Corrosion Fatigue Cracking and Thermal Fatigue Cracking Detected in Boiler Tubes Using Hawkeye

FTF # 17

TesTex STATE OF THE ART PRODUCTS AND SERVICES FOR NON-DESTRUCTIVE TESTING

FROM THE FIELD

The Problem:

A power plant in New Jersey experienced a failure in a slag screen tube in one of their boilers. Following the rupture, the "S" shaped tube was removed and analyzed. The results of the metallurgical analysis identified corrosion fatigue cracking and thermal fatigue cracking as the reasons for the rupture. The corrosion fatigue cracking, which originated on the internal surface of the tube, was a result of corrosive elements introduced into the system by a leak in the condenser. River water deposited sulfur, sodium, and potassium into the boiler tubes, leading to corrosion. After the corrosion fatigue cracking occurred, thermal fatigue cracking further propagated the existing problem, leading to the rupture. It was also noted that the cracking occurred both circumferentially and longitudinally throughout the cut out tube.

The power plant needed to determine if this problem was occurring in all of the slag screen tubes in the unit or just those with bends. With both safety and lost revenue in mind, the company's plan was to remove any tubes that exhibited severe cracking.

The slag screen tubes are 3" O.D. x 0.340" NWT Carbon Steel.

The Solution:

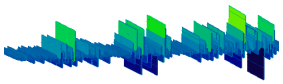
TesTex, Inc. was notified of the situation and was provided with the results of the metallurgical analysis. It was decided that the Hawkeye 2000 system was the ideal inspection technique for this application. The Hawkeye 2000 and its variants use the principles of the Balance Field Electromagnetic Technique (BFET) to detect surface and sub-surface cracking in welds and base metal. The system also requires very little if any surface preparation.

Due to the prevalence of both circumferential and longitudinal cracks, TesTex, Inc. developed a special 45° orientation Hawkeye scanner to inspect the tubes. The 45° orientation allows for maximum identification of both circumferential flaws and longitudinal flaws. The scanner was also fitted with a larger driver coil to increase penetration, due to the thick wall of the tube.

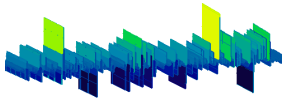
Figure 1: Deep penetrating 45° Hawkeye scanner.

With the use of the specialized probe, TesTex, Inc. was able to identify light, moderate, and severe cracking in almost every tube in both boilers. As the following waveforms indicate, the cracking was widespread throughout the length of each tube.

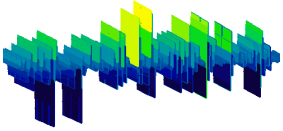
Tube exhibiting no cracking



Tube exhibiting light cracking



Tube exhibiting moderate cracking



Tube exhibiting severe cracking

Conclusion:

After the inspection was completed, the power plant cut and removed several samples from the most highly corroded areas. The removed samples indicated the same conditions as the previously analyzed tube, confirming the results of the TesTex, Inc. inspection.

The information provided by TesTex, Inc. allowed the company to remove only the tubes that exhibited severe cracking, while postponing the replacement of less severe tubes to future planned outages.

For more information on the TesTex, Inc. Hawkeye 2000 system or other TesTex, Inc. products and services, please visit http://www.testex-ndt.com. Contact us at testex-ndt@verizon.net or call at (412) 798-8990.