

A close-up photograph of industrial machinery, likely a furnace, featuring a braided metal hose and various metal components. A large blue semi-transparent shape is overlaid on the left side of the image, containing text.

Topsoe Furnace Manager benefits for ammonia producers

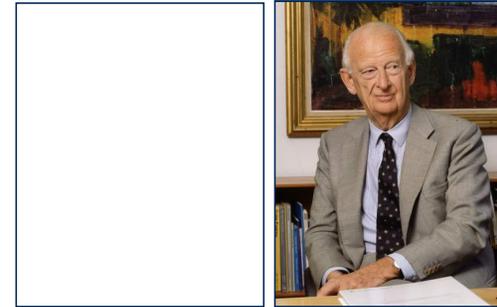
Sachin Panwar
Business Development Manager

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Haldor Topsoe Company in brief

- Established in 1940 by Dr. Haldor Topsøe.
- Market leader in heterogeneous catalysis and surface science for 75 years.
- More than 2,800 employees in 11 countries across five continents.
- 2015 revenue of approximately USD 1 billion
- Headquarters in Denmark.
- Production in Denmark, and Houston, Texas, USA.
- New plants in Tianjin, China, and Joinville, Brazil, in 2015.
- Spends more than 10% of revenue on R&D.



We provide a full range of products and services for a broad range of business

Chemical Processing



Hydroprocessing



Emissions Management



Process design,
Engineering, & licensing

+

High-performance
catalysts

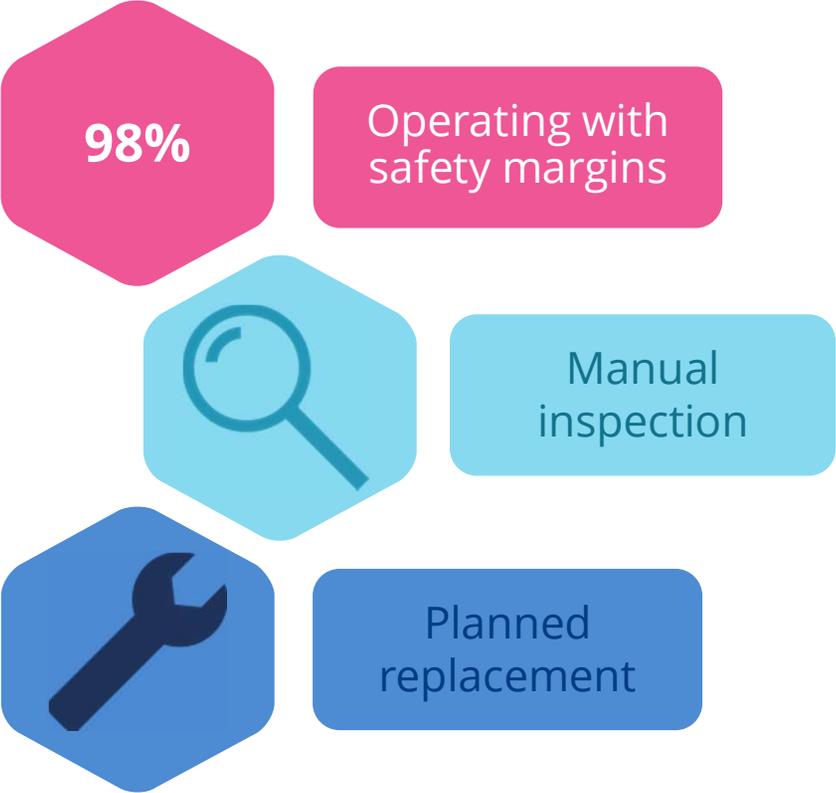
+

Proprietary
equipment

+

Business &
technical services

Conventional methods to operate the furnace



Critical areas associated manual inspections



Manual
inspection

Skills

- A new Topsoe study shows the 1.0 pyrometers the most accurate. They are also very sensitive and difficult to operate and requires enhanced training.

Safety

- Manual inspections exposes risk to personnel.
- IR can cause long-term, permanent eye damage leading to impaired vision or blindness. Source: ISEA

Frequency

- Is it being done?
- Lack of manpower due to slimming
- During transition constant monitoring is crucial.

Critical areas associated with planned maintenance



Planned
Replacement

- What if tubes have been stressed and need replacement before it is planned?
- What if you could avoid replacing “healthy” tubes?

Topsøe observations. Unplanned stops

- 15 days down / year, related to typical faults



Operating with high safety margins

98%

Operating with
safety margins

- Relatively small temperature differences can lead to significant revenue loss

$\div 20\text{ }^{\circ}\text{C} \rightarrow \sim 2\% \rightarrow 7\text{MM USD/year}$

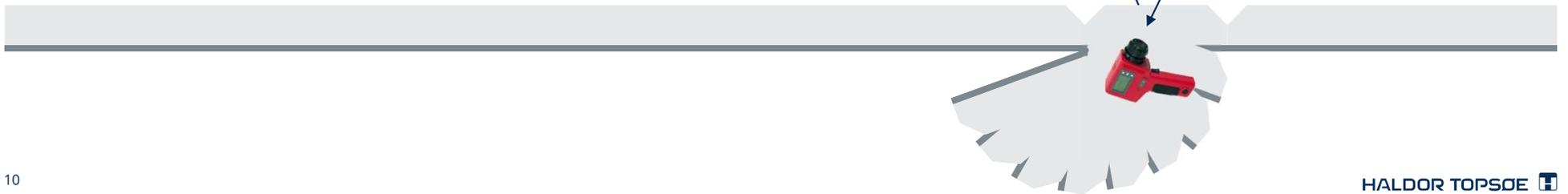
*2,000 MTPD ammonia plant – 480 USD/MT ammonia

Tube measuring sequence

Cooling at peep door opening

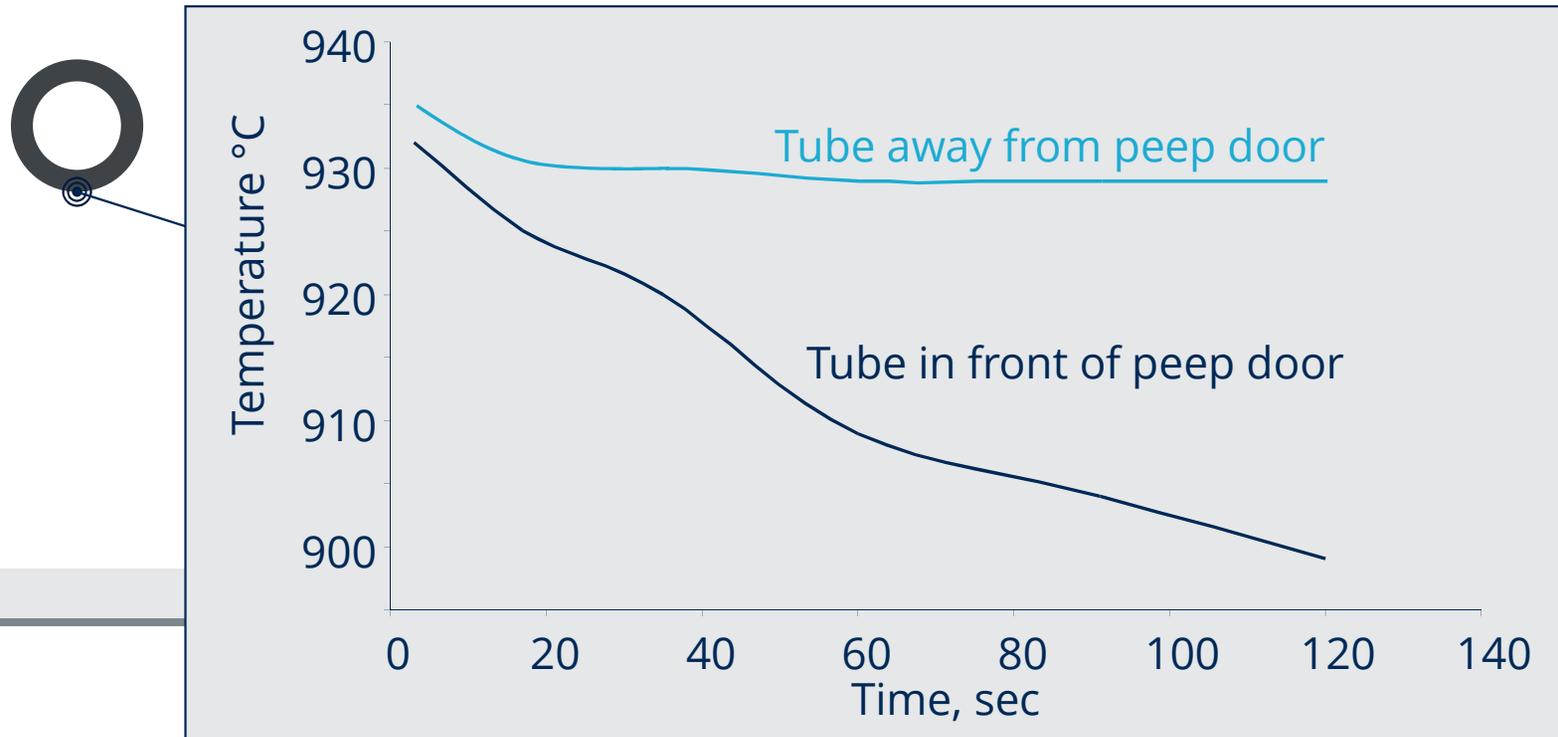


Maximum **3 sec** opening
for measuring **in front** of
the peep door



Tube measuring sequence

Cooling at peep door opening



TWT measurements

Why is accuracy important

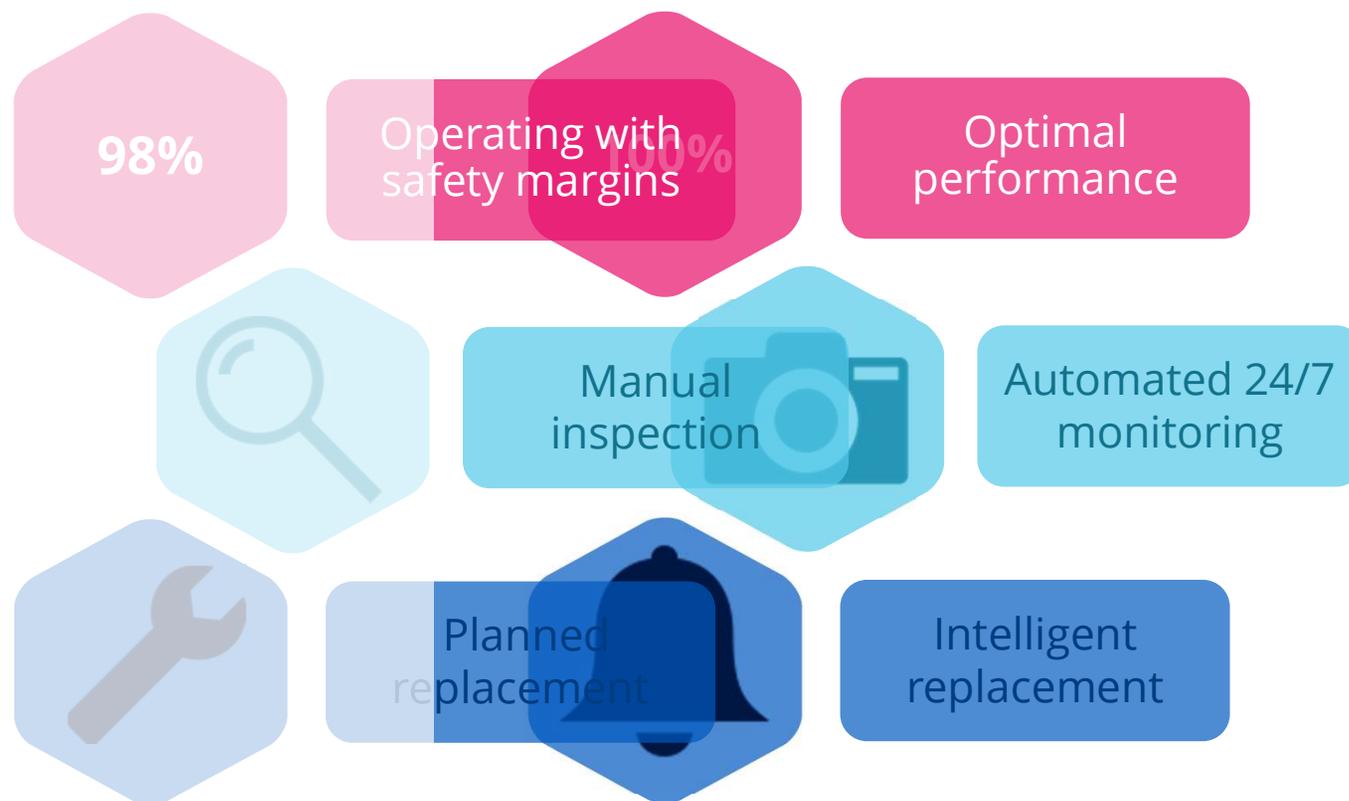


~7 million USD/year lost production

How well do you know your temperatures?

A new way forward...

TOPSOE FURNACE MANAGER



A close-up photograph of industrial machinery, likely a furnace, featuring a braided metal hose and a cylindrical component. A large, semi-transparent blue shape is overlaid on the left side of the image, containing the text.

Topsoe Furnace Manager

Furnace Information Acquisition & Analysis

What is it?

Topsoe Furnace Manager (TFM) is a patented, computerized, fully integrated, image-based system that monitors the furnace inside the SMR continuously.

TFM is a “furnace GPS” providing:

- Process efficiency
- Reliability
- Safety and
- Equipment status
- To your entire organization – locally and remotely – 24/7

Topsoe Furnace Manager shows the 'big picture' continuously

What is it monitoring?

- 100% of all burners (typical)
- Critical heat transfer tube surface area
- Mechanical Integrity images with data
- Overall furnace status

Topsoe Furnace Manager Views the Furnace

What does it do?

- Provides Status Change indications with alarms
- Archives benchmark operational & equipment information
- Provides direct visual images with translated data displays
- Provides a User friendly Historian

Topsoe Furnace Manager is Practical

Image-modules and control-boxes

- Modular, Multi Unit System
- Plug-and-play
- Interchangeable components
- Weather proof, industrial grade
- Ease of access for PM & upkeep
- Readily available spare parts
- Long life design
- Flexible mounting orientation to avoid interference with furnace work



Topsoe Furnace Manager is “industrial grade”

End Wall Burner Configuration



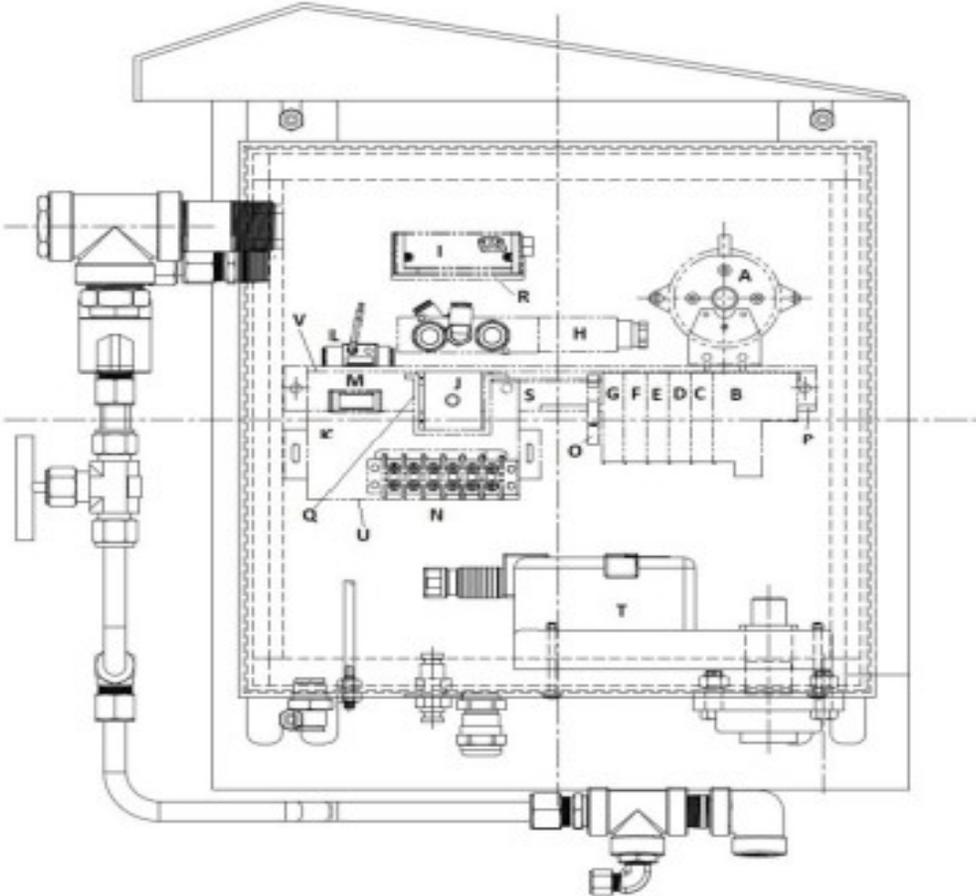
Side Wall Tube Configuration



FMT Sensor



Control Box

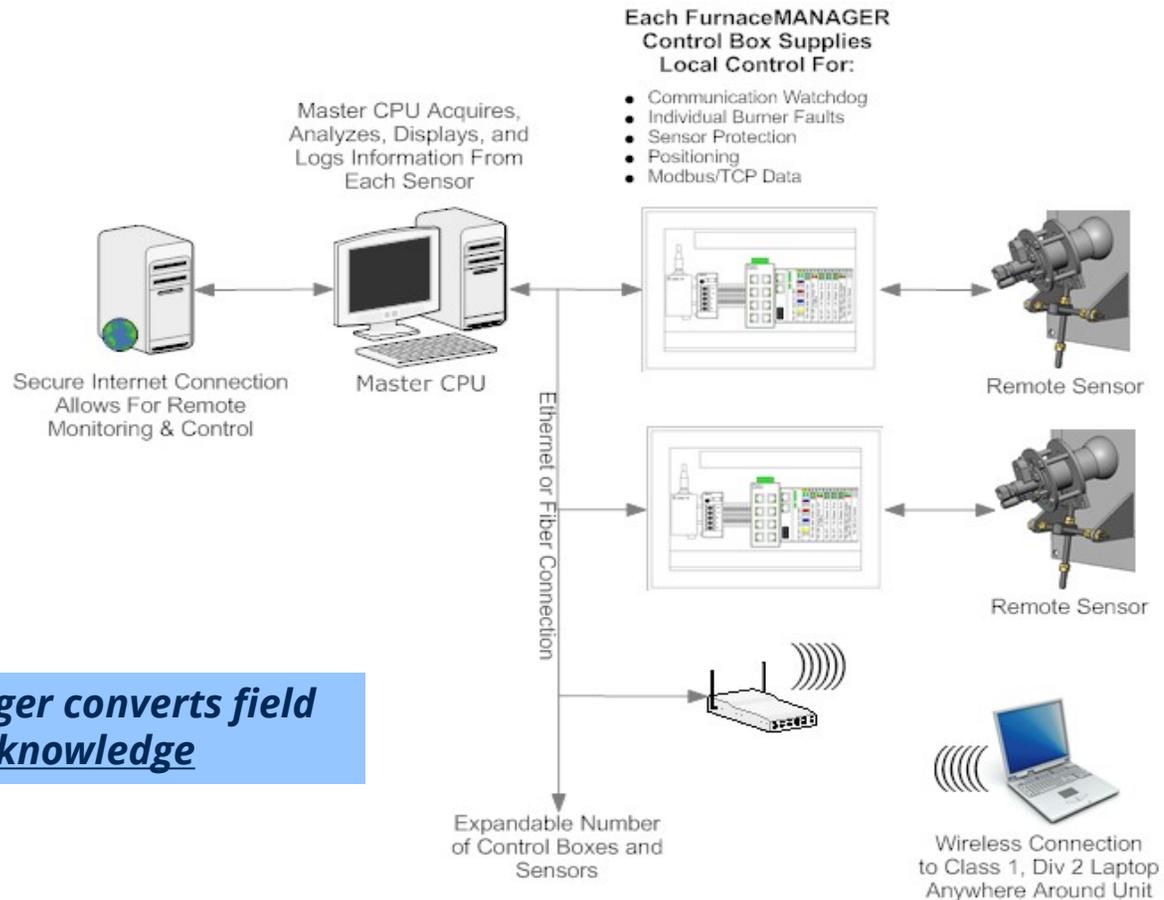


- A- Box pressure Switch
- B- PLC
- C- Digital Output Card
- D- Analog Output Card
- E- Digital Input Card
- F- Analog Input Card
- G- End Modules
- H- Retract Solenoid
- I- Camera
- J- Power Supply
- K- Power Cover
- L- Line pressure Switch
- M- Main Power Switch
- N- Line Terminal Strip
- O- Switching Relay
- P- Vertical Mounting Bracket
- Q- Power Clamp Bracket
- R- Camera Mounting Bracket
- S- 24VDC Terminal Strip
- T- Camera Actuator
- U- 24 Volt P.S.U.
- V- 12 Volt P.S.U.

CONTROL BOX COMPONENTS

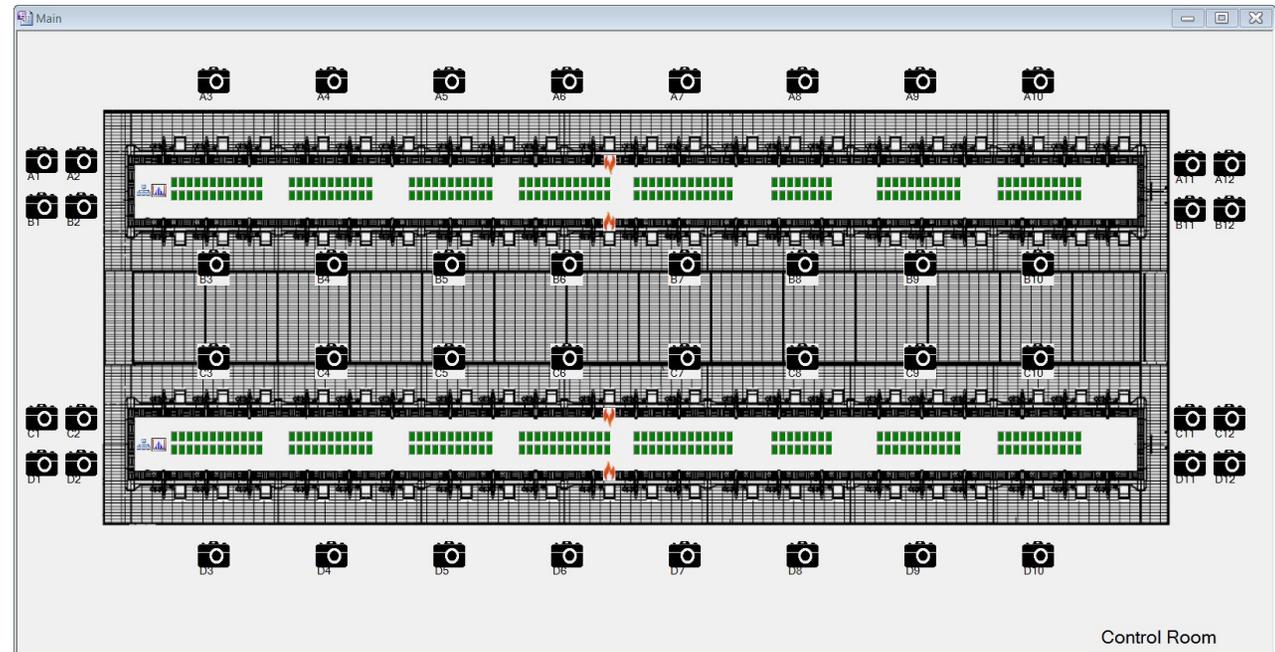
Note: Components may be in different locations in different Boxes.

Topsoe Furnace Manager architecture



Furnace data display screen

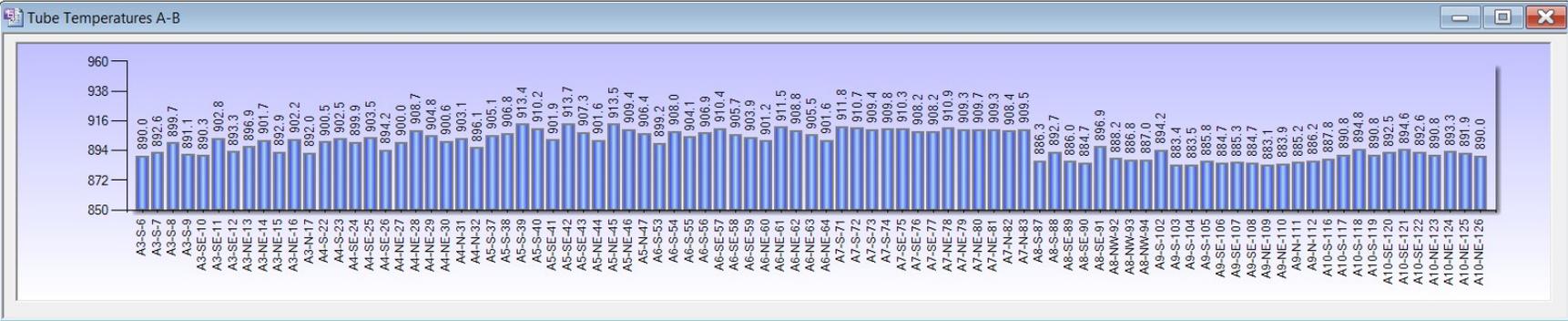
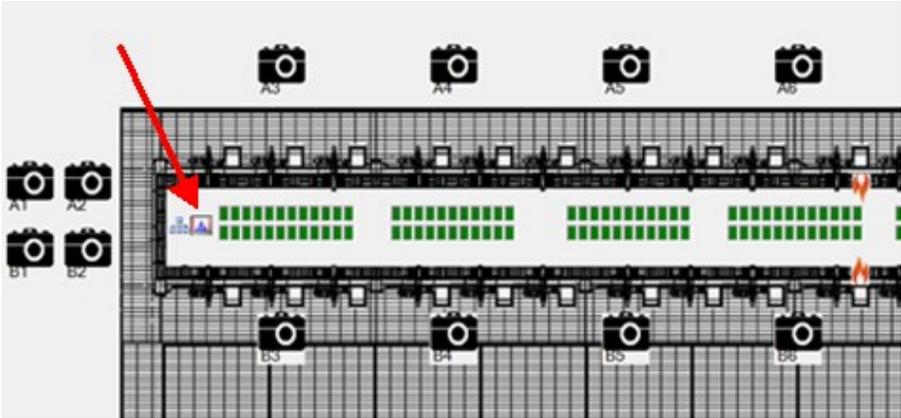
- Example overview graphic with status of tube monitoring
- Rows of green boxes in the center of each cell indicate the tube status:
 - **Green** = within tolerance
 - **Yellow** = slightly out of tolerance
 - **Red** = out of tolerance
 - **Cyan** = camera has not inspected this tube yet.



*Topsoe Furnace Manager snapshots
highlight problems early*

Tube Temperature details

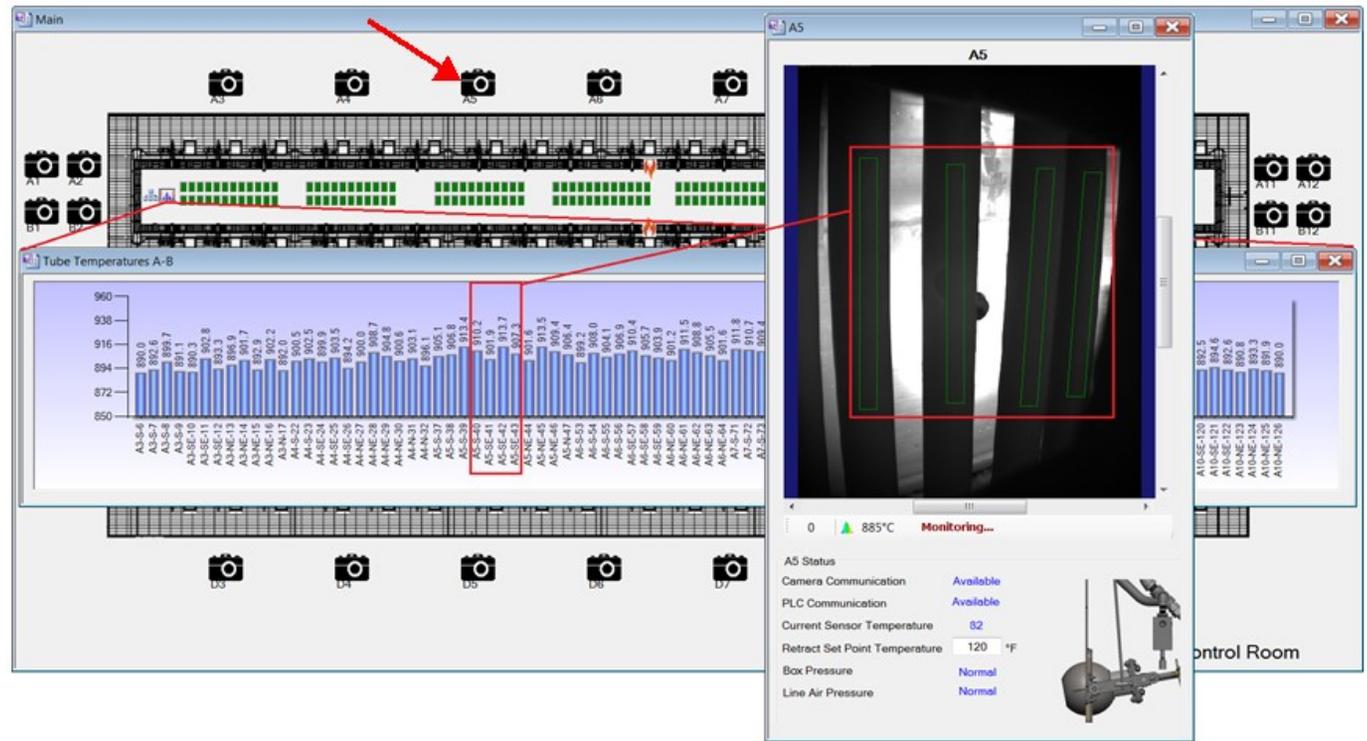
- Clicking the icon indicated displays a tube temperature graph showing tube number and average tube temperature.
- Each of the tube imagers, A3-A10, B3-B10, C3-C10 and D3-D10 move to one-of-four positions every minutes. This cycle ensures that the temperature of every tube updates every 20 minutes.



Topsoe Furnace Manager detailed data drives action

Tube details

- Clicking one of the Tube imager icons displays the view from that imager with status shown below.
- Tube images correlated to temperature data.



Topsoe Furnace Manager correlates image to data

Tube images

- Tubes viewed directly in a group
- Tubes viewed individually
- Tube images captured at different angles

Left View



Center Left View



Center Right View



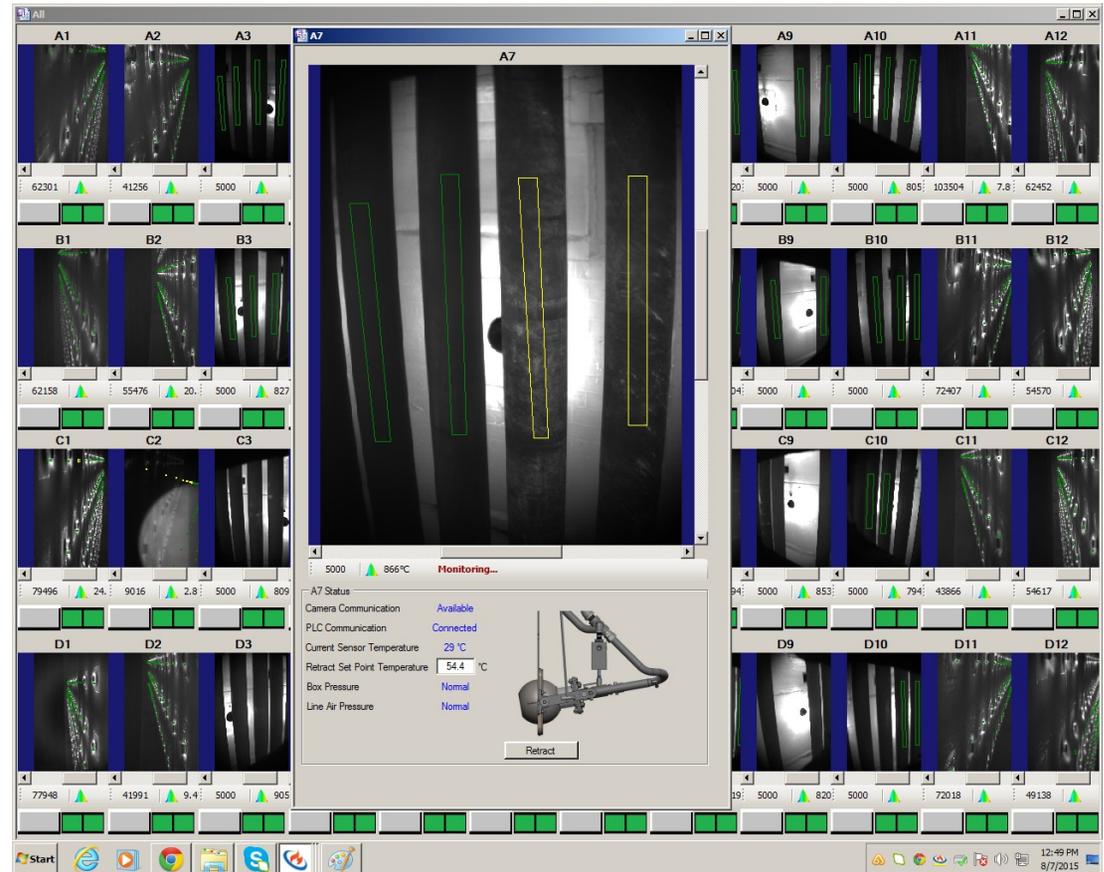
Right View



Topsoe Furnace Manager looks at all angles

Problem Tube Images

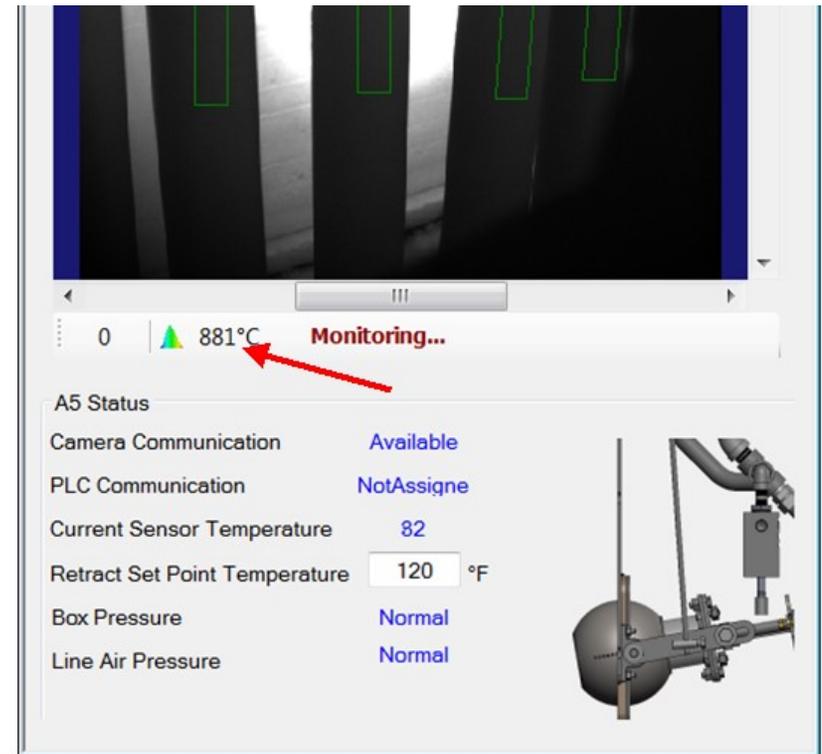
- Easy to see problems
- Compare and contrast quickly
- Store & compare over time
- Earmark for outage reference
- Distribute for analysis



Topsoe Furnace Manager finds the problems

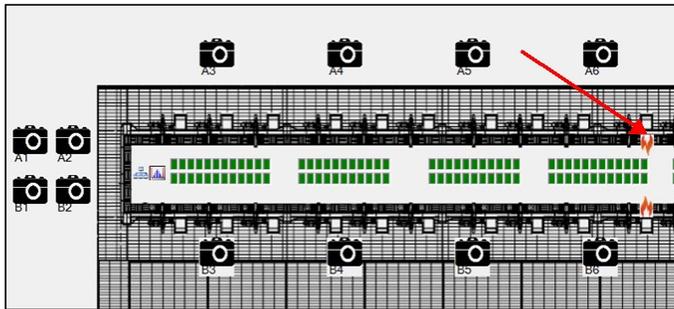
Detailed asset status

- The temperature displayed below the picture of the tubes indicates a point temperature from anywhere the cursor is pointed.
- The message next to that indicates current status of the image module.
- The remaining data provides status of cooling and pressure for sensor and control box.

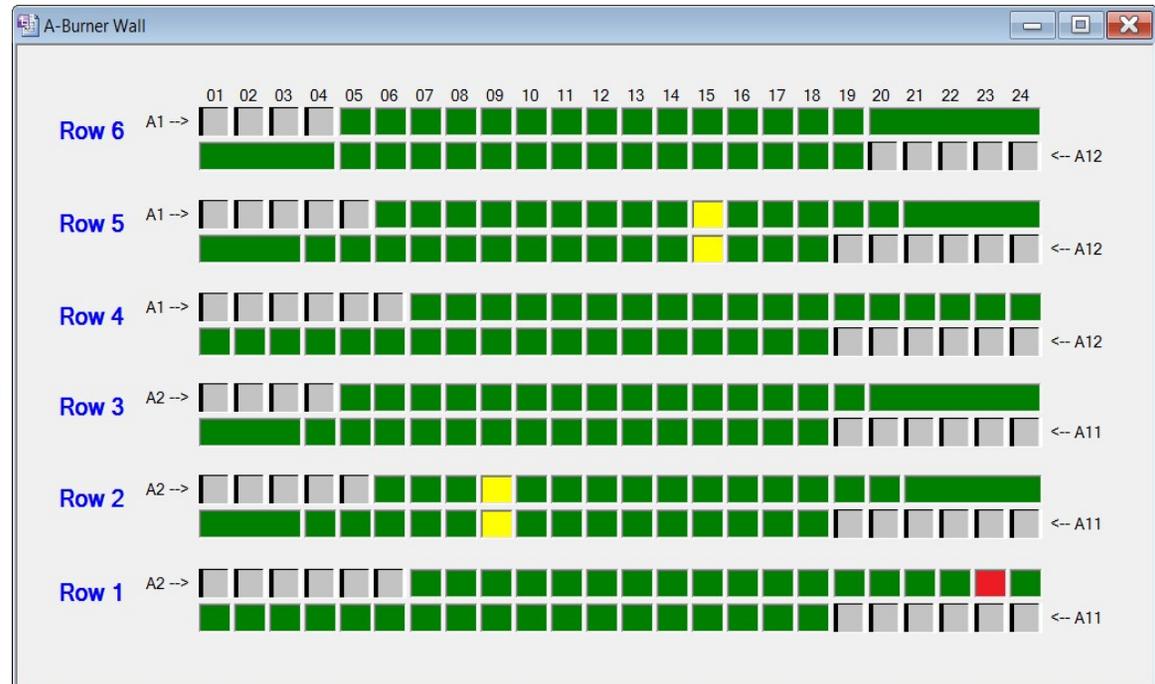


***Topsoe Furnace Manager monitors
firebox & its own health***

Burner status

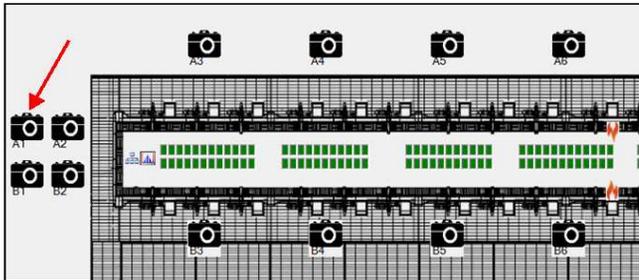


- Clicking the icon indicated brings up a screen showing the status of burners on wall selected:
 - Grey = not visible from this camera
 - Green = within tolerance
 - Yellow = slightly out of tolerance
 - Red = out of tolerance
 - Cyan = camera has not inspected inspected this burner yet.

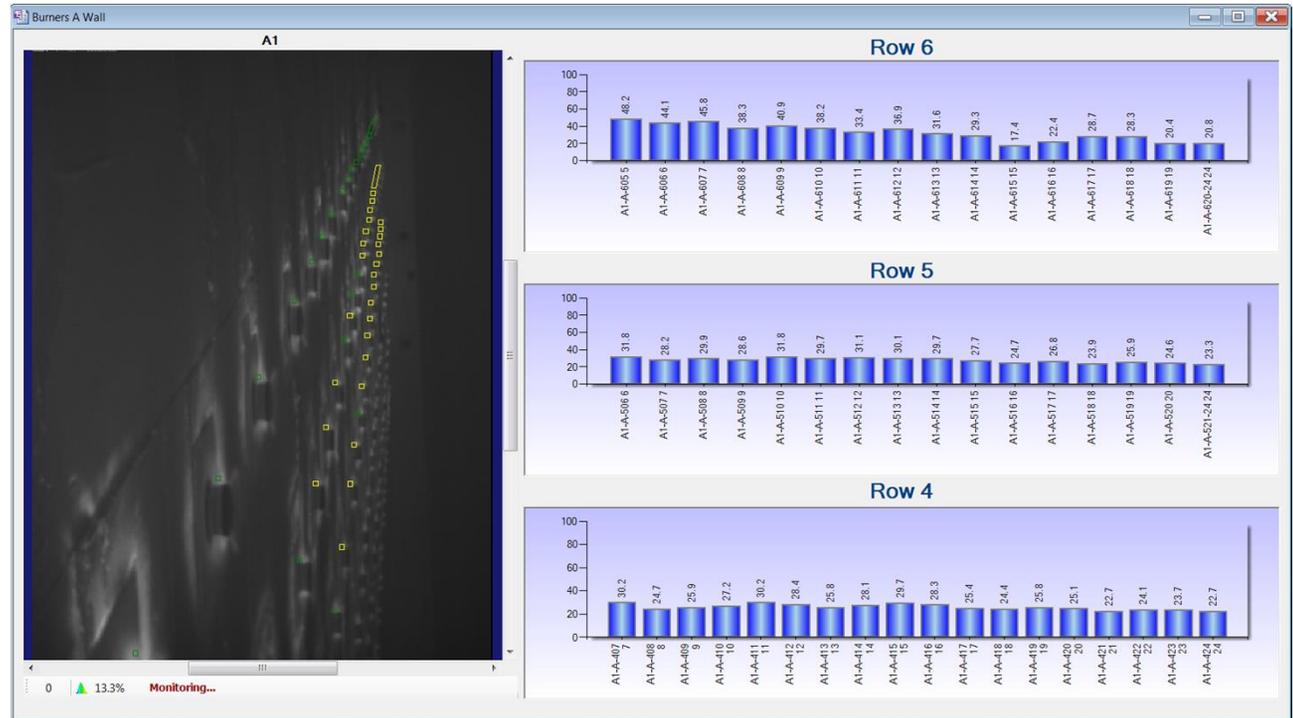


Topsoe Furnace Manager interprets burner performance

Burner performance



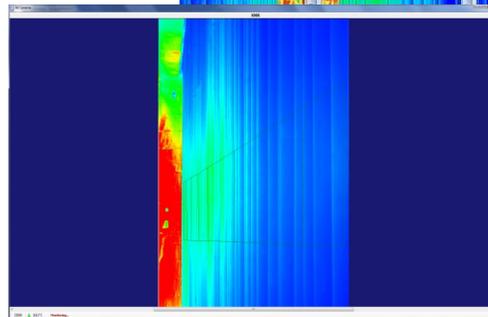
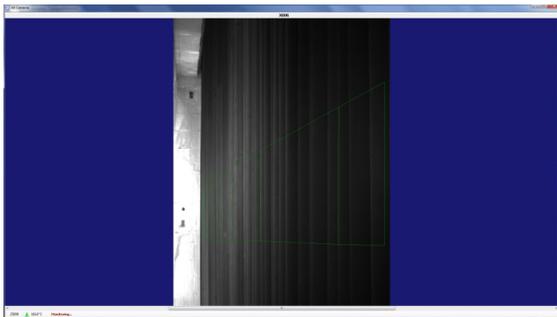
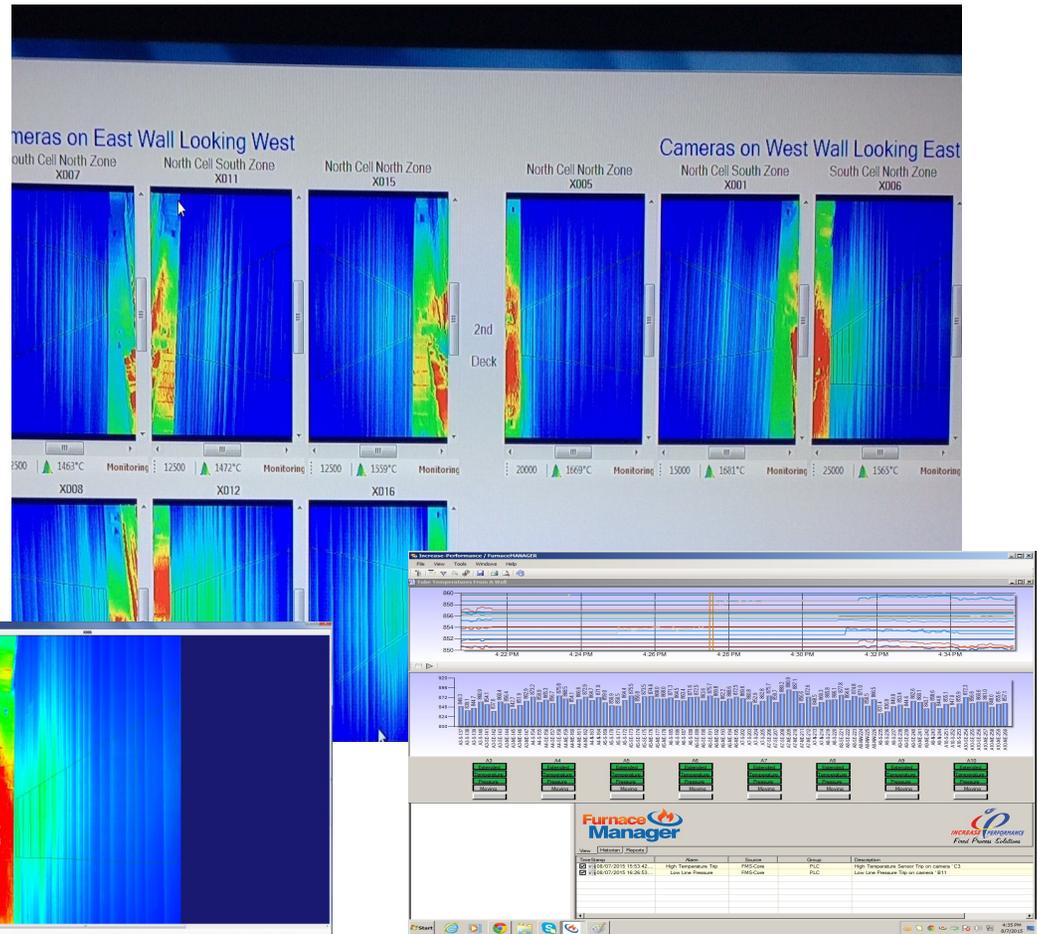
- This image shows one of the four burner imagers looking at this burner wall.
- Can view multiple burner rows.
- Charts indicate burner intensities for each of the rows monitored.



Topsoe Furnace Manager provides process knowledge

Image color coding

- Color coded surface temps
- Easy identification of abnormalities
- Quick view of furnace health
- Images provide context of overall furnace condition
- Images correlated with data



Topsoe Furnace Manager has vivid displays

Benefits – operational excellence

Asset protection: Reliability and mechanical integrity:

- Longer tube life and catalyst life
- Real-time images of firebox integrity (arch condition, refractory, burners, tube integrity)

Safe operation: Safety and compliance

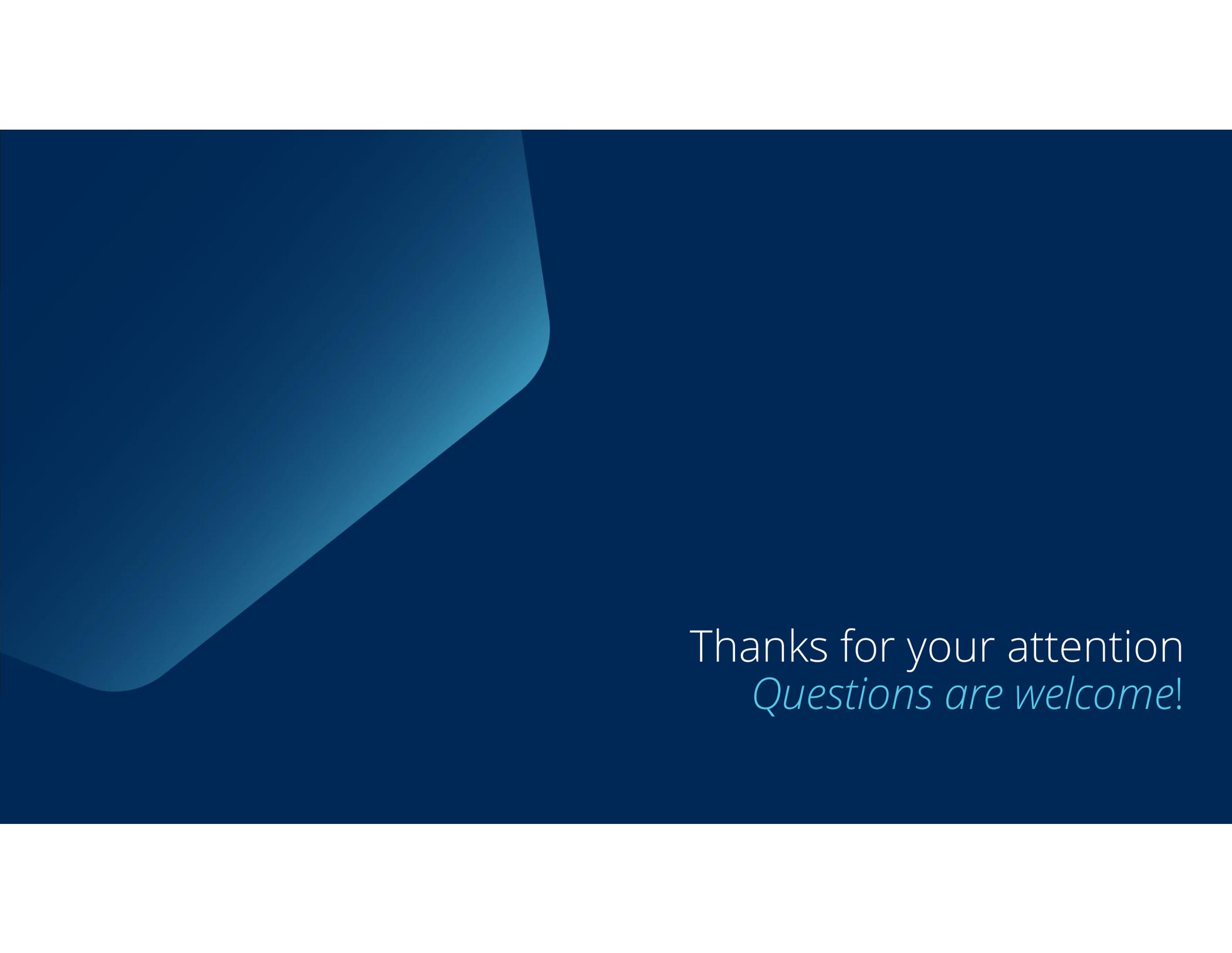
- During burner ignition burner status will be indicated directly
- Detection of overheated tubes immediately, minimizing risk of tube rupture.
- Efficient burner operation, with elimination of afterburning, poor combustion & startup problems
- Reduced operator interaction with the hot parts of the furnace. No burned eyes or eyebrows!

Topsoe Furnace Manager leverages entire organization

Benefits – operational excellence

- Plant Optimization: Productivity and variable margin Improvement
 - Lower energy consumption with balanced firing
- On-line monitoring (remotely accessible)
 - Data collection 24/7 retained in Historian
 - Benchmark operation easily identified
 - Data collected continuously, systemically and without interference. More accurate data

Topsoe Furnace Manager leverages entire organization



Thanks for your attention
Questions are welcome!