

Reinhold Environmental Ltd.



2010 NO_x-Combustion Round Table & Expo Presentation

February 8 & 9, 2010

Chattanooga, TN

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Care and Feeding of SNCR Systems

Presented to

2010 NO_x-Combustion Round Table

by

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Quinapoxet Solutions

8 February 2010



Outline

- **Training Objectives**
- **O&M Guidelines**
- **Operational Issues**
- **A Few Examples**



Training is for You

- What is your experience?
- What would You like to discuss in the next hour?
- What SNCR issues do you face?



What Kind of Animal is SNCR?

- Inject chemical (like SCR)
- Temperature, time are critical (like combustion)
- Love it or hate it!
- Take time to get to know it
- Works best as a NO_x trim

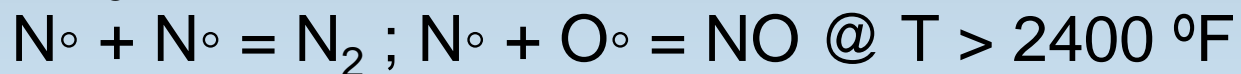
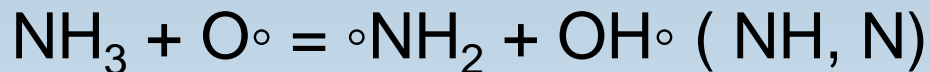
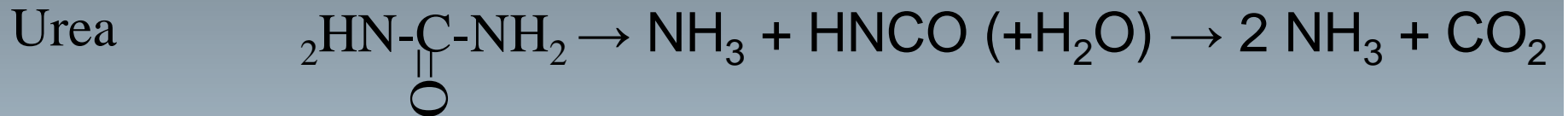


SNCR Operating Strategy

- Use after LNB/OFA
- Select NO_x Set Point
- Typical NO_x reduction is 20-40 percent



Chemistry (Hopefully Painless)



SNCR Design

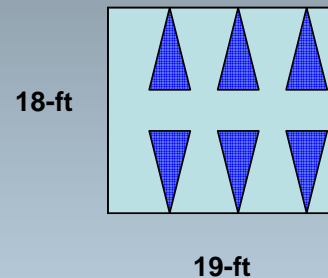
- **AKA: where do you put the injectors?**
 - **Design factors:**
 - Temperature vs. Load
 - Time
 - Dispersion/coverage
 - CO
 - **Operation: question becomes which injectors do you use?**
-



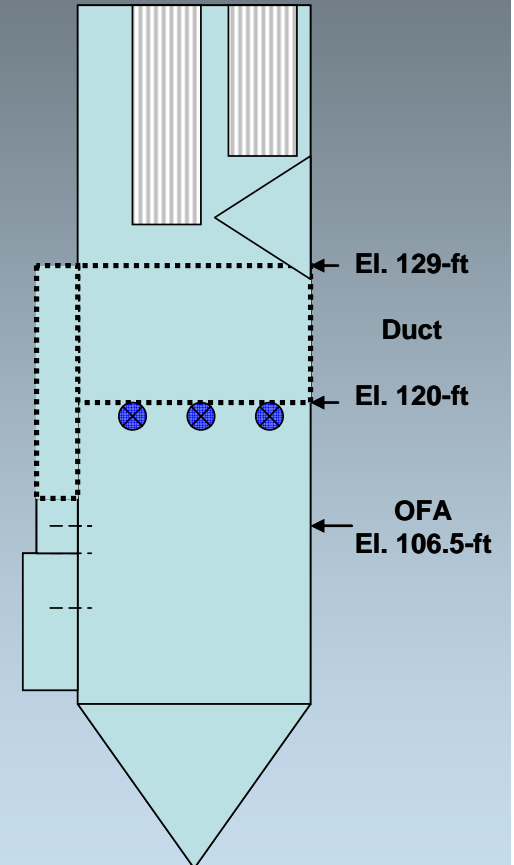
Small Boilers

- Smaller furnace cross section.
- Steeper temperature gradients
- Pay attention to urea coverage

Top View

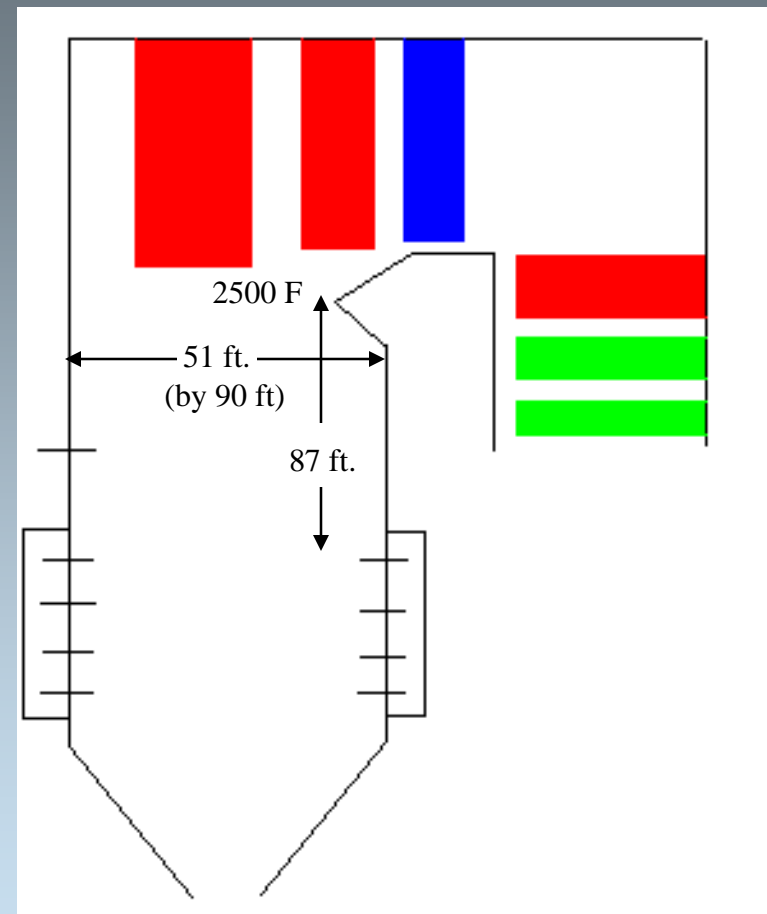


Side View



Large Boilers

- Furnace cross sections over 50-ft
- Hotter in the middle, cooler on the edges
- Treat the edges
- Need computer simulation for design
- Need operating experience to find the “sweet spot”



Other Design Factors

- Urea vs. ammonia
- Droplet size (atomizer selection)
- Reagent concentration



Fuel Tech Control

- Injector level and flow rate indexed to load.
- NO_x emission set point selected
- NO_x CEM provides feedback for reagent flow
- Reagent flow is trimmed to hold set point



SNCR Limiting Factors

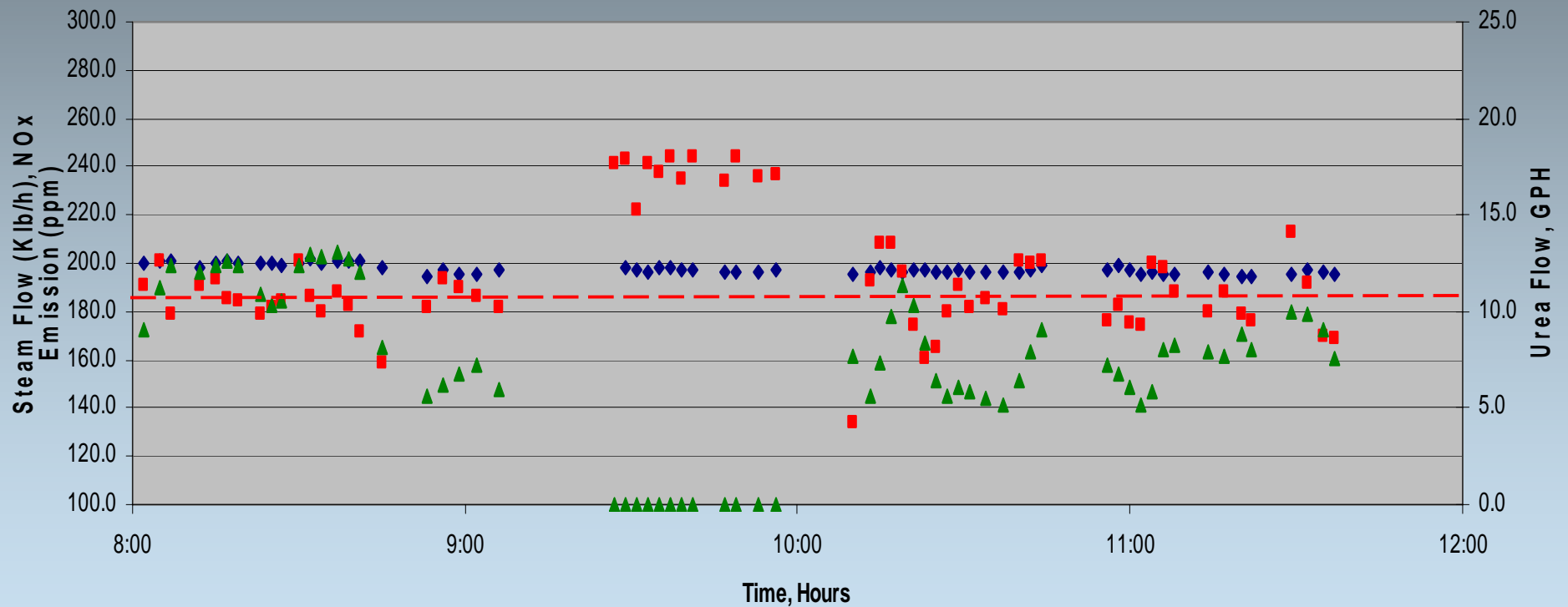
- **Control system responds to NO_x set point**
 - More reagent!
 - Reagent utilization depends on temperature and dispersion
 - Can range from 10% to 50%.
- **Too much reagent causes ammonia slip**
 - Air preheater pluggage
 - Sulfate plume
 - Fly ash contamination



NOxOut Control

NO_x Emissions for Boiler 1 on 24 JULY 2008

◆ Steam Flow ■ NO_x ▲ Urea Flow



Alternate Control Scheme

- **Constant reagent flow selected based on experience.**
- **Over-control NO_x early in the day**
- **Calculate NO_x reduction required for compliance**
- **When NO_x reduction is zero, turn off reagent**



Temperature Control

- **FuelTech also sells temperature monitors for an optional control trim.**
 - Select injectors in service
 - Vary atomization pressure
- **Temperature is also a useful SNCR tuning tool**

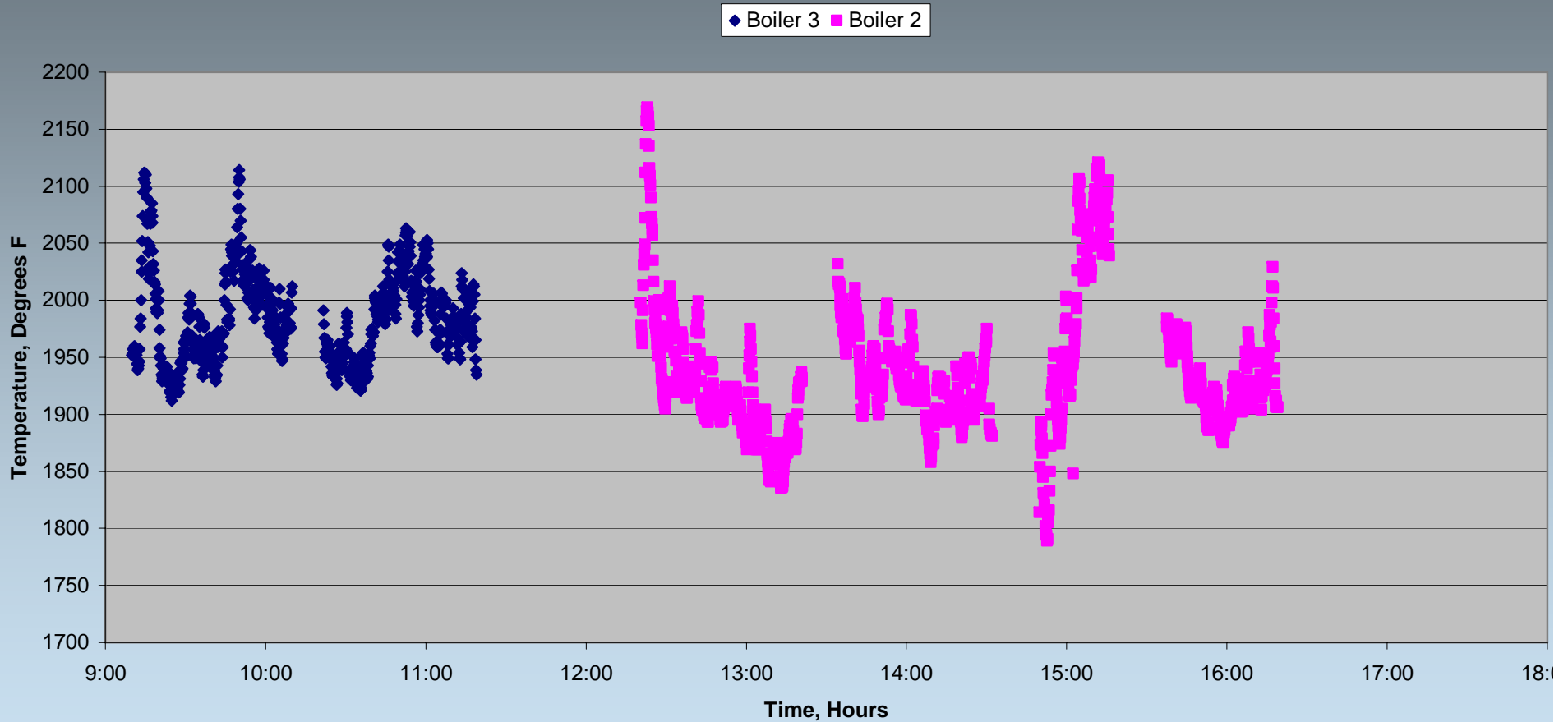


SpectraTemp



Typical Temperature Fluctuations

Furnace Temperatures at the SNCR Injection Elevation on 23 July 2008

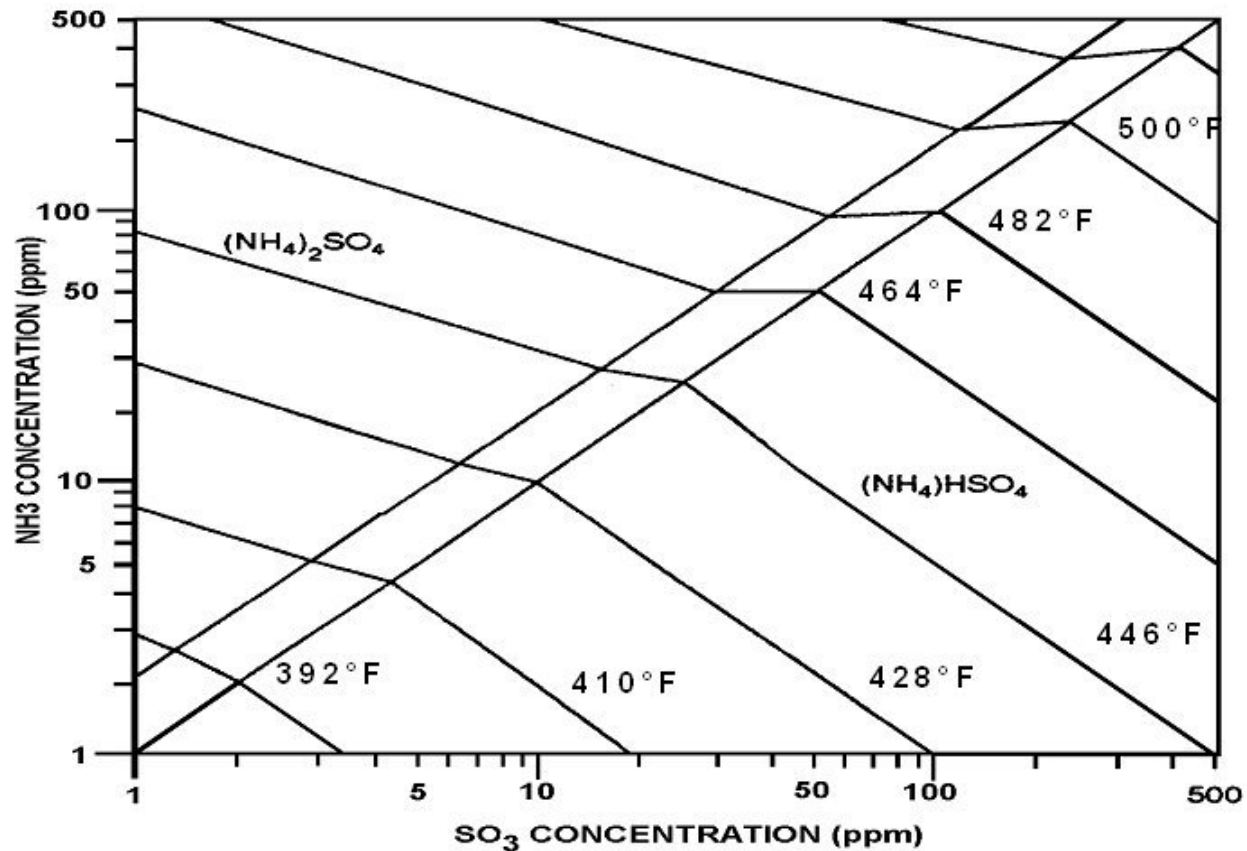


NO_x reduction is limited by ammonia slip

- **Consequences of NH_3**
 - Ammonium bisulfate
 - Air heater fouling
 - Ash contamination
 - “blue plume”
- **Can also consume lots of reagent!**



Ammonium Bisulfate Forms

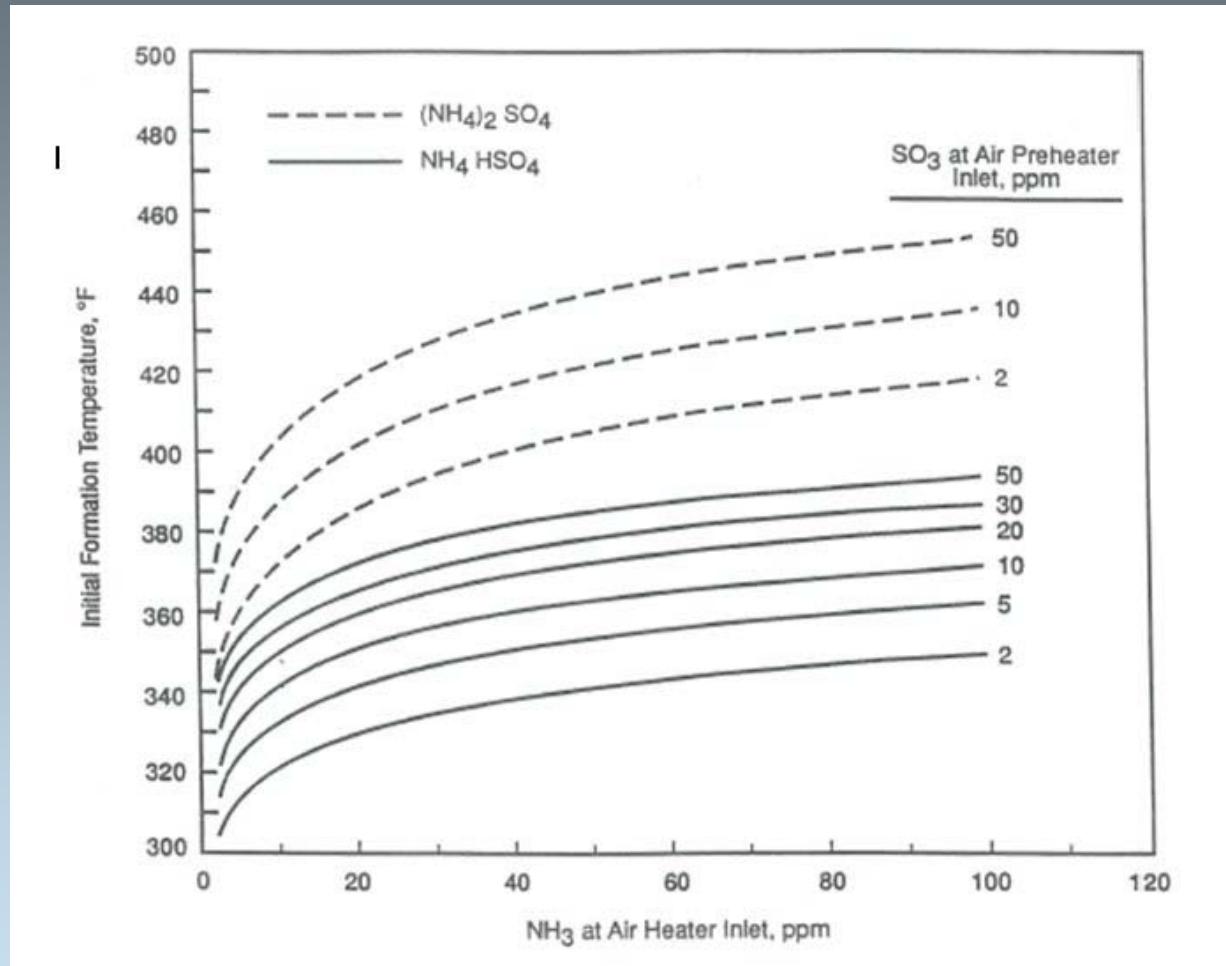


$(\text{NH}_4)_2\text{SO}_4$ = Ammonium Sulfate

$(\text{NH}_4)\text{HSO}_4$ = Ammonium Bisulfate



Ammonium Bisulfate Condenses



AbSensor – AbS/SO3

Measure with a Breen System (details later in the conference)



- 4" 150 lb 8-bolt flanged port
- 50 psi service air
- 12 cfm air consumption
- 110 VAC power supply



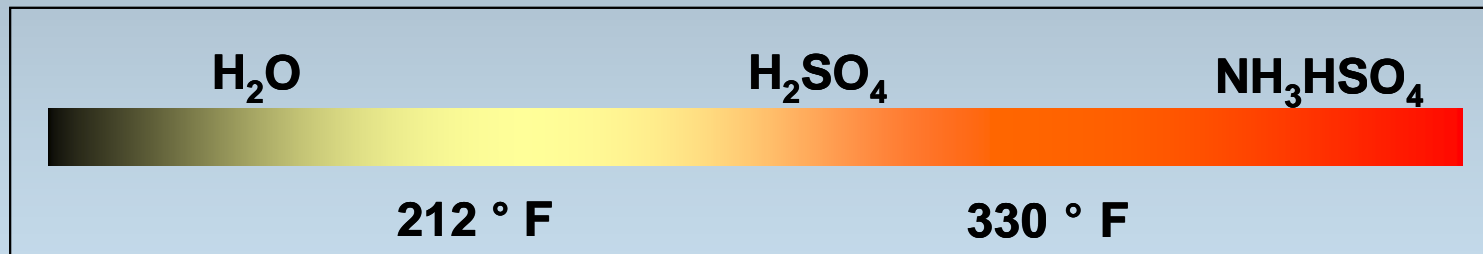
AbSensor – AbS/SO3

What is it? What does it do?

- **In-Situ, Continuous** measurement
- Temp at which material condenses out from flue gas

This material could be:

- Moisture (H_2O),
- Sulfuric Acid (H_2SO_4) ($\text{H}_2\text{O} + \text{SO}_3$)
- Ammonium Bisulfate (NH_3HSO_4) ($\text{NH}_3 + \text{H}_2\text{O} + \text{SO}_3$)

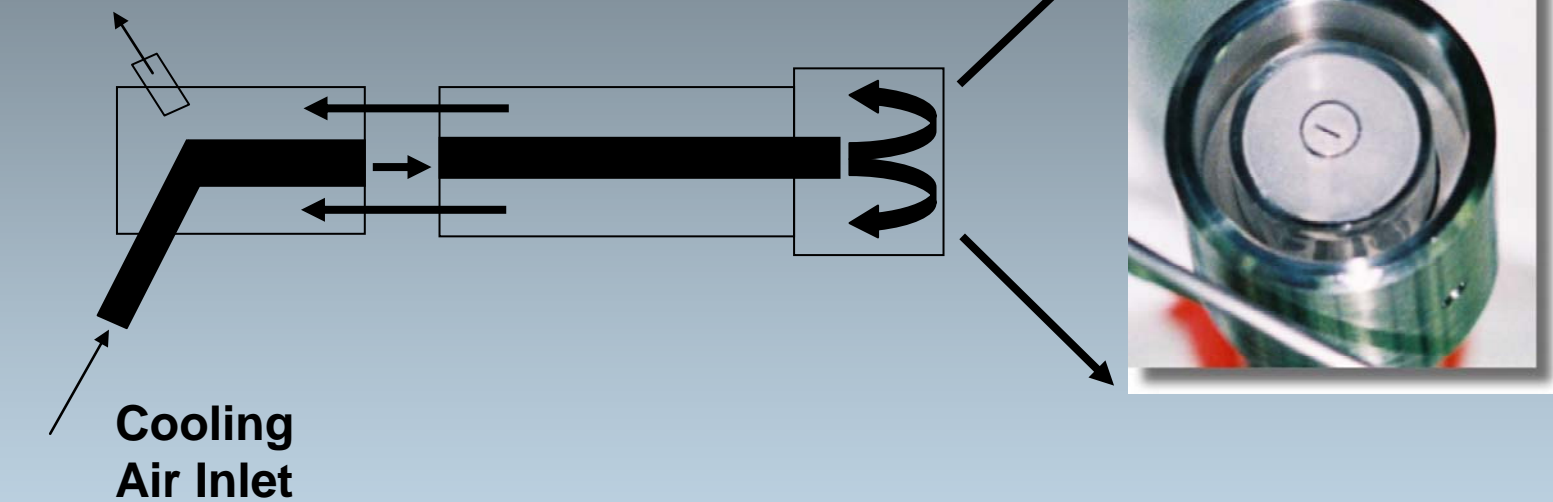


The same device measures condensables across the spectrum!



How does it work? - I

Cooling Air Return



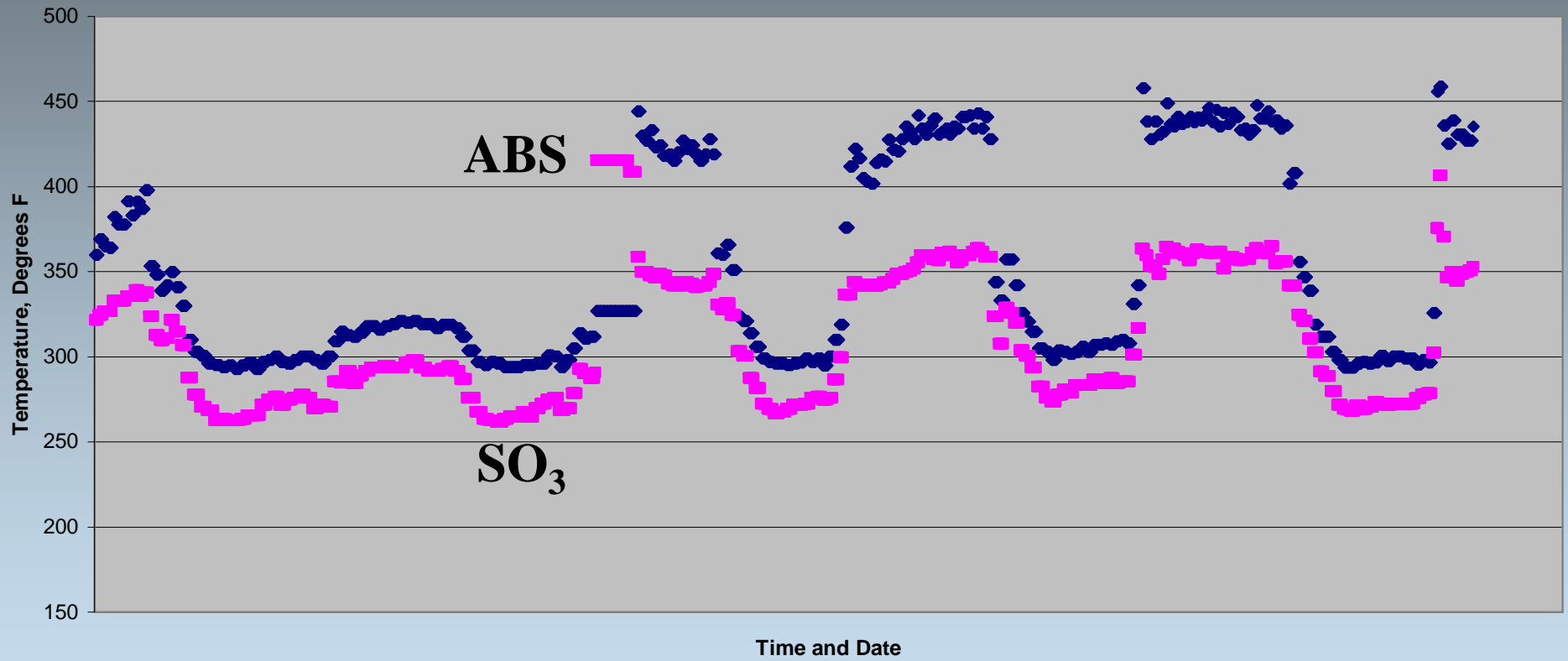
Cooling air flow to the probe tip is precisely controlled to induce condensation on the probe surface



Typical ABS Results

Dew Points at Air Preheater Inlet

◆ Evaporation ■ Formation



SNCR Tuning

- **Equipment Inspection**
- **Temperature**
- **Injector location**
- **Injector sprays**



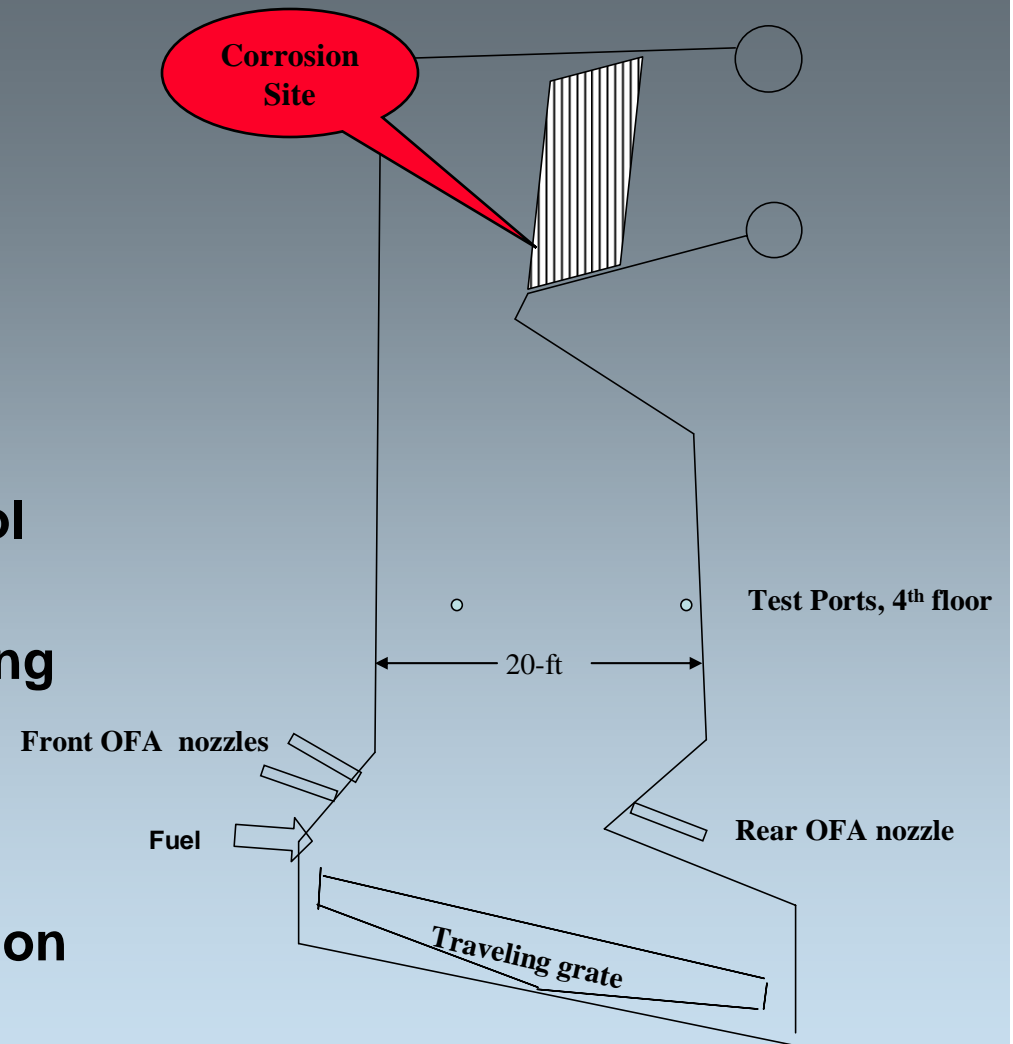
Example of SNCR Tuning

- **Waste Burning Plant**
- **SNCR installed nearly 20 years ago**
- **Boiler changes affect SNCR performance**

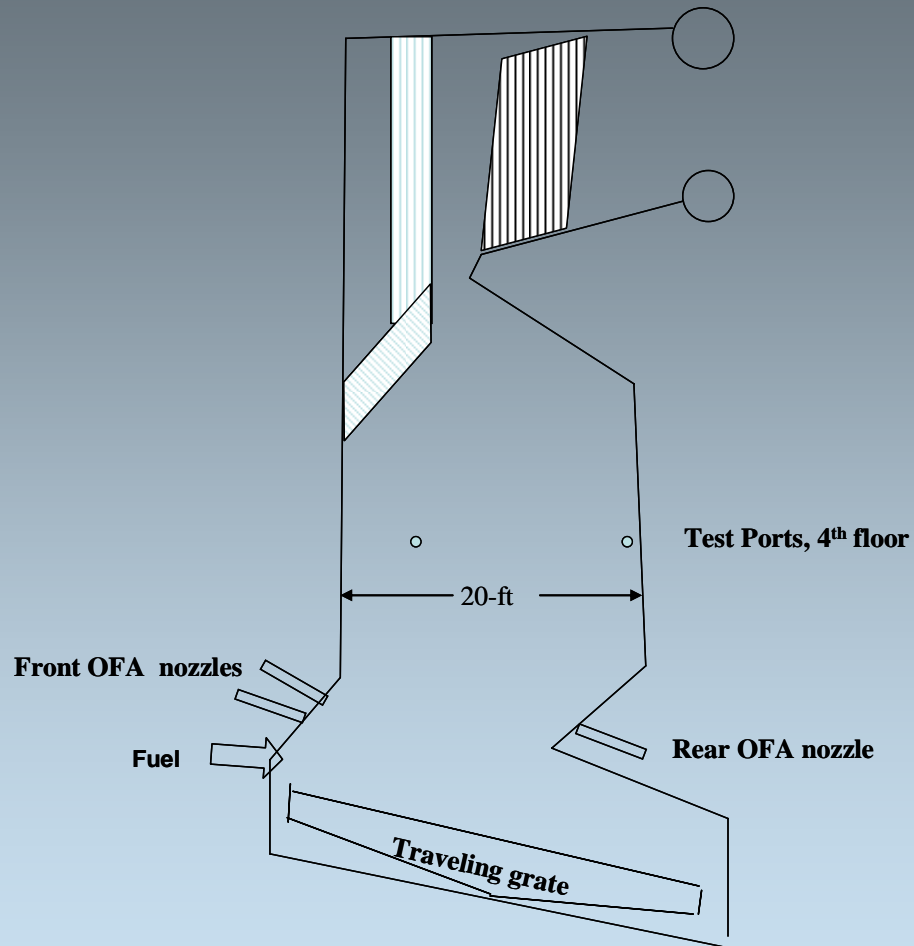


History

- Quinny helped design original SNCR
- Boilers suffered superheater corrosion
- De-rated boiler to control corrosion
- Later, Plant added cooling surface
- SNCR re-tuned but Corrosion not cured
- OFA bias solved corrosion problem

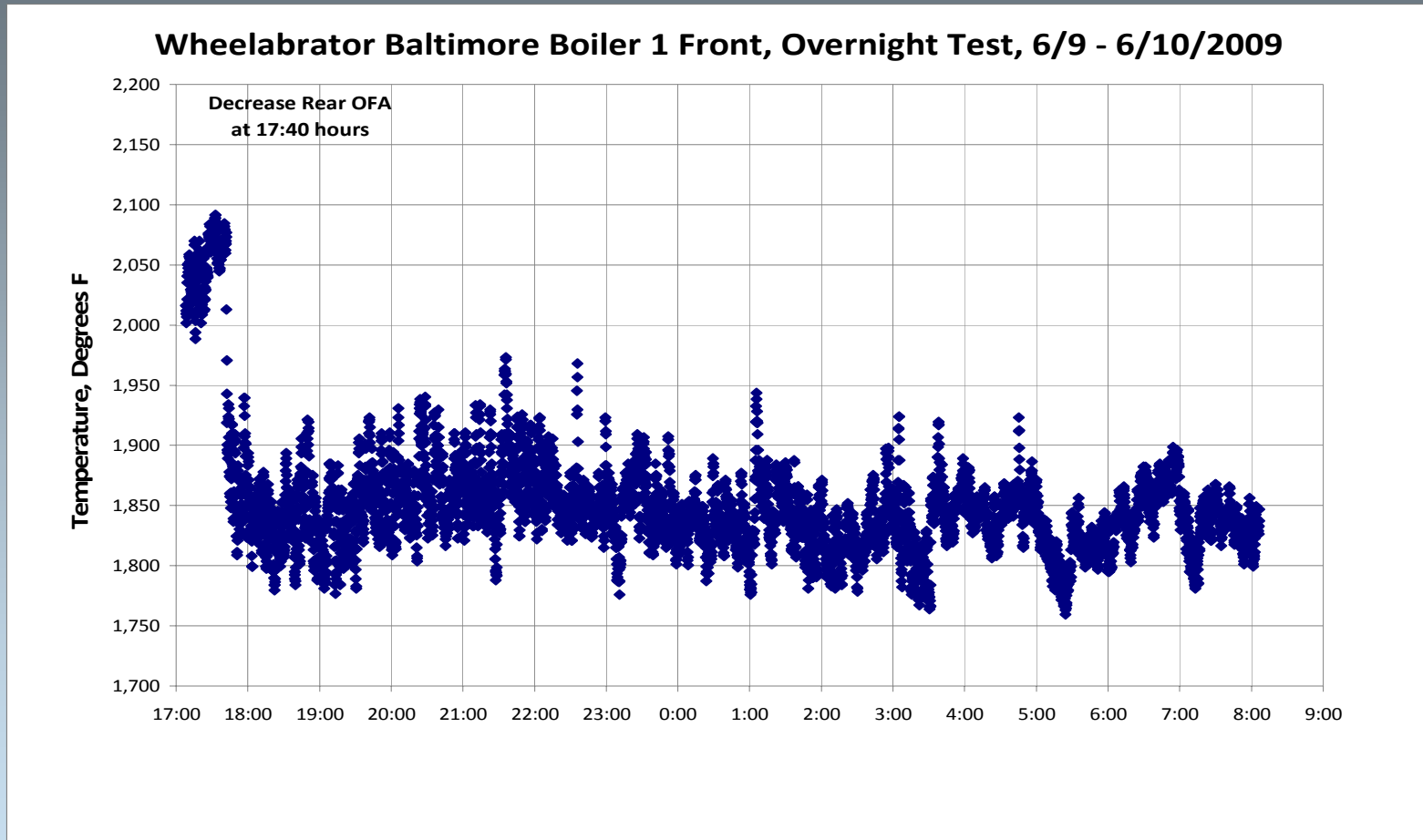


Example: SNCR Tuning

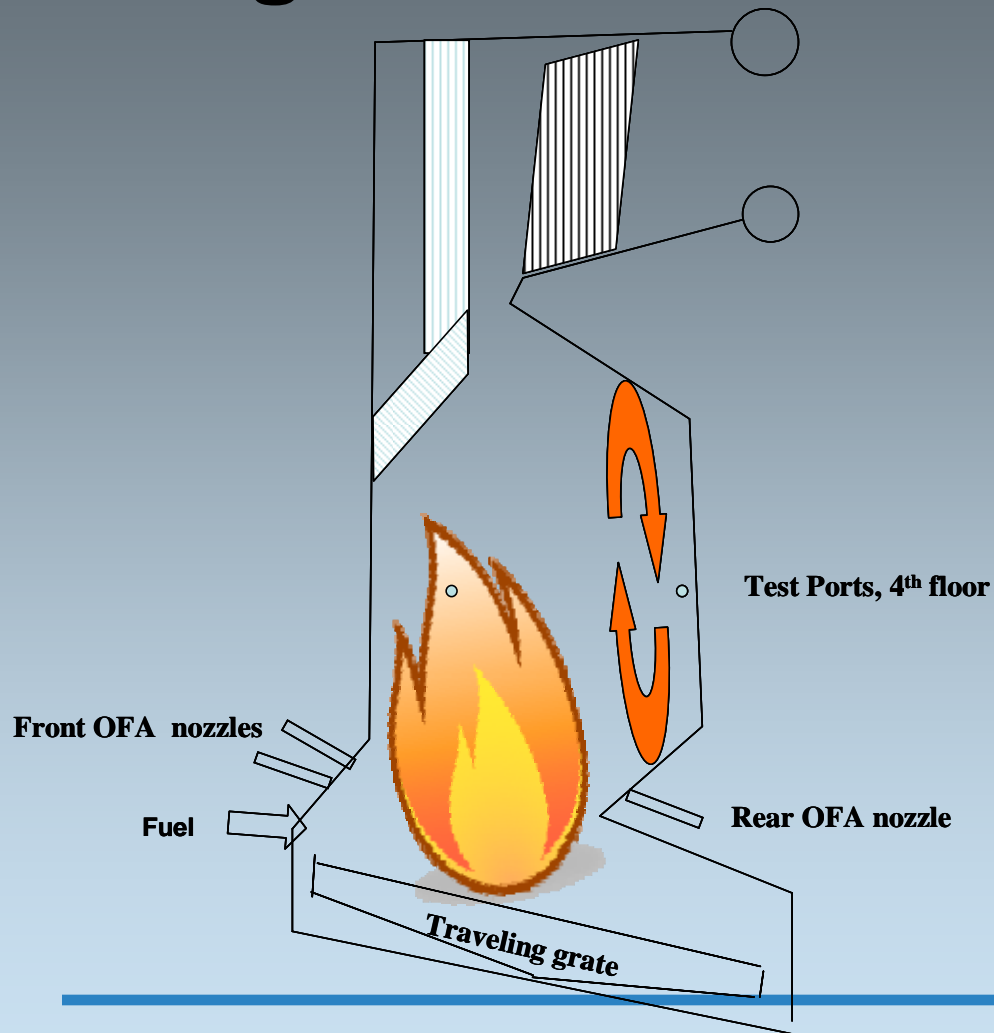


- **New wing walls**
- **Changed OFA distribution**
- **SNCR system used more urea**
- **Quinapoxet contracted to find out why.**

Effect of OFA Balance on Temperature

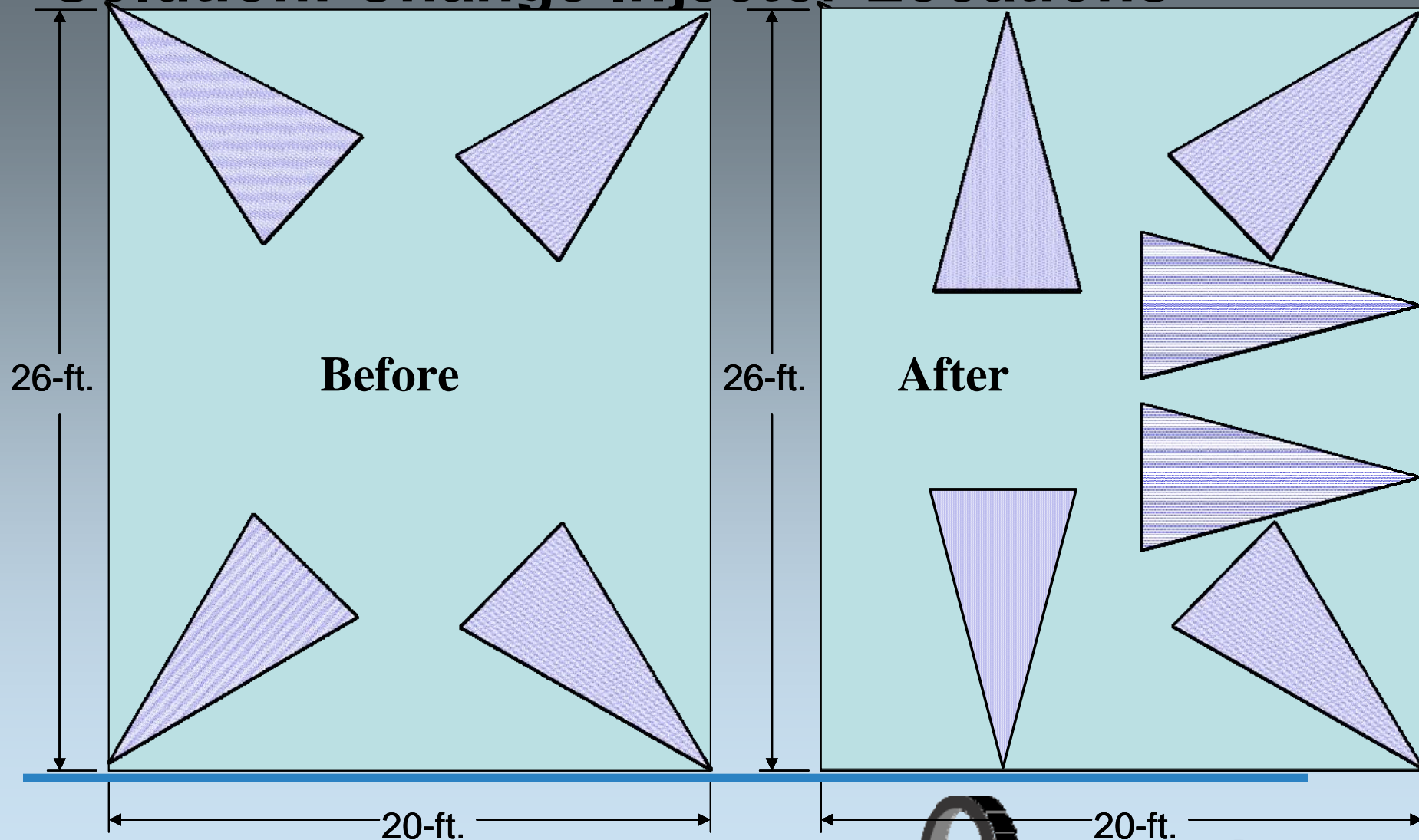


Diagnosis and Recommendation



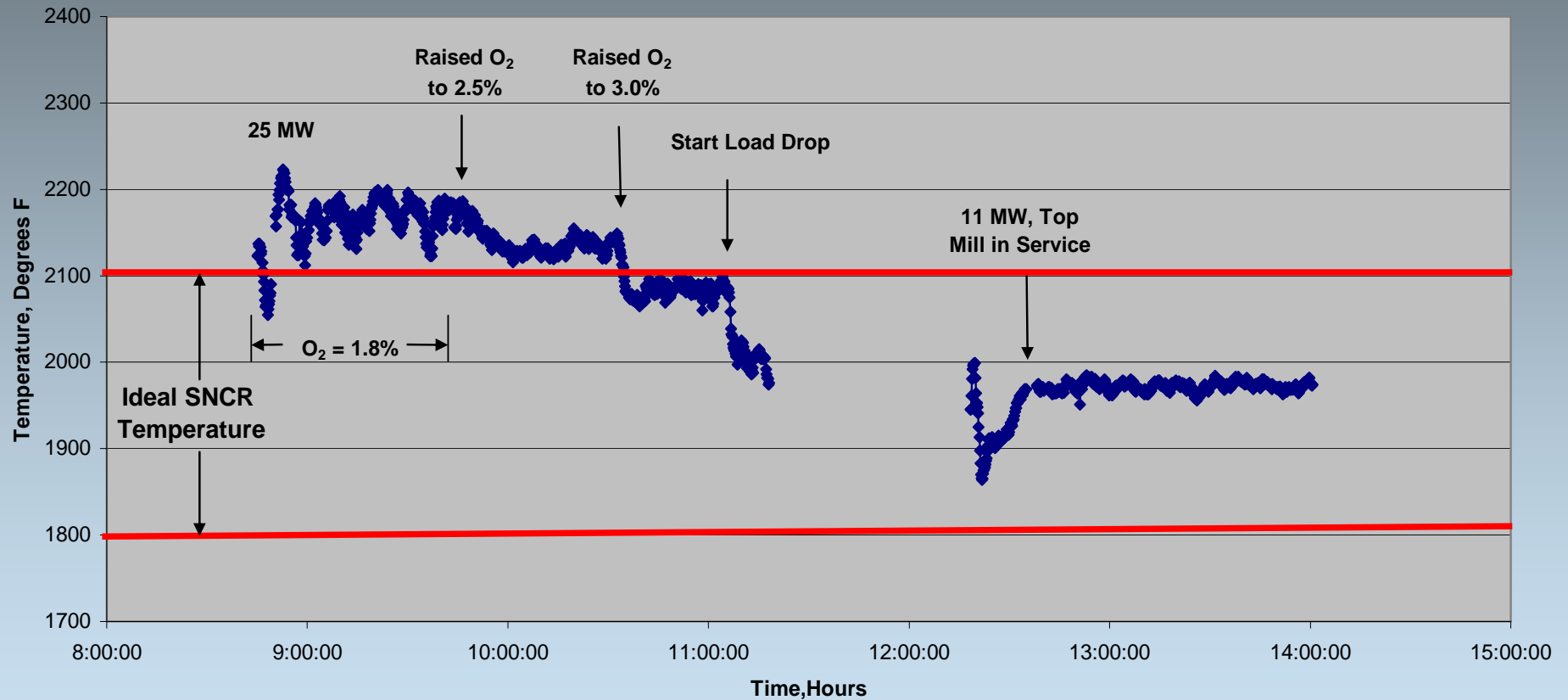
- With more rear OFA flow, gas flow skewed toward the front wall!
- Dead zone near rear wall (observed through view ports)
- Inject more reagent near the front wall

Solution: Change Injector Locations



Another Example of Temperature Changes in a Coal-Fired Boiler

Furnace Temperatures at Vineland, Boiler 10 on 11 January 2007



Spare Parts

- **Jackson Machine (JMC)**
- **JMC has tilting lances and different spray patterns to compensate for temperature changes.**
- **ACT/Fuel Tech has a portable injection system that they use to show improved operation of their components**



Now Back to Your Concerns...

- Comments?
- Questions?





Thank You!