NIST Workshop

Improving Measurement for Smokestack Emissions

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NIST Gaithersburg

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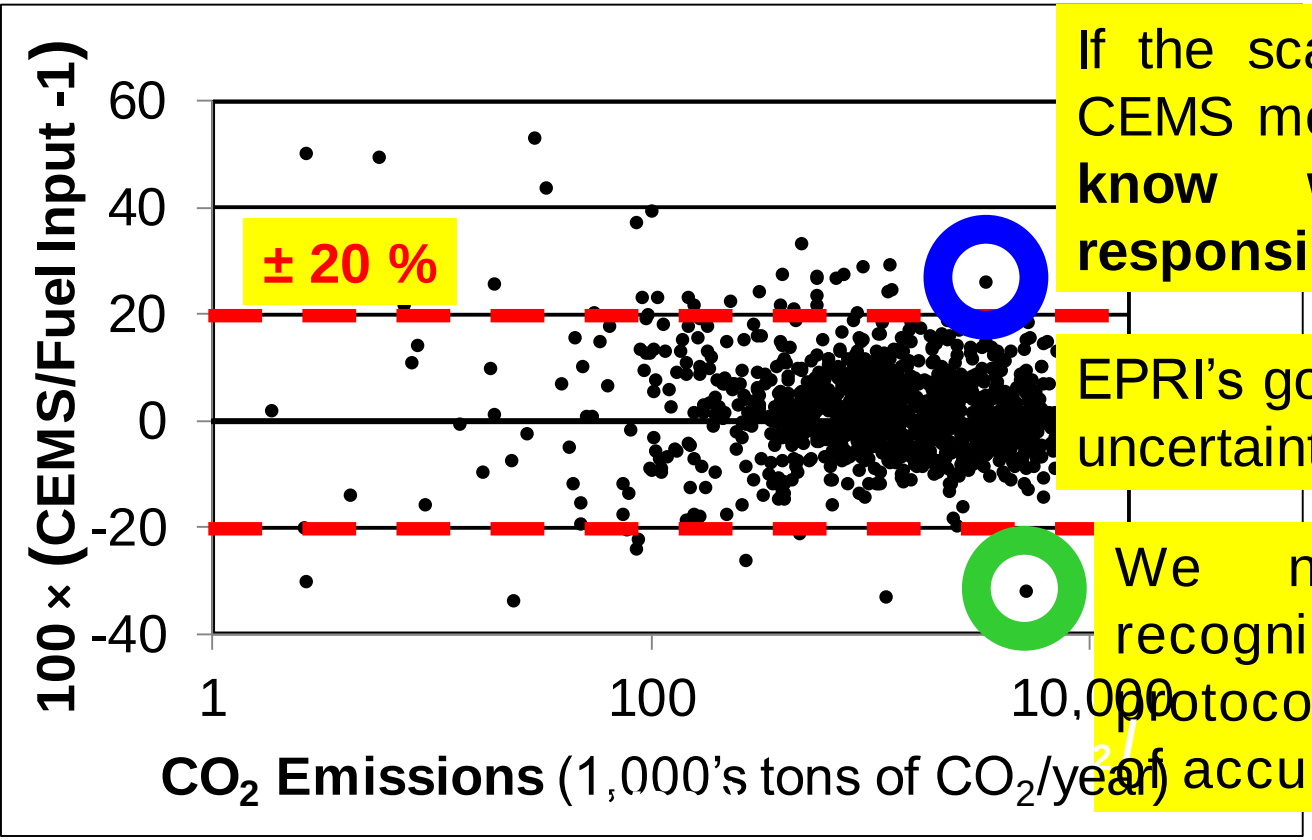
NIST

Coal-Fired Plants: Emissions vs. Fuel Input

Do they agree?

Will shutting down the **blue** plant **instead** of the **green** plant save 4,000,000 tons/year of CO_2?

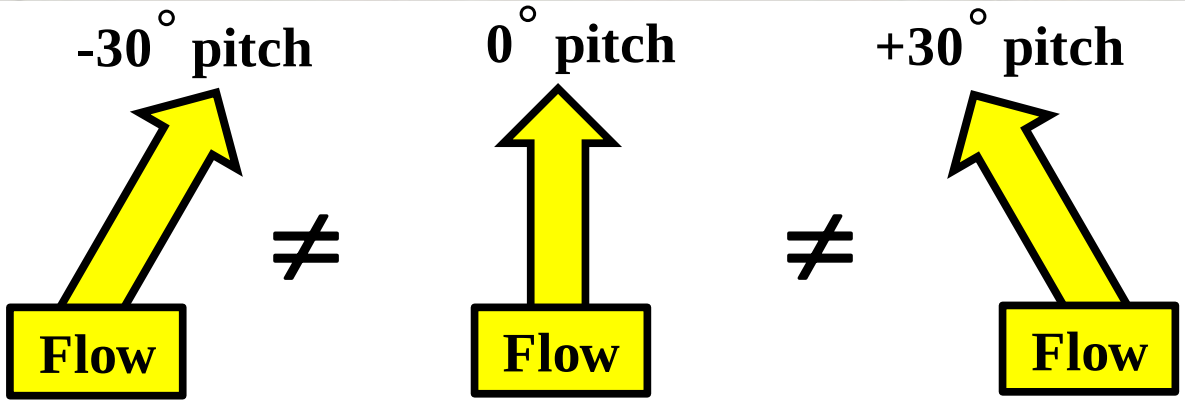


If the scatter results from poor CEMS measurements, **we don't know which plants are responsible for high emissions**

EPRI's goal is 1% measurement uncertainty

We need internationally-recognized measurement protocols to reach this level of accuracy

S-Probe: Workhorse for EPA protocols for stack flow measurements



Cannot Determine Pitch Component of Velocity

Goals…

To Answer the Following Questions

1. **Where are we now?** What is the uncertainty of the S-probe RATA? NIST's results indicate accuracy ranging from 5% - 10%

2. **Where do we need to be?** What accuracy is needed in the field?

3. EPRI set an accuracy **target accuracy of 1 % ... NIST efforts are designed to support this level of accuracy, if needed.**

What Has NIST Done?

- **Attended stack conferences** to better understand the problem
- **Established cooperative relationships** with stakeholders (EPRI, CEESI, NIM, KRISS)
- **Held workshops to exchange ideas** and **keep you informed** of our progress
- **Invested in 4 Special Measurement Facilities**
  - Wind Tunnel
  - Scale-Model Smokestack Simulator (SMSS)
  - National Fire Research Laboratory (NFRL)
  - Long Wavelength Acoustic Flow Meter (LWAF)

1. Wind Tunnel

- **Function**
  - generates well-defined airspeeds to calibrate anemometers
  - calibrate ΔP probes as function of: air speed, pitch & yaw angles, turbulence

- **Results**
  - **S-Probe** has large pitch angle **dependence (10 % effect)**
  - **3-D probes accurately measure velocity** (Reynolds number and turbulence dependence should be characterized)
  - **High accuracy, non-nulling methods have been developed for 3-D probes**

2. Scale-Model Smokestack Simulator (SMSS)

- **Function**
  - Generates a known flow (± 0.7 % uncertainty) in 4ft test section
  - Establishes Smokestack-like flows (*i.e.*, skewed, swirling, turbulent)
  - Evaluates complex flow effects on Δ*P* probes and CEMS flow meters
  - Characterizes novel flow measurement concepts

- **Results**
  - Typical ***S-Probe RATA overestimates*** Flue Gas Flows by about 6%.
  - 3-D probe RATAs measure flow to accuracies of 1% - 3%,
  - **X-pattern ultrasonic flow meter (USM)** compensated for swirl and had **errors** of **less than 1 %** for flow velocities from 20 ft/s to 85 ft/s
  - **Single path USM** had absolute **errors** ranging from **5 % to 17 %**

3. The National Fire Research Laboratory (NFRL)

- **Function**
  - Experimental facility for the study of fire behavior and the structural response to fire
- **Results**
  - Added an independent flow confirmation measurement, the tracer gas dilution method
  - Demonstrated mass balance of CO_2 emissions using measurements from CEMS and the Fuel Input

What NIST has done is only part of the Story ….

- **All NIST measurements made in labs – not stacks**
  - How do these measurements **translate to the field**?
  - What **field test** should be done to **validate** NIST **findings**?
  - What is the next round of testing NIST should do?
  - What's the best way to use NIST measurements to benefit stack measurement community?

- **During this workshop we hope to**
  - candidly discuss challenges and limitations of accurately measuring stack emissions in the field
  - **exchange ideas** and **experiences**,
  - identify **best practices** that improve measurements at a reasonable cost

Desired outcome of this workshop

- Gauge the industry's interest toward reducing the spread between Fuel Input vs. CEMS CO_2 measurements

- **Identify the best way to transfer NIST research results into practical solutions** (products, services, best practice guidelines, etc.)

- **Identify the significant technical roadblocks** (What makes the industry collectively scratch their head? Where does the industry need help?)

- Obtain the **industry's perspective** on the **best course of future NIST research**