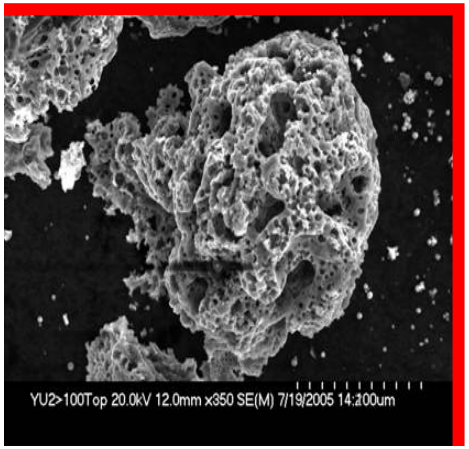
Reinhold Environmental Ltd.

2008 NOx-Combustion Round Table & Expo Presentation

February 4-5, 2008 in Richmond, VA

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

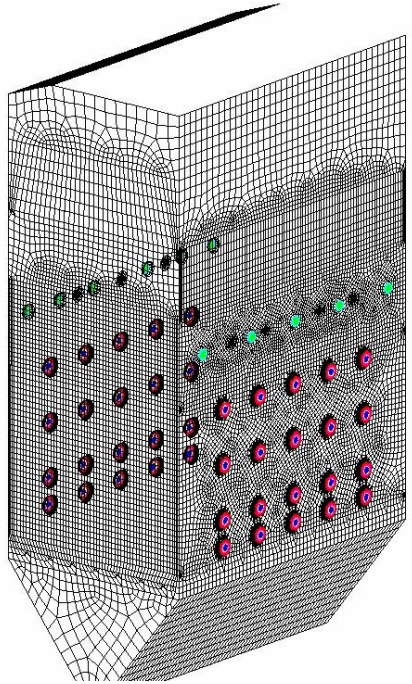
Impact of Fuel Quality and Boiler Design on NOx, Hg, and Performance



Tony Facchiano
Ramsay Chang

NOx-Combustion Round Table

February 4th, 2008



Impacts of Fuel Quality
Generalizations

Sub-bit. coal much more “NOx friendly” than bit.

- **Lower sulfur, chlorine:**
  - **low fireside corrosion (can stage deeper)**
  - **ABS formation less of an issue (AH tolerates higher NH_3 slip)**
  - **SO2 oxidation (across SCR) not an issue**
- **Greater volatility:**
  - **UBC / LOI typically not an issue (can stage deeper)**
  - **More amenable to staged operation in general**
- **Higher moisture**
  - **lower thermal NOx**

Impacts of Fuel Quality
Generalizations

Bit. coal more “Hg friendly” than sub.-bit. Coal?

- Higher chlorine:
  - Improved mercury oxidation
- Lower volatility:
  - UBC available for mercury capture
- Higher SO3 may be a potential issue

Bit. coal more “Performance friendly” than sub-bit. Coal

- Lower water content
  - Higher UBC somewhat offsetting, but typ. not significant

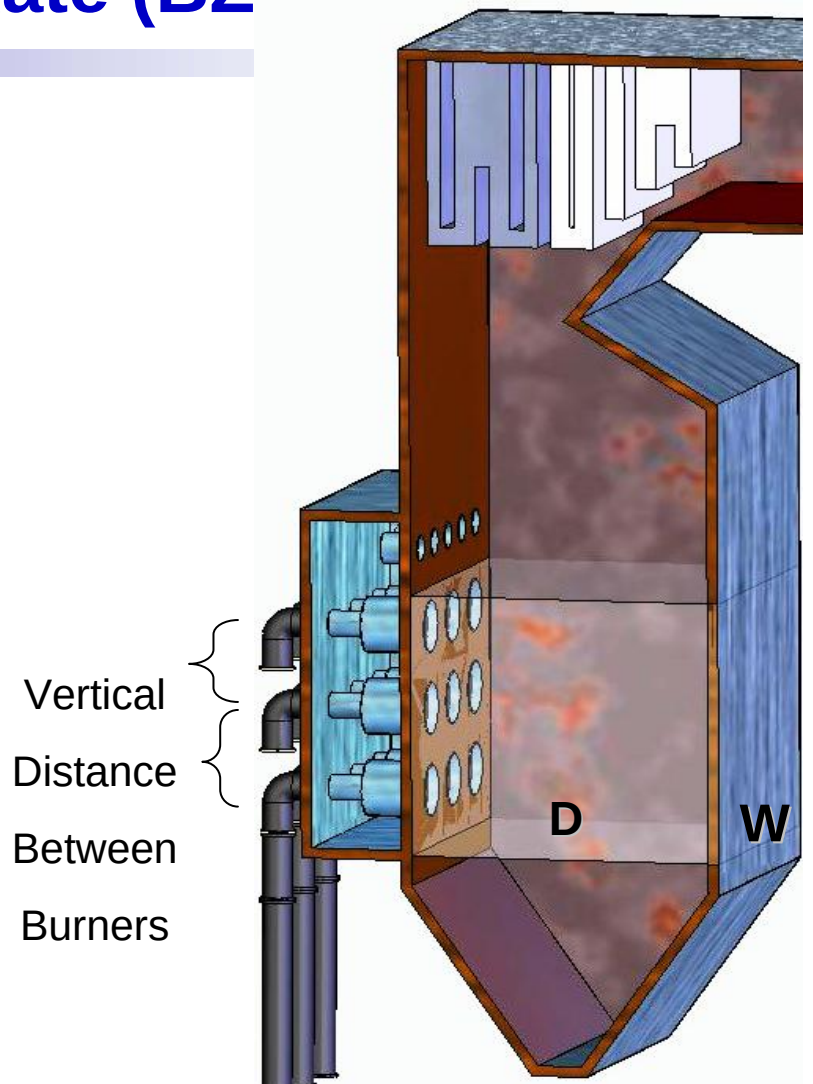
NOx Impacts:
Impacts of Fuel Quality on Comb. NOx

Unit	Coal Type	Control	NOx Level	CEMs Ref
A	PRB	LNCFS III	0.093	3Q 2006
B	Low S Tx Lignite	ABT LNB + OFA	0.160	3Q 2006
C	Low S E. Bit	OFA + LOFIR	0.25	3Q 2004
D	Low S E Bit	Mobotec ROFA™	0.25	1Q 2003
E	Med S E Bit	Mobotec ROFA	0.22 - 0.23	Field Test

NOx Impacts:
Burner Zone Heat Release Rate (BZHRR)

- **Measure of rate of heat released per plane area or volume – *Good indicator of potential thermal NOx formation***

- **Calculated using burner zone plane area (Btu/Hr-Ft2) or burner zone volume (Btu/Hr-Ft3)**



BZHRR FW boiler example

Full load fuel heat input (BTU/hr) / (boiler L x W x the vertical distance between the burners x [# of burner elevations]) = Btu/hr-ft^3

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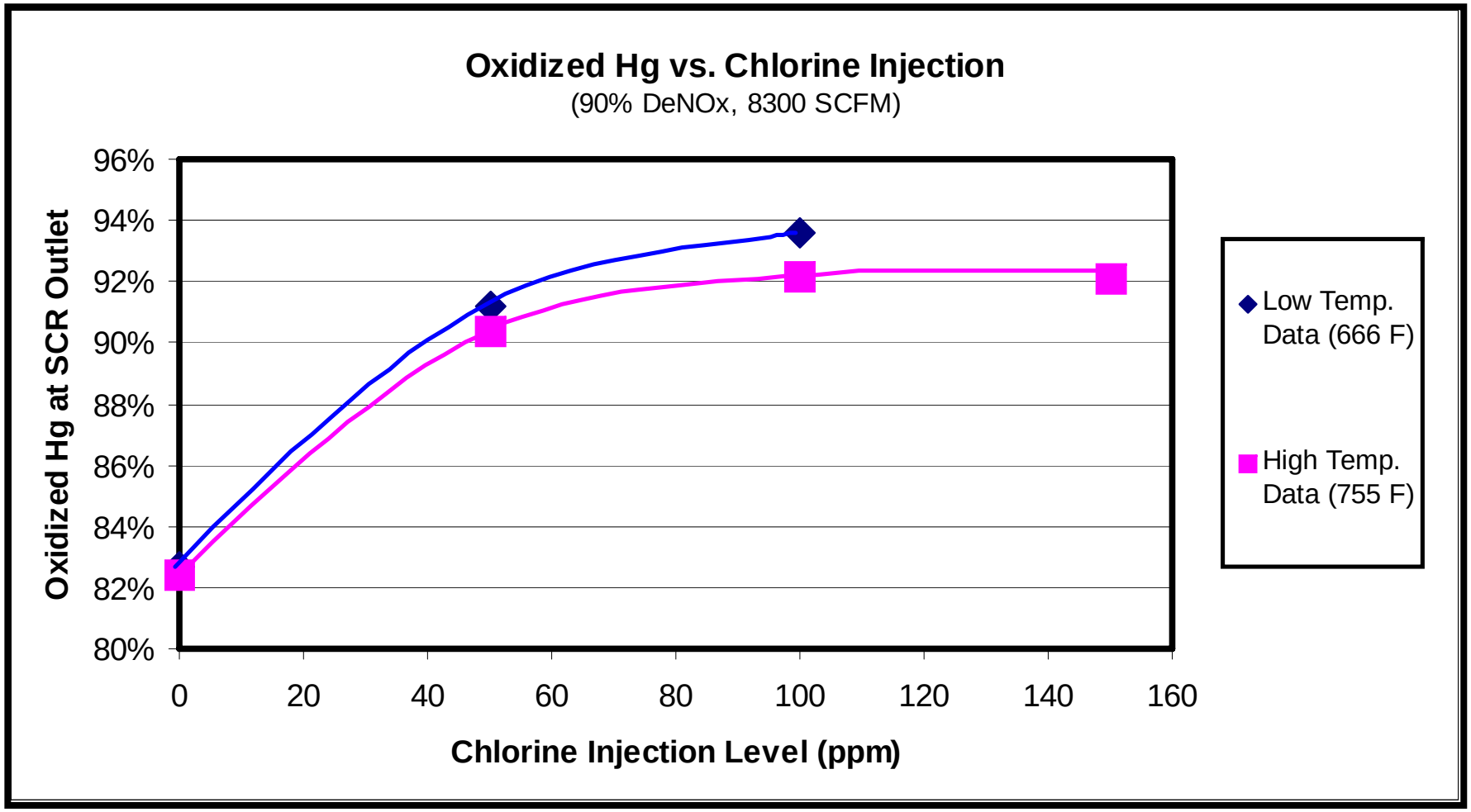
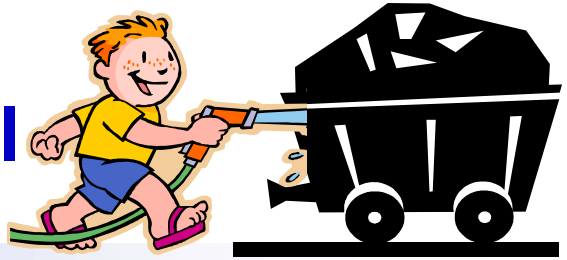
Hg Impacts:
Flue Gas Impacts on SCR Catalyst
Preliminary Results



Coal Cleaning and Mercury Removal



- Decreasing amount of coal cleaned in US
  - Statistics not kept
  - Increasing PRB use
  - Decreasing number of cleaning plants, though larger
- Widely variable mercury reductions through cleaning
  - 12% to 78%--WHY?
  - Inherent differences in coal, mercury association
  - Different cleaning approaches employed
- Goal of conventional coal cleaning doesn't necessarily provide maximum mercury reduction
- EPRI project in progress to quantify, value coal cleaning contribution to mercury control

Conclusions and Observations

- **Fuel quality has a major impact on achievable levels of NOx, Hg, and boiler performance**
- **Many unknowns – much to be learned:**
  - **Impacts of blends on NOx, corrosion, cracking, etc.**
  - **For Hg, impact of SO_3 , Cl, UBC**
  - **Ability of advanced SCR systems to overcome fuel quality issues**
  - **Cleaning and Beneficiation: What's festivity, limitations, costs vs. benefits**
- **Fuel quality and fuel purchasing decisions are paramount in evaluating emissions, performance, reliability, and cost**

Impacts of Fuel Quality
For Discussion

Although fuel quality has a first order impact on emissions, reliability, and performance, fuel purchasing decisions are often made without due consideration of these impacts. What is the current situation with regards to this issue at your organization, and what can be done to improve it?

Impacts of Fuel Quality
For Discussion

When prioritized against reliability and emissions, Heat rate has historically finished a distant third. But with looming CO_2 regulations, this is changing. Has prioritization of heat rate been increased at your organization, and if so, what specific steps have been taken at to improve heat rate? What additional tools, programs, etc. are needed?