State of the Art Products and Services
for Non-Destructive Testing
B-203, Arjun Centre, BSD Marg,
Govandi Stn. Road,
Deonar, Mumbai - 400088
Tel.: 91-22 67978015 / 16,
Tel / Fax : 91-22 25510788,
Email : testex@mtnl.net.in, admin@testex.in
Website : **www.testex.in**

# Case Study

## *Tubular Inspection using Internal Rotary Inspection System (IRIS)*

Inspection of **R. G. Boiler** was carried out using **Internal Rotary Inspection System (IRIS)** to measure the thickness of Exchanger Tubes up to Ferrule area

The Inspection was carried out on June 2014.

### A. TECHNICAL DETAILS:

| | |
|---|---|
| **Unit Name** | **R. G. Boiler** |
| **Material** | **SA-213 Gr. T12** |
| **Tube Dimension (in mm)** | **42.0 x 4.5 x 8375** |
| **Total # of Tubes** | **432** |
| **Plugged** | **29** |
| **No. of Tube Inspected** | **403** |

### C. EQUIPMENT USED:

Electronic Box : Helix – XT (01-3145-01)
Transducer : 15MHz, (36515)
Focal Length : 1.50”
Turbine : TB 048
Centering Device : Flexible CDV066110
Pump : 11-7003-01
Scan Direction : Retract

### CALIBRATION STANDARD:

The calibration sample should have the same material properties such as Longitudinal Sound Velocity / Wall thickness as that of the tube to be inspected.
Artificial machined flaws are generated in the Calibration Tube at suitable distance from one another. Calibration is always performed in the lab prior to leaving for the job site and stored in set up menu.

**BRIEF DESCRIPTION OF EQUIPMENT HARDWARE & SOFTWARE FEATURES:**

The ***TesTex Helix-XT I.R.I.S. (Internal Rotating Inspection System)*** was developed to provide a means to test tubing and piping. The system is designed to do an ultrasonic test of tubing and piping from the inside of the tubes. Ultrasonic IRIS is more sensitive to smaller defects and is the only technique that provides true remaining wall thickness. IRIS can differentiate OD and ID defects however it is slower, requires the tubes to be clean of any scale / deposits and chances of missing thickness information on the bend region, and requires the tube to be filled with the water through the entire length.

**Theory of Operation**

Precision ultrasonic thickness gauges usually operate at frequencies between 500 KHz and 100 MHz, using piezoelectric crystal transducers to generate bursts of sound waves when excited by electrical pulses. A wide variety of transducers with various acoustic characteristics have been developed to meet the needs of industrial applications. A pulse-echo ultrasonic thickness gauges determines the thickness of a part or structure by accurately measuring the time required for a short ultrasonic pulse, generated by a transducer, to travel through the thickness of the material, reflect from the back wall surface, and be returned to the transducer. In most applications this time travel is only a few microseconds or less. The measured two-way transit time is divided by two to account for the down-and-back travel path, and then multiplied by the velocity of sound in the test material.

**Equipment Description**

***ELECTRONICS:***

The Helix-XT system is an all-digital, microprocessor-controlled instrument. It contains all necessary electronics for collection and analysis of data using the IRIS inspection method.


**Helix XT Electronic Box**

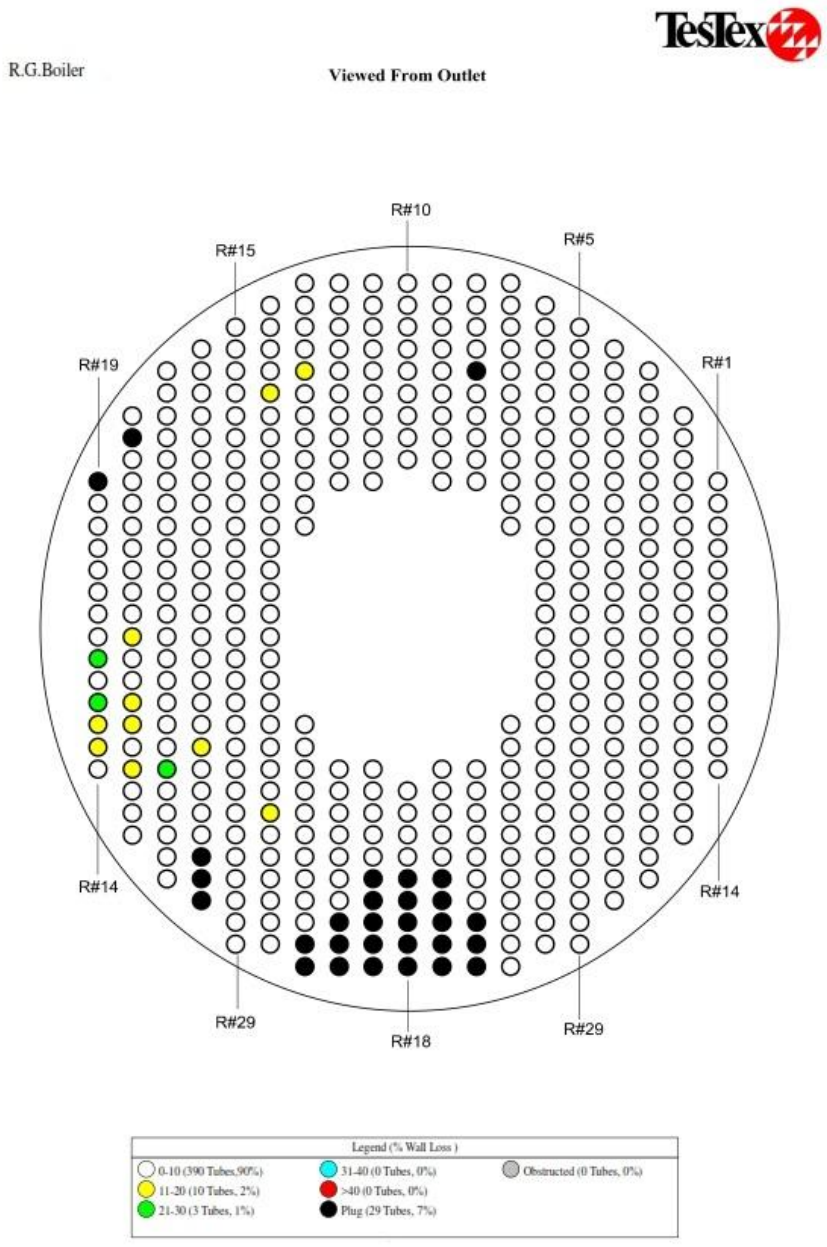
**Transducers, Probes, Centering Devices**

***SOFTWARE*:**
The Helix-XT system also contains all software for data acquisition and analysis. The menu driven, user-oriented program provides for real-time display of wall thickness, gain, PRF, Reads/Rev and RPM of turbine. The screen layout of the Helix-XT consists of a B-Scan, Profile, Zoomed Profile, and Status Windows. The A-Scan can also be viewed through the acquisition software. The data acquisition module also handles the row number, tube number, and other bookkeeping details. The data analysis and display software contains a dialog box for data entry and tube information. Real time analysis can also be performed during acquisition.

**SCANNING PROCEDURE:**

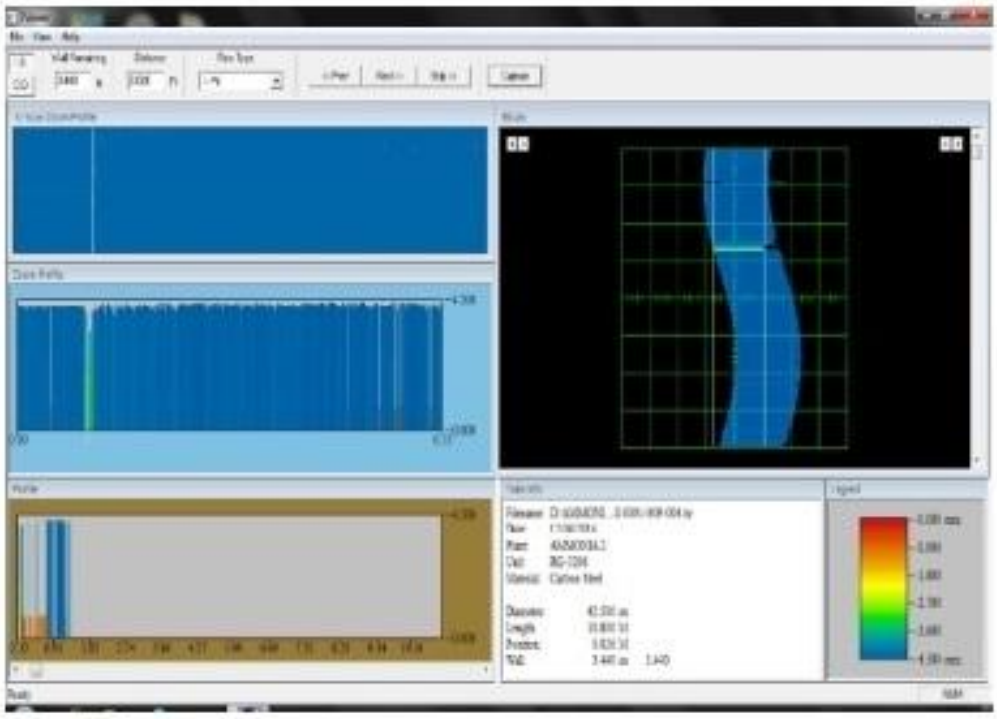
Water was passed in the tubes from Ferrule side, while the inspection was going on Outlet side. The tubes were numbered from top to bottom & Rows were numbered from Right to Left. IRIS probe is inserted up to ferrule end and while retracting the probe, thickness is measured.

## Color Coded R. G. Boiler layout (Inspected in 2014)

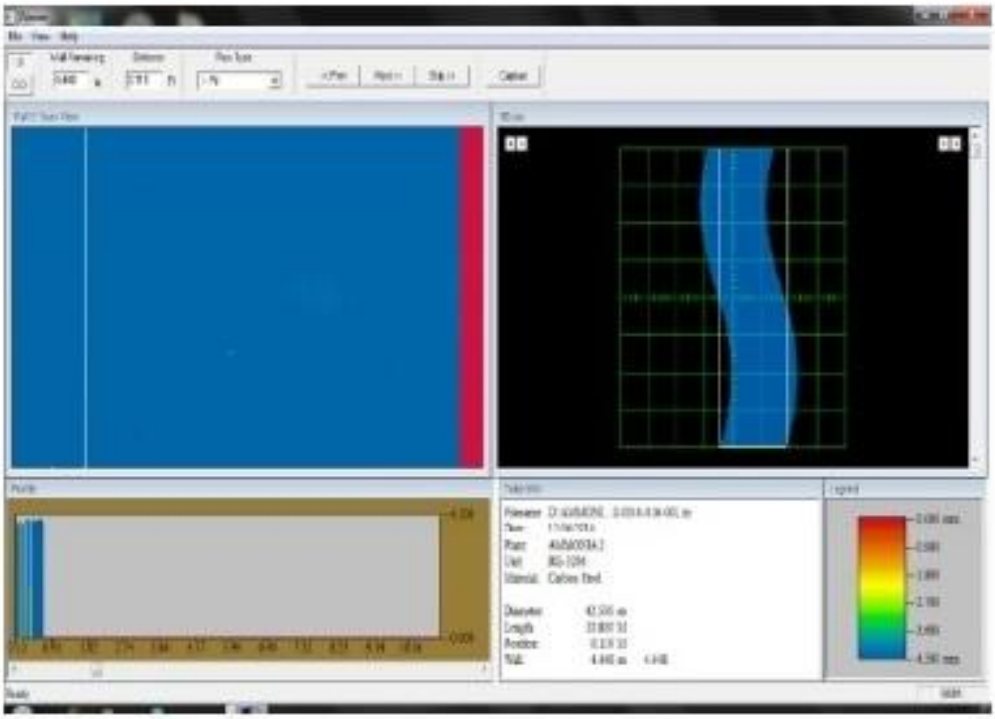


# Sample Waveform of Defective Tube

R.G. Boiler Sample Waveform



Above wave form of Tube # 9 of Row # 19 shows min. reading of 3.4mm



Above wave form shows good region with min. thickness 4.48mm

**Discussions:**

Tubes were offered for routine inspection during shutdown period as no inspection technique was used to know the condition of the tubes in the past. R. G. Boiler was having leakage history because of which few of the tubes were already plugged in the past. Client was interested in knowing the thickness of the remaining tubes to avoid any failures during running operations. IRIS was the chosen technique as it can give information on general health of the tubes.

**Conclusions:**

On Inspection it was observed that many tubes in the RG Boiler were undergoing corrosion activity as shown in the diagram above and need further plugging. Before plugging client pulled out one tube and verified the results by split opening the tubes. When the results matched further plugging decision was taken.

By deploying above Advance NDT Technique, Plant Operators can identify the tubes which are undergoing any type of wall reduction due to corrosion / erosion etc. At this point of time client can also decide if he needs to go for further investigation (selective or complete) using any other NDT technique and prepare himself for the same.