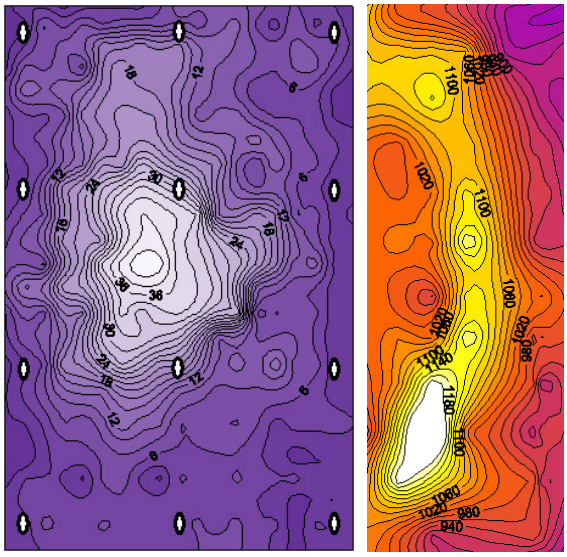
On-Line Plant Integrity and Real-Time Thermal Mapping Scanner Systems

Permanent Installations – Part of a Suite of Scanner Systems



New ‘Windows’ into Plant Health and Performance

Non-Intrusive Mapping of Internal Plant Conditions using External Sensor Arrays

Specifically Tailored for Monitoring Fireside Conditions of Boiler Tube Walls, Internal Surfaces of Pipelines, Storage Vessels etc.

On-Line Monitoring of Surface Corrosion, Cracking and Thermal Behaviour such as Heat Flux and Hot-Side Metal Temperatures

Monitoring of Hundreds of Square Metres or Small Localised Areas

Enhanced Knowledge and Awareness for Smoother Operations and Reduced Downtime

Established Technology - In Use Since1999

ROWAN
TECHNOLOGIES LTD

www.rowantechnologies.co.uk

PRINCIPLE SCANNER FEATURES

- Continuous on-line monitoring of internal conditions using external sensors.
- Monitoring of corrosion, erosion or crack propagation.
- Thermal performance - surface temperatures and heat transfer.
- Monitors whole areas, not just point locations.
- The actual plant itself is monitored - no need for insert probes and entry ports.
- Robust electrodes - welded to external plant surfaces.
- Low maintenance instrumentation/electronics.
- Interface with plant information systems.
- Real-time thermal mapping - view from control room or office.
- Established technology.

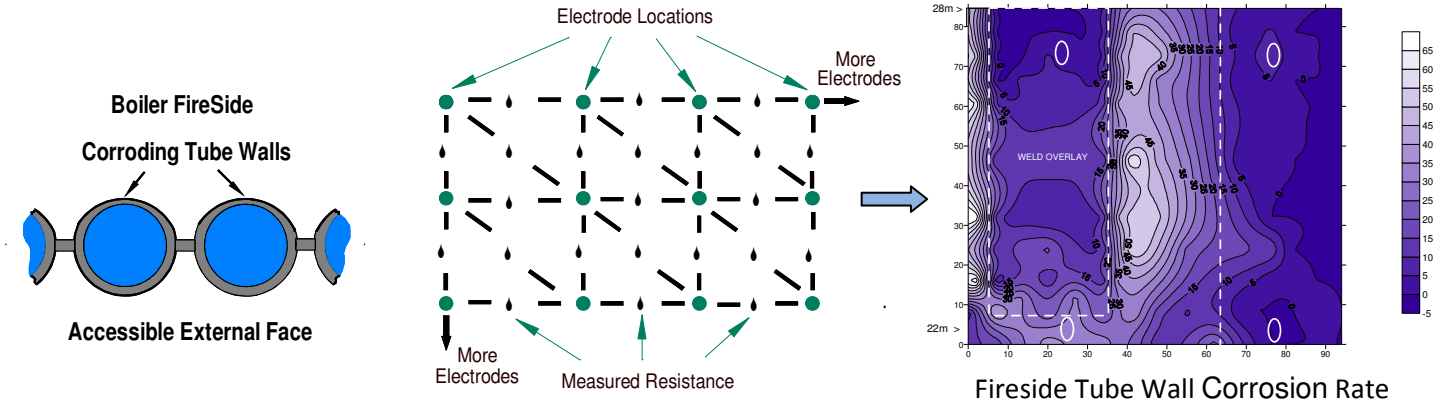
PRINCIPLE BENEFITS

- On-line mapping of large areas provides new insights into operations.
- Provides early warning of potentially damaging wall conditions.
- Allows operations to be fine tuned to avoid damaging conditions.
- Opportunities for improved efficiency without compromising plant integrity.
- Minimise forced plant outages - extend intervals between planned outages.

PLANT INTEGRITY

Externally applied electrodes are used to monitor internal, or fireside, damage including corrosion and cracking using well-established and enhanced electrical resistance techniques. Measurements are performed between adjacent electrodes in a pre-defined sequence to build complete 2D maps of wall integrity. As part of the measurement cycle, metal temperatures are measured or predicted to compensate for background 'noise' induced by thermal variations.

Corrosion monitoring scanners have been operational in coal fired generation plant since 1999, the longest serving system now has a minimum planned operational life of 11 years. Crack monitoring is relatively new application of this technology, only briefly introduced here - see our web site for more details.



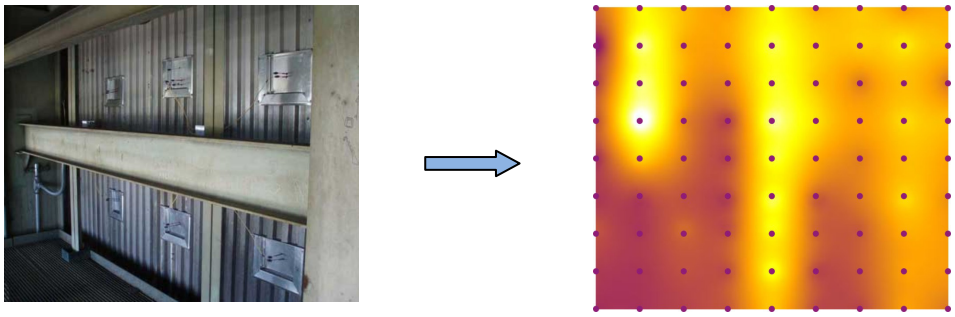
Fireside Tube Wall Corrosion Rate

THERMAL PERFORMANCE

The scanner systems can perform rapid real-time monitoring and processing of thermal data for on-line mapping of surface temperatures and, in the case of heat transfer surfaces such as boiler membrane walls, heat flux and fireside (or hot-side) tube wall surface temperatures.

System are readily interfaced to plant information systems for real-time or retrospective data processing.

For dedicated thermal monitoring scanners, see our NTScan systems.

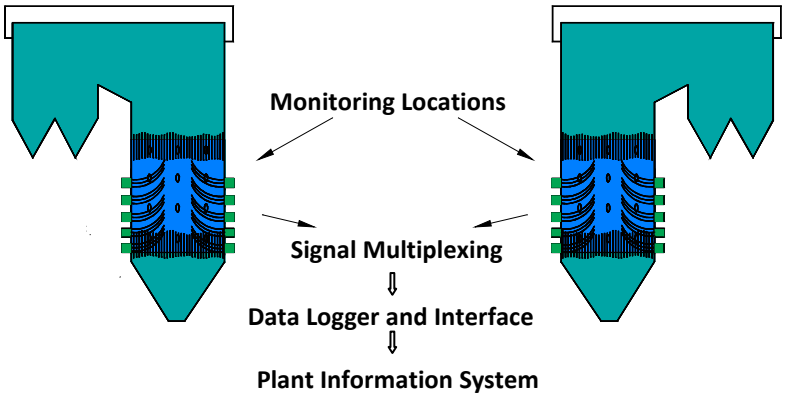


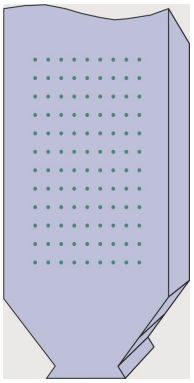
The six scanner electrode locations (left) form part of a larger electrode matrix defined by the dots in the fireside wall temperature map (right).

CORROSION MONITORING - BOILER MEMBRANE WALLS

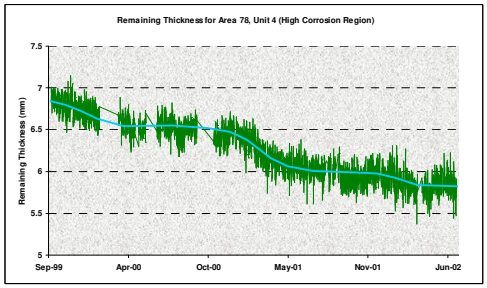
The scanner technology was originally designed for monitoring real-time fireside tube wall corrosion rates for boiler membrane walls. The schematic below shows example monitoring of both sidewalls of a power generation boiler, with a similar layout to existing scanner installations. Logging of corrosion data only needs to be performed every few hours; dedicated thermal monitoring may be performed between corrosion measurements.

Corrosion data may be presented in a variety of ways - corrosion rates, metal loss, remaining thickness (from known start thickness) or time to replacement. Data is processed in the form of 2-D maps or as time - dependant traces from individual sensor locations.

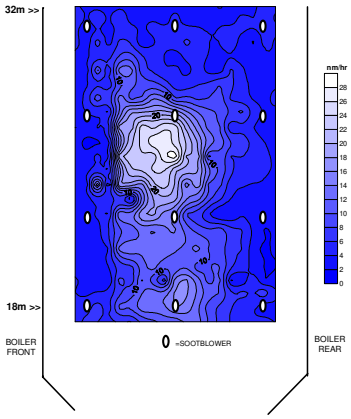




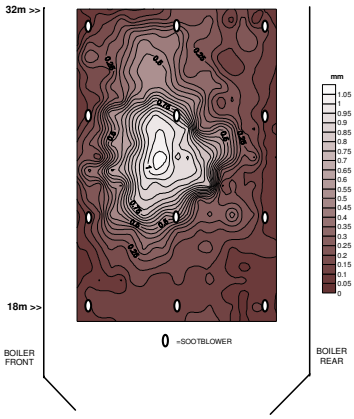
To produce the Maps Below, an Array of Electrodes Spaced Roughly 1m Apart are Used, as Shown on the Left



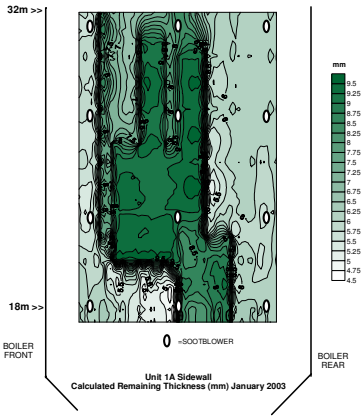
Data from Individual Electrode Sensor Locations produce Time Dependant traces such as Fireside Metal Loss, Above.



Tube Wall Fireside Corrosion Rate



Tube Wall Fireside Metal Loss



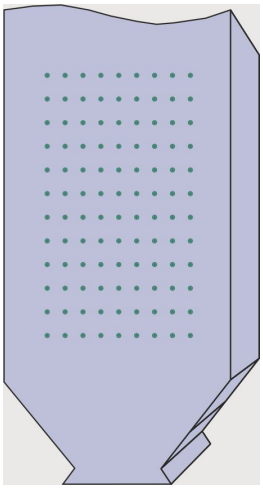
Tube Wall Remaining Thickness

Possible scanner applications for corrosion/erosion monitoring include:

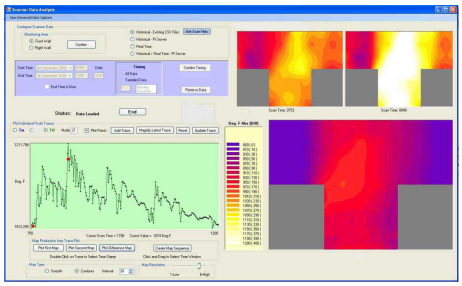
TUBE WALLS - PIPELINES - DUCTING - STORAGE VESSELS

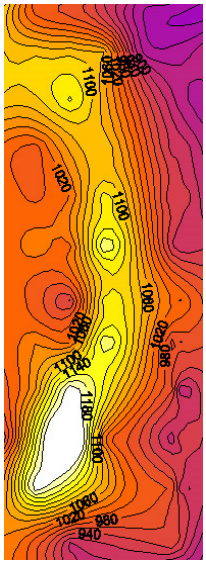
THERMAL MONITORING

The scanner technology has the capability to monitor both heat flux and fireside tube wall conditions of boiler wall tubing. Fast thermal scanning allows capture of rapid thermal transients resulting from operational changes or slag removal. Data can be sent directly to plant information systems for immediate data processing and presentation in the form of maps or time-dependant linear traces from specific sensor locations using dedicated data processing and presentation software. Further details can be found in our dedicated thermal monitoring system (NTScan) brochure.

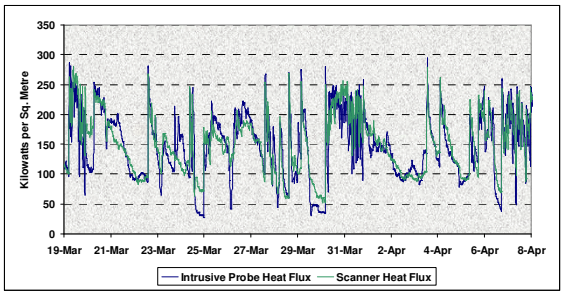


DATA PROCESSING AND DISPLAY SOFTWARE

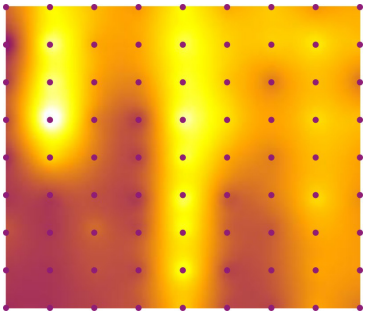




POST-PROCESSING – 2D CONTOUR MAPS



TIME DEPENDENT TRACES – INDIVIDIVUAL SENSOR LOCATIONS



REAL TIME MAPPING – OFFICE OR CONTROL ROOM

- External sensors provide information on tube fireside temperatures, heat flux and external surface temperatures.
- Rapid thermal scanning – data sent directly to plant information systems.
- Real time or retrospective data processing – office or control room.
- Maps, ‘video’ sequences or time dependant trace from individual sensor locations.
- Helps identify possible damaging tube wall conditions, monitors effectiveness of wall cleaning and enhances general understanding of operations and thermal behaviour.

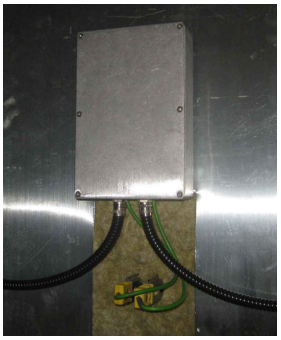
SCANNER SYSTEMS – HARDWARE AND INSTALLATION

Flexible hardware configurations cater for a variety of sensor layouts and possible site restrictions such as high ambient temperatures and boiler exclusion zones. Sensors are welded to external surfaces and do not require specialist welding skills. System layouts are sensitive to the need to remove hardware at the monitoring areas for possible maintenance. Recent additions to the scanner hardware portfolio help to make installation quicker and simpler.



Weatherproof and dustproof electronics cabinets are used as appropriate to help ensure many years of trouble-free system operation with minimal maintenance.



Customers choose a variety of ways to install cabling and sensors, depending on preference, site requirements or environmental restrictions.

SPECIFICATIONS

CORROSION/EROSION MONITORING

Sensitivity to Metal Loss - Typical Values*

Laboratory controlled conditions	50 ppm (1 part in 20000)
Site Location: thermally-quiet conditions	200 ppm (1 part in 5000)
Boiler wall ** (hot central zone): thermally dynamic conditions	2000 ppm (1 part in 500)

Corrosion/Erosion Rate – Quantification

Quantification is achieved more quickly for:

- Thinner surfaces/ membranes
- Higher corrosion rates
- Less thermally dynamic conditions

Typical Figures:

10 mm pipe wall : +/- 0.5^{o}C uncertainty (long term), 1mm/year metal loss	15 days
6 mm furnace wall tube: +/- 5^{o}C uncertainty (long term), 0.5mm/year metal loss	40 days
5 mm tank membrane: +/- 0.1^{o}C uncertainty (long term), 0.1mm/year metal loss	15 days

* Average metal loss between adjacent sensor locations.

** Based on a sensor spacing of roughly 1 – 1.5 metres.

THERMAL MONITORING (Latest Hardware):

- Max. speed approx. 150 msec per sensor measurement - a matrix of 100 nodes scanner in about 30 seconds.
- Temperature differences accurate to approx 0.2^{o}C - systems are specifically designed for accurate and stable temperature differences between adjacent sensors.
- Absolute measurement stability approx. +/- 1 C.
- Absolute accuracy within approx +/-3 C.
- Accuracy of estimated fireside temperature and heat flux depends on system application but typical figures estimated to be within approx +/-15% after system calibration.

Above figures may be subject to change.

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