

Heat Flux and Corrosion (HFC™) Monitors

Non-Invasive Systems for Monitoring at Point Locations using External Sensors. Primarily Designed for Boiler Membrane Walls. Applications also include Pipelines and Storage Vessels.



Developed from our Established Scanner Technology and Tailored for Point Locations



On-Line Monitoring of Boiler Fireside Conditions using Non-Invasive and Robust External Sensors



Real-Time Monitoring of Thermal Behaviour: Heat Flux, Surface Temperatures, Slagging, Fouling and Wall Cleaning



Can be used in Place of Intrusive Heat Flux Sensors e.g. for Wall Cleaning Operations



Continuous Monitoring of Fireside Tube Wall Corrosion and Erosion



Compact Fully-Autonomous Technology: Multiple Configurations with Low Installation Costs



Multiple Interface Options with Plant Information Systems



Monitoring of Pipelines and Storage Vessels



Patented Technology

ROWAN
TECHNOLOGIES LTD

www.rowantechnologies.co.uk

SYSTEM OVERVIEW

HFC monitors are non-invasive heat flux monitoring systems with in-built tube wall corrosion and erosion monitoring capability.

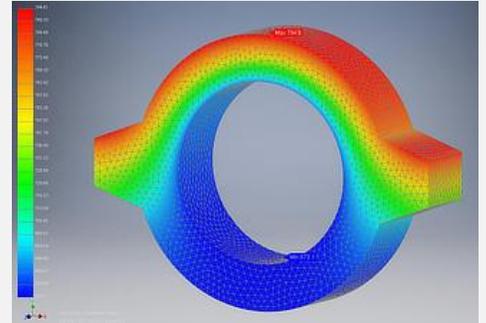
They use refinements of our scanner's measurement techniques. For tube walls, 'active' signals are applied through the whole tube cross-section, both for thermal and corrosion measurements, to directly determine fireside tube wall conditions.

HFC systems monitor at point locations. For membrane walls, measurements are typically taken across 1 or 2 tubes, compared to the 'whole wall' approach, using rectangular sensor arrays, used by our scanners.

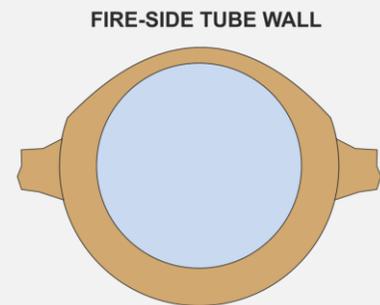
Like scanner sensors, HFC sensors are non-invasive: no access through the boiler wall is required. The sensors are welded directly to the cold-side wall surfaces.

HFC monitors comprise fully-independent electronics with on-board computing power, all housed within a small double-sealed enclosure that can be interfaced to plant information systems using a variety of methods. Additional multiplexing creates multi-point monitoring capability.

These systems can be used for monitoring other surfaces such as pipeline walls and storage vessels.



Finite Element Tube Wall Heat Flux Simulation:



Fireside Corrosion:
Subcritical Boiler



Sensor Configuration



Sealed Dual-Enclosure Design

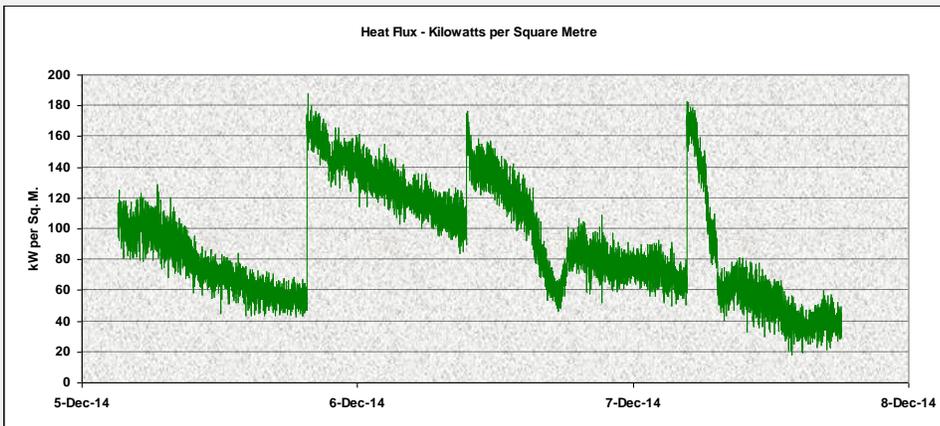
THERMAL MONITORING

For heat flux monitoring of tube membrane walls, HFC systems use a dual measurement approach: the first method (a refinement of the scanner's technique) uses passive measurement of tube surface conditions, whilst the second method actively passes signals through the whole wall cross-section, including the fireside tube wall. Results from both methods reinforce each other and are combined to optimise data quality.

Regular Logging Cycle

Up to around ten measurements per minute are processed in real-time, stored locally at the electronics and made available to the plant information systems via a number of methods: 0-10V or 4-20 mA analogue signals and digitally via serial or Ethernet links.

These methods provide a range of options for real-time data acquisition and display using an office or control room computer.

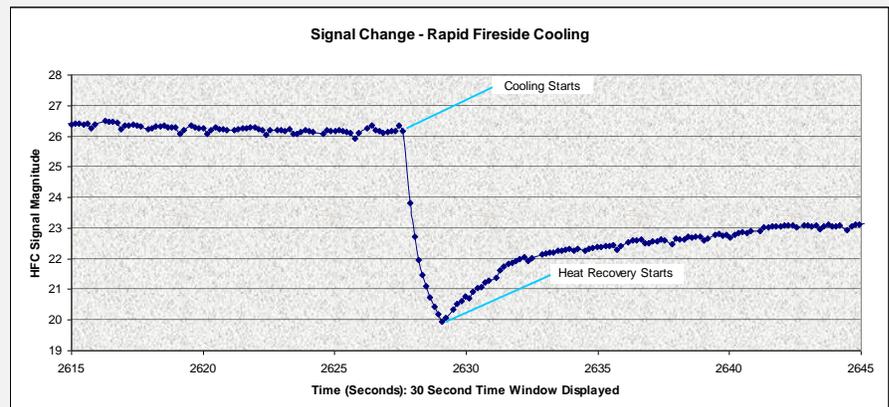


HFC Heat Flux Data:
Subcritical Boiler

Fast Transient Logging Cycle – Water Cleaning Operations

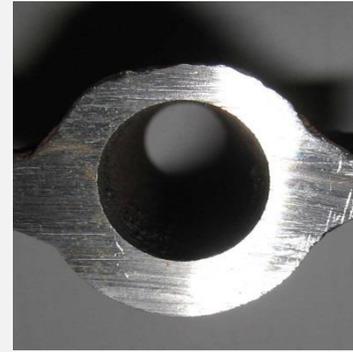
System can be configured to capture thermal transients caused water cleaning of boiler walls, using a sampling rate of around 7 samples per second. In doing so, they capture and quantify thermal shock events on fireside tube wall surfaces, enabling data post-processing in relation to cumulative tube wall stress.

HFC Heat Flux Data:
Laboratory Data of
Rapid Fireside
Cooling



CORROSION MONITORING

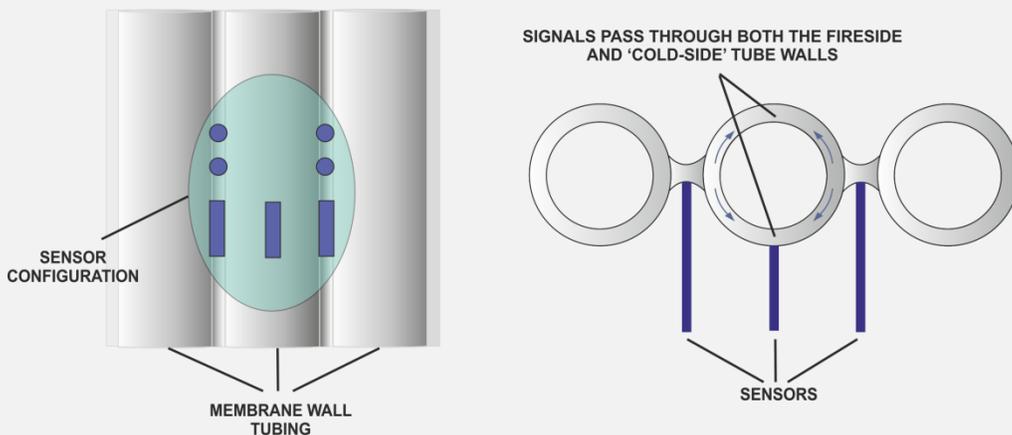
HFC monitors use a refined version of the scanner's electrical resistance corrosion monitoring methods. The highly-focused monitoring approach i.e. typically across a single tube, helps to minimize sources of measurement noise (mainly caused by the dynamics of the boiler wall), resulting in improved response times when detecting metal loss. Corrosion data is stored locally at the electronics and is also delivered to plant information systems in the same way as thermal data.



Superheater Tube Wall Corrosion

HARDWARE OVERVIEW – TUBE MEMBRANE WALL

The schematic below shows the electrode/sensor arrangement. A total of seven robust sensors are welded directly to the cold-side of the tube wall, typically around a single tube. During the measurement sequence, signals pass around both cold-side and fireside tube walls, enabling the cold-side sensors to detect fireside tube wall conditions.



HFC enclosures are usually positioned in readily-accessible locations within about 15 metres of the sensor locations. Signal cables, pre-connected to the enclosure, run to the sensors in suitable conduit. Enclosures are powered from a single low-voltage DC supply.



SPECIFICATIONS AND CONFIGURATION OPTIONS

THERMAL MONITORING

- Regular logging cycle: approx. 10 heat flux measurements per minute.
- Fast transient logging cycle: approx. 7 measurements per second.
- Sensor difference accuracy $<0.2^{\circ}\text{C}$ (most critical for heat flux measurements).
- Cold-side surface temperature stability approx. $\pm 1^{\circ}\text{C}$ and accuracy approx. $\pm 2^{\circ}\text{C}$.

CORROSION/EROSION MONITORING

Sensitivity to metal loss - typical values:

- Boiler wall (dynamic central zone) 2000 ppm (1 part in 500).
- 6 mm tube wall @ $\sim 0.5\text{mm/year}$ metal loss ~ 30 days response time.

Quantification is achieved more quickly for higher corrosion rates, thinner walls and thermally less-dynamic conditions. Above figures assume 'uniform' corrosion, as compared to highly localized pitting.

COMMUNICATION, DATA STORAGE and POWER REQUIREMENTS

- 2 x 4-20 mA and 2 x 0-10V outputs.
- Bespoke serial data link to (optional) data logger.
- Ethernet.
- Minimum 10 GBytes on-board storage.
- Monitors require either a 24 or 48V DC supply. Max. 3A.

HARDWARE CONFIGURATIONS

- Single base unit will serve up to two sensor locations.
- Multiple base units can be configured with central data logger.
- Optional multiplexing electronics for increased sensor capacity with scanner capability.
- Can be integrated with standard scanner electronics.