

Reinhold Environmental Ltd.



2009 NOx-Combustion Round
Table & Expo Presentation

February 9 & 10, 2009, Cleveland, OH

Care and Feeding of SNCR Systems

Presented to

2009 NO_x-Combustion Round Table

by

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Outline

- **Workshop Objectives**
- **O&M Guidelines**
- **Operational Issues**
- **A Few Answers**



Workshop Objectives

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

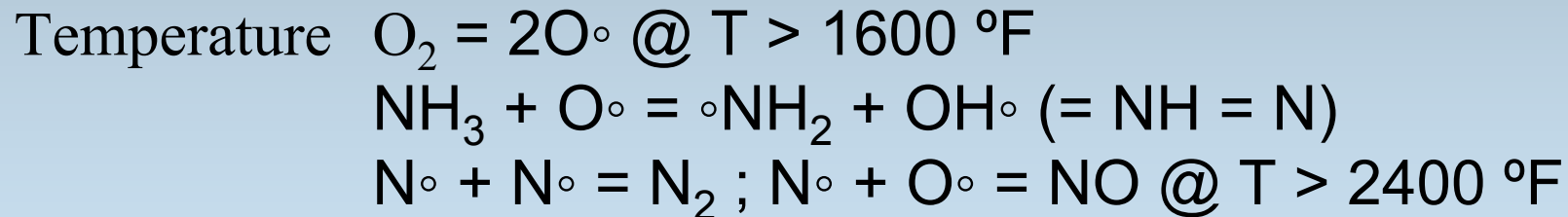
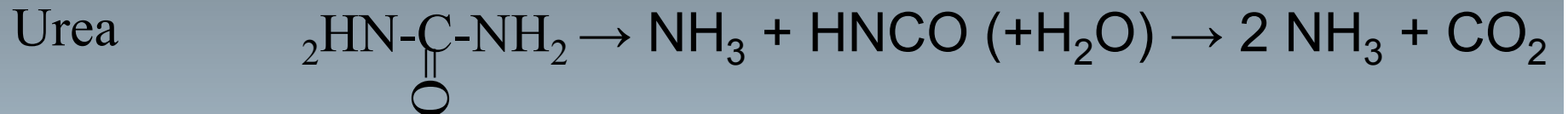


SNCR Operating Strategies

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



Chemistry (Hopefully Painless)



SNCR Design

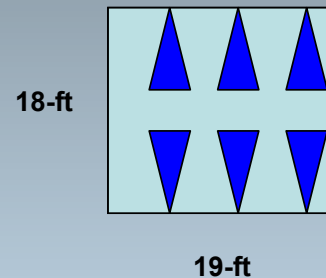
- **AKA: where do you put the injectors?**
 - **Design factors:**
 - Temperature vs. Load
 - Time
 - Dispersion/coverage
 - CO
 - **Operation: question becomes which injectors do you use?**
-



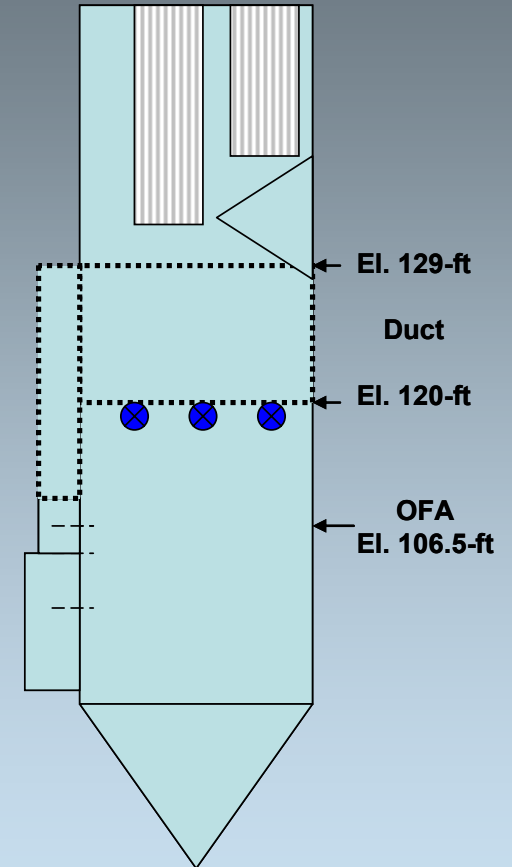
Small Boilers

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

Top View

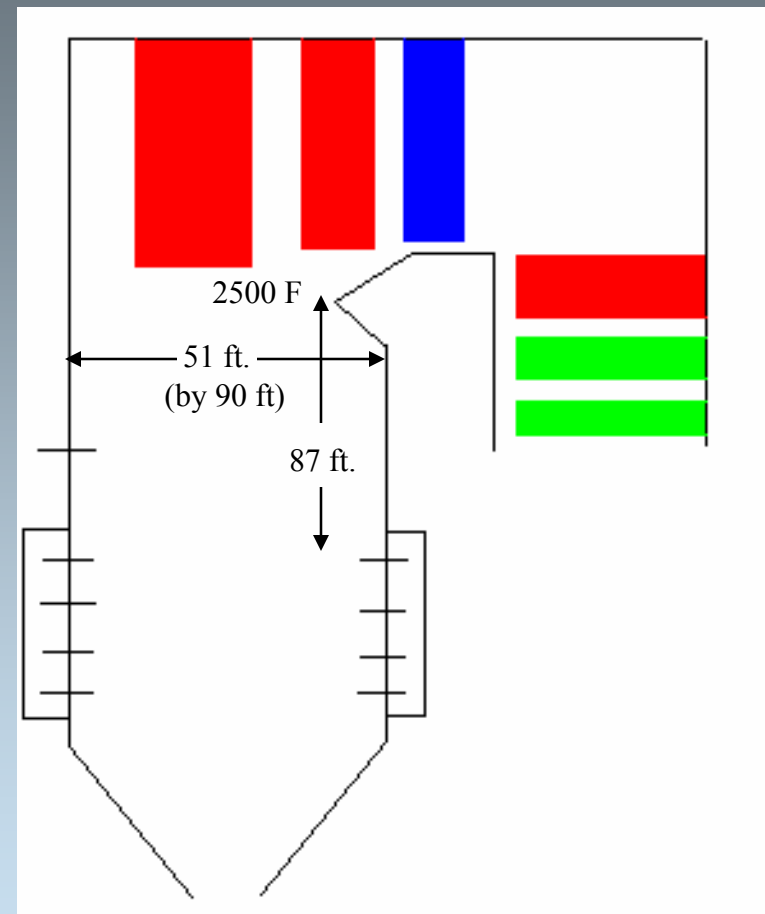


Side View



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



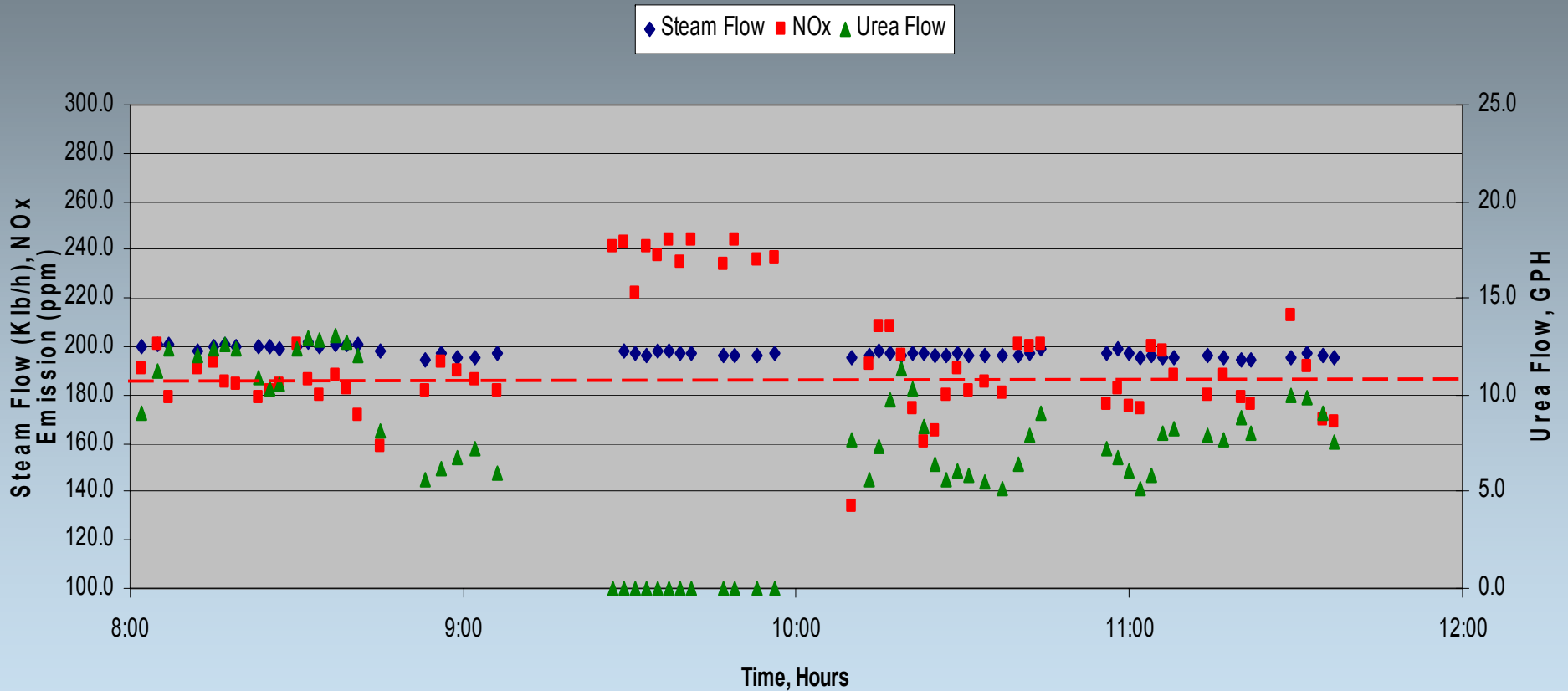
SNCR Limiting Factors

- **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
 - Catalyst deactivation
 - Fly ash contamination



NOxOut Control

NO_x Emissions for Boiler 1 on 24 JULY 2008



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**

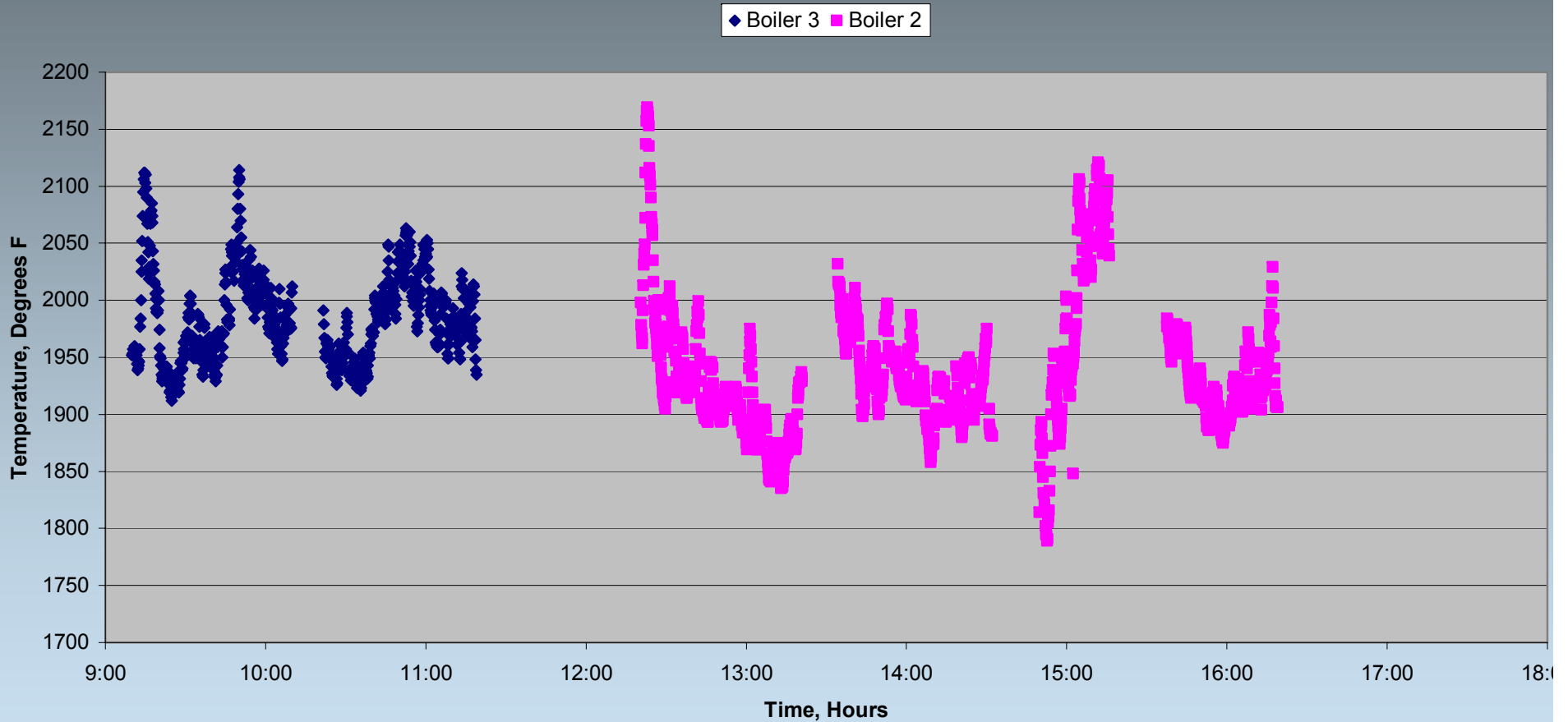


SpectraTemp

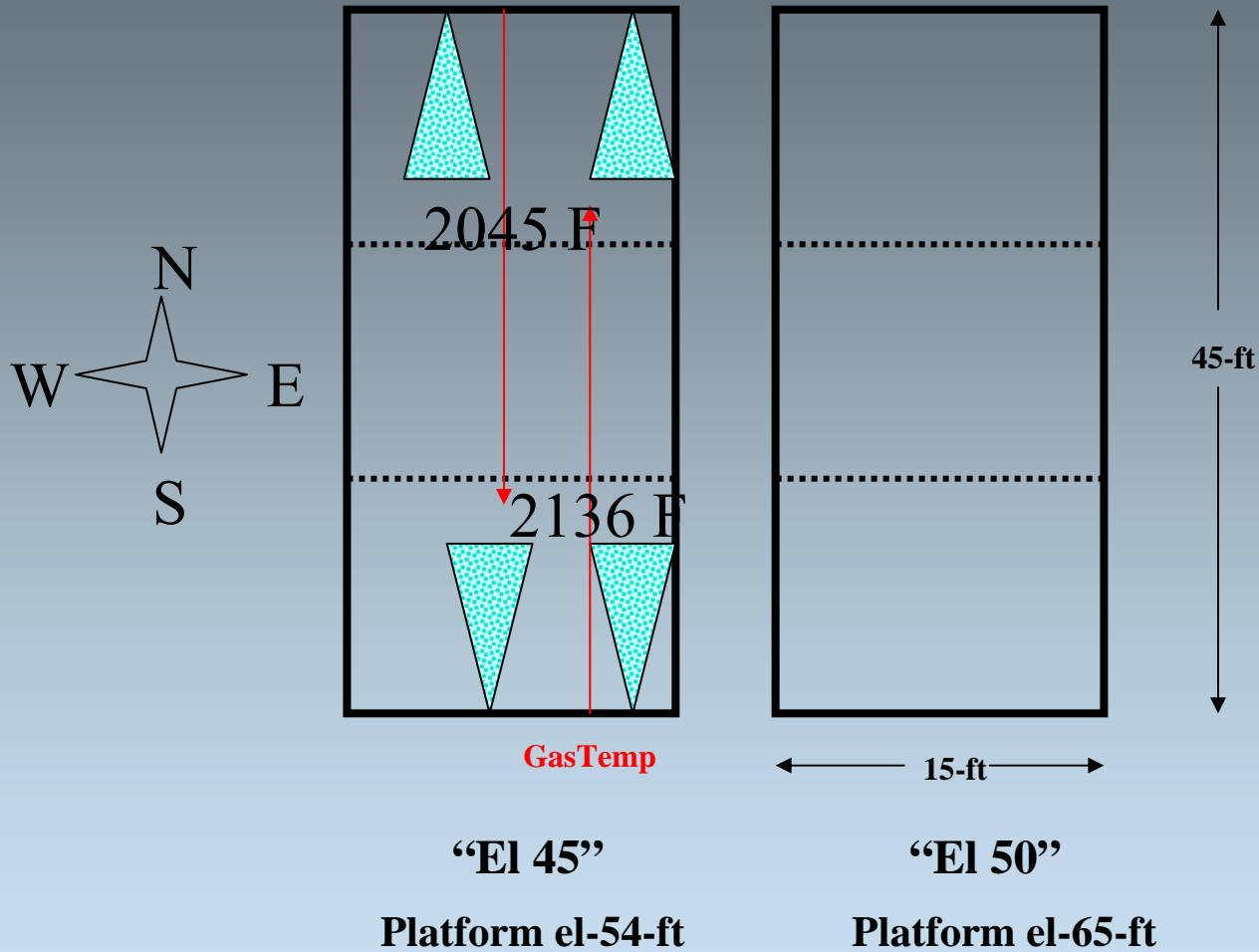


Typical Temperature Fluctuations

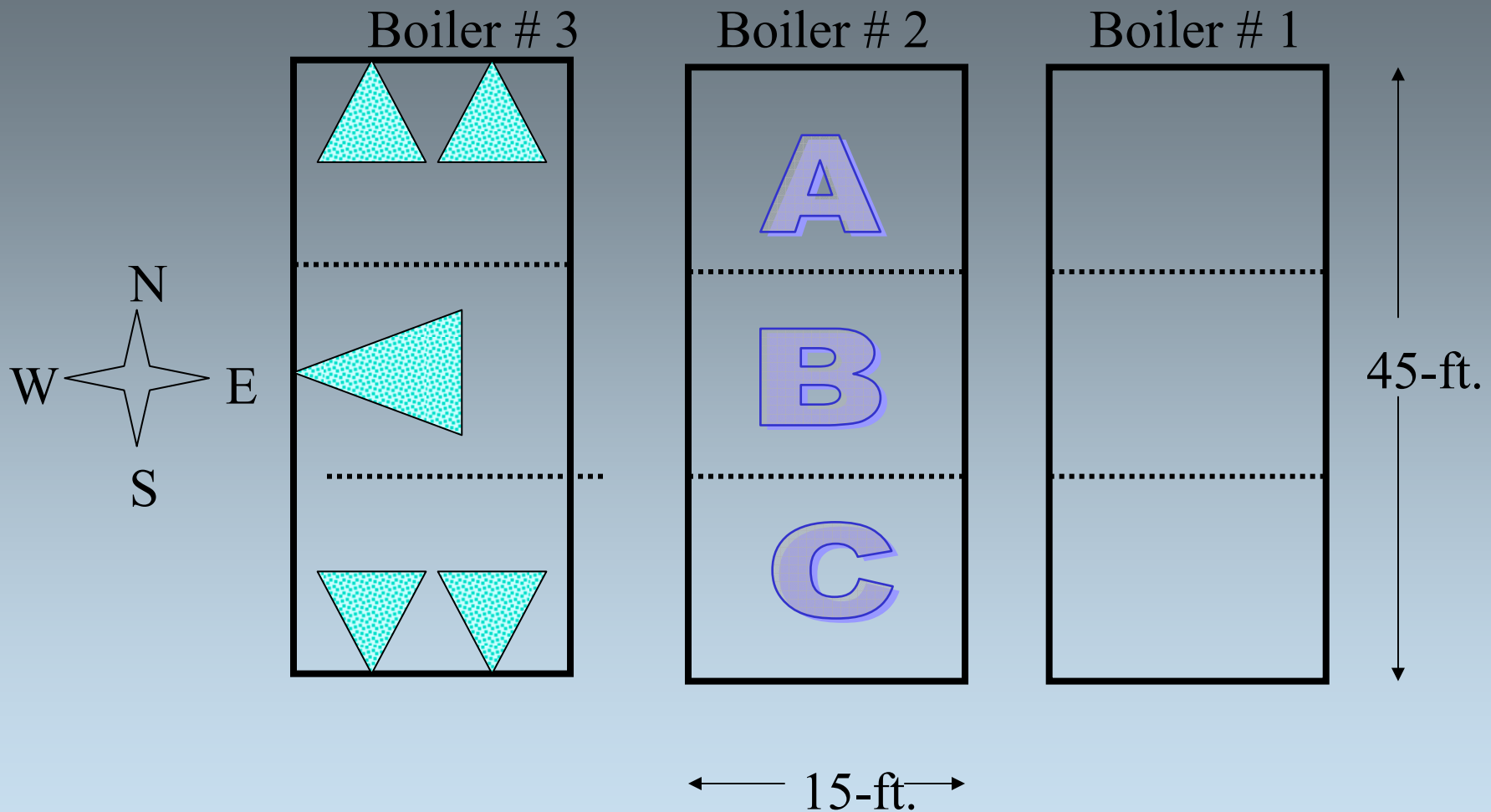
Furnace Temperatures at the SNCR Injection Elevation on 23 July 2008



Temperatures at Boiler #2 Urea Injector Locations



Alternate Arrangement

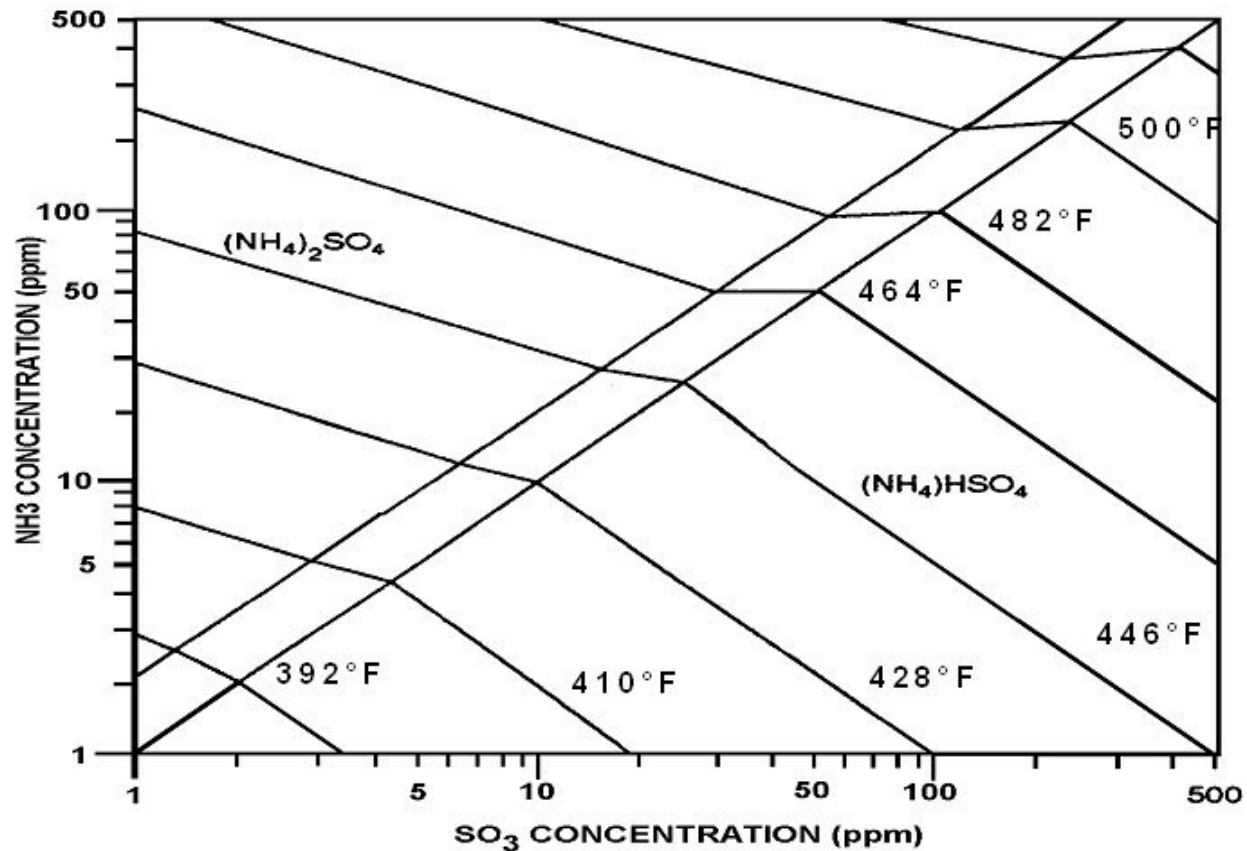


Operating Issues

- **NO_x reduction is limited by ammonia slip**
- **Consequences of NH₃**
 - Ammonium bisulfate
 - Air heater fouling
 - Ash contamination
 - “blue plume”
- **Can also consume lots of reagent!**



Ammonium Bisulfate Forms

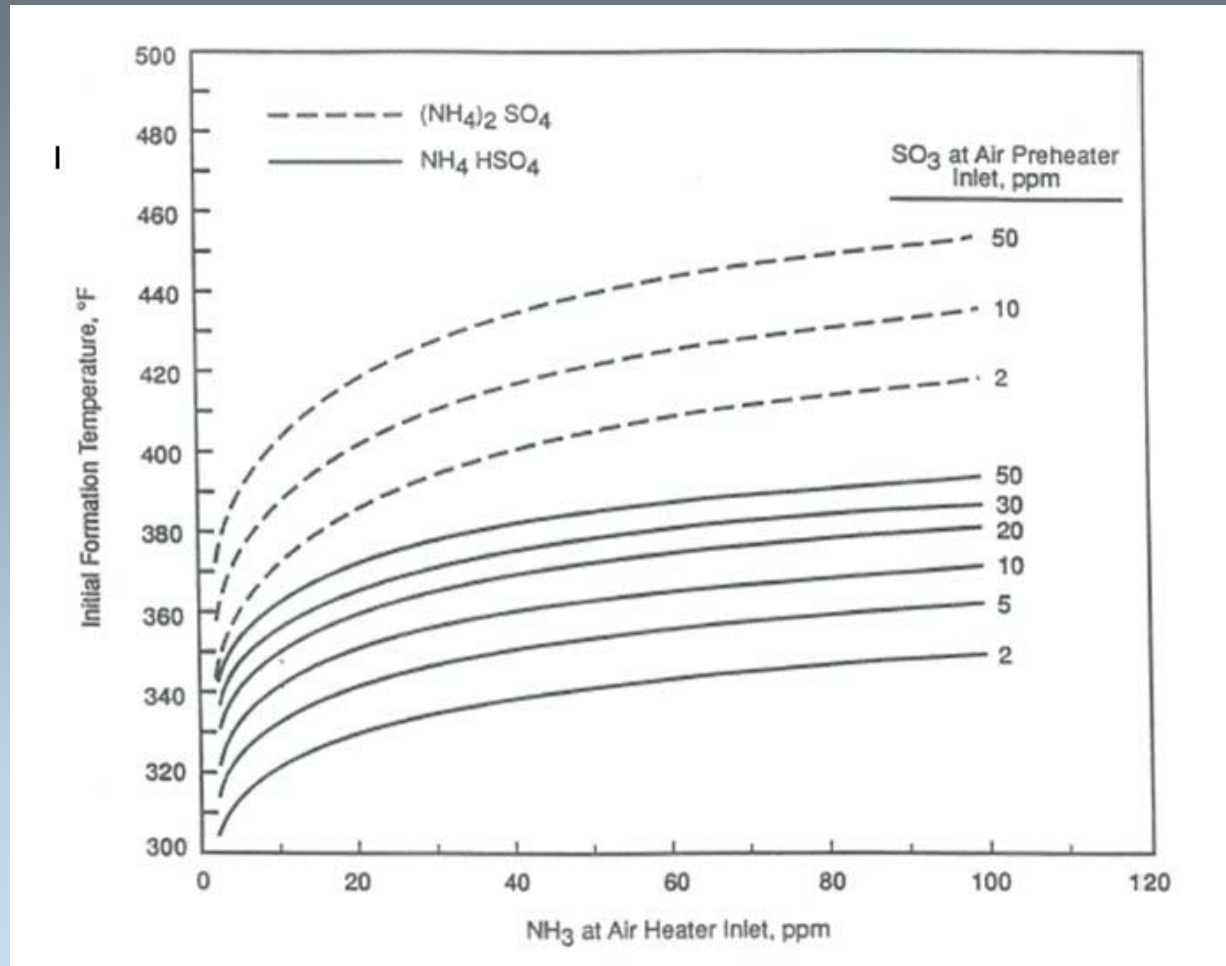


(NH₄)₂SO₄ = Ammonium Sulfate

(NH₄)HSO₄ = Ammonium Bisulfate



Ammonium Bisulfate Condenses



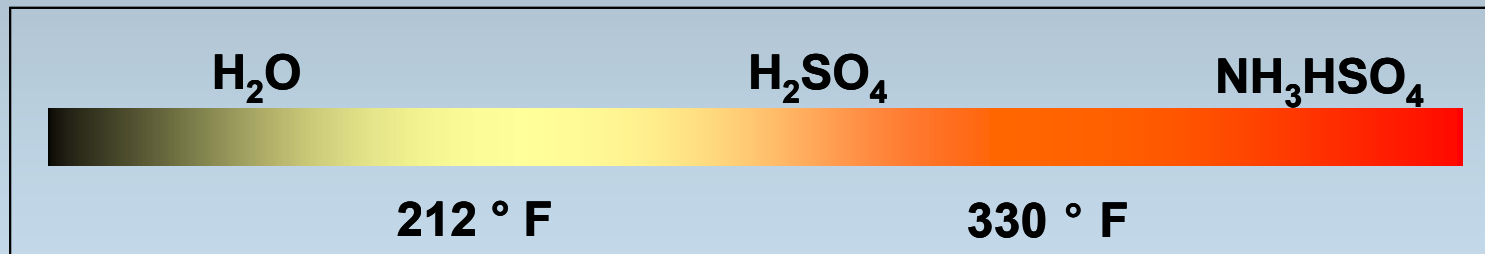
AbSensor – AbS/SO₃

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 (H₂O),
- Sulfuric Acid (H₂SO₄) (H₂O + SO₃)
- Ammonium Bisulfate (NH₃HSO₄) (NH₃ + H₂O + SO₃)



The same device measures condensables across the spectrum!



How does it work? - I

Cooling Air Return



Cooling Air Inlet



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



AbSensor – AbS/SO3 System



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

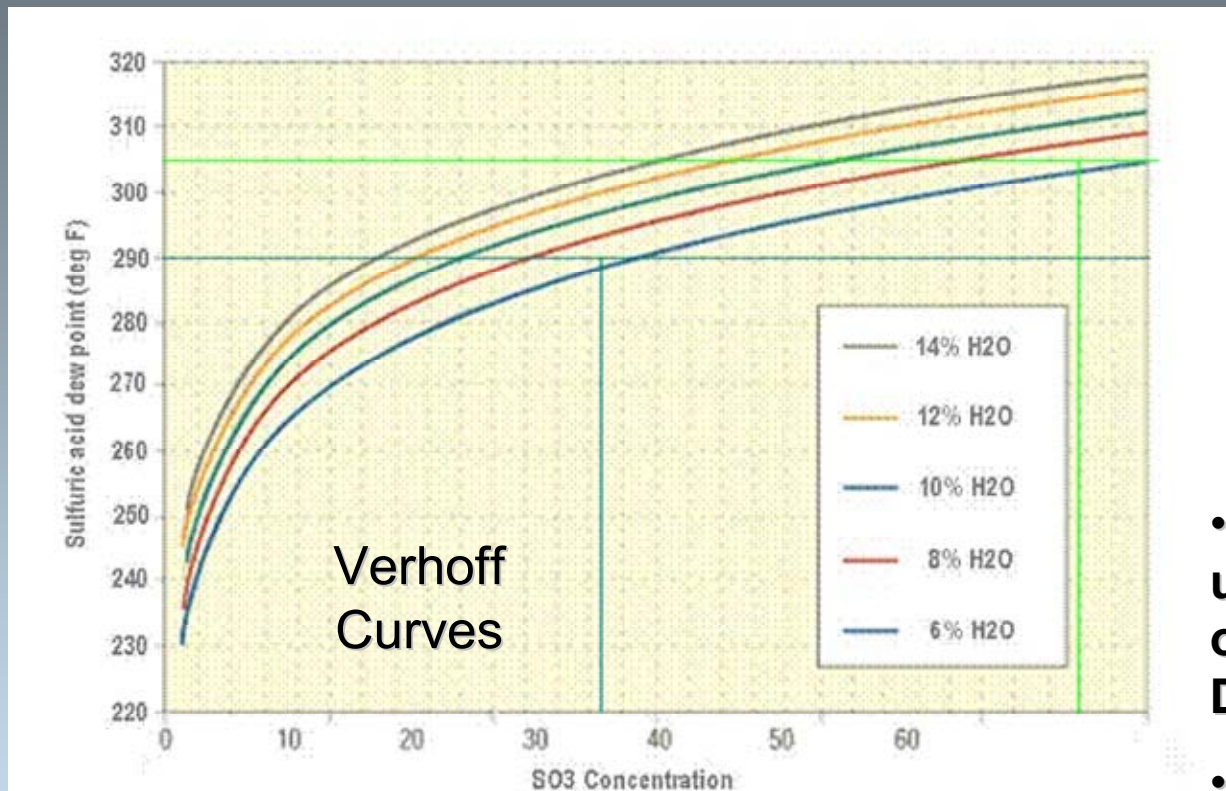


Terminology

- *Formation Temperature*
 - The temperature at which condensation is first detected
- *Evaporation Temperature*
 - The temperature at which condensed material on the instrument tip evaporates below the threshold current level
- *Dew Point*
 - The temperature at which the current curve peaks. This is the temperature where evaporation from the probe is in equilibrium with the condensation onto the probe.



Dewpoint to SO₃ ppm



- SO₃ ppm can be calculated using a relationship based on Flue Gas Moisture and Duct Pressure.

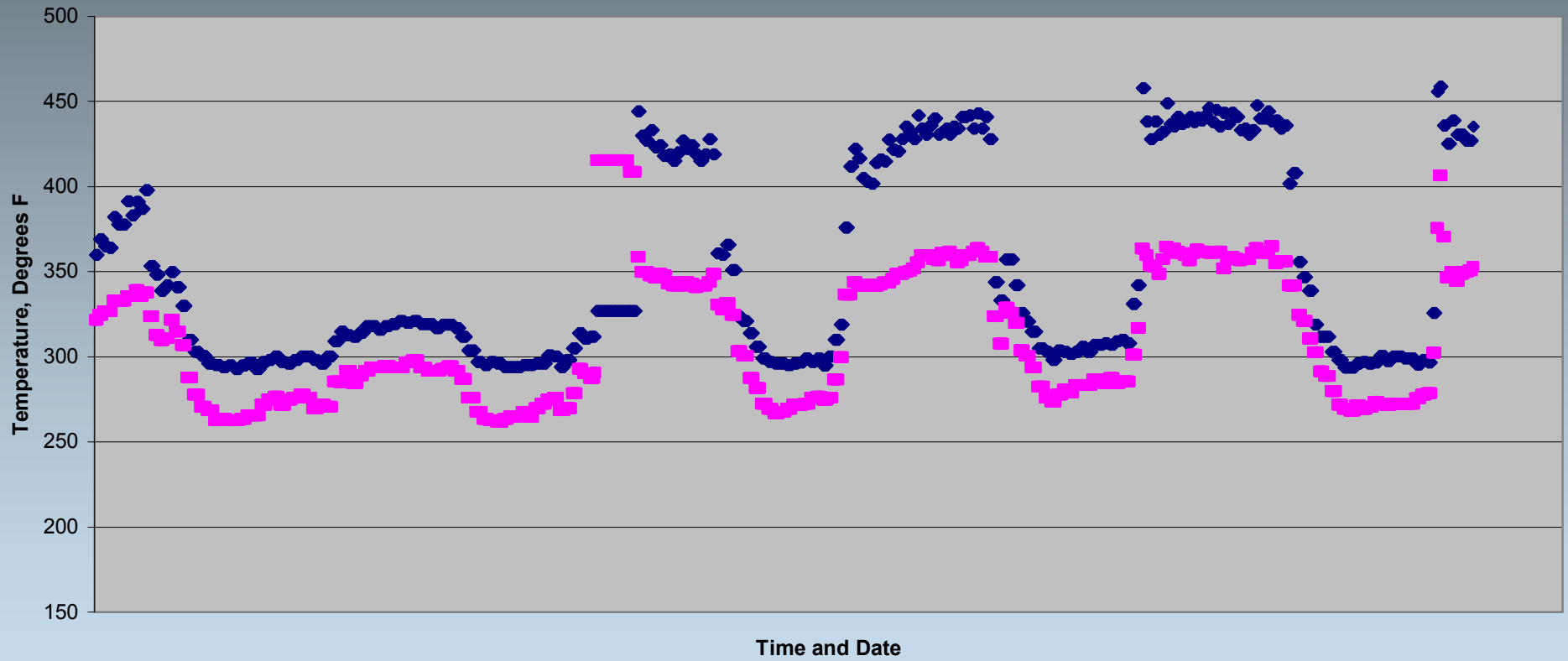
- This calculation is part of the AbSensor algorithm.



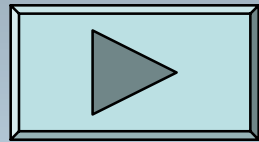
Typical ABS Results

Dew Points at Air Preheater Inlet

◆ Evaporation ■ Formation



SO₃ & ABS Control



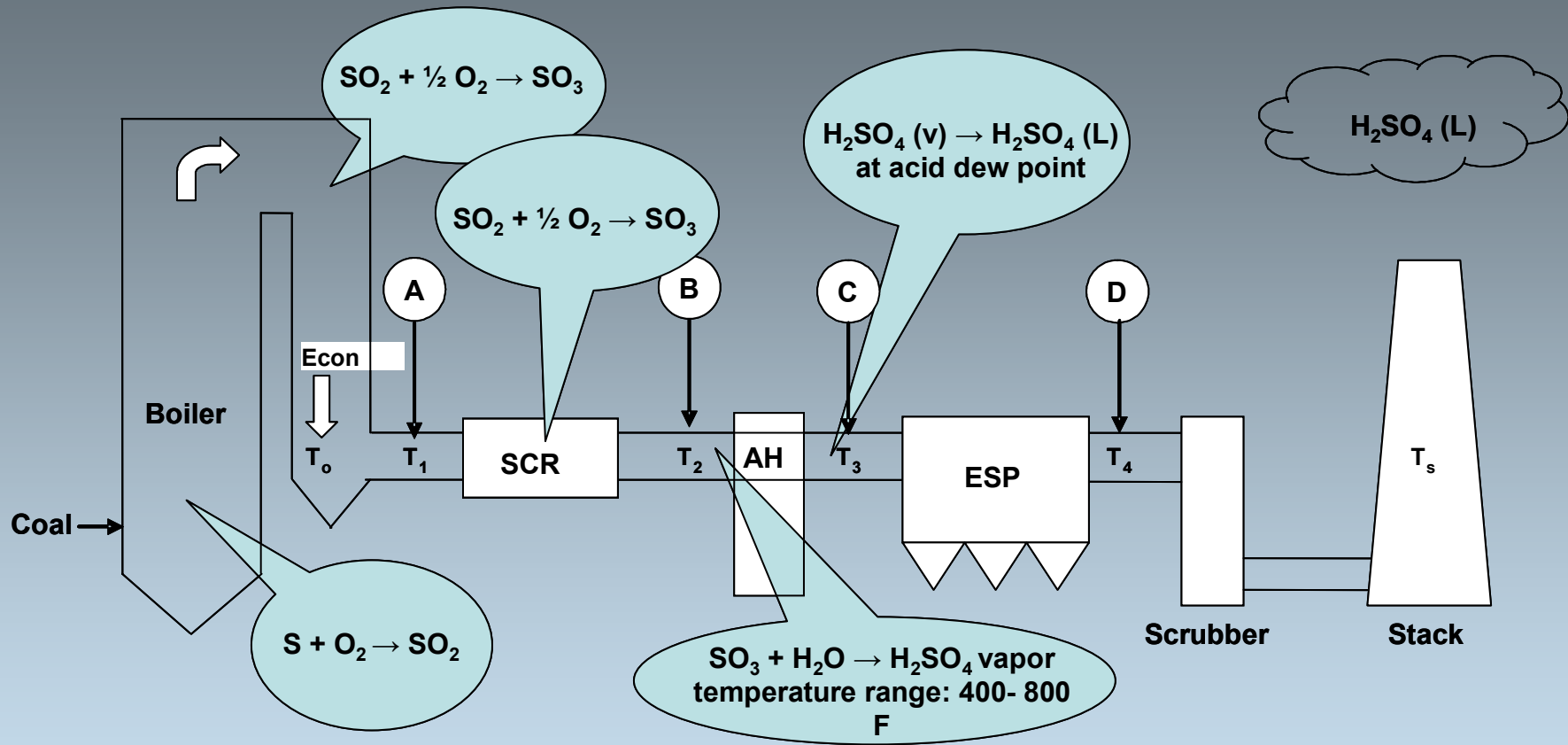
SO₃: need Sorbent
Injection Control



ABS: need integrated
NO_x and Air Heater
Control



SO₃ Formation and Reagent Injection Points for a Typical Coal-Fired Boiler



Typical Injection Materials	
Lime / Limestone	Ca
Trona	Na
MgO	Mg



SNCR Tuning

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



Spare Parts

- Jackson Machine
- Advanced Combustion Technology (ACT) is now part of FuelTech
- ACT has a portable injection system that they use to show improved operation of their components



Now Back to Your Concerns...

- Comments?
- Questions?





Thank You!