

CASE STUDY

Inspection of Drum to Drum Boiler tubes using Remote Field Electromagnetic Technique (RFET)

Tube Inspection of **Boiler Unit # 5** was carried out by TesTex NDT India Pvt. Ltd. in February 2010 with **EAGLE 2000 System** at one of the Power Plants in India to detect, locate and measure the extent of Corrosion, Erosion if any in the tubes.

The unit details were as follows,

❖ Boiler No.	5
❖ Tube O.D.	51.0 mm
❖ Tube Thickness	4.5 mm
❖ Tube Material	Ferrous (SA 179)
❖ No. of Tubes	724
❖ No. of Tubes Plugged	5

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 magnetic field at Low frequency in the circumferential direction. 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.

During inspection all the internals from the Steam Drum were removed and probe is inserted from the Steam Drum (in individual tubes) till it reaches the Mud Drum. Data is collected while pulling from Mud Drum to Steam Drum.

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,

- Inspection is done from Steam Drum
- Tube sheets of Steam Drum / Mud Drum 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.

Sample Waveform of Defective Tube



Above Waveform is of Row # 7, Tube # 5 showing Wall Loss > 50%.

Discussions:

Tubes were offered for routine inspection during Boiler shutdown as no inspection technique was used to know the condition of the tubes in the past except visual inspection and localized UT survey on accessible outer rows of the tubes. Client was interested in knowing general corrosion / erosion type of flaws if any in the tubes as there was no access to inner rows of the tubes to ascertain the condition of the tubes. RFET was the chosen technique as it required minimum cleaning; good inspection speed and can give information on general health of the tubes.

Conclusions:

On Inspection it was observed that many bank tubes in the boiler were undergoing corrosion as shown in the diagram above and need plugging. Most of the defects were observed on / near the steam drum bend. Outer rows of boiler tubes were not inspected as there were various support structures attached to them which were interfering with the signals. 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, Boiler 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.