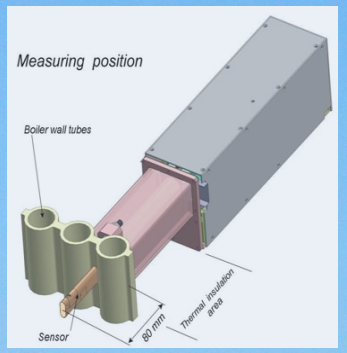
Universal Control System (FTR)

Real-Time, Non-Contact direct Measurement of Fouling Thickness , Reflectivity and Flame Temperature in coal and biomass firing boilers.



Berlin, January 15, 2024

AMS Advanced Measurement Systems Ltd.

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Introduction

- **AMS – Advanced Measurement Systems Ltd**

  Established in 1990, privately held with HQ in Haifa, Israel. Engaged in developing, manufacturing and selling of electro-optical systems for the micro-electronic, power plants and medical industries

- **G.E.E.R. GmbH**

  Established in 2007, privately held with HQ in Berlin, Germany

  Provides consultancy, investments, and in marketing services in energy-saving technologies and cyber security.

FTR is a laser-based system for non-contact measurement in real-time

- FTR is a laser-based system for non-contact measurement in real-time online three critical parameters: Fouling Thickness and Fouling Reflectivity (FTR) and Flame's Temperature inside the Furnace on the operated units.

- The FTR system is evaluated for new and advanced applications by the Institute of Combustion and Power Plant Technology (IFK) at Stuttgart University in Germany in close cooperation with G.E.E.R. GmbH, Berlin, Germany and AMS Ltd, Israel.

- The advanced system is used at the test furnace of the university to evaluate the slagging and fouling behavior of co-firing biomasses and residues in advanced air and oxy fuel conditions.

- The developments are supported by a National German R&D Project which is performed by a consortium of utilities and different research institutions and led by Institute of Combustion and Power Plant Technology (IFK), Stuttgart, Germany.

Problem definition and the FTR solution

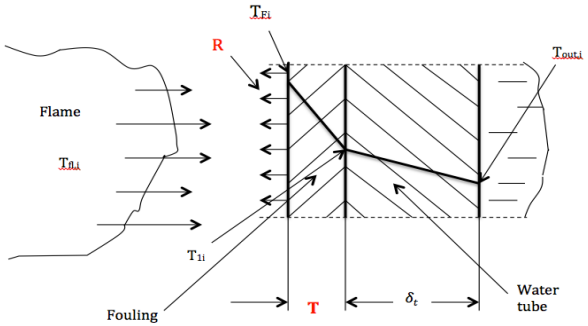
Fouling -the deposition of coal combustion residuals on the furnace wall and the tubes of the convection pass, is a major cause for decreased boiler efficiency

- **Our goal** improves heat transfer between the flame and water in power generating units
- **Our solution:** decrease fouling in the most effective and optimal way

Parameter of Optimization – the **Total Cleanliness Factor** of the unit $CF_{Tot} = Q/Q_0$

$$Q=(Q_1 + Q_2 + \ldots + Q_N); \qquad Q_0 = (Q_{01} + Q_{02} + \ldots + Q_{0N})$$

Q_i and Q_{0i} are computed by calculation of heat transfer between the flame and the water in each zone where FTR sensors are located , using local values of the Fouling Thickness and Reflectivity



Direct measurement of T and R in real time for all locations of FTR sensors

Problem definition and FTR approach (cont.)

- **Local Cleanliness Factor (Cf_i)** is calculated by solving the heat transfer equation (including conduction, convection and radiation) at all of FTR devices at each cycle of measurements

- **Total CF** is calculated after each measurement cycle

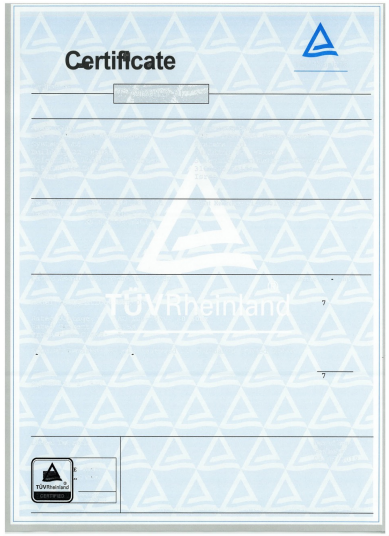
- **Optimal Location for Cleaning**: the optimal zone once cleaned, will generate the maximal increase of CF_{Tot}, is identified every 30-min using an optimization algorithm based on directly measured values T and R in all zones

- **Automatic activation** of the soot blowers in zone of Optimal Cleaning

FTR Intellectual Property & legal status

- **FTR method & FTR system are AMS-patented technology:**
  - US patent No. 9,709,384
  - EU patent No. 2929317

- **FTR system was tested, inspected, certified and allowed for industrial use by:**
  - TÜV (Technischer Überwachungsverein / Technical Surveillance Association) Certification # T-72190809 01



The FTR System Monitors the Water Wall Tubes Metal Loss Rate

- The FTR system provides real-time information on the fouling status and flames temperature inside the furnace. The number of cleaning cycles can be adjusted, minimizing the tubes excess damage of the tubes.
- The FTR system is capable to provide data related to the combustion and heat process inside the furnace
- The FTR-F system can also directly measure changes in the water wall tubes thickness and quantify over time the rate of metal loss due to erosion.

FTR System Installation, operation and maintenance

- FTR devices are electrically powered using standard voltage, pneumatically actuated (compressed air of 6 atm pressure, technical grade). No cooling is required.
- A special design automatically closes the boiler opening when the FTR sensor is removed from the furnace after each measurement, which provides high degree of safety.
- The complete system contains on a boiler furnace entails several FTR devices located in predefined locations where the control of heat transfer parameters is required.
- Each device interfaces with an FTR Main Computer, and the data is transferred to the designated end user (power plant control room, remote location, mobile device etc.)
- FTR Main Computer is interfaces with the sootblowers controllers for automatic activation of optimal cleaning sequence.
- The system has a built-in protection mechanism for voltage failure, furnace pressure drops and for communication lines failure.

FTR System installed on a 550 MW B&W opposed walls fired boiler (a total of 8 FTR sensors installed on 2 side walls)

The FTR System Installation on 550 MW B&W unit

- The **FTR system** has been operating for **> 6 years** at power plants
- Each of these Power Plant has **550 and 575 MW boilers**

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Summary: key benefits of the FTR system

- The direct measurement of **thickness** and **reflectivity** of fouling enables, **flames temperatures** inside the furnace to **optimize operating conditions and improve heat transfer in the boiler in real time**.
- FTR provides **automatic activation** of optimal cleaning procedure of the furnace.
- FTR helps optimizing the number of cleaning cycles, **avoiding excess damage of the water tubes**.
- The FTR system enables direct measurement of the changes in the water wall tubes thickness and **quantifies the tube metal loss rate due to erosion.**

Summary: key benefits of the FTR system

- **Cost effective,** providing monetary savings through:
  - **Reduced** needs for **fuel** due to increased boiler efficiency and reduced RH spray (annual estimate is **0,3 -0,4** even in boilers where ISB is active)
  - **Reduced** usage of **compressed air, water or steam for sootblowing and operation cost**
  - **Improved maintenance** due to increased tubes lifetime from reduced erosion and reduced FEGT (estimated 30% reduction in maintenance cost and increase of annual saving)
- **Return on Investment** (ROI) for the FTR system less than 2 years

Thank you

Let's do a pilot project on a single block as a proof of FTR benefits at your plant!

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Please watch the “FTR Movie”

https://tinyurl.com/reecuqj

Appendix

- **The FTR Technology: How it Works**
- **The FTR system generates unique data**
- **Soot blowing sequence Controlled by the FTR System - Cleanliness Factor = 0.85**
- **FTR Sensor Installation**
- **FTR-F System hardware elements supplied by AMS / G.E.E.R.**

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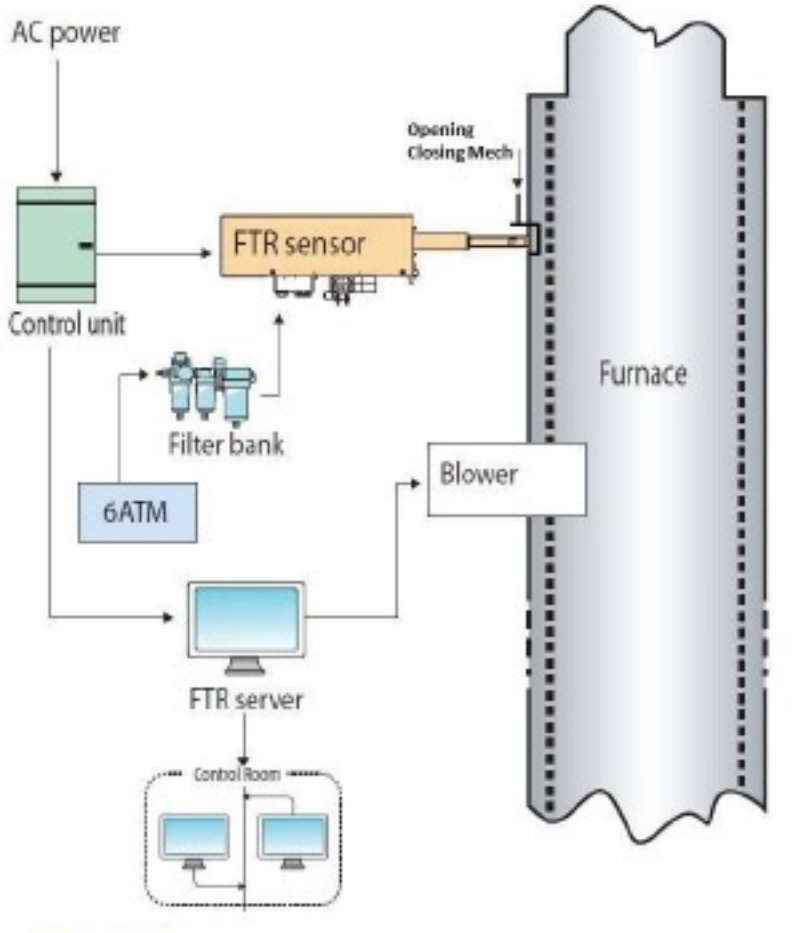
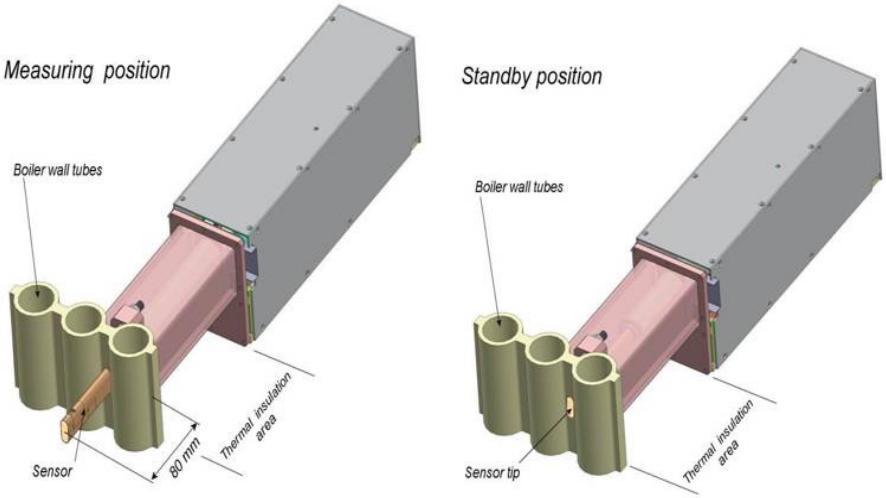
The FTR Technology: How it Works



AMS Sensor schematics



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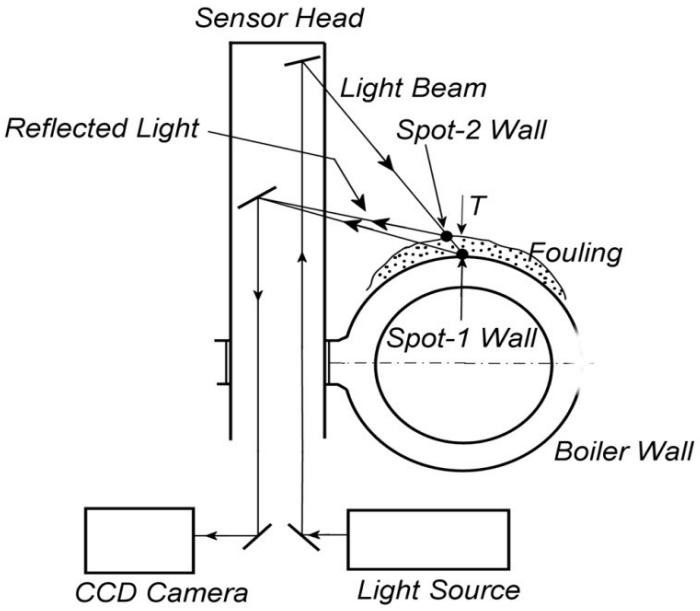
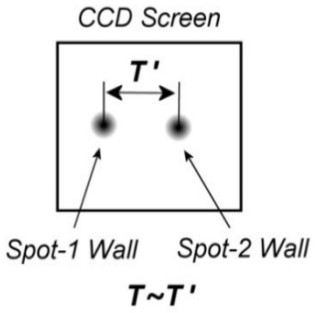
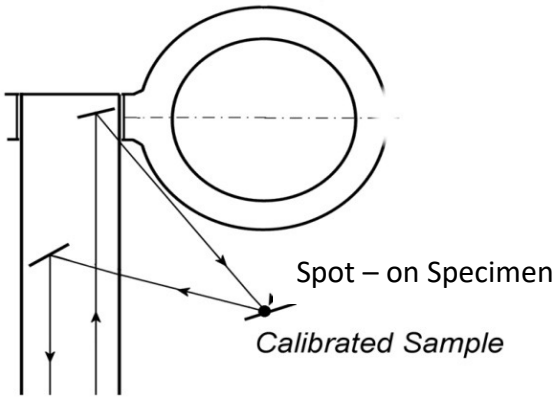
The FTR Technology: How it Works

Step 1 – sensor inside the furnace





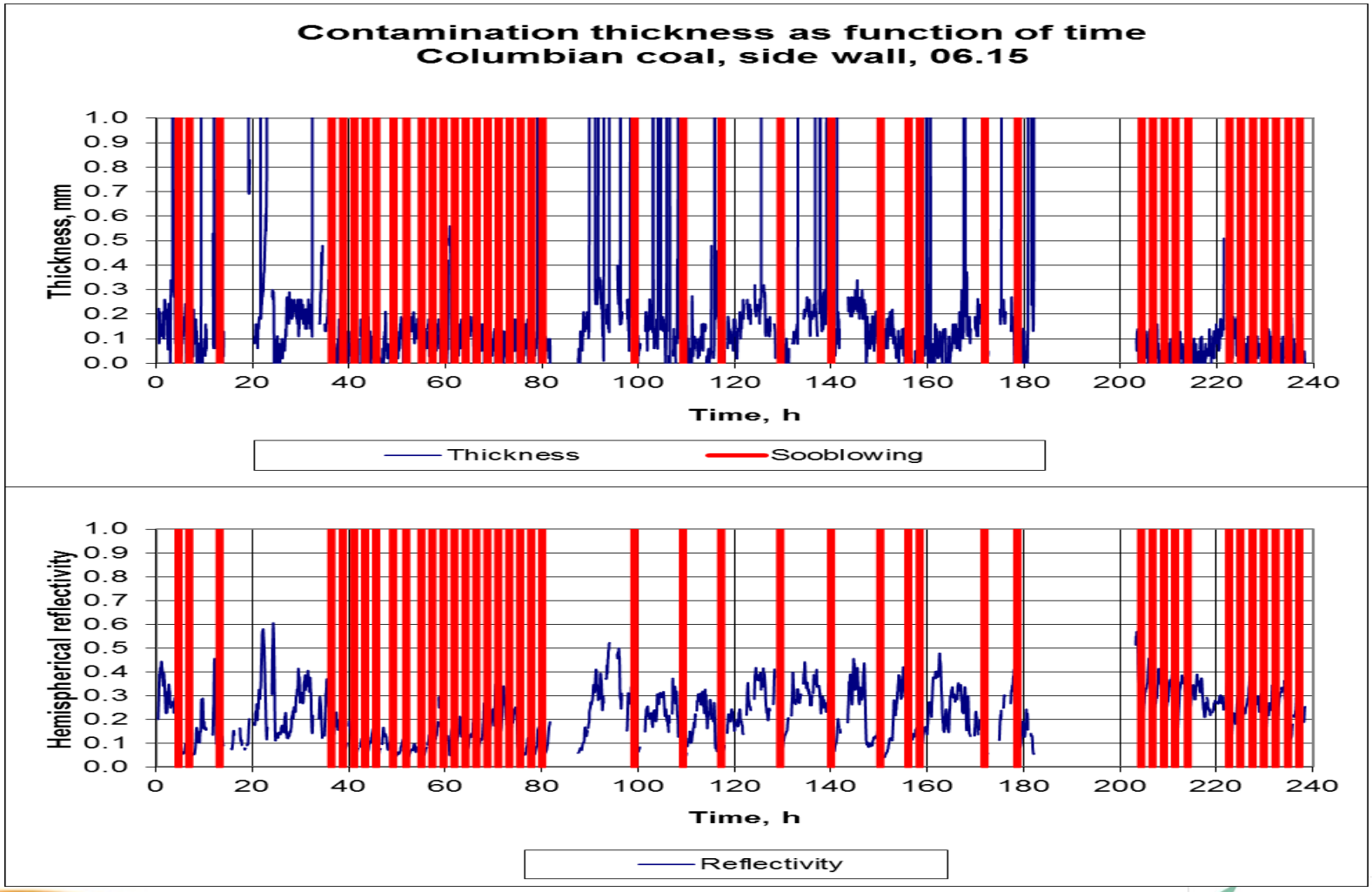
Step 2 – sensor outside the furnace



Fouling Thickness is proportional to the distance between two spots on CCD, T = KT'

The FTR system generates unique data:

Sootblowing sequence – without FTR, with Heat Flux Sensors, Cleanliness Factor = 0.7



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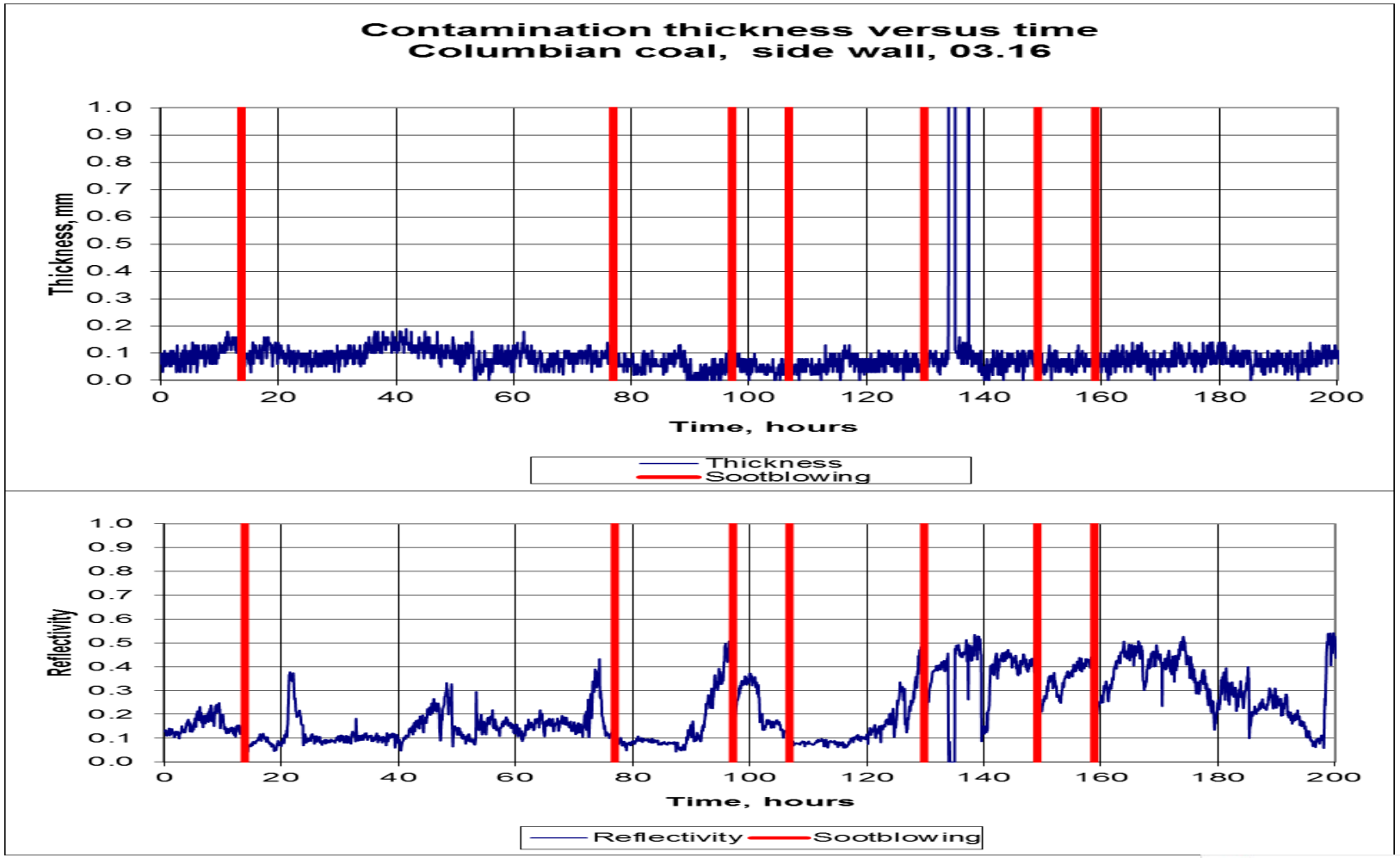
Soot blowing sequence Controlled by the FTR System - Cleanliness Factor = 0.85



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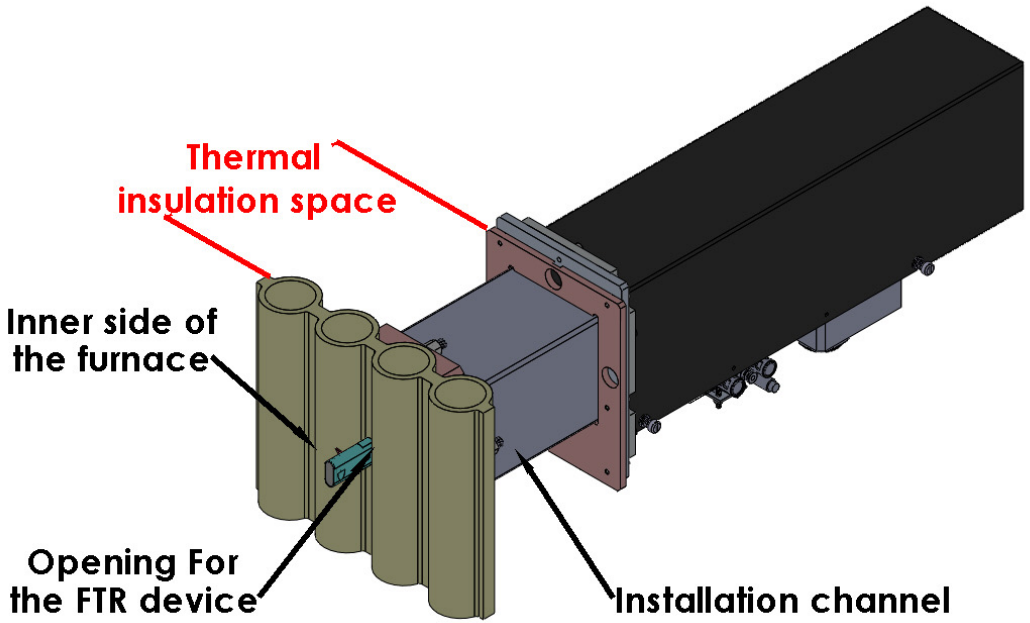
FTR Sensor Installation

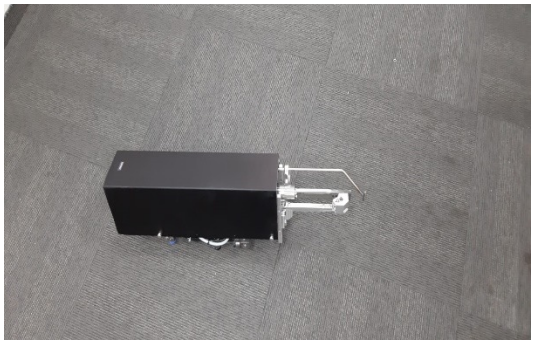
Schematics of the Sensor on the furnace wall



FTR-F System hardware elements supplied by AMS / G.E.E.R.

Casing (item # 5)
Size: 15 cm x 12 cm x 30 cm
Weight: 3.7 kg

Air Filters bank (**item # 2**)
Size: 40 cm x 18 cm x 15 cm
Weight: 6 kg



FTR Sensor with laser optics (item # 1)
Size: 45 cm x 15 cm x 14 cm
Weight: 5.3 kg

Processing unit (**item # 3**)
Size: 40 cm x 45 cm x 22 cm
Weight: 6 kg

FTR Server (**item # 4**)
Size: 53 cm x 65 cm x 28cm
Weight:7 kg

F

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