

## **CASE STUDY**

### **Inspection of R. G. Boiler tubes using Remote Field Electromagnetic Technique (RFET)**

Tube Inspection of **R. G. Boiler (1206 A / B)** was carried out by TesTex NDT India Pvt. Ltd. in January 2009 with **EAGLE 2000 System** to detect, locate and measure the extent of Corrosion, Erosion if any at one of the Fertilizer plant in India.

The unit details were as follows,

<b>R. G. Boiler No.</b>	<b>1206 A</b>	<b>1206 B</b>
<b>Tube O.D.</b>	38.1 mm	42.4 mm
<b>Tube Thickness</b>	4.5 mm	4.5 mm
<b>Tube Material</b>	Ferrous	Ferrous
<b>No. of Tubes</b>	871	432
<b>No. of Tubes Plugged</b>	3	7

TesTex Inc. USA manufactured "**Eagle 2000 System**" uses **Remote Field Electromagnetic Technique (RFET)** which is based on the transmission of an electromagnetic field through the tube material. The exciter coil generates Eddy Currents at Low frequency in the circumferential direction. The electromagnetic field transmits through the thickness & travels on the outer diameter. A receiver coil that is placed in the remote field zone of the exciter picks up this field. In this zone, the wall current source dominates the primary field directly from the exciter. The separation between the two coils is between 2 to 3 times the tube OD. Since the magnetic field penetrates the tube wall twice, it will undergo a delay (phase lag) and attenuates (amplitude attenuation). The phase lag & amplitude attenuation incurred will depend on the local wall thickness & are measured. The measurement signal is displayed on a screen.

Calibration Standards were fabricated on tube of same material & same dimension. These tubes were used to generate a Calibration Table required for quantification of the flaw.

Inspection was carried out in the following sequence,

- Tube sheets were visually inspected for any edge defects in the tubes.
- Tubes were numbered according to the clients specifications.
- Boiler tubes were inspected using Eagle 2000 system.
- Any flaw or abnormalities in the tubes were analyzed using calibration table.

## EQUIPMENTS USED

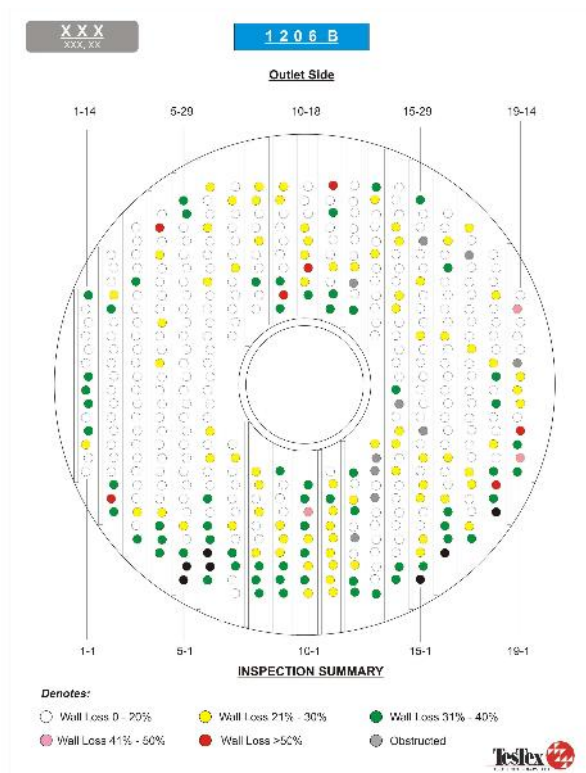
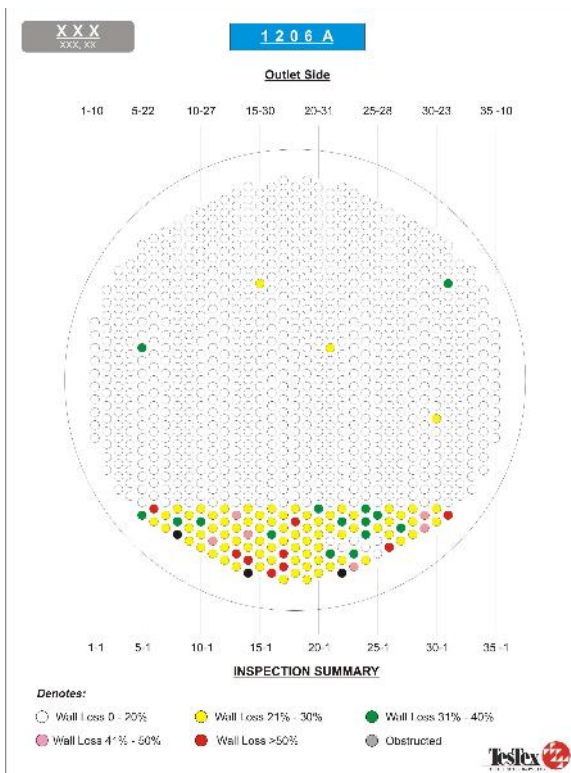
**Eagle 2000 Plus**



**Probes**

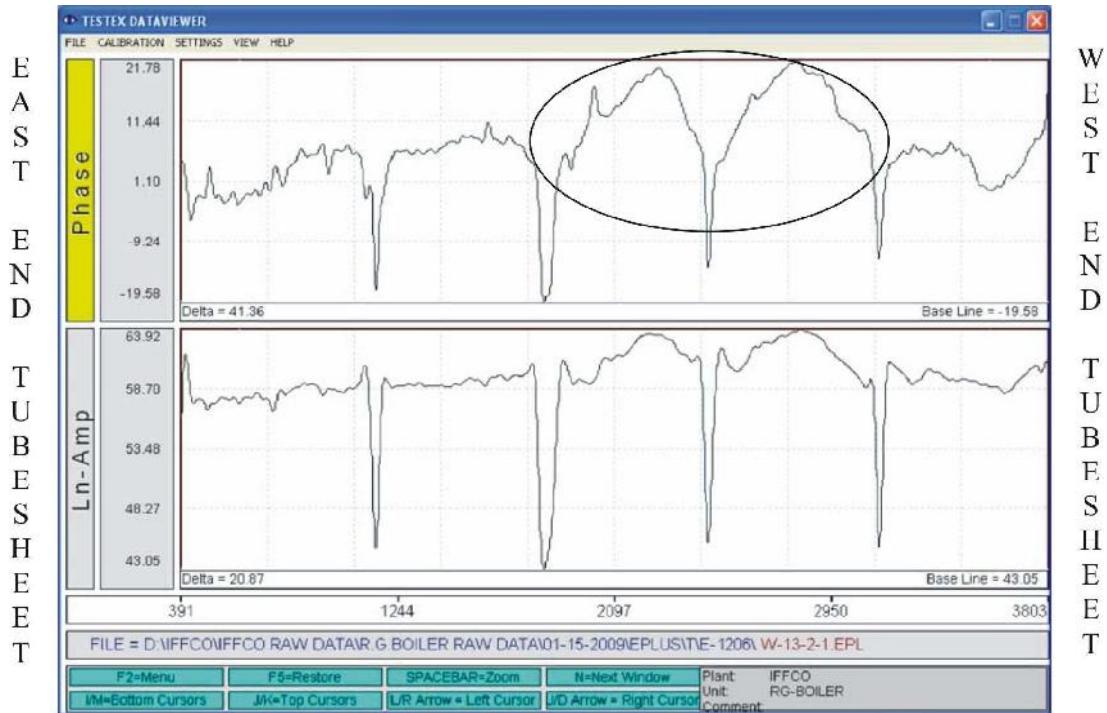


## Color Coded R. G. Boiler layout



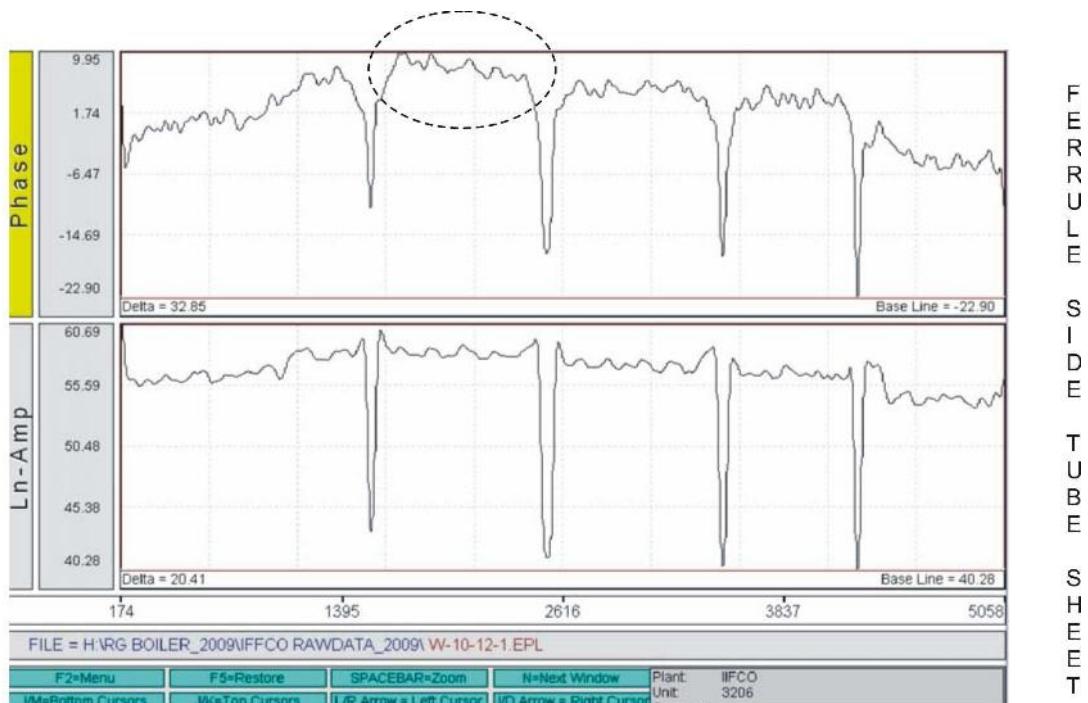
# Sample Waveform of Defective Tube

## R. G. Boiler # 1206 A



Above Waveform is of Row # 13, Tube # 2 showing Wall Loss > 50%.

## R. G. Boiler # 1206 B



Above Waveform is of Row # 10, Tube # 12 showing Wall Loss > 50%.

**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 health of the remaining tubes to avoid any failures during running operations. RFET was the chosen technique as it required minimum cleaning; has good inspection speed and 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.