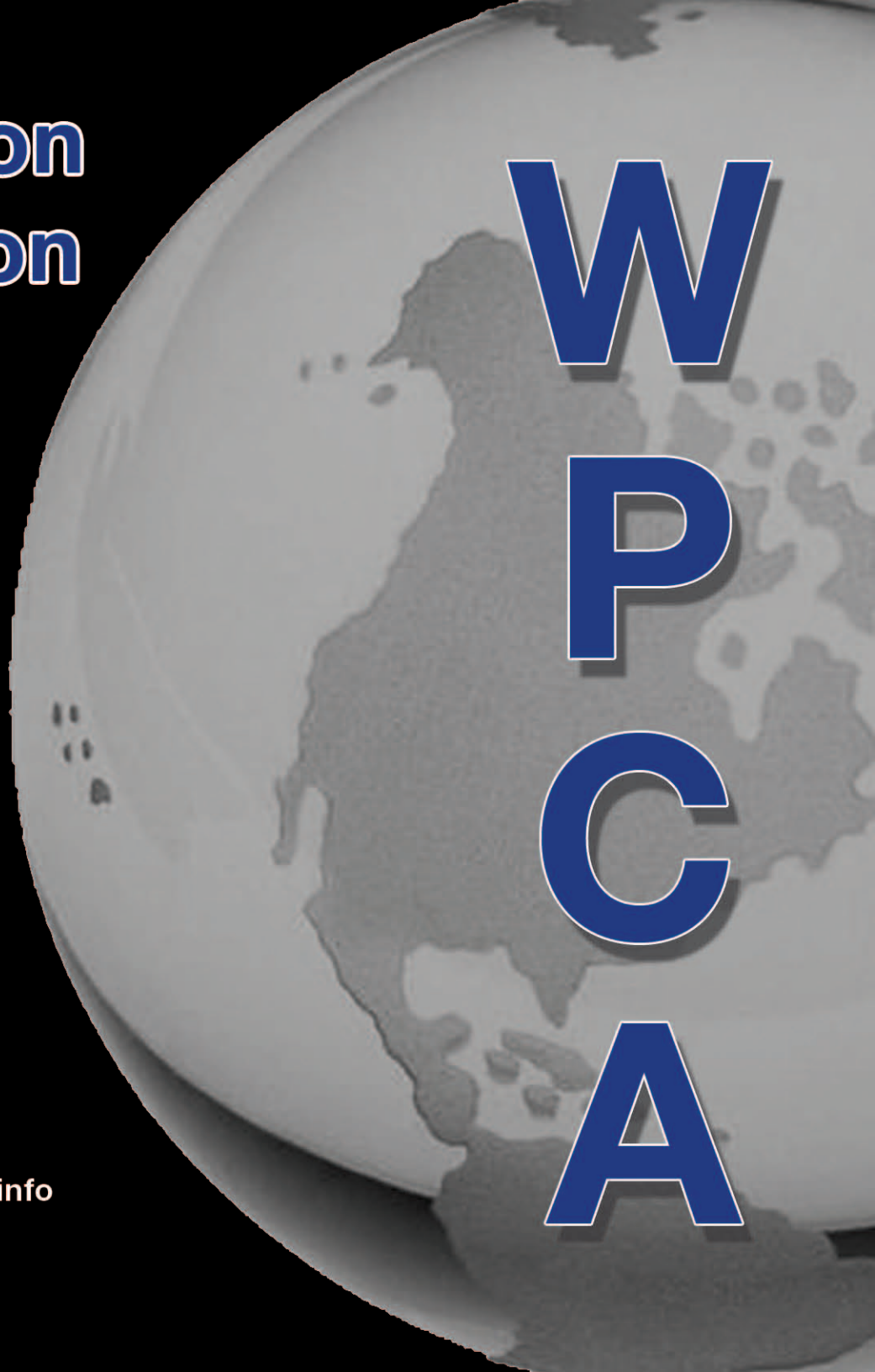
# Worldwide Pollution Control Association




## Duke Energy Seminar

**September 3 – 5, 2008**

**Concord, NC**

WPCA

Vist our website at www.wpca.info

# Care and Feeding of SNCR Systems

**Presented to**

2008 WPCA / Duke Energy Seminar

**by**

**Steve Johnson**

**Quinapoxet Solutions**

**4 September 2008**

# Outline

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

# Workshop Objectives

- **What would <u>You</u> 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

# 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?

# 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

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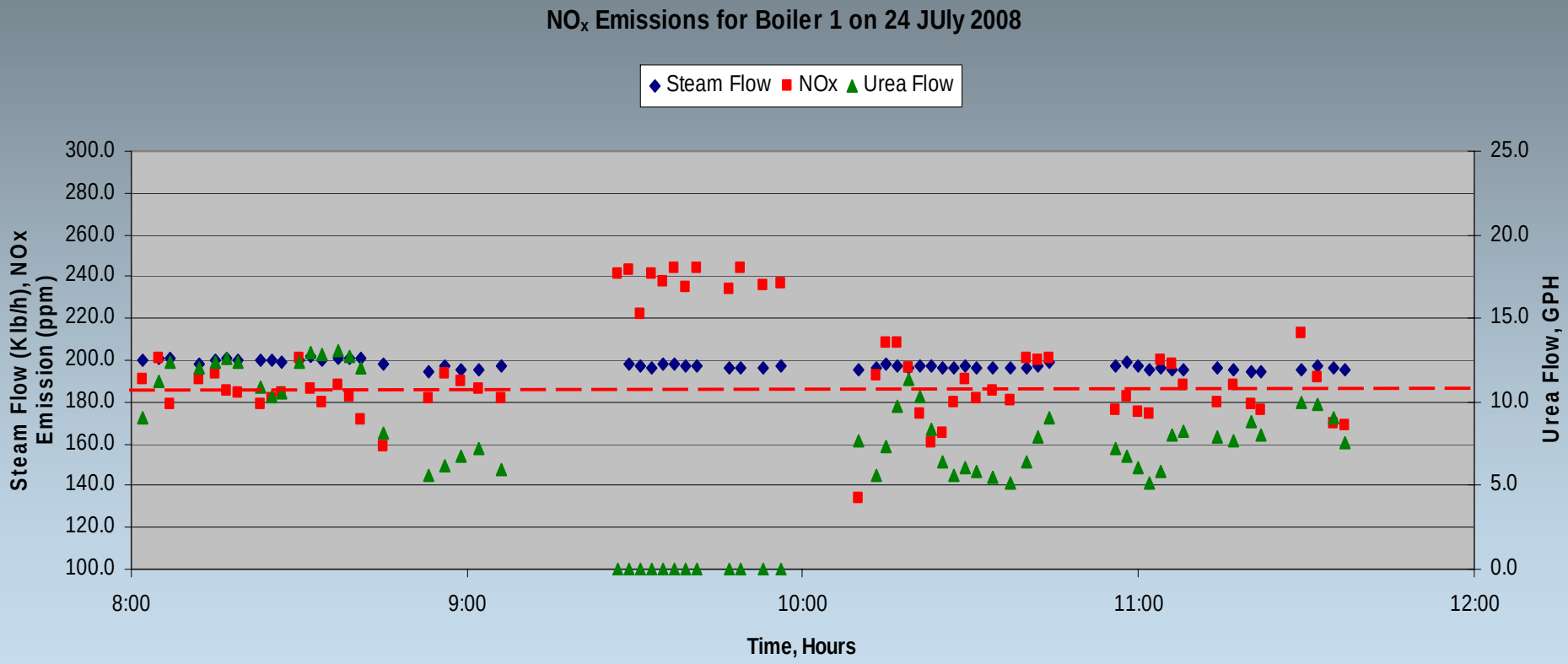
# NOxOut Control



# 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

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# Operating Issues

- $NO_x$ 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!

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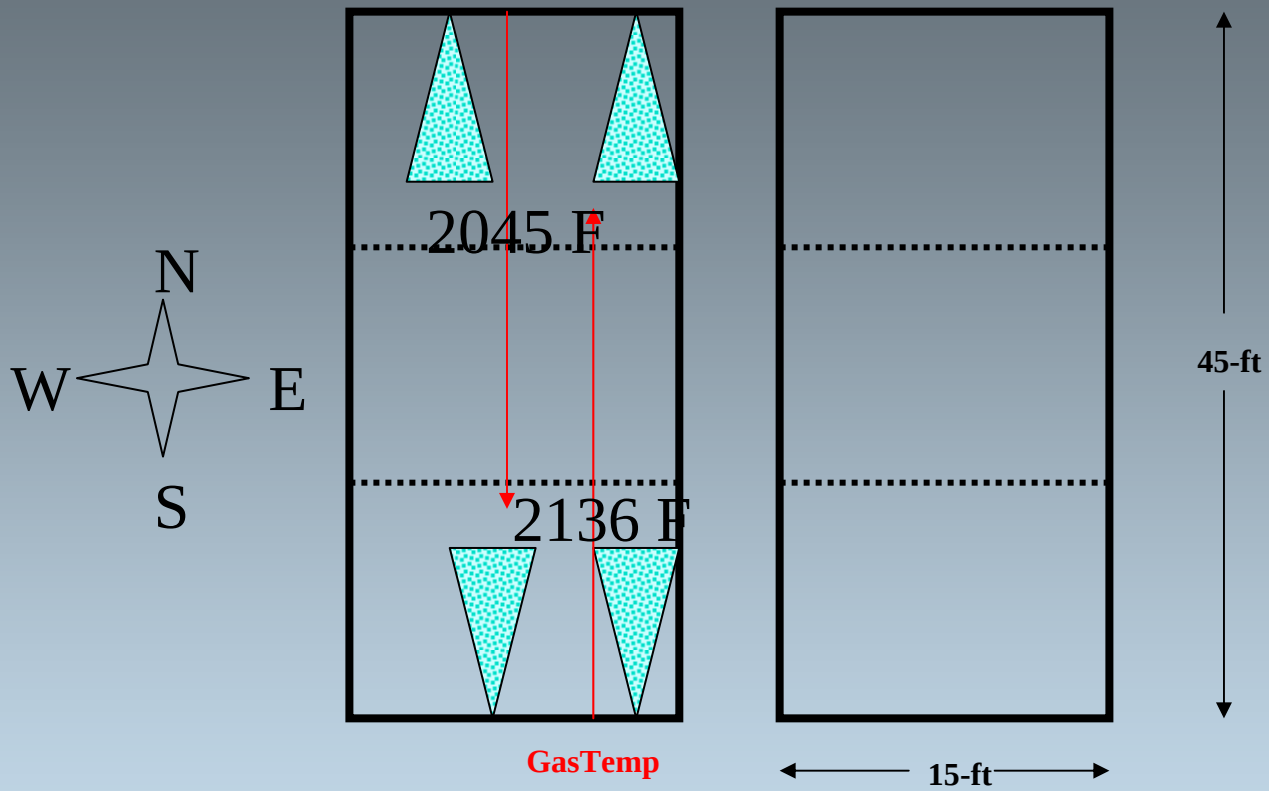
# Temperatures at Boiler #2 Urea Injector Locations




**“El 45”**

**Platform el-54-ft**

**“El 50”**

**Platform el-65-ft**

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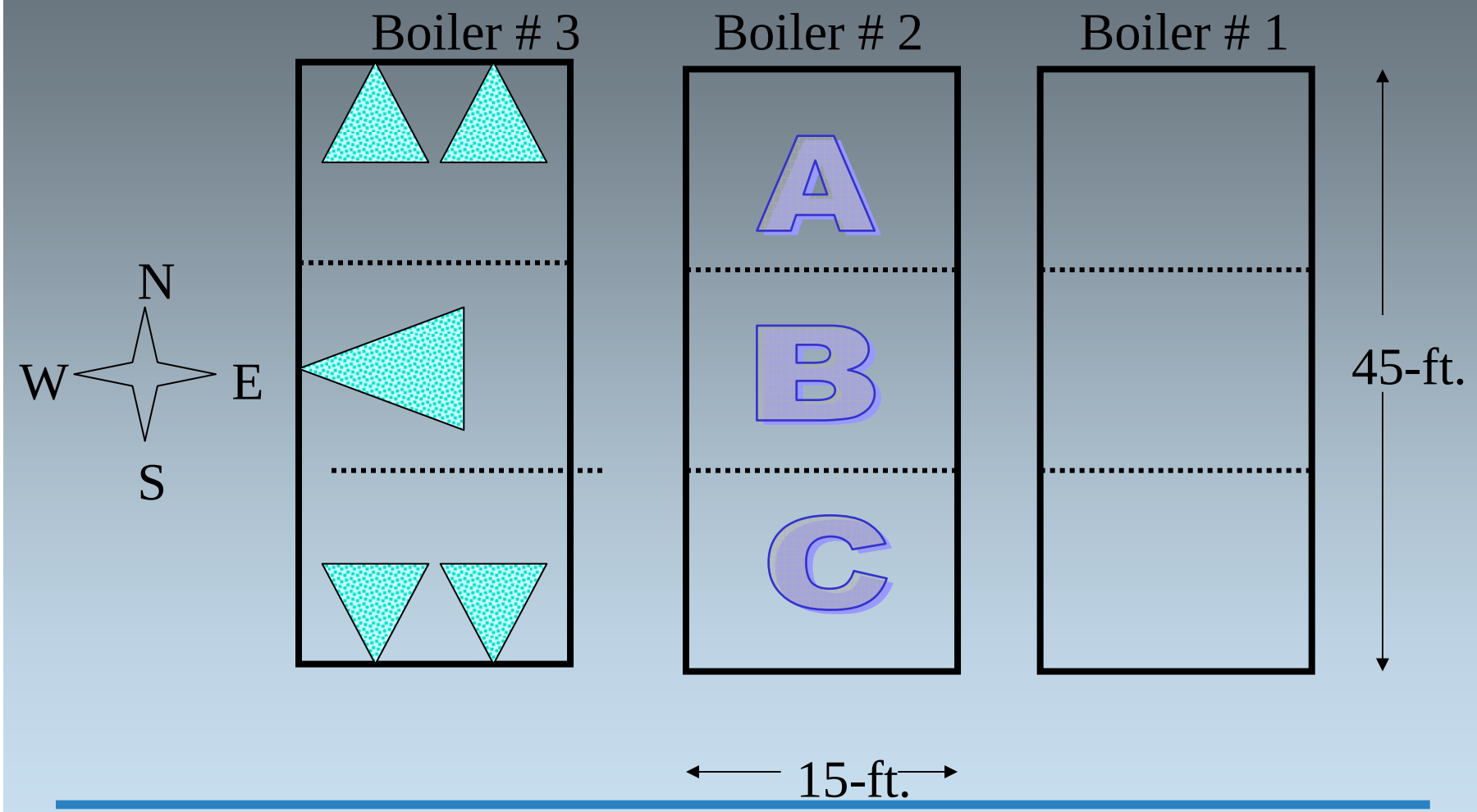
# Alternate Arrangement



# SpectraTemp

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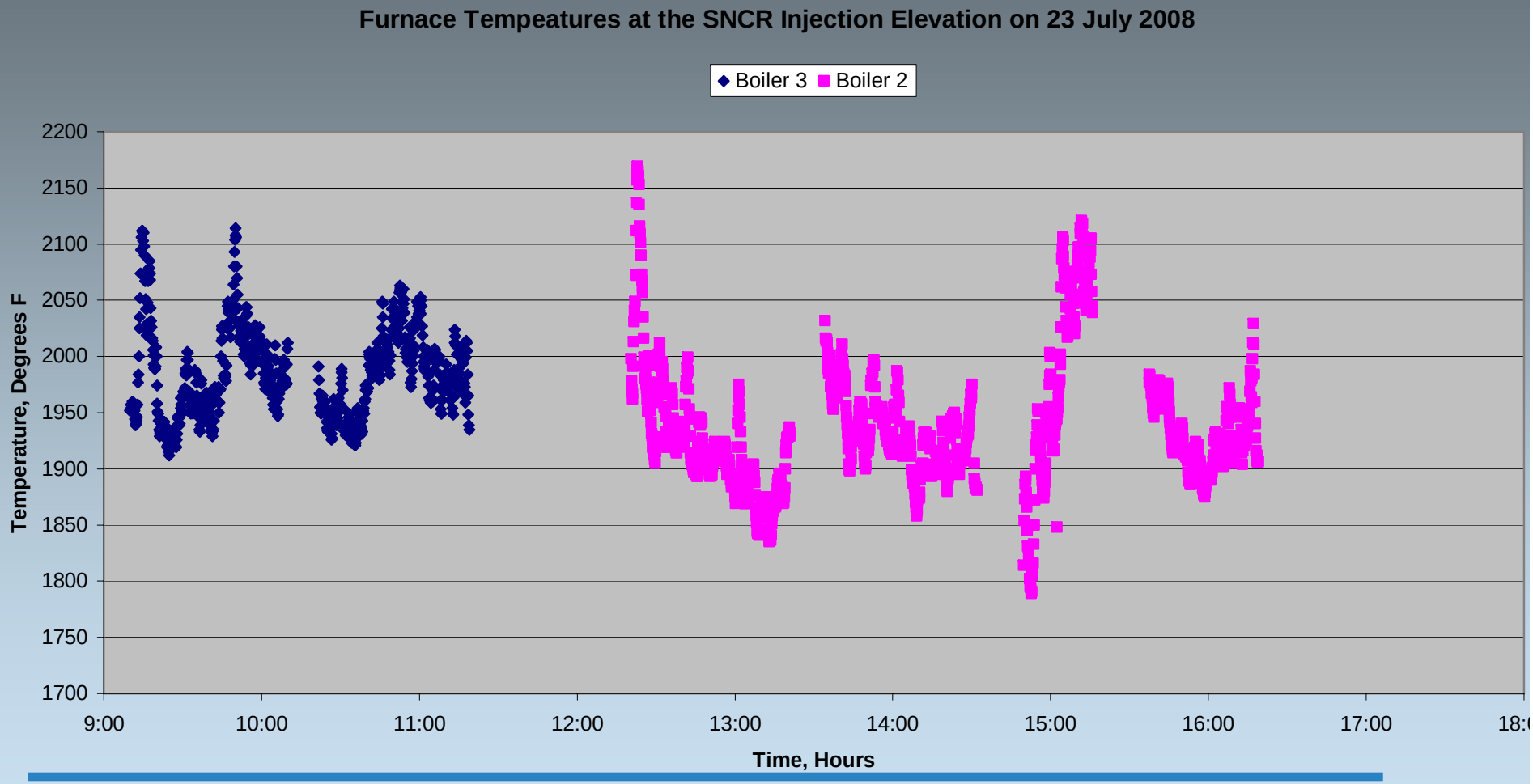
# Typical Temperature Fluctuations

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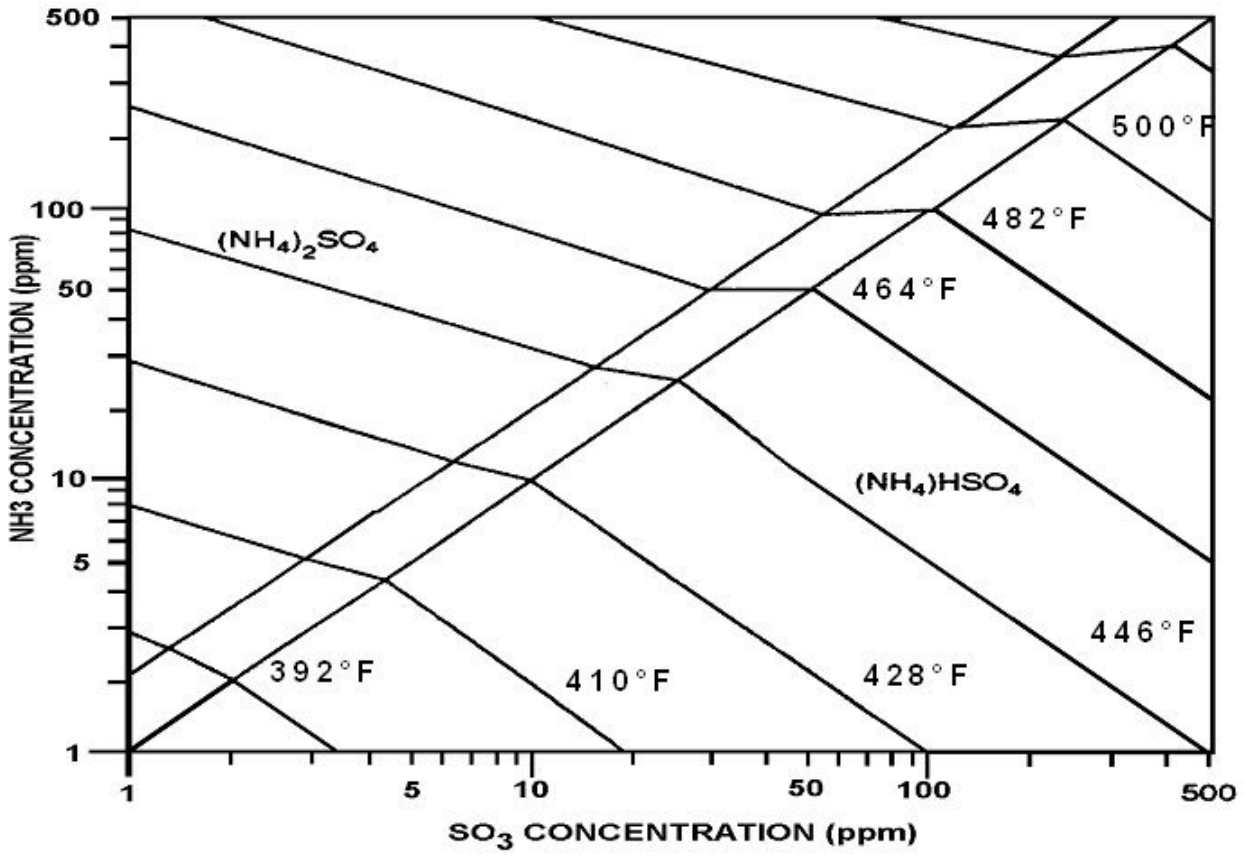
# Ammonium Bisulfate Forms




$(NH_4)_2SO_4$ = Ammonium Sulfate

$(NH_4)HSO_4$ = Ammonium Bisulfate

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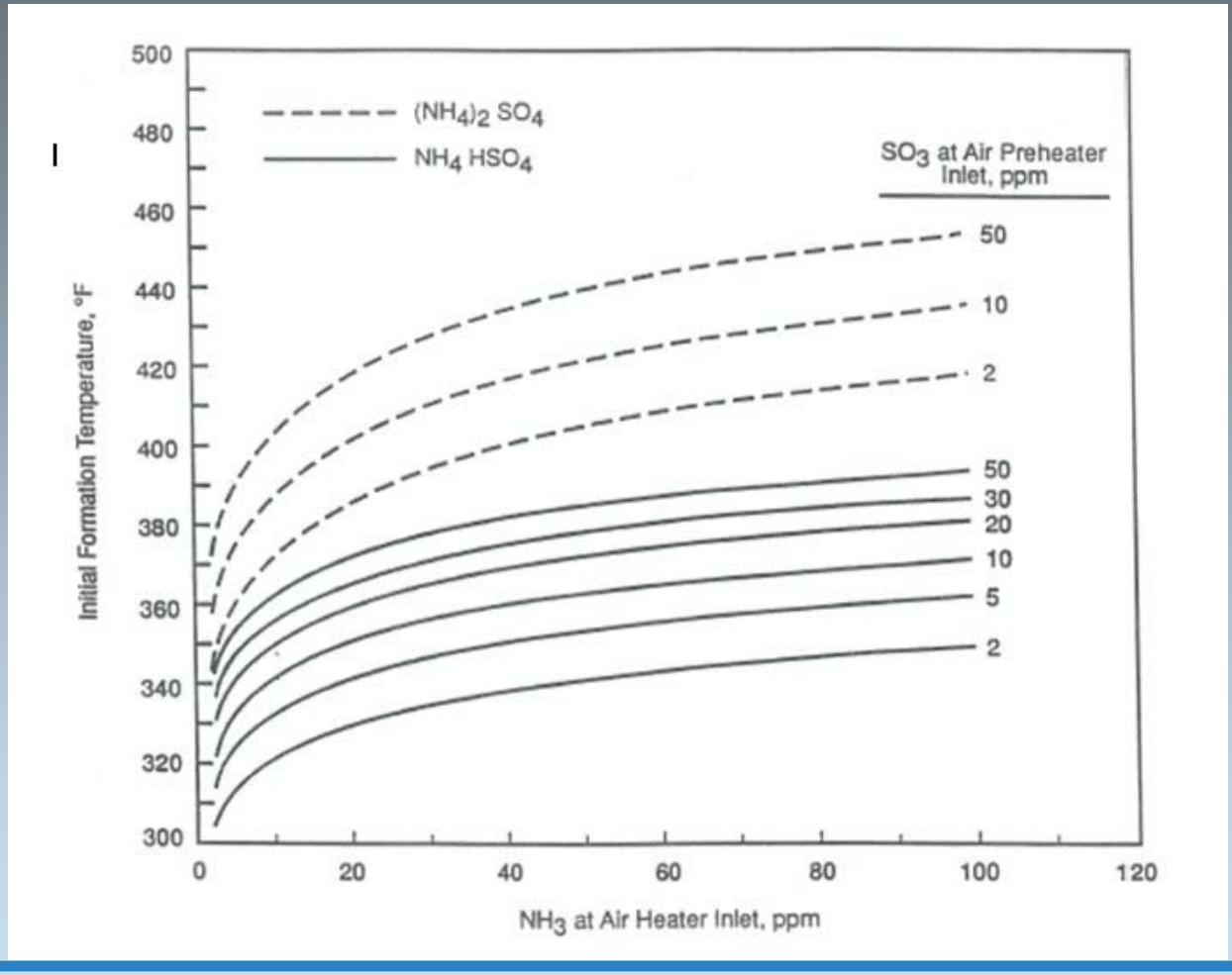
# Ammonium Bisulfate Condenses

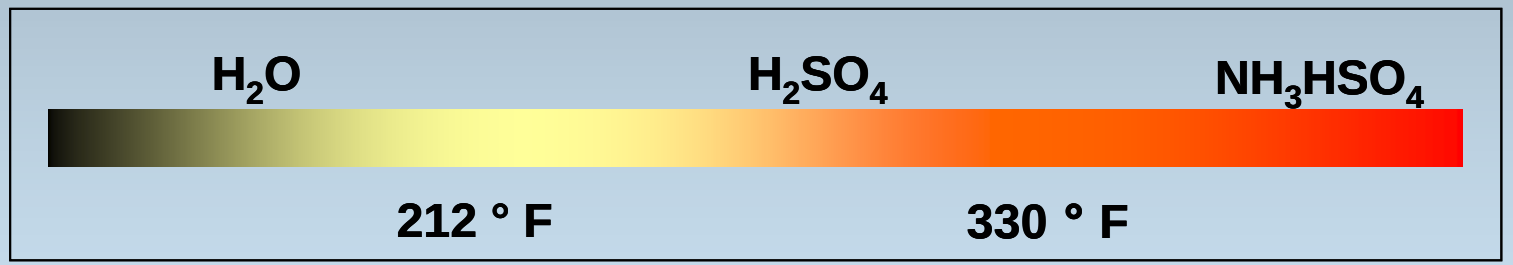


# AbSensor – AbS/SO3
# What is it? What does it do?

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

**This material could be:**

- **Moisture ($H_2O$),**
- **Sulfuric Acid ($H_2SO_4$) ($H_2O + SO_3$)**
- **Ammonium Bisulfate ($NH_3HSO_4$) ($NH_3 + H_2O + SO_3$)**




**The same device measures condensables across the spectrum!**

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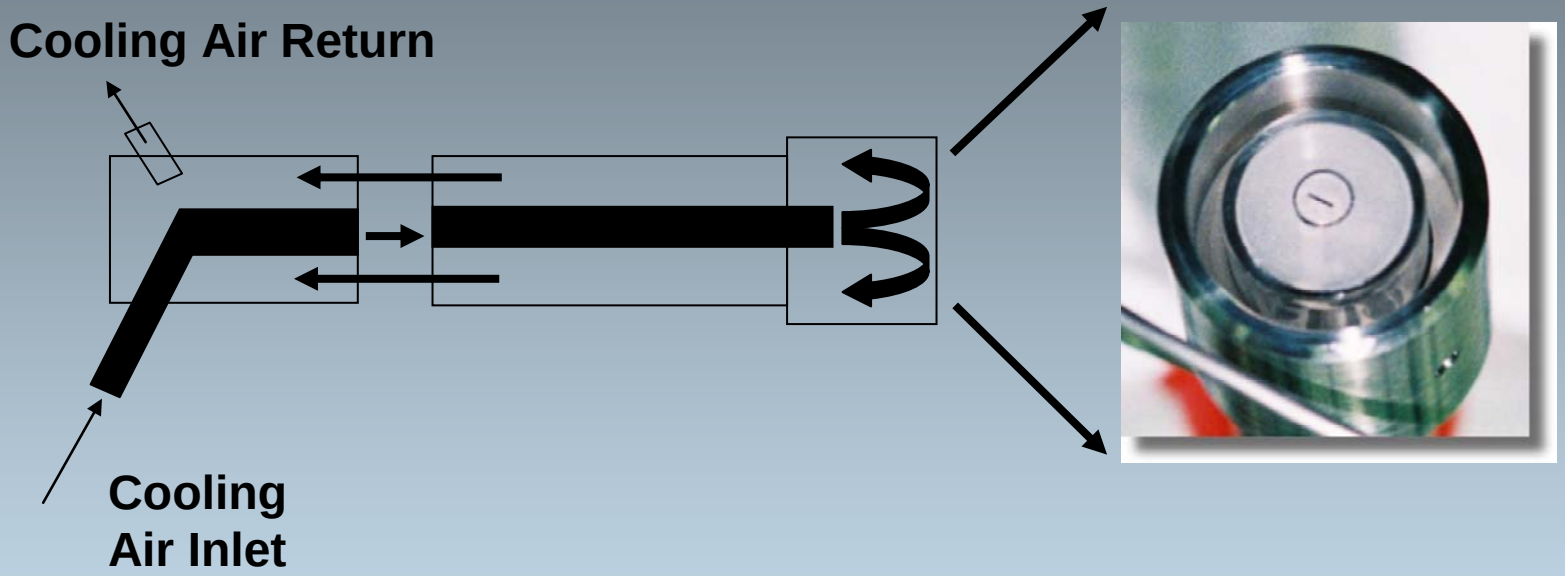
# How does it work? - I




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

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# AbSensor – AbS/SO3 System

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

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# 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.**

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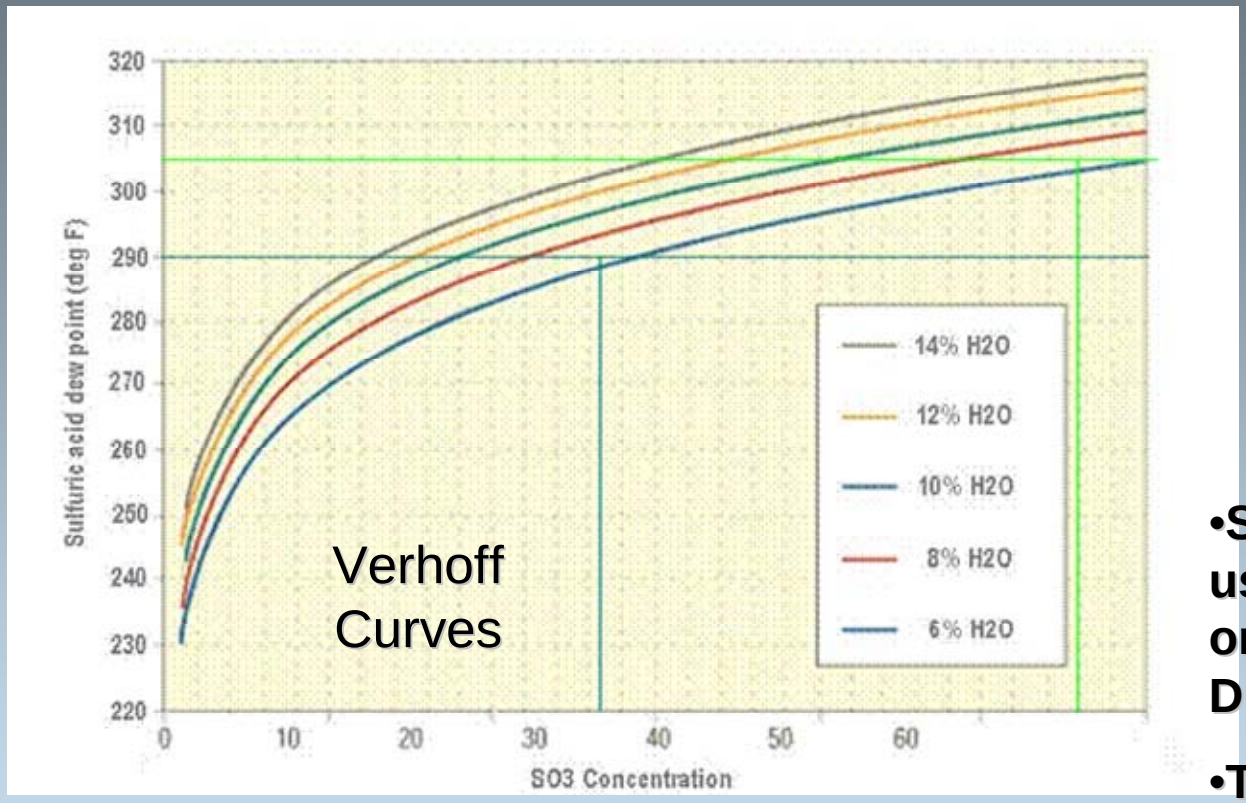
# Dewpoint to $SO_3$ ppm




- **SO3 ppm can be calculated using a relationship based on Flue Gas Moisture and Duct Pressure.**
- **This calculation is part of the AbSensor algorithm.**

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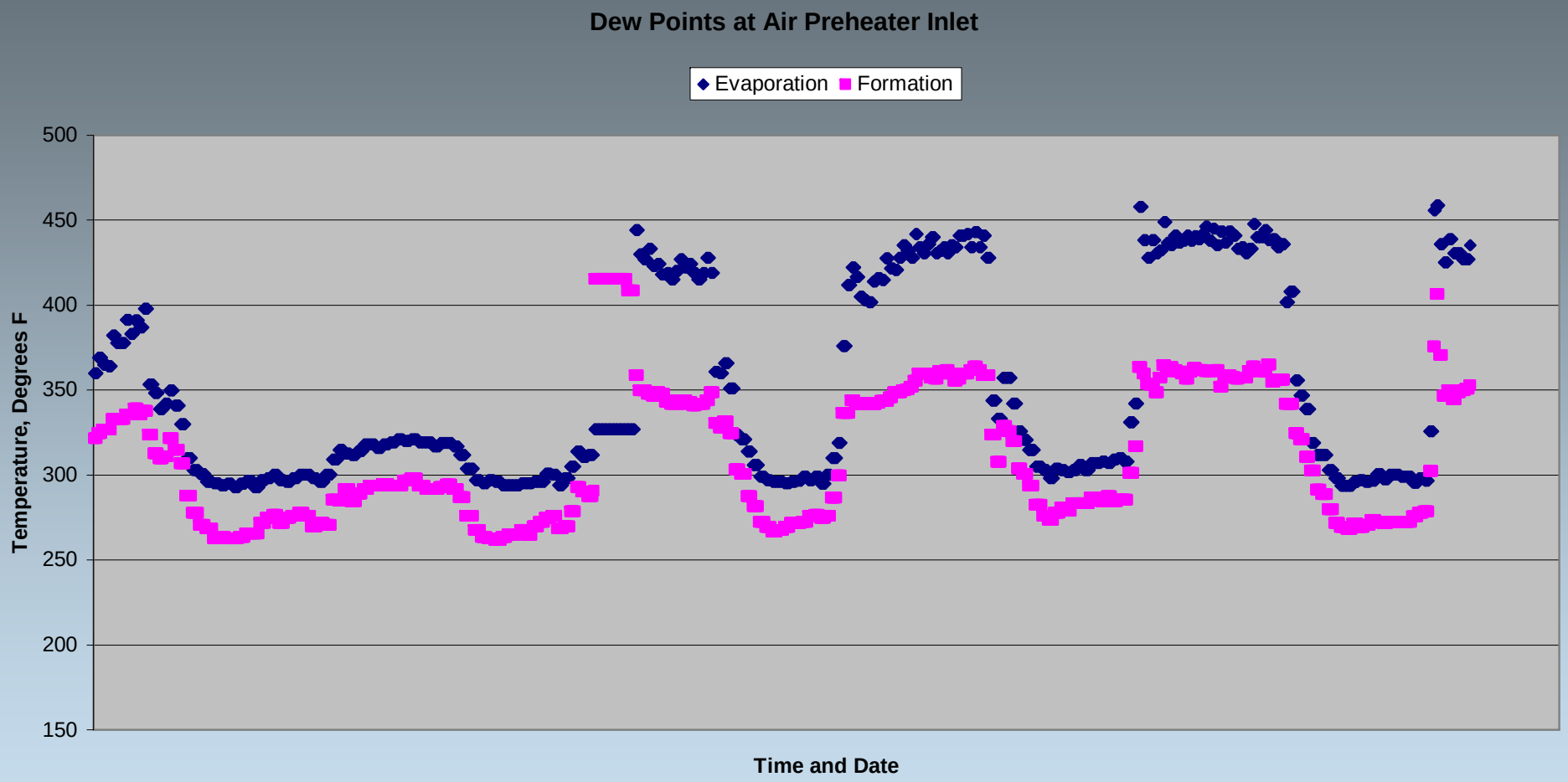
# Typical ABS Results

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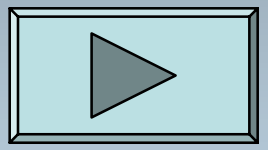
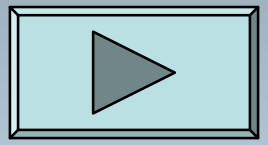
# $SO_3$ & ABS Control



SO3: need Sorbent Injection Control

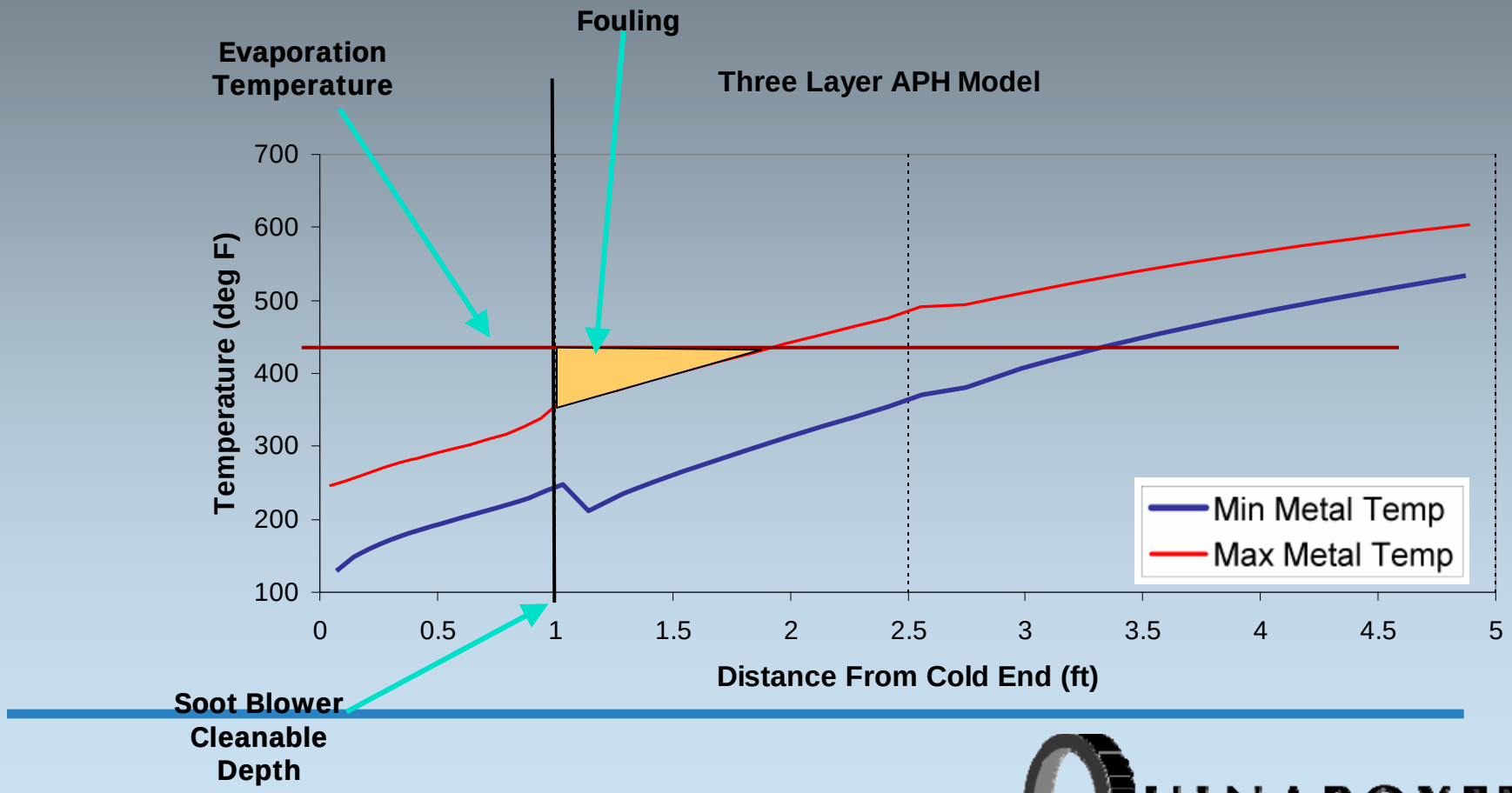


ABS: need integrated NOx and Air Heater Control

# Air Heater Fouling Breen Model*

***Increase Air Heater Outlet Temperature***

***Reduce Ammonia Flow***




* Licensed from EPRI; developed by Lehigh

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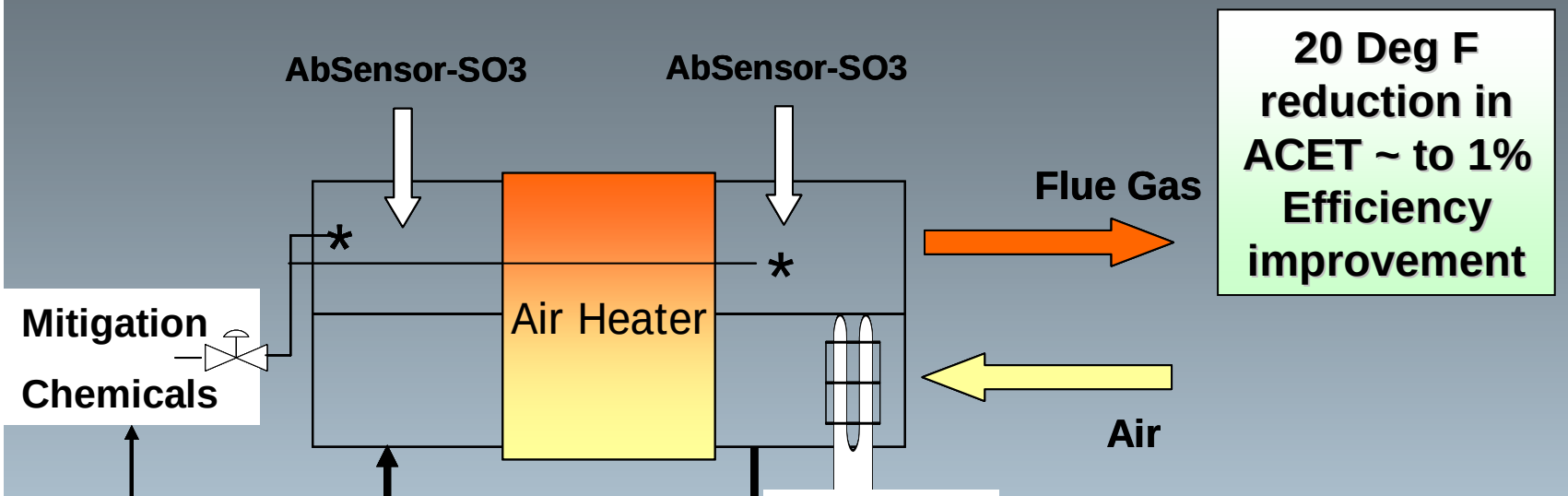
# Integrated Air Heater Temperature/Mitigation Controller




- Hydrated Lime
- Trona,
- MgOH
- Ammonia

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# Air Heater Sootblowing

- **The AH Controller allows control of the $NH_3$ reagent based on effective cleanable depth**
- **If the cleanable depth were not a factor, more reagent could be employed and NOx could be lowered**

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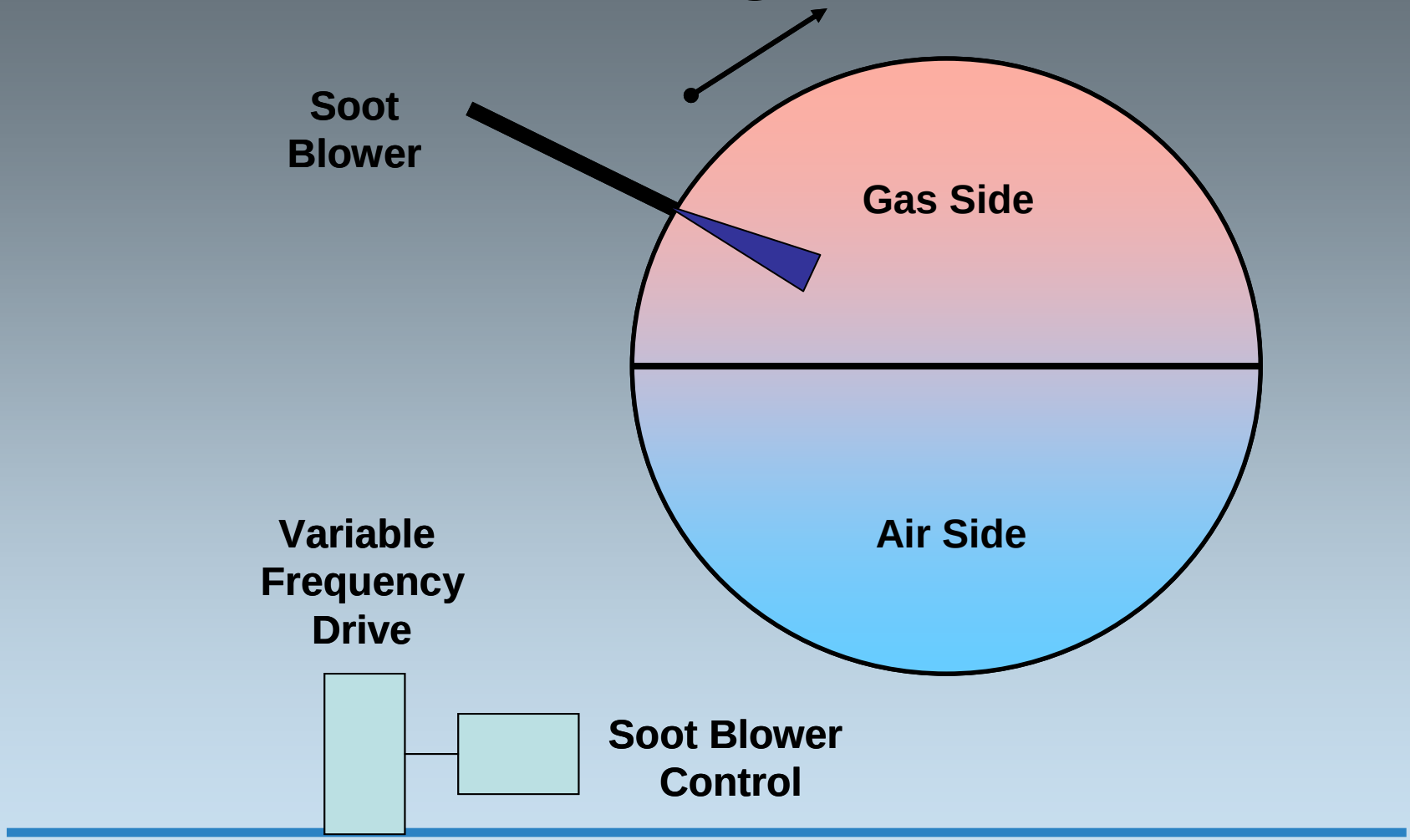
# Air Heater Cleaning

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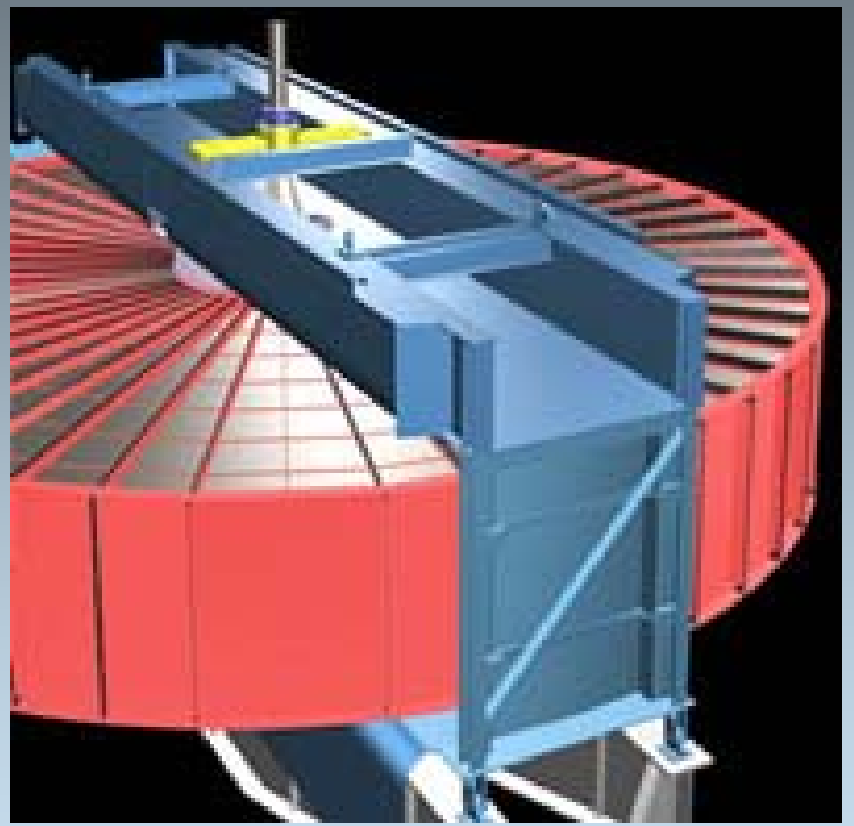
# LSBB (Low Speed Bottom Blow)

- Bottom soot blower operation only (reduces hot end element damage)
- Uses VSC operation (1.5 rpm – 0.33 rpm)
- Reduced ‘step’ (75mm to 60mm)
- Increased SB sequence from 1 hr – Over 4 hrs
- But reduced number of daily SB operations (4 per day - one to two per day)



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# Belews Creek – What was the Benefit?

- Eliminated two scheduled outages per year
- Reduced forced outage time – SAH cleaning not mandatory
- Off-line cleaning is more efficient – 24 hrs vs. 48 hrs
- Lowered CCE set point
- Reduced $NO_x$ – Raised $NH_3$ slip
- Eliminated hot side element damage ($$)

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# SNCR Tuning

- Temperature
- Injector location
- Injector sprays

# Spare Parts

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

# Now Back to Your Concerns…

- Comments?
- Questions?

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Thank You!