PROMECON USA

MECONTROL

Boiler Combustion Optimization

Real-Time Monitoring of Unburned Carbon-in-Ash

Presented by: **Todd A. Melick**
PROMECON USA, Inc

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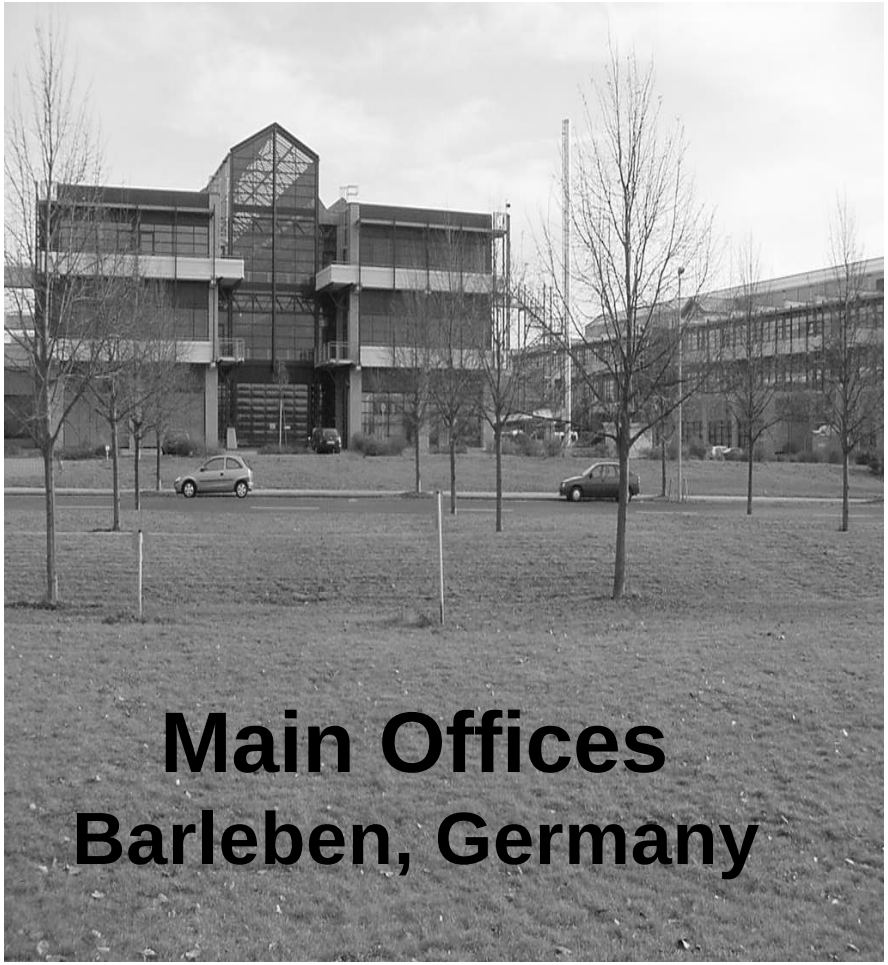
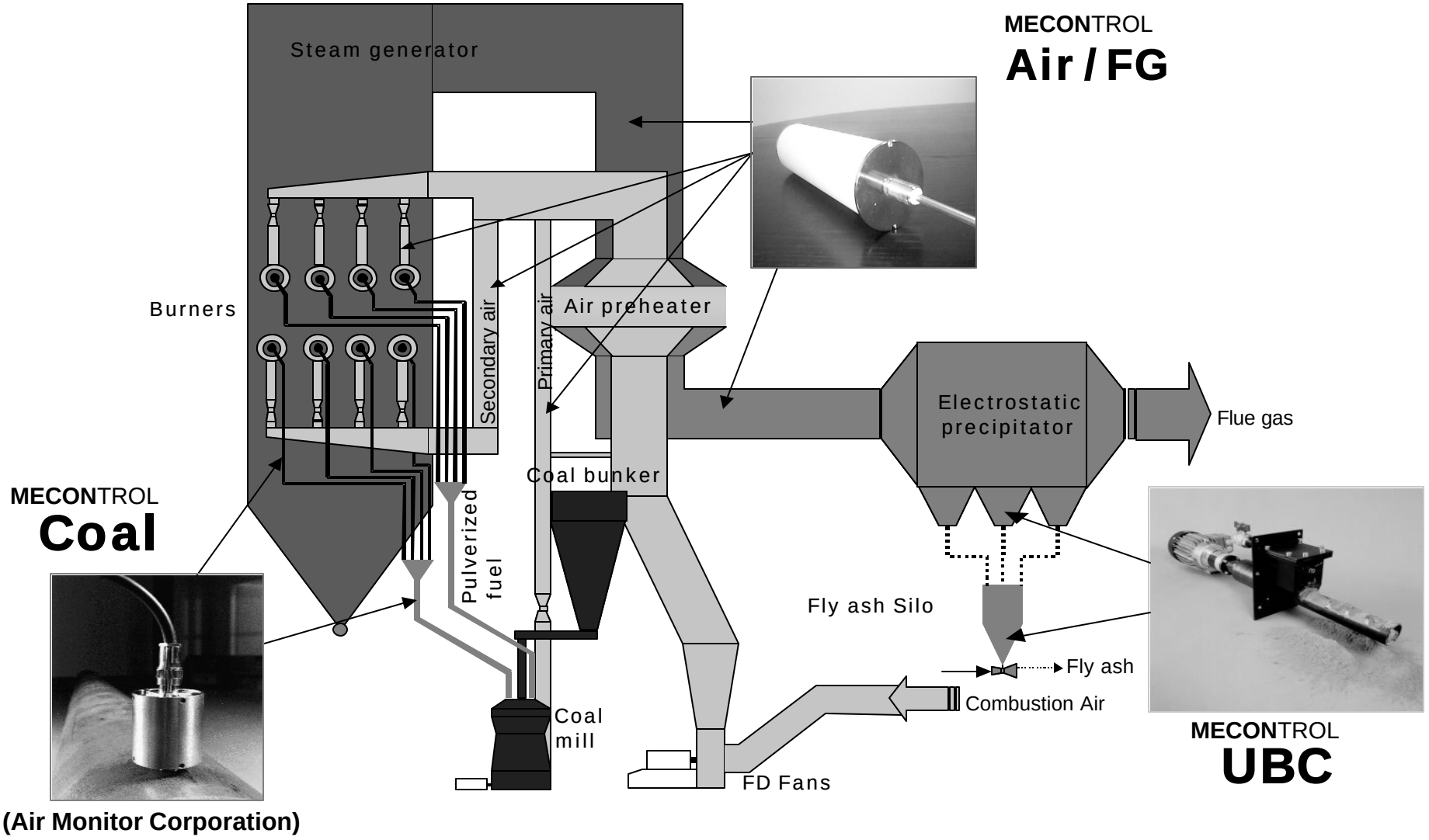


- Established 8/01/95
- Privately Held
- Offices in Barleben & Hanover, Germany
- Subsidiary in USA
- Sales Reps Worldwide
- Sales ~$5M (+20%/yr)
- Application/Process Eng'rg
- Sensor Design, Development and Assembly

PROMECON USA, Inc.

- Established 10/06/00
- Wholly-owned subsidiary of PROMECON, GmbH
- Offices in Orrville, OH
- Sensors/Services to power generation and industrial clients

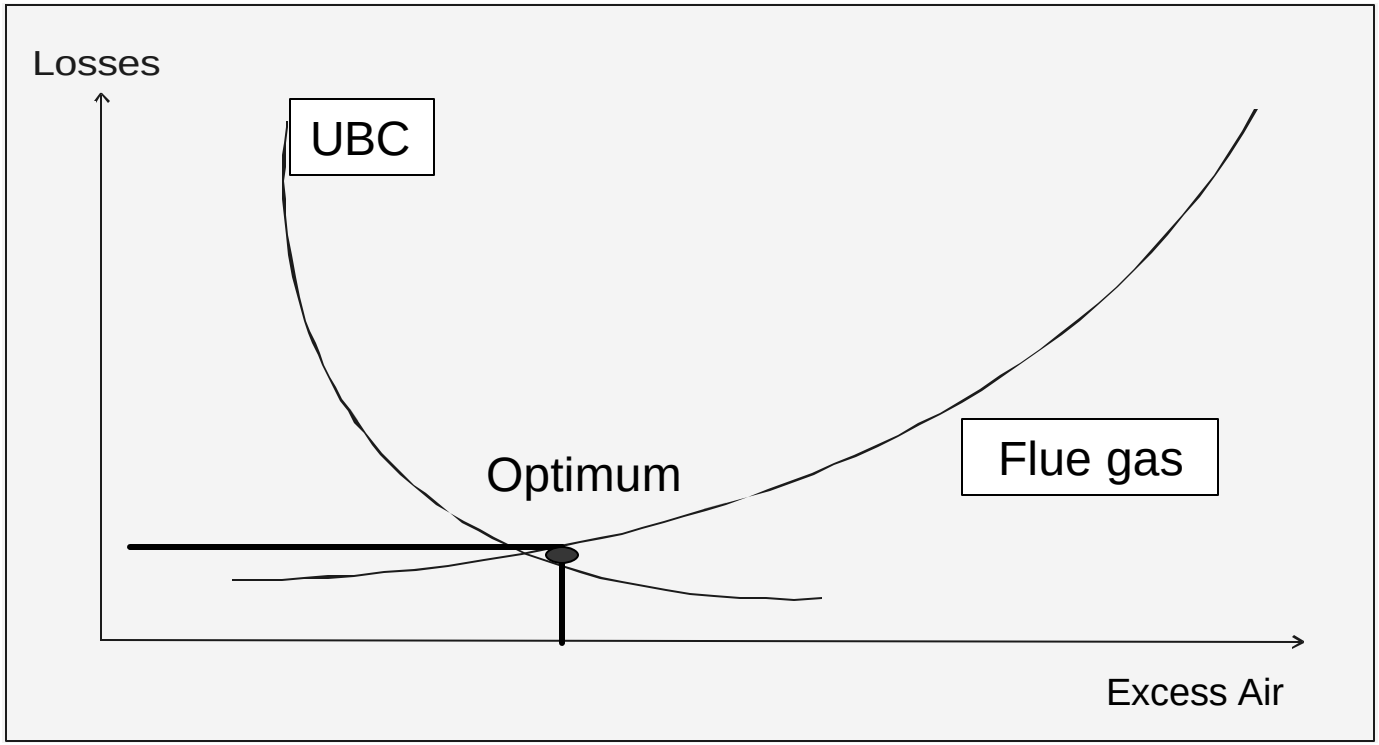
“New” Instrumentation for Boiler Optimization



(Air Monitor Corporation)

Efficiency Optimization Principle

Minimize energy losses from unburned carbon &
flue gas -- function of excess air levels



Key Functions

- SAMPLING

  Instrument must collect a representative sample

- MEASUREMENT

  Instrument must accurately measure the amount of unburned carbon in the sample

Sampling Approaches

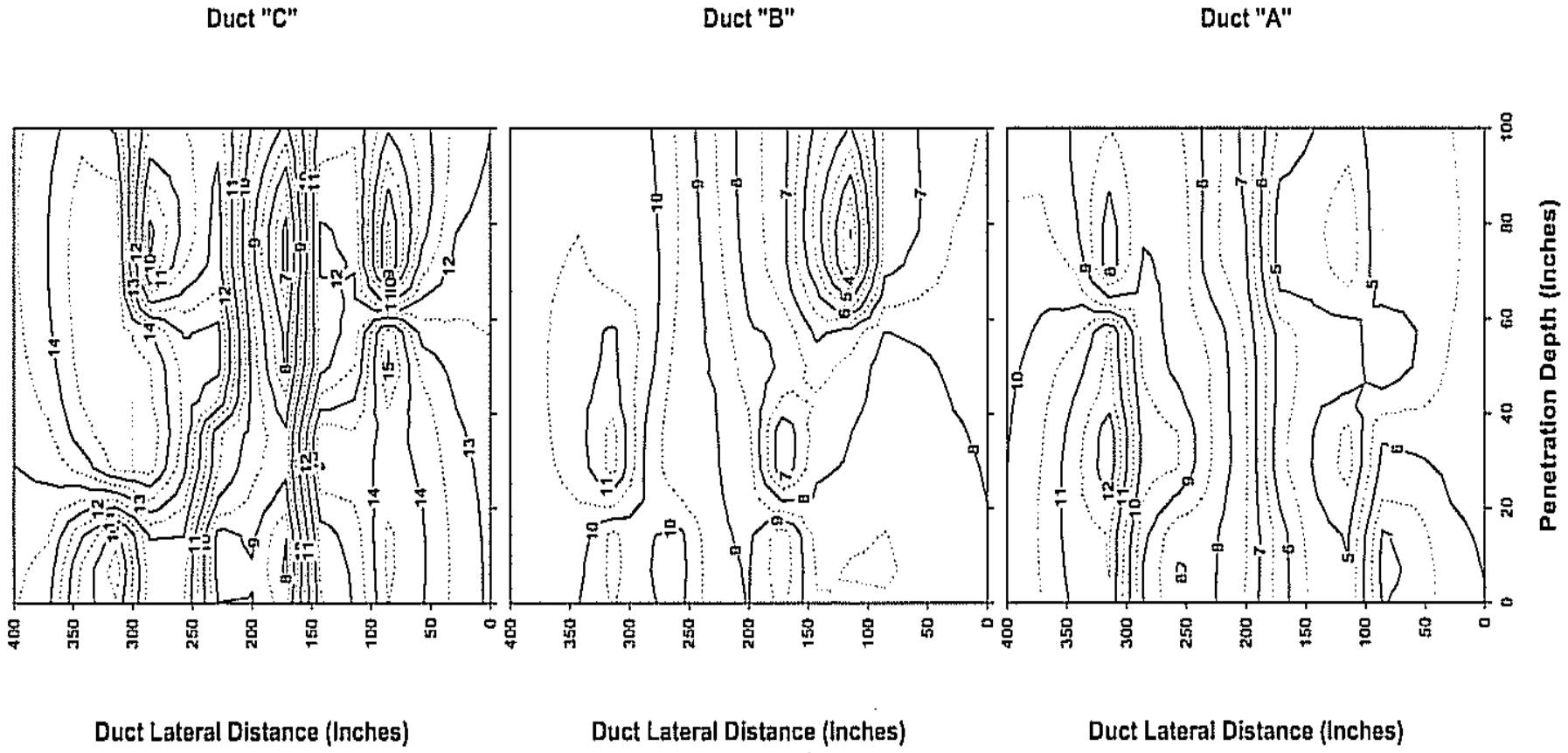
- Extractive (remove ash from handling system to make measurement)

  Classical approach used for early instrument design

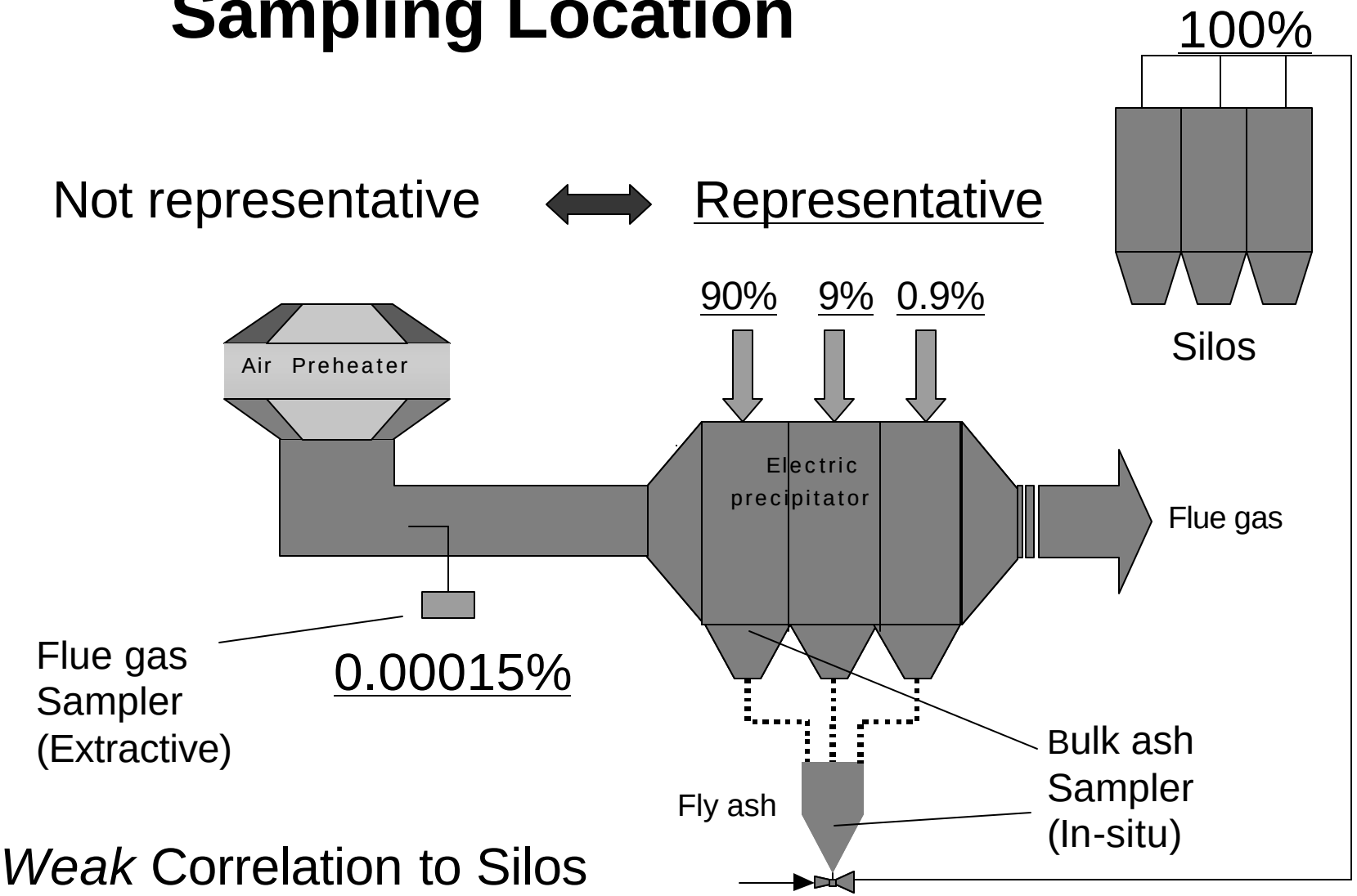
- In-situ (measurement made within ash handling system)

  New approach – providing significantly better reliability

Typical Fly Ash LOI Distribution

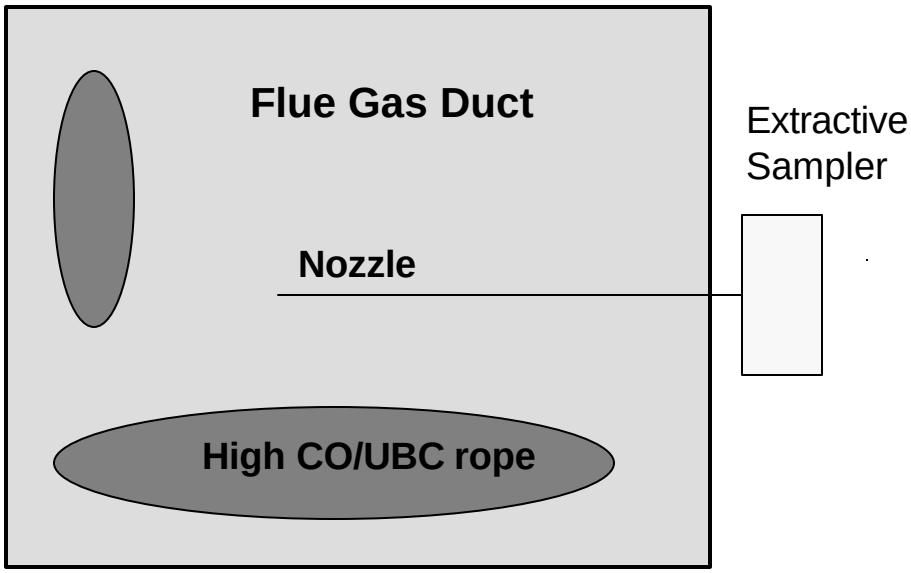


Sampling Location



Sampling of the Ash Flow

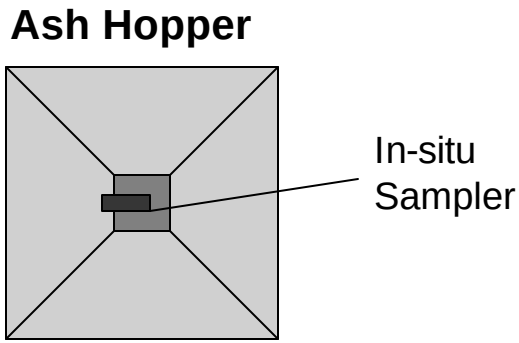
Ash and gas not uniform



Cross sectional coverage: 0.000005%

Fly ash concentration: 5g/m^3

Ash discharged in dense quantities



Cross sectional coverage: 2-8%

Fly ash concentration: 200,000 g/m^3

Measurement Response Time

- ash travel time from burner to DUCT sampler: **3 secs**
- ash collection time: **5 minutes**

Adequate response time only achievable by a very small sample size

- ash travel time from burner to HOPPER sampler: **15 secs**
- ash collection time: **5 minutes**

Sampling can achieve both:

✓Large, representative sample size

✓fast response time

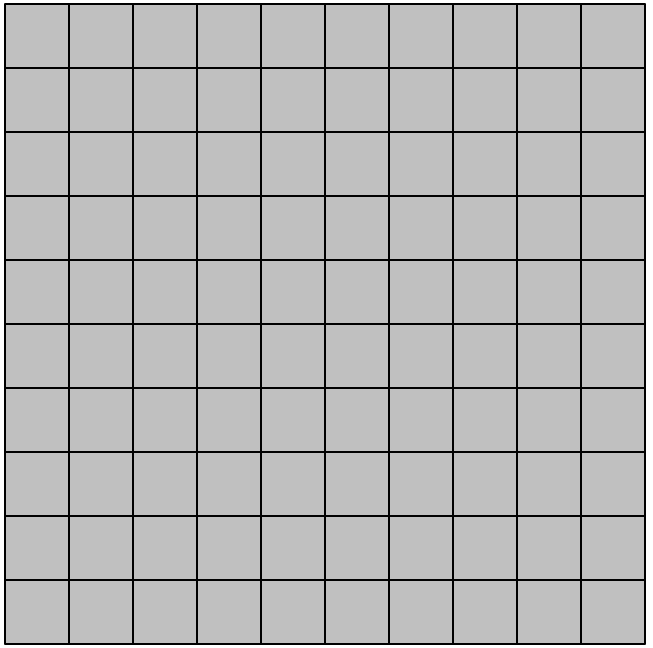
Fly Ash Collection Rate

Flue Gas Duct
1g/minute

ESP Hopper
100 g/minute

Sample Size

5 g out of flue gas duct
(Extractive)



500 g out of precipitator
(In-situ)

Key Functions

- SAMPLING

  Instrument must collect a representative sample

- MEASUREMENT

  Instrument must accurately measure the amount of unburned carbon in the sample

Measurement Approaches

- Microwave
  - Basis: Response to microwave radiation

    Simple; Accurate

    Infrequent calibration

    Insensitive to fuel type or blend

    Multiple sampling points w/ one instrument

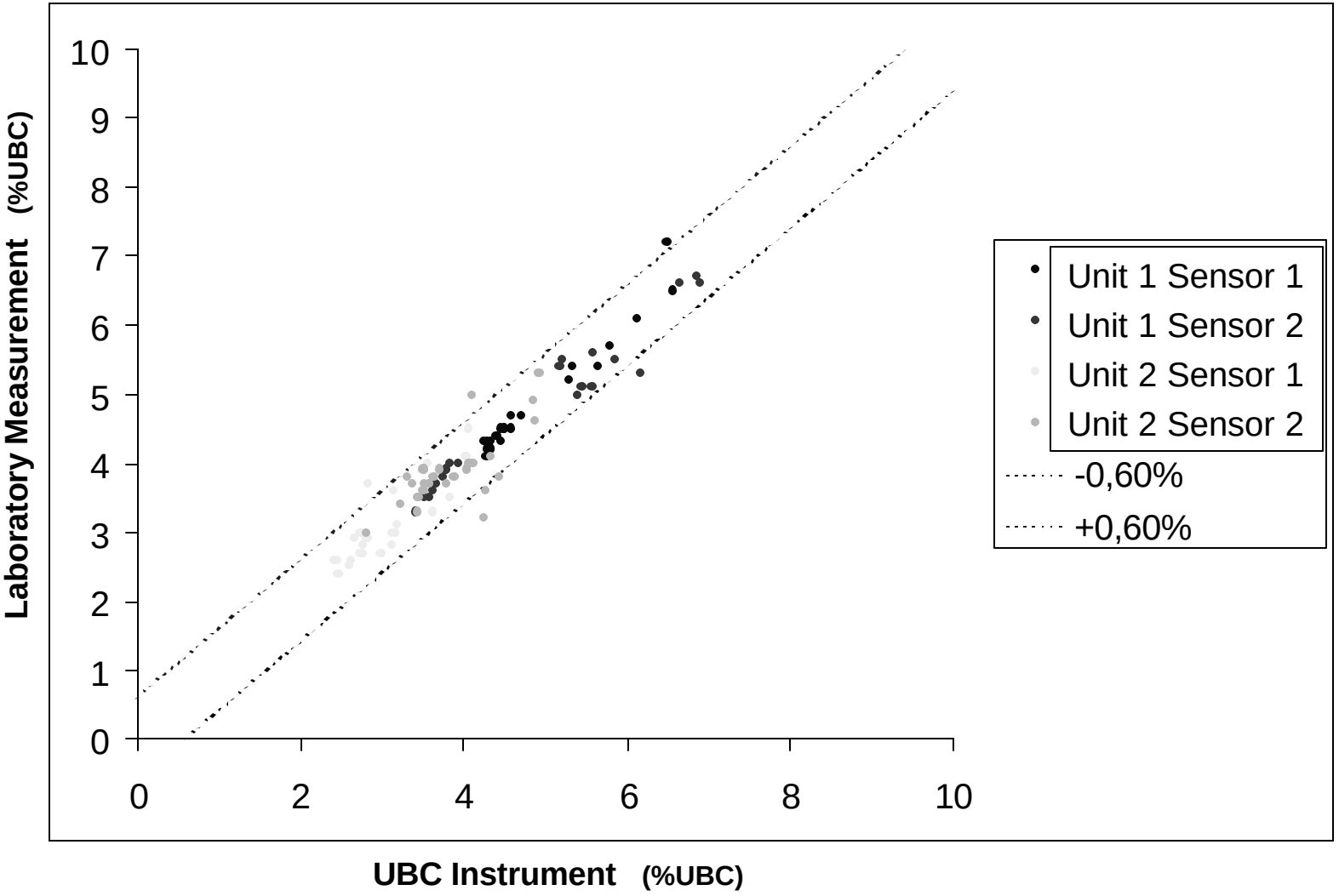
PROMECON UBC Measurement Principle

Dielectric constant of fly ash is a function of the carbon content. Measuring the shift of frequency in a resonator (Δ f) enables the carbon content to be calculated.

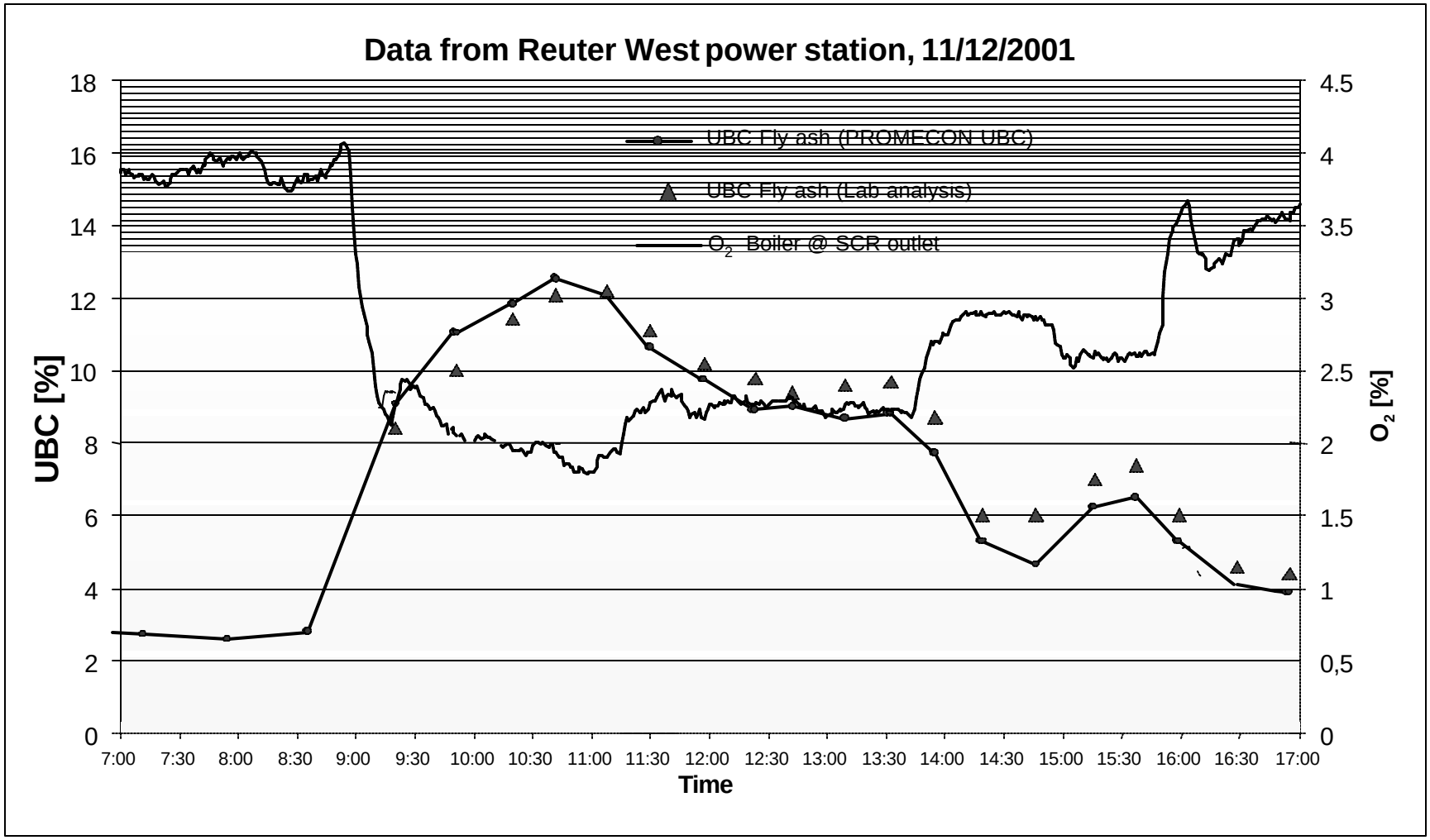
$$UBC = A + B \cdot \Delta f$$

A and B are the calibration coefficients

Typical Measurement Data Accuracy



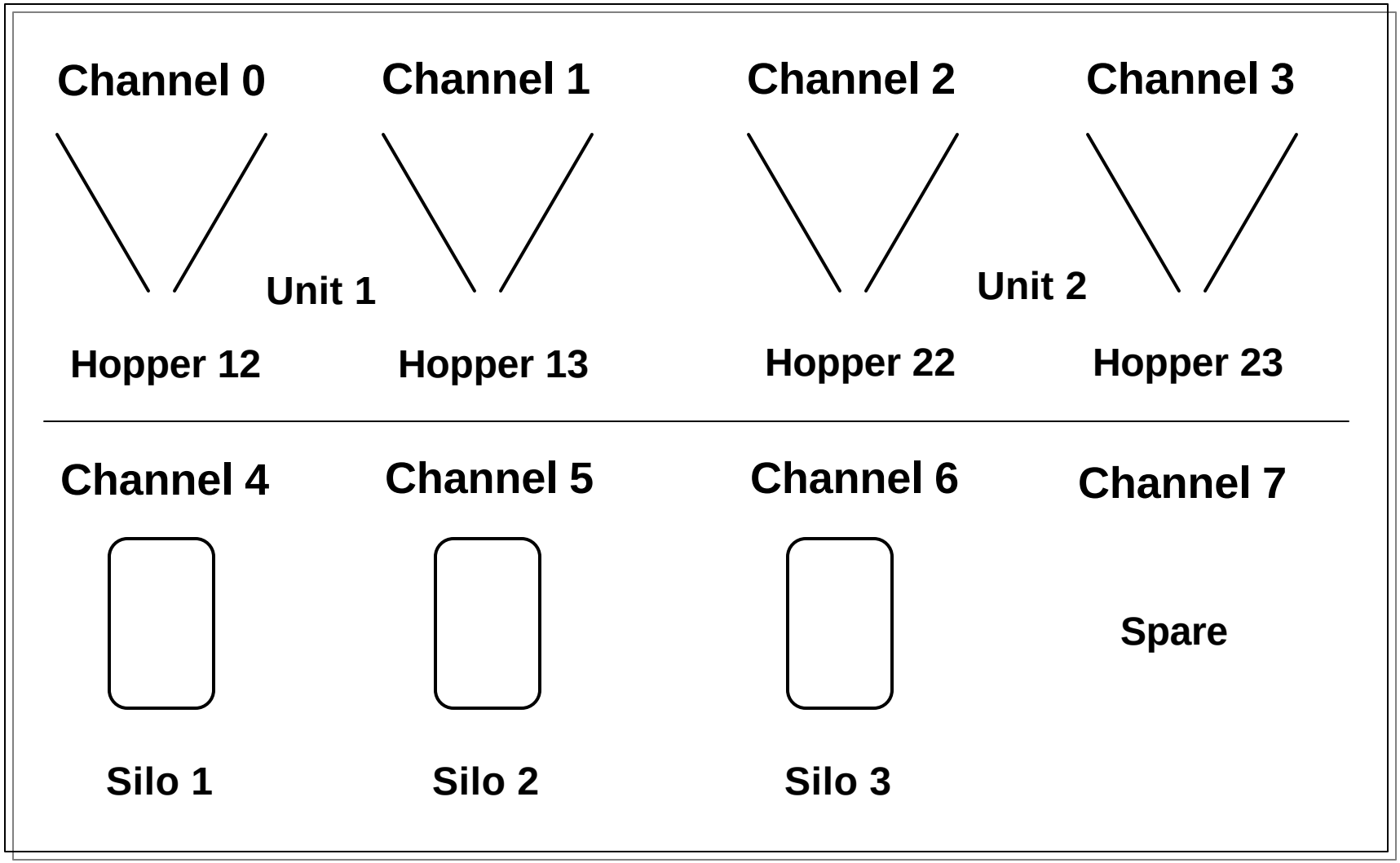
Boiler/Mill Optimization w/ UBC Monitoring



W. Va Power Station

- Utility Power Plant
  - 2 Down-fired B&W PC units
  - Installed 1952/1953
  - Boiler MCR ~ 210 MWe
- 8 Channel UBC system
  - 2 sensors/boiler (2)
    - 1st ESP field hoppers
  - 1 sensor/fly ash silo (3)
  - 1 measurement cabinet
  - SCADA display in control room

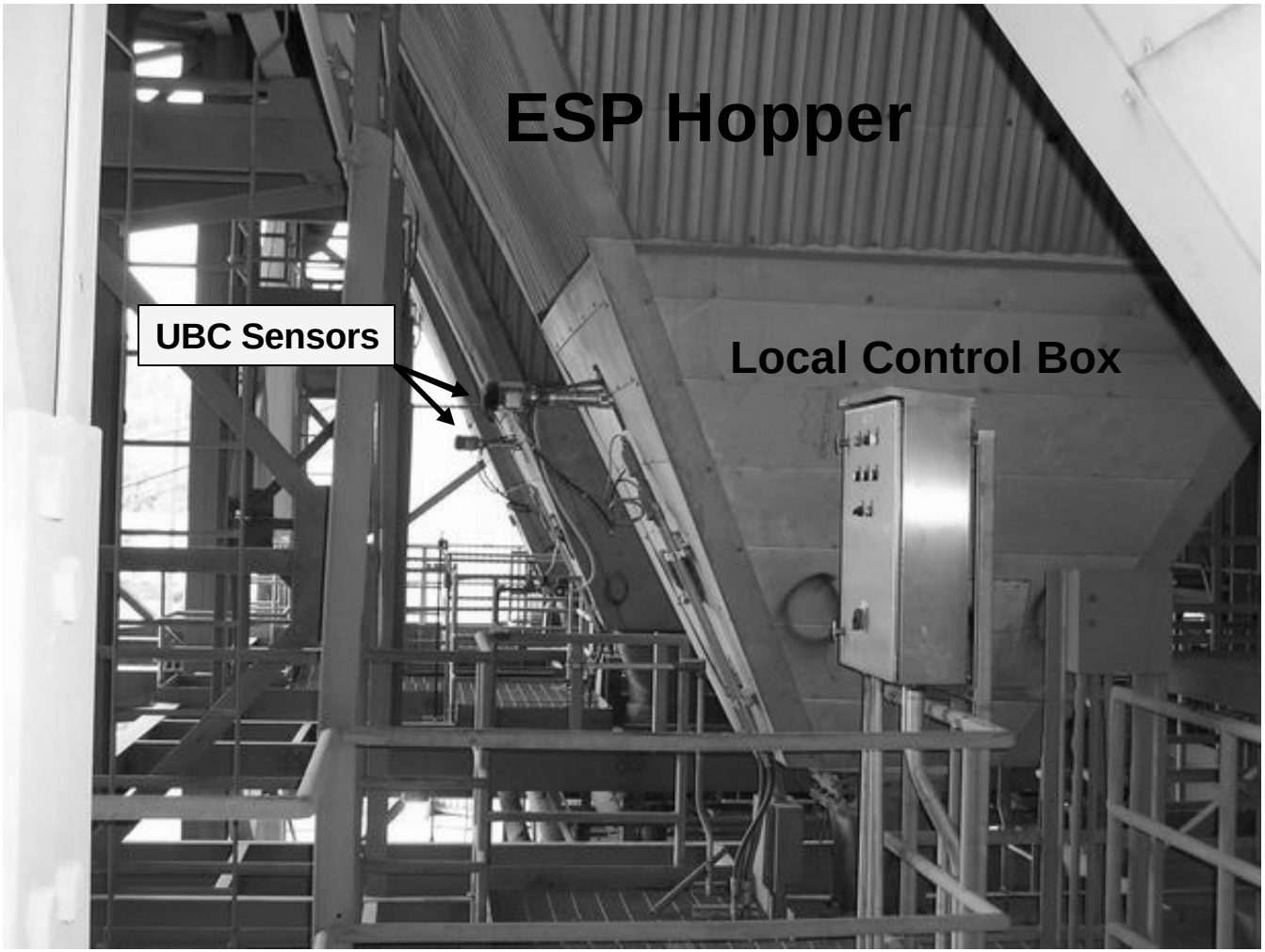
UBC Measurement Locations



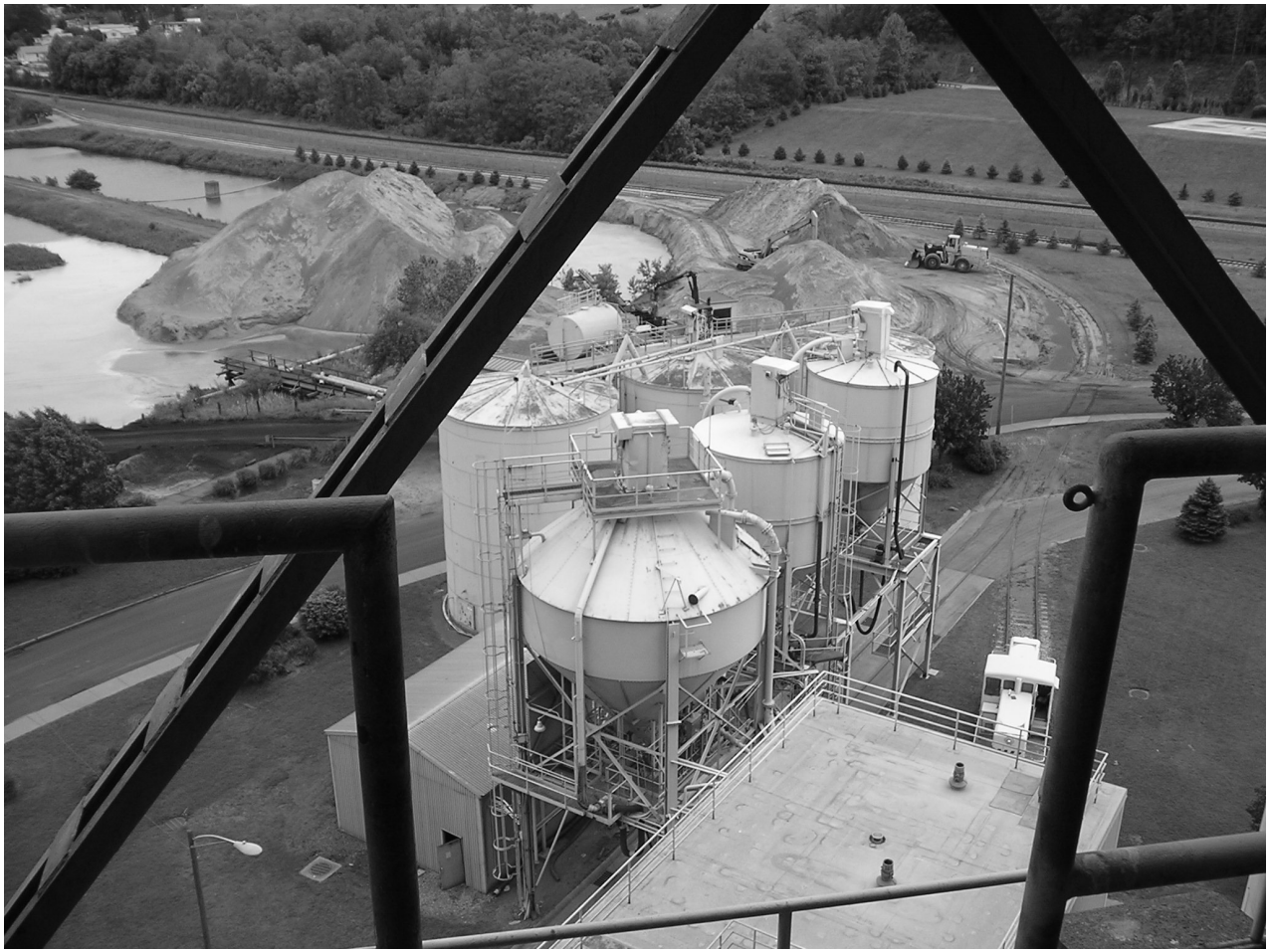
Sensor Installed In ESP Hopper

- Simple Robust Design
- One Moving Part
- No Extractive Sampling
- No Weighing
- No Pneumatic Transport

ESP Hopper Installation



Typical Ash Loading Facility



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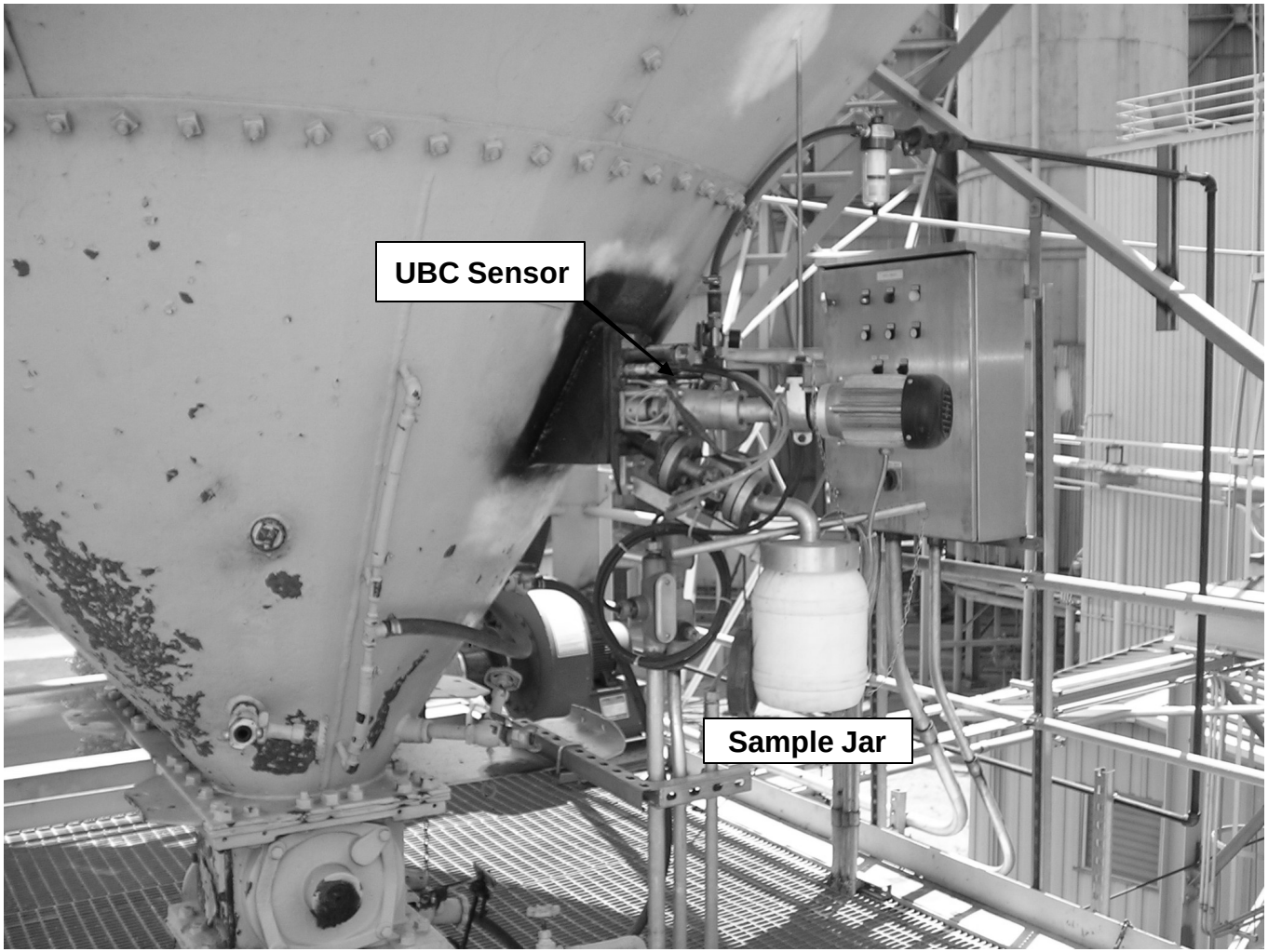
Ash Silo Sensor Installation

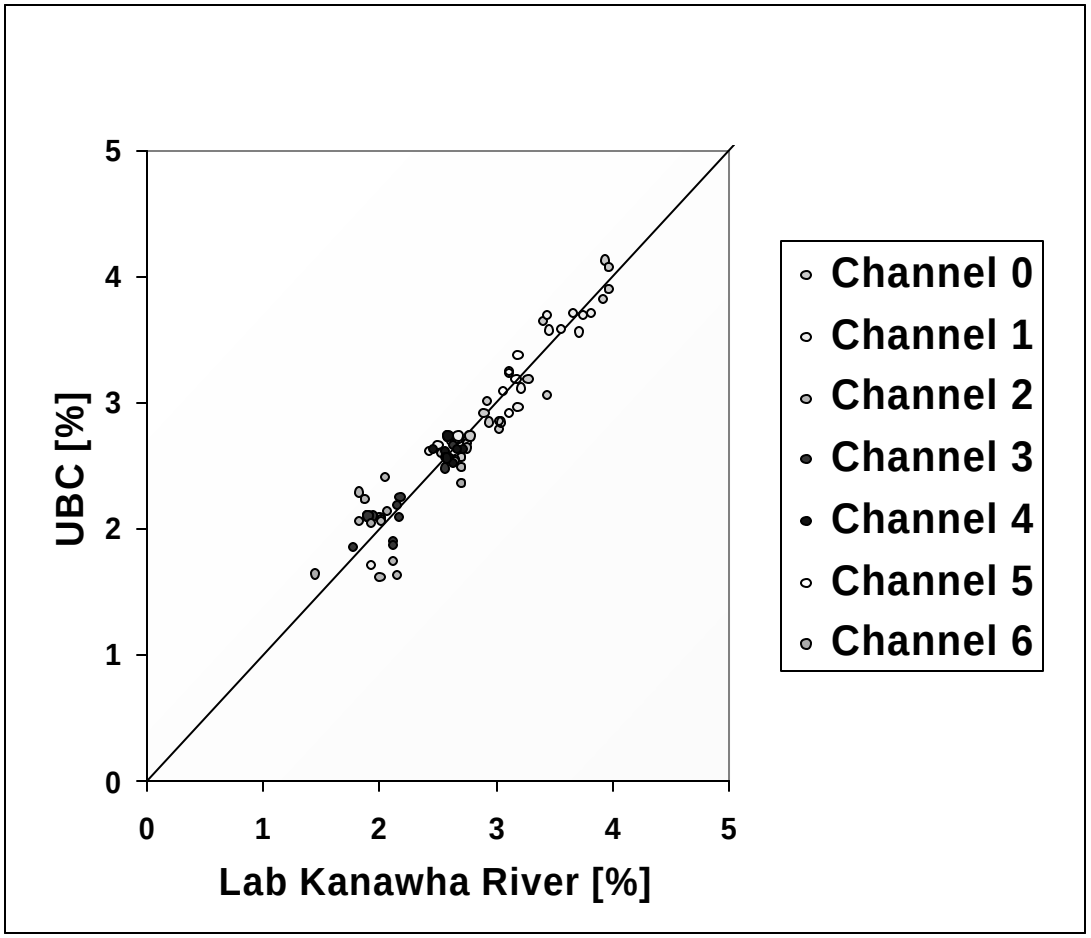
(w/ auto sampling feature)



Main Control Cabinet

- 8 Channel Capability
  - 63” x 24” x 79”
- 4 Channel also available
  - Only 32” wide
- Touch Screen Operator Interface
- Error Messages
- NEMA 12 Rated
- Data Communication:
  - Modem, FTP, PROFIBUS
  - MODBUS, Others

Initial UBC Data Comparison

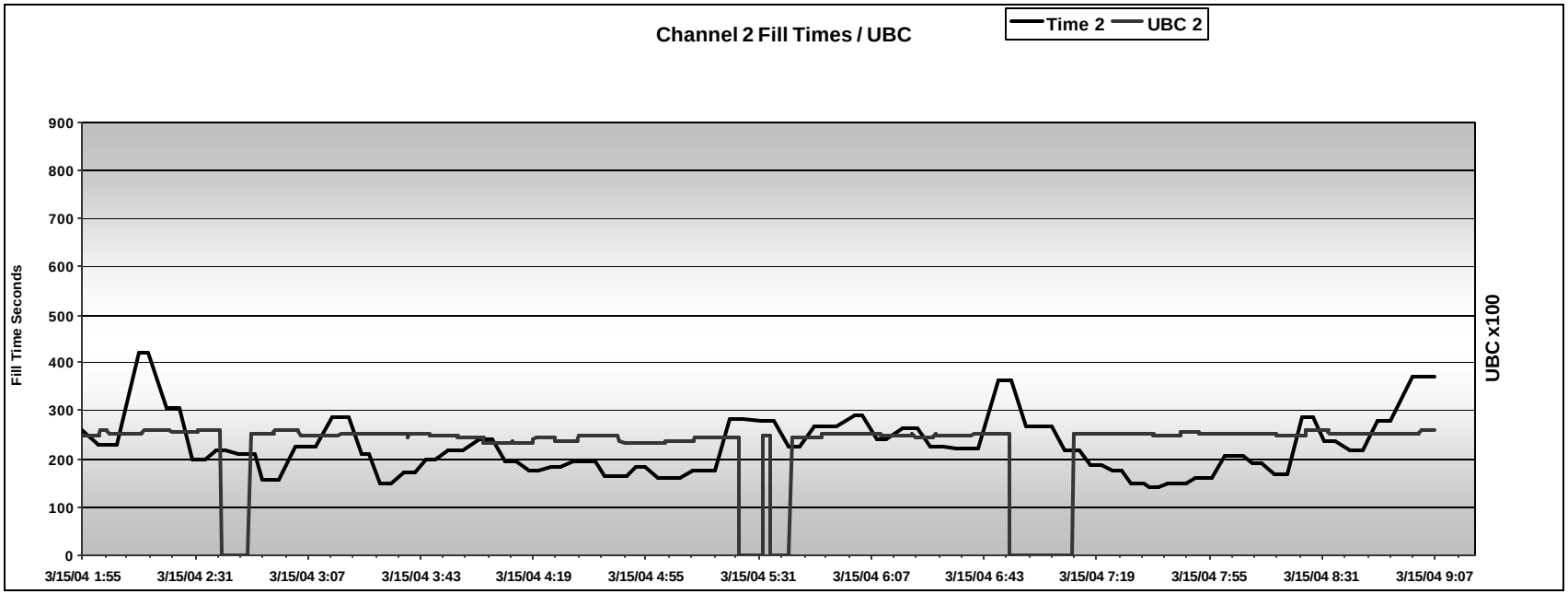


Standard Deviation
of UBC Measurements

Channel 0: 0.17%
Channel 1: 0.15%
Channel 2: 0.28%
Channel 3: 0.15%
Channel 4: 0.10%
Channel 5: 0.16%
Channel 6: 0.25%

All Channels = 0.18%

Operator Display of UBC Data



- SCADA part of UBC system supply
- No interface to old analog control system
- Data monitoring only – no “active” control
- Could easily be integrated in DCS/optimization software

Benefits to the Power Plant

- **Accurate measurement of a very key combustion parameter (UBC)**
- Optimization of mill/boiler performance
- Improvement of NOx, CO, O_2 and UBC (quantity and consistency)
- Operating cost savings by reduction of primary losses and increased fly ash sales

Long-term Plant Benefits

- **Experience with >40 in-situ systems:**
  - Boiler efficiency increase: 0.4 – 1.0%
  - Reduced UBC: 10 – 30%
  - Reduced CO emissions: 50 – 80%
  - Significant increases in fly ash quality/sales
  - Reductions of excess air levels have also indicated reduced NOx emissions and ammonia consumption.

Questions?

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