TesTex
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Case Study

Inspection of Utility Boiler Furnace Wall Tubes using Low Frequency Electromagnetic Technique (LFET)

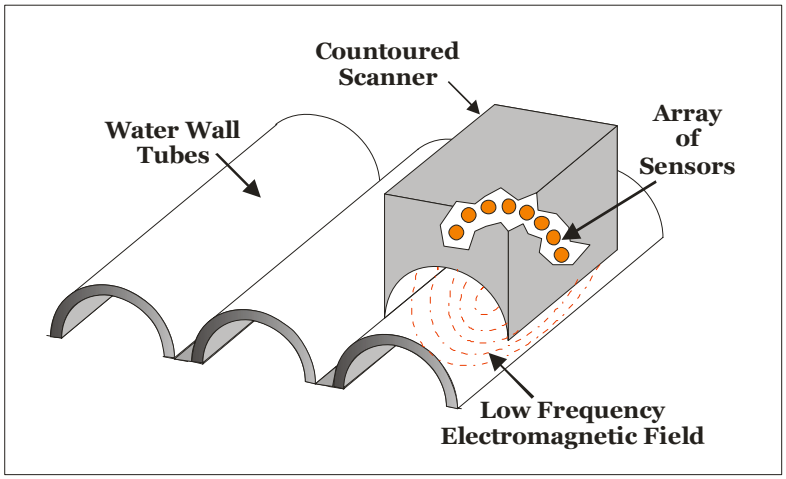
Inspection of Boiler #B Furnace Wall tubes was carried out by TesTex in one of the Petrochemical Plant in India. Scope of inspection included 100% scanning of Furnace side water wall tubes to detect Internal / External pitting, corrosion and any type of flaws in the tubes.

The unit details were as follows,

- **Boiler no.** B
- **Year of Manufacturing** 1987
- **Capacity** 70T/Hr
- **Tube Material** Carbon Steel
- **Tube O.D.** 57 mm
- **Tube Thickness** 4.5 mm

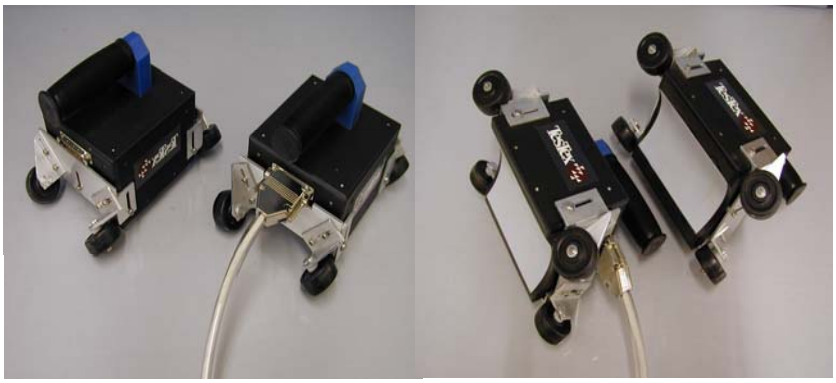
Tubes were inspected using specially fabricated Multi-channel Water Wall Scanner matching tube OD along with TS 2000 System, which is based on the Advanced Inspection Technique known as **Low Frequency Electromagnetic Technique (LFET)**.

LFET Technique works by injecting Low Frequency Electromagnetic Field in the material to be inspected. Any defect in the material distorts the magnetic flux lines, which are sensed by the sensors. The severity of defect is determined by comparing the change in phase with the phase at good region. The LFET technique is faster (scanning speed 4 mtrs per minute) then other NDT techniques and works on moderate cleaning conditions, covers entire area on furnace wall and not just crown.



Water wall scanning is being done

Waveforms are observed on line



Standard OD Scanners

The curved portions of the water wall was inspected using bend scanners / UT. The regions that could not be scanned using the scanner were inspected using Ultrasonic Technique (UT).

Inspection was carried out in the following sequence,

- Tubes were visually inspected for any surface defects
- Tubes were numbered according to the clients specifications
- Tubes were scanned and defects were marked for further verification
- Actual Thickness of the defective area was verified by UT

Boiler tubes were having leakage at two locations on south-side wall prior to the inspection.

On inspection of the tubes many more locations were detected which were showing remaining thickness as low as 1.7mm. The results of inspection were as follows:

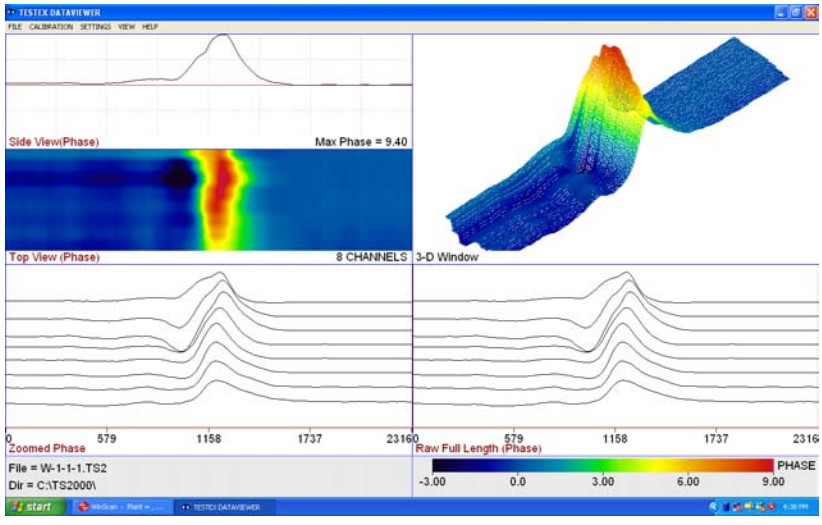
North side wall :
3 locations were having isolated internal corrosion more than 50% of the tube thickness and two locations were having internal corrosion of 18% at 0 to 2 Meters.
4 locations were having internal corrosion of 20% at 2 to 4 Meters.

South side wall :
2 locations were having isolated internal corrosion more than 50% at 0 to 2 Meters.
17 locations were having internal corrosion up to 22% at 2 to 4 Meters.

East side wall :
5 locations were having isolated internal corrosion up to 20% at 0 to 2 Meters.

Tube showing Internal Corrosion Detected during LFET Scanning

Waveform showing above tube location as observed during Scanning



Discussions:

Conventional NDT Technique such as Ultrasonic Thickness measurements at various levels in the boiler tubes, which is the General Practice, followed by the industry for number of years does not give complete picture of water wall tubes. Large areas in furnace wall remain un-scanned leading unscheduled shutdowns because of tube leakage taking place during running operations in turn leading to heavy production losses.

The above losses can be avoided by using **Advanced NDT Technologies** such as **Low Frequency Electromagnetic Technique (LFET)** which can scan Water Wall Tubes 100% and can detect OD as well as ID flaws in the tube in a single scan.

Conclusions:

By deploying above Advance Technique, Plant operator can identify all the tubes which are undergoing any type of tube wall reduction because of hydrogen damage, caustic gauging, corrosion / erosion etc. Exact locations of the defective tubes can be identified along with the severity of the damage with respect to remaining wall thicknesses without waiting for another tube failure in running plant.

Tube replacements can be made only in the effected localized areas in boiler instead of replacing the entire panels with out through survey.