turnover
- 82 Employees
- 19 North American Manufacturer Sale Reps
- 12 International Manufacturer Sales Reps
- Privately Owned

Products & Services

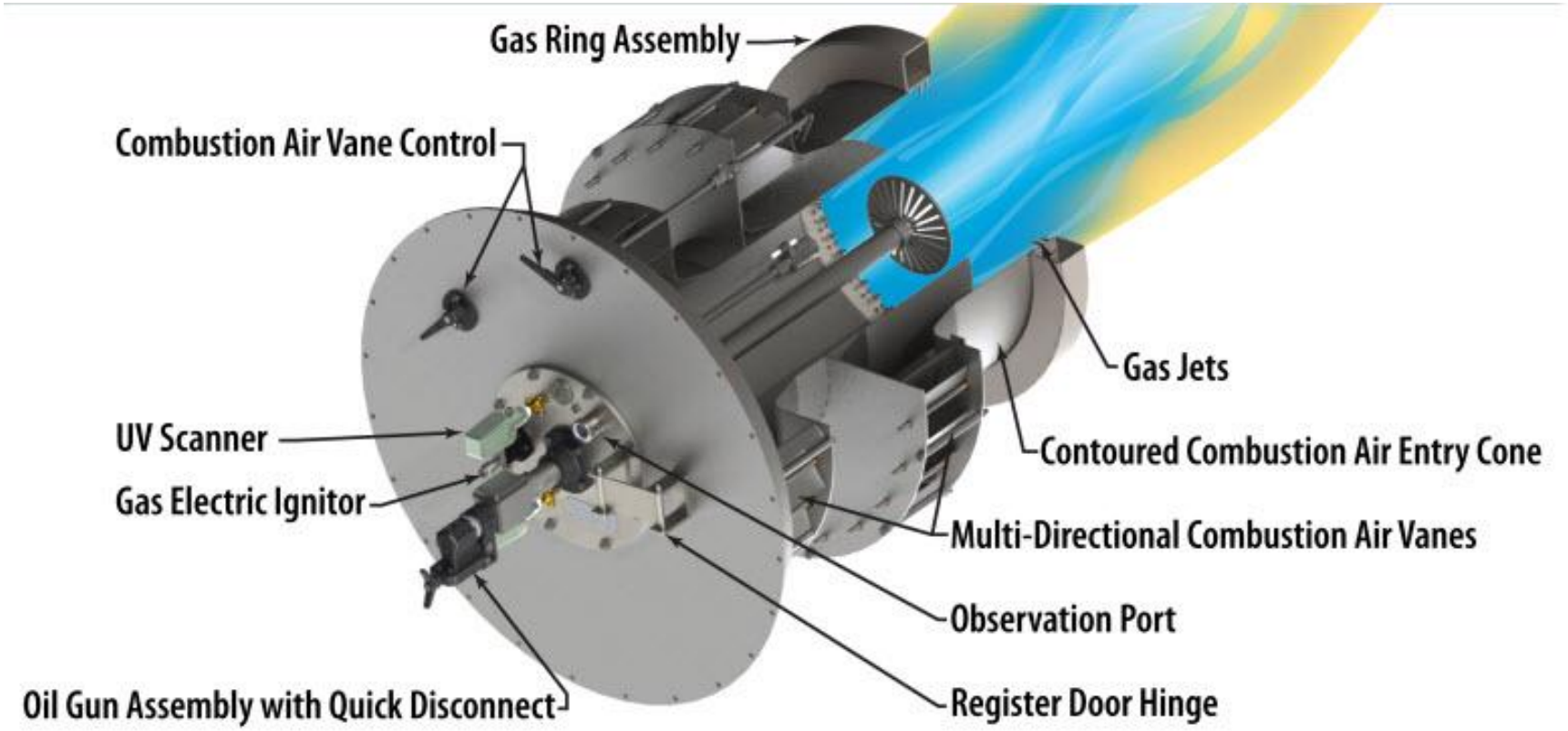
- Solid Fuel Combustion Systems
- Solid Fuel Feeding Systems
- Rotary Seal Feeders/Double Flap Airlocks
- Low NOx Gas/Oil Burners
- Aftermarket Parts & Services
- Engineering Studies
  - CFD Analysis for Air Systems and Furnace Design
  - Pilot Scale Testing

Solid Fuel Combustion Systems

- Spreader Fired Combustion
  - Detroit Hydrograte
  - Detroit VCG
  - Detroit RotoGrate
- Mass Fired Combustion
  - Detroit Reciprograte
  - Detroit GTS Grate

Detroit Burner Technology



Domestic Projects

2008	Texas	210	Wood Waste
2008	Tennessee	204	Wood
2008	Georgia	45	Wood
2009	Wisconsin	90	Wood, RR Ties, TDF, DDG, Corn Stover
2010	Ohio	91	Forest Waste, Switch Grass, Renewable Pellets
2010	Washington	102	Wood
2011	California	195	Wood Waste
2011	Virginia	181	Wood Waste
2011	Kansas	227	Cake, Syrup, Corn Stover
2011	Georgia	159	Wood
2011	Florida	222	Wood
2011	Texas	195	Wood
2011	Pennsylvania	18	Chicken Litter
2012	South Carolina	136	Wood
2012	South Carolina	79	Wood

Over 2,540 Tons/hr Steam (~560MWe) in Design/Construction/Commissioning for 2013.

“New” Refuse Biomass Fuel

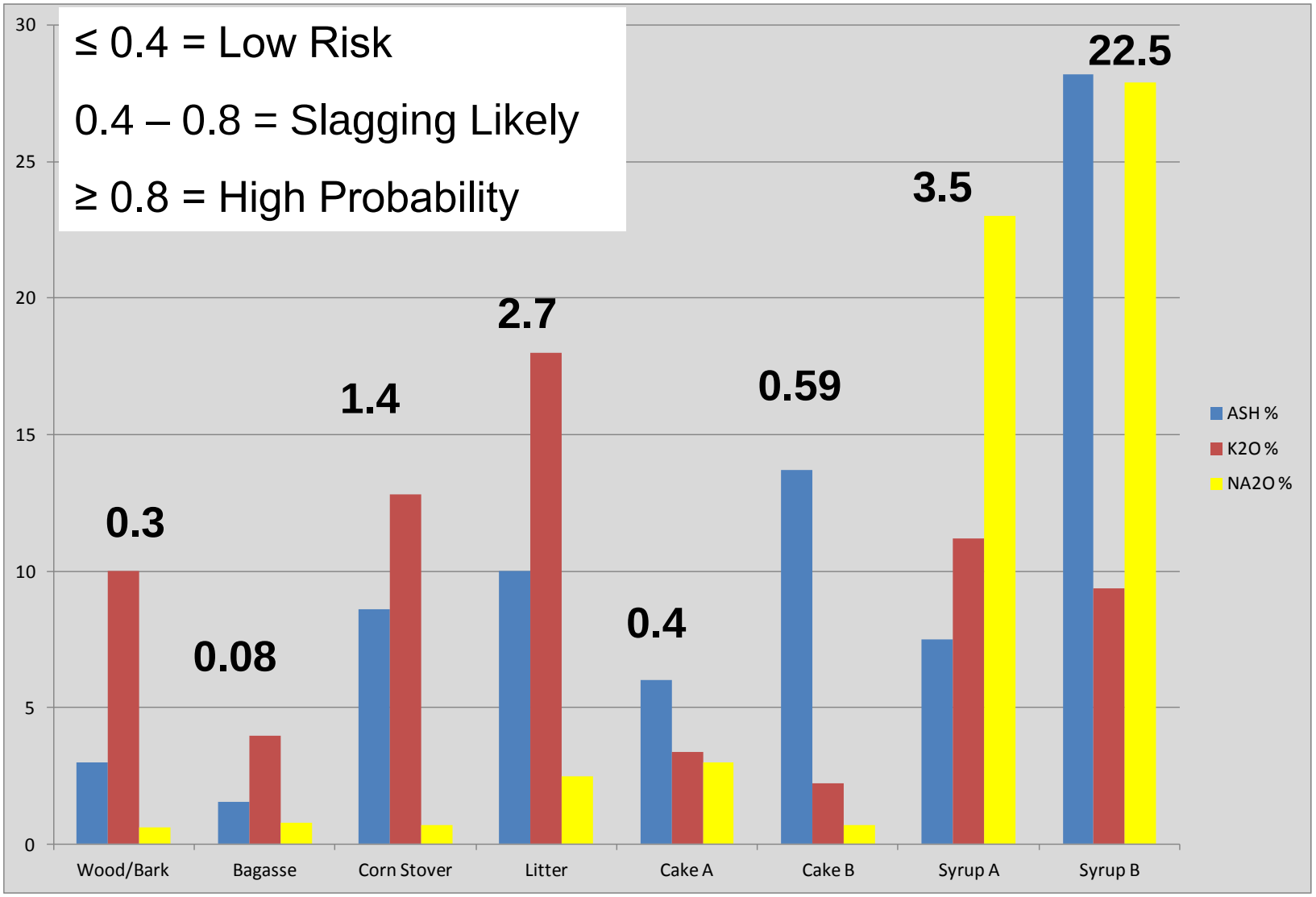
Lignin Based Refuse - Ethanol

Residual from Sugar Solution– “CAKE”

Distillation refuse – “SYRUP”

AKA – Breakfast Fuels

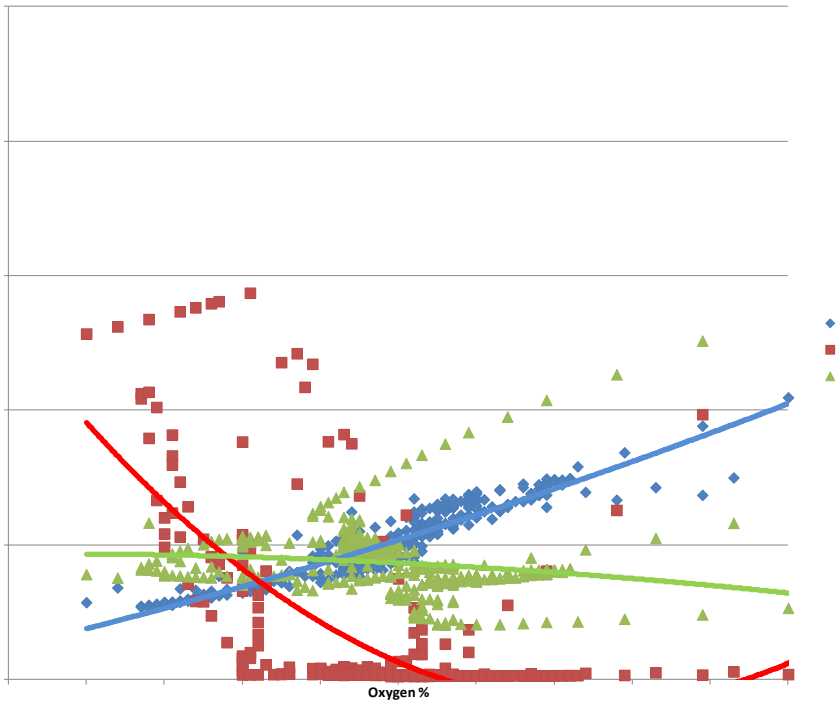
As Received – Typical Fuel Analysis



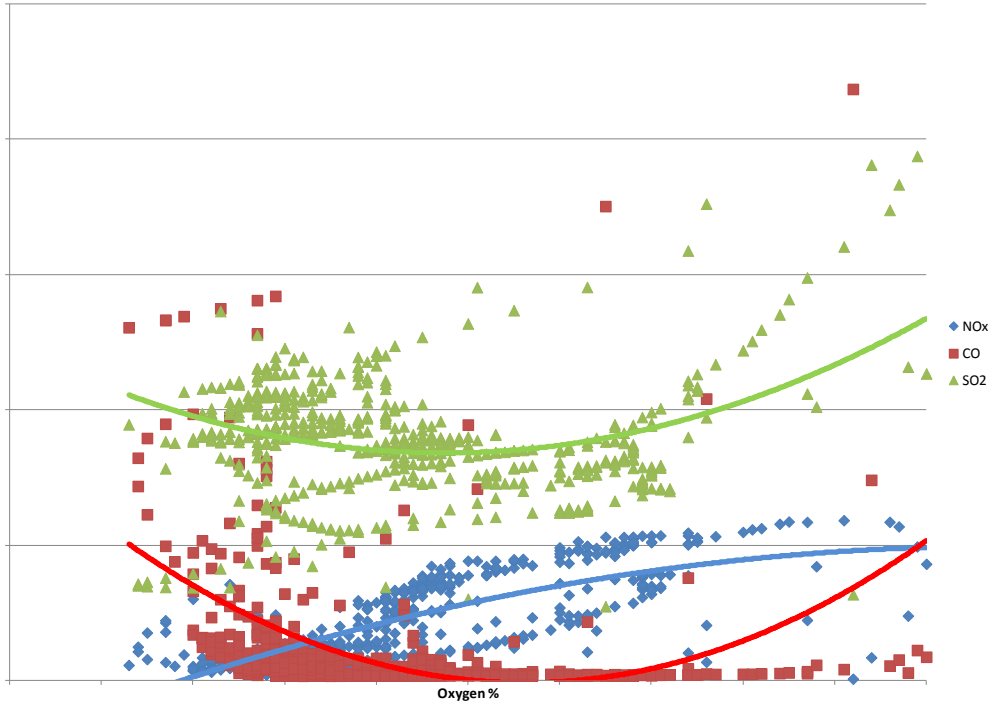
Cake & Syrup Trials

- Determine Suitability of Cake as a fuel
- Determine suitability of Cake combined with Syrup
- Determine suitability of Cake, Syrup and “Other” fuels.

Emission Trends
Cake Vs. Cake w/ Syrup



Cake Only



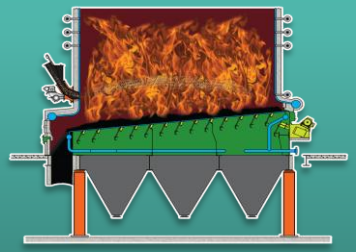
Cake and Syrup

2012 – Domestic Boiler

Lignin “Cake” & Syrup fired Combustion system

+300 Klbs/hr steam flow

- 900 psig
- 750 F temperature



Detroit Water Cooled Combustion System

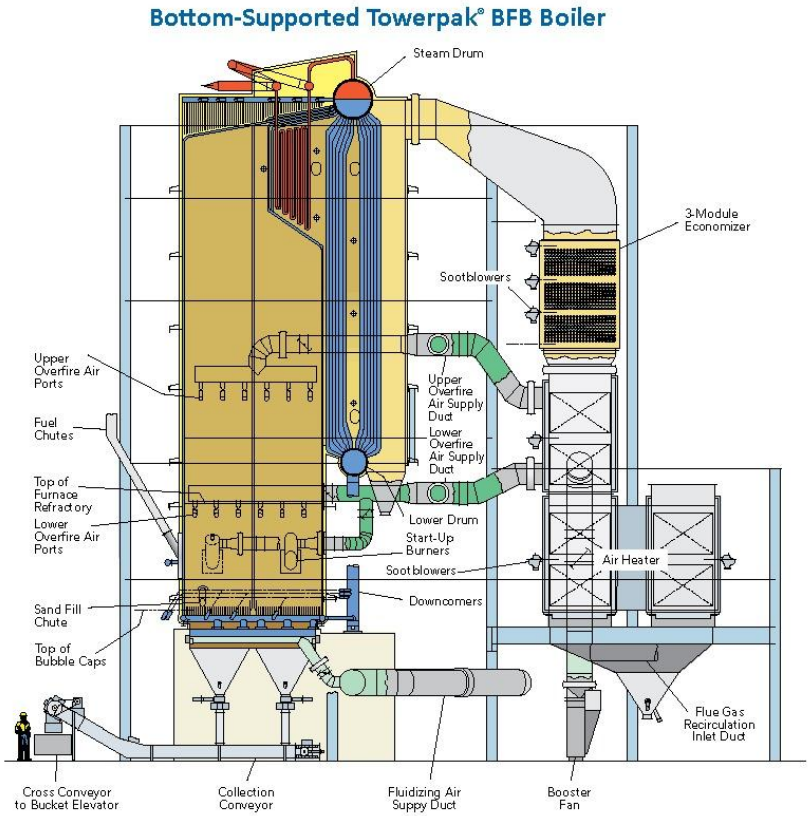
- 28 ft Wide X 22 ft Long
- Grate system, Fuel Distribution, Secondary air

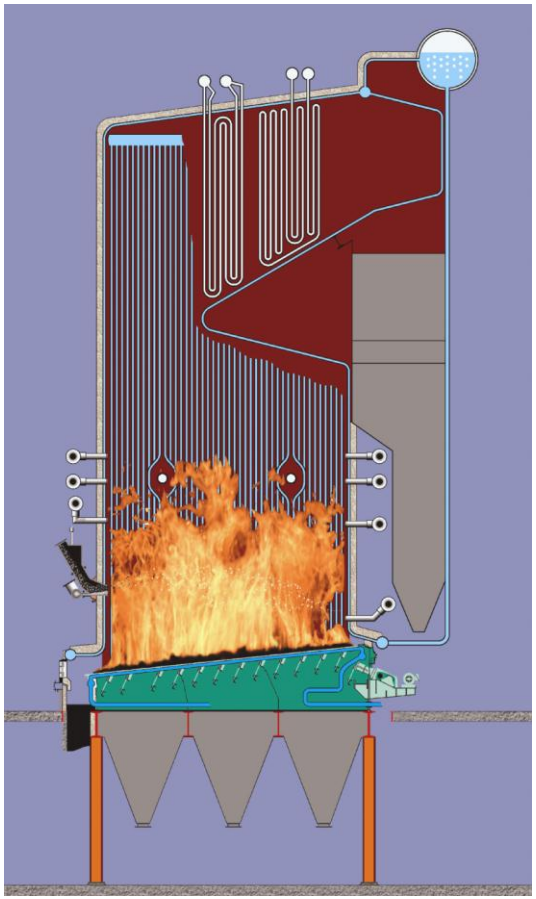
Fuels & Emissions

- Cake, Syrup, Biogas, Ag fuel (Design H_2O = 45%)
- 0.12 lbs/MMBtu for CO and NOx


Combustion
Technology

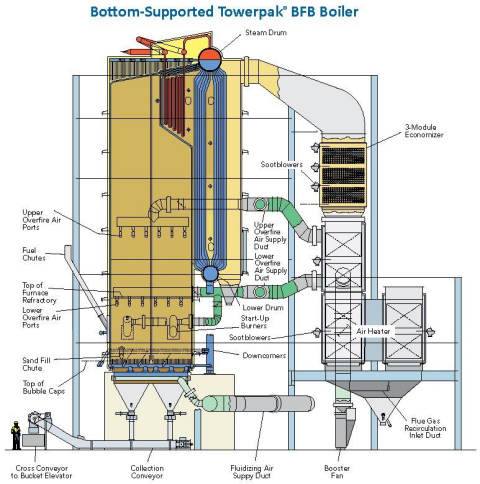
BFB & Grate



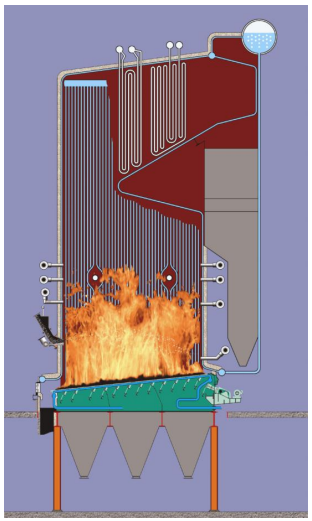


BFB vs. Grate Combustion

- Heated Silica sand bed 0.039” dia.
- Fuel fed into bed
- Fluidizing velocities 3.6-8.2 ft/s
- Bed temperatures 1490°F. SR <0.9
- Excess air 20-35%



- Fuel fed above bed
- Furnace velocities 16-23 ft/s
- Combustion Temp +2200°F.
- Excess air 25-35%



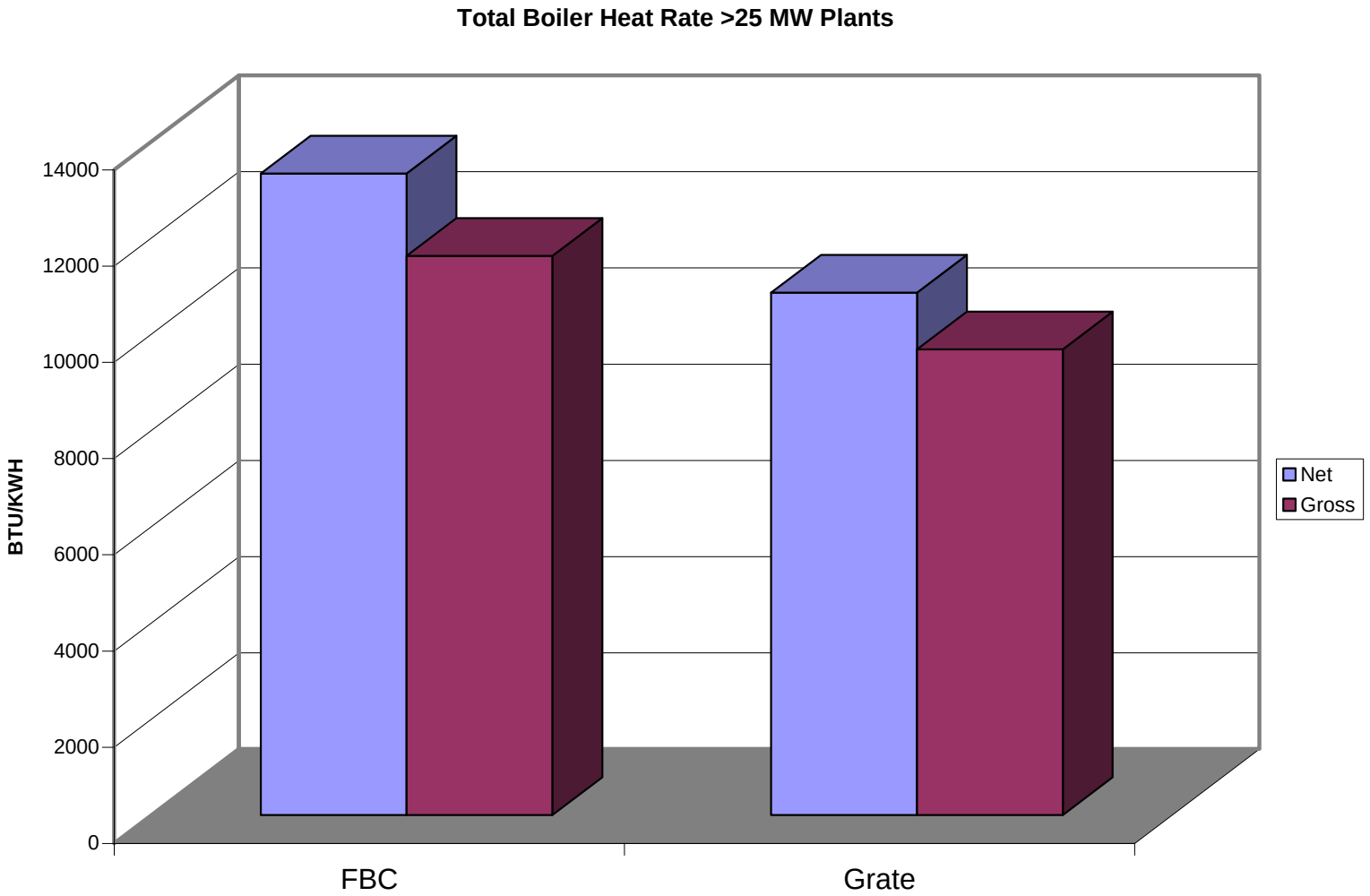
Categories of Comparison

- Fuel Considerations
- Heat Rates
- Availability
- Response Rates
- Issues & Summary

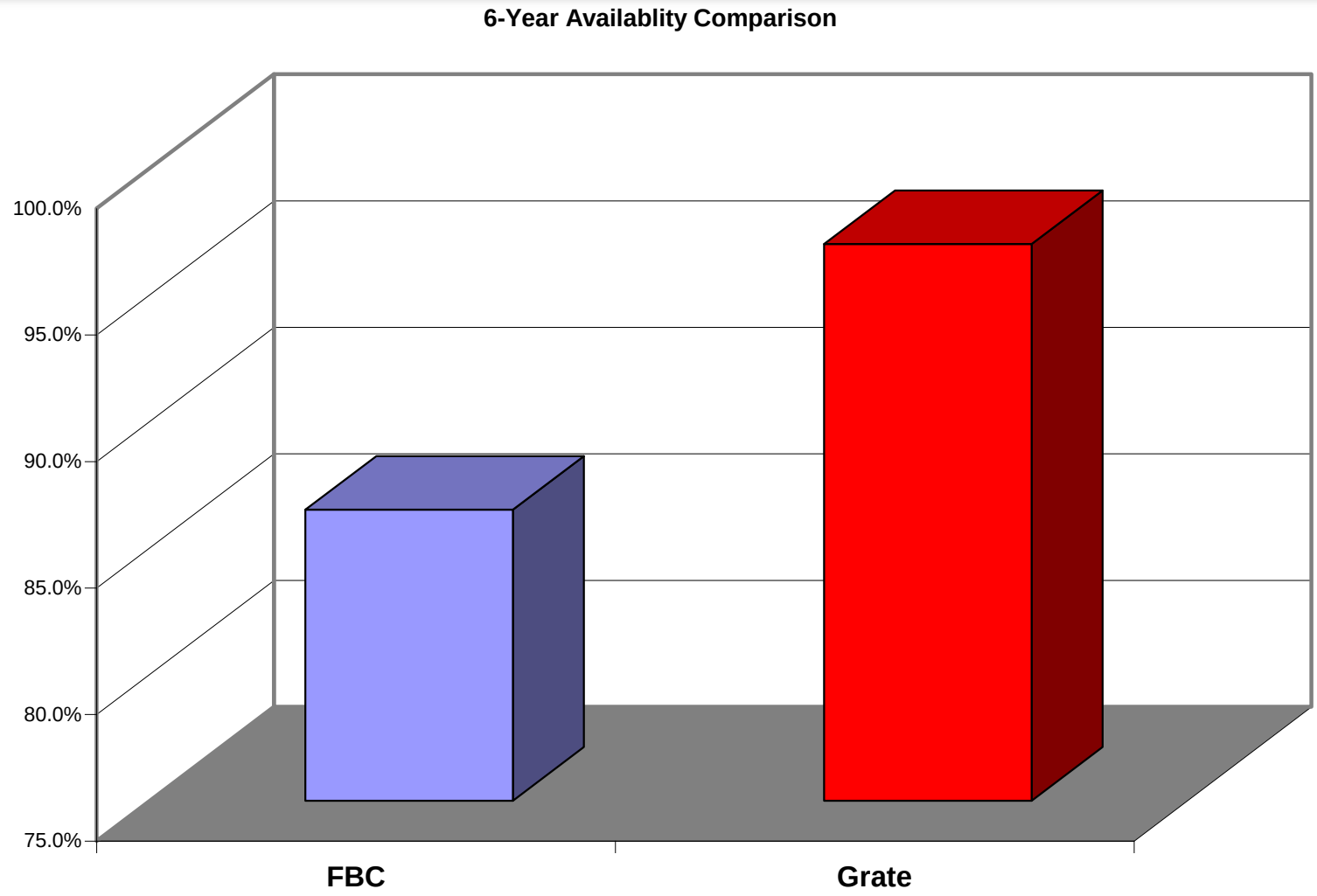
Fuel Flexibility

	GRATE	BFB
Moisture	5 to 60%	30 to 65%
Sizing	Suitable for spreader firing	Suitable for spreader firing. Finer,dryer fuels may require in-bed injection

Heat Rate Comparison



Availability



Response Characteristics

- Grate
  - Cold Start – 4.5 hr
  - Warm & Hot Start *(Depends on Drum Sat Temp)*
  - Steam Swing – 10% of MCR
  - Ramp Rate
    - 20%/min of MCR
    - 40-100% MCR
- BFB
  - Cold Start – 7 hr
  - Warm - 2 hr
  - Hot – 1hr
  - Steam Swing – 10% of MCR
  - Ramp Rate
    - 4%/min of MCR
    - 50-100% MCR Increasing
    - 100-50% MCR Decreasing

	BFB	Grate
Capital Cost	High complex fuel and ash systems	Low
Operating costs	High Fan HP, Bed material	Low
Availability	<85% Depending on fuel	High >95%
Fuel Flexibility	Limited at low H_2O Higher % H_2O good	Good Flexibility
NOx (#/MMBtu)	0.10-0.25	0.12-0.30
CO (#/MMBtu	0.10-0.40	0.05-0.30

Existing Unit Comparison

Category	CO Range	MACT 3-run ave.	MACT 30 day ave.
Hybrid Suspension grate Fuel >40% H2O	64-383	2,800	900
Biomass Wet Stoker/sloped grate Fuel >20% but <40% H2O	64-383	1,500	720
Kiln dried Stoker/Sloped grate Fuel <20% H2O	64-383	460	ND
FBC	128-510	470	310

CO values = ppm @ 3% O2

New Unit Comparison

Category	CO Range	MACT 3-run ave.	MACT 30 day ave.
Hybrid Suspension grate Fuel >40% H2O	64-383	1,100	900
Biomass Wet Stoker/sloped grate Fuel >20% but <40% H2O	64-383	620	390
Kiln dried Stoker/Sloped grate Fuel <20% H2O	64-383	460	ND
FBC	128-510	230	310

CO values = ppm @ 3% O2

Start up, Shut down & Malfunction SSM

- Sierra Club v EPA case in 2008 resulted in vacatur of 2 provisions that exempted sources from meeting MACT requirements during SSM.
- There has to be some requirement at all times, either a numeric standard or a work practice.

Work Practice Possible?

- Clean Air Act 112(h) allows EPA, in cases where it is not feasible to prescribe or enforce an emission standard to promulgate a design, equipment, work practice, or operational standard.
- Not feasible means you can't design something to capture/control the emissions or it is technologically or economically infeasible to measure the emissions.

Evolution of SSM - MACT

- 2004 rule – Facilities do not have to meet MACT requirements during periods of SSM (vacated).
- 2010 proposal – Emission limits apply at all times, including startup, shutdown, and malfunction.
- 2011 final rule – work practice to minimize time in SS, follow manufacturer's procedures. No definition of startup and shutdown in the rule.

2011 Reconsideration

- Startup and shutdown definitions based on 25% load (startup ended when unit reached 25% load.
- Work practices include maintain good combustion conditions, optimize O2 concentrations, train operators, maintain records.

2013 Final Rule Work Practice

Part 1 – Clean Fuels

You must use one or a combination of the following clean fuels: natural gas, synthetic natural gas, propane, distillate oil, syngas, ultra-low sulfur diesel, fuel oil soaked rags, kerosene, hydrogen, paper, cardboard, refinery gas, and liquefied petroleum gas.

MACT Startup Work Practice

Part 2 – Start your controls

If you start firing coal/solid fossil fuel, biomass/bio-based solids, heavy liquid fuel, or gas 2 (other) gases, you must vent emissions to the main stack(s) and engage all of the applicable control devices except limestone injection in fluidized bed combustion (FBC) boilers, dry scrubber, fabric filter, selective non-catalytic reduction (SNCR), and selective catalytic reduction (SCR). You must start your limestone injection in FBC boilers, dry scrubber, fabric filter, SNCR, and SCR systems as expeditiously as possible.

Ruh – Roh!!!!

They Forgot ESP's

Startup Definition

- Startup means either the first-ever firing of fuel in a boiler or process heater for the purpose of supplying steam or heat for heating and/or producing electricity, or for any other purpose, or the firing of fuel in a boiler or process heater after a shutdown event for any purpose. Startup ends when any of the steam or heat from the boiler or process heater is supplied for heating and/or producing electricity, or for any other purpose.

Monitoring/Recordkeeping

- You must keep records concerning the date, time, duration, and type and amount of fuel usage during startup and shutdown.
- You must operate all CMS during startup and shutdown (even though emissions and operating limits do not apply).

GACT Startup/Shutdown

- Same definition of startup/shutdown but less prescriptive work practice.
- Minimize the boiler's startup and shutdown periods and conduct startups and shutdowns according to the manufacturer's recommended procedures. If manufacturer's recommended procedures are not available, you must follow recommended procedures for a unit of similar design for which manufacturer's recommended procedures are available.

FLUID BED & STOKER FIRED BOILER OPERATIONS AND PERFORMANCE CONFERENCE

May 20-22, 2013

Seelbach (Hilton) Hotel, Louisville, Kentucky

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Thank You !!!