

REINHOLD ENVIRONMENTAL Ltd.



2014 NO_x-Combustion Round Table & Expo Presentations

February 10 & 11, 2014, in Charlotte, NC / Hosted by Duke Energy

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Increasing Efficiency to Meet Future GHG Regulations for Existing Units

2014 NO_x-Combustion Round Table

Charlotte, NC

Feb. 11, 2014

The Issue

The EPA Has Been Directed to
Develop Rules to Limit
Greenhouse Gas Emissions
From Existing Facilities

What & When

The Rules Will Be Under the Provisions of Section 111(d) of the Clean Air Act

- It Will Be Up To The States To Develop Plans For Implementation (SIPs)

- May include requirements for efficiency improvements

Proposed Rules Scheduled To Be Out For Comment In June 2014

Focus of Panel

Assuming The Proposed Rules Will
Include Efficiency Improvement
Provisions:

What Modifications May Be Possible/Reasonable?

How Do They Rank From Least Cost to Highest Cost?

What Are Realistic Targets?

Panel Members

Chair – Don Ryan, Mgr Advanced Technology Development;
40 years with Babcock & Wilcox

Steve Johnson – Quinapoxet Solutions
43 years developing and applying emission controls and
boiler improvements for the power industry.

Sterling Gray – URS Corporation – Process Technologies
25+ years experience with utility emission controls

Tony Licata – Licata Energy & Environmental Consulting
40+ years in the power industry

Rules of The Road

On the Steam Side:

In 1823 Carnot Said – Max Efficiency = $(T_1 - T_2)/T_1$

On the Boiler Side:

Efficiency is a Function Of:

Gas Temp Leaving AH

Ambient Temp

Excess Air

Fuel Properties

Steve Johnson

Back-Up Material

Some Definitions

- Efficiency = Net Plant Heat Rate (NPHR)
- $NPHR = (\text{Heat In} - \text{Heat Losses}) / (\text{KW} - \text{KW used})$
- Generating Efficiency = (Turbine Eff.) (Boiler Eff.)
~36-42% **~ 84-90%**
- Combined = **30-38%**

Efficient Boiler Operation

- Boiler Efficiency =
(Combustion Efficiency) (1- Σ heat losses)
 - Combustion typically > 99%
 - Home in on avoidable losses

Potential Efficiency Gains are Small

- Air Heater Outlet Gas Temperature



- Flue Gas Moisture



- Excess Air



- Tramp (non-preheated) Air



Sustainable Gains?

- What if...
- Air heater pluggage
- Casing leaks
- Soot blowers out
- Wet coal
- Much more!
- **No one fined (or jailed) for not meeting heat rate goals!**



Tony Licata

Back-Up Material

Plant Efficiency Options

- Boiler island improvements
 - Coal transport, conveying, and grinding
 - Burners
 - Boiler operation/overhaul with new heat transfer surface
 - Neural network (NN) control system
 - Intelligent sootblower (ISB) system
 - Air heater
- Turbine Island
- APC System
- Transmission

Plant Efficiency

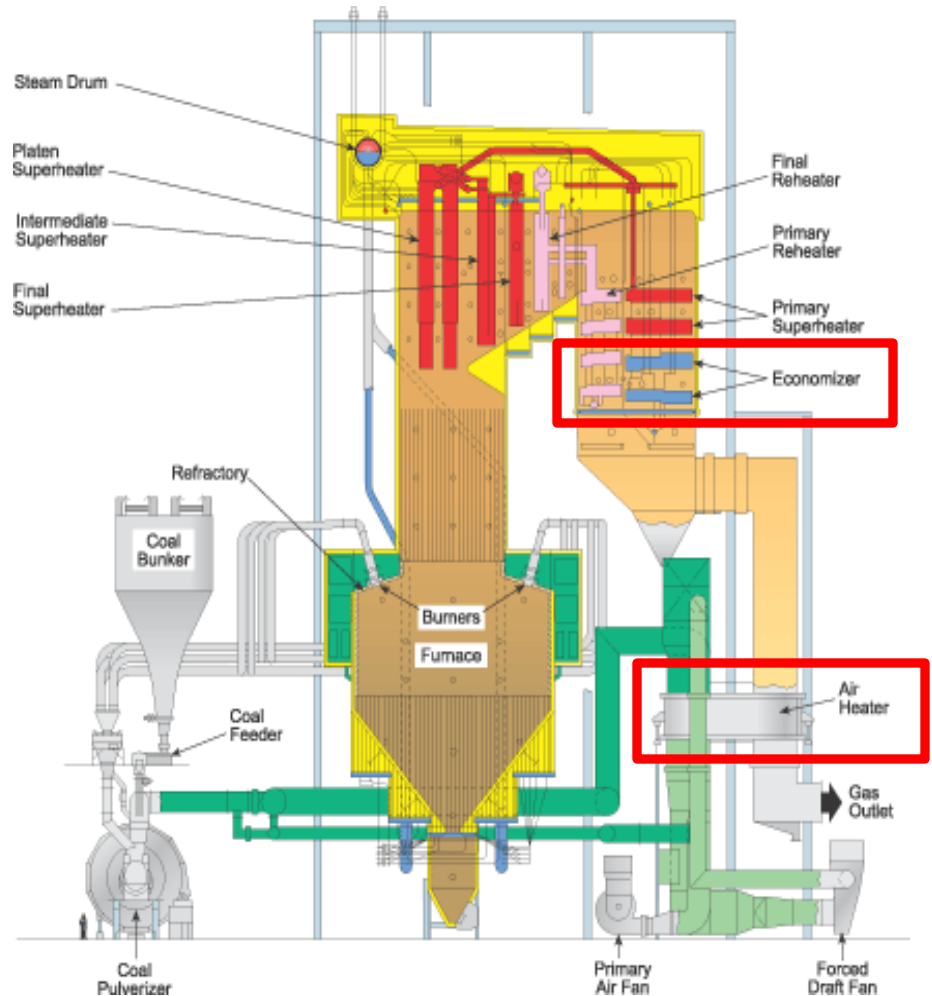
- **WHAT CAN YOU DO WITHOUT TRIGGERING NSR or classified as modified source (rules not published)**

Sterling Gray

Back-Up Material

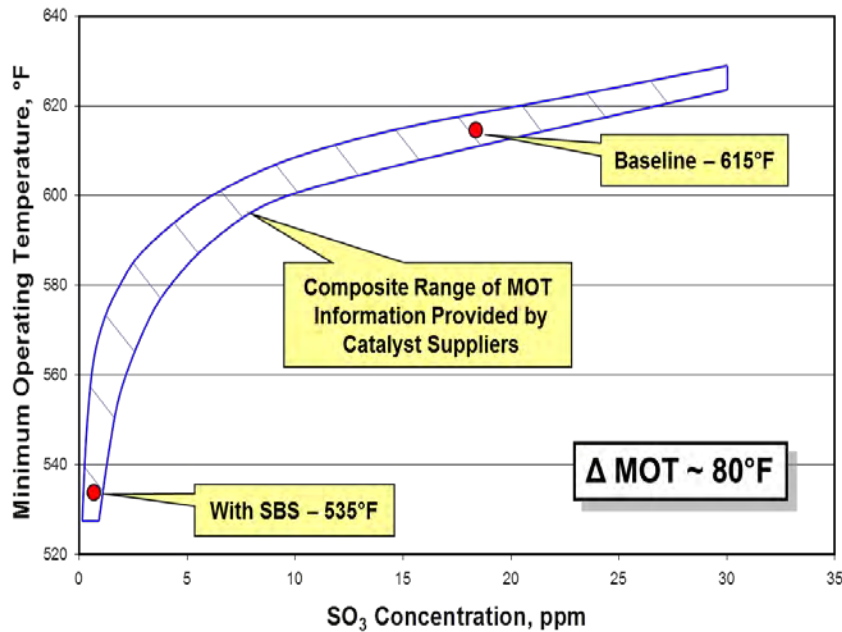
Last Chance for Heat Recovery

- Economizer
 - SCR constraints
 - NO_x Removal
 - Min Op Temp
- Air Preheater
 - Acid Condensation
 - Fouling/Corrosion
 - Other acids/H₂O



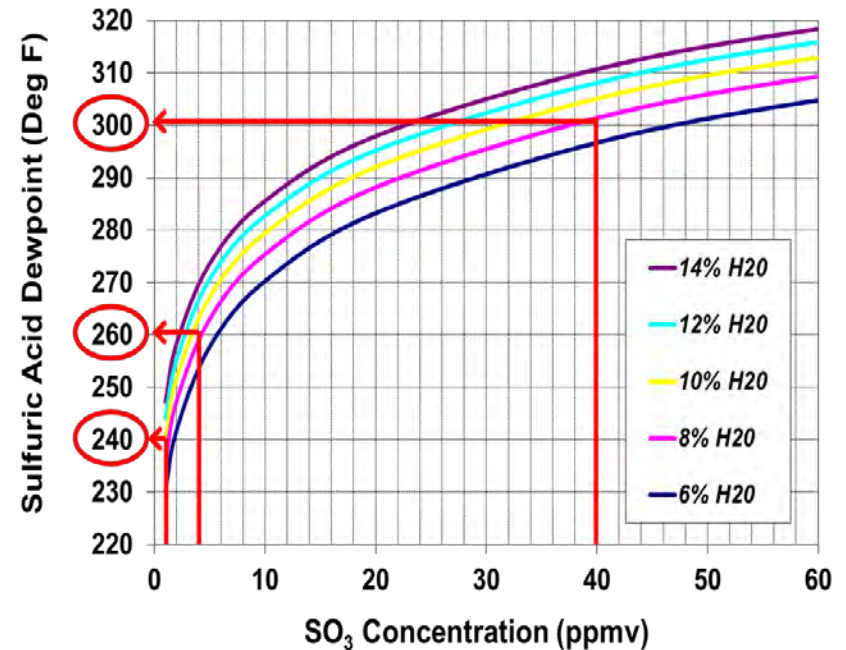
Benefits of Removing SO₃

Ahead of SCR



- Lowers Min Op Temp
- Increases Hg Oxidation

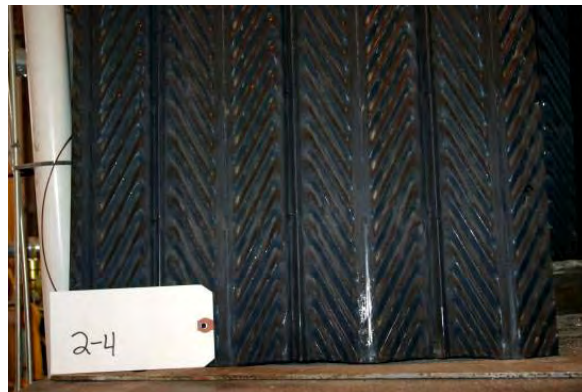
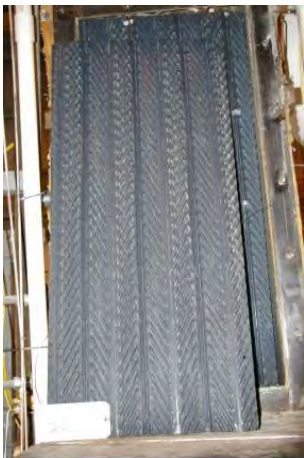
Ahead of APH



- Lowers Acid Dewpoint
- Increases Hg Capture

Hi-Efficiency Pilot APH Demo

- 0.5 MW Scale Pilot
- Simulated SBS Injection
- 5 ppm SO_3 at APH
- 220°F Gas Out Temp
- Stable dP for 1500 hrs



Tower 1 Gas Side Pressure Drops

