APPLICATION REPORT
ON LINE ACOUSTIC EMISSION TESTING OF REFORMER TUBES.

INTRODUCTION:

The early assessment of the condition of catalytic reformer tubes has been an important part of preventative maintenance program for a number of years. The increased cost of shutting down a reformer and the inspection of the tubes can be costly in that beside the cost of the inspection method used, to find out that there are ten suspect tubes and you only have four spares, with delivery of new tubes two months away. The cost of the inspection becomes a minor issue compared to the loss of production costs.
Acoustic Emission Testing (AET) has long been used to detect the presence of defects that are thermally generated, providing the thermal stresses can be simulated during the test.
This application discusses the use of AET as a tool to with very little effect on production detect the presence and determine the condition of reformer tubes during operation.

METHOD OF TEST:

AET is a well-established and proven NDT methodology that is commonly used in the Petrochemical Industry to determine the presence of discontinuities in the material under test.
The basic principle of AET is very similar to that utilized by the seismic industry. Just as the movement of the earth's crust in the form of an earth quake releases energy as a shock wave detectable by sensors, so materials under stress release energy detectable by sensors placed at strategic locations. The main difference between seismic and AET are the frequency spectrums used. The seismic industry uses low frequencies of 0 to 10 Hz that would create problems if used in noisy environments, another difference is the distance used between sensors. In the seismic industry, the sensors are placed many miles away from the source. AET uses frequencies of between 20 and 400 kHz, which allows the monitoring of equipment subject to high noise from pumps and liquids flowing in piping etc. Typical AET sensor spacing is in the order of 40 to 65 feet apart.

The thermal stresses that are the main cause of the creep damage also give rise to the release of energy when there is a stress concentration at the tip of the discontinuities. Unlike other NDT methods the sensors that are used do not have to be over the discontinuity to detect it.

Owing to the high operating temperature use is made of wave guides that are attached via a threaded barrel nut to the flange of each of the tubes being inspected, in the case of the Kellogg type reformer on the top and on the case of the Forster Wheeler type the bottom (the latter does not require the use of wave guides). As many as 56 tubes can be inspected at the same time.
It is important to note that flange joints that leak badly could interfere with the test.
The AET equipment is then calibrated and the test is then ready to begin. A 10 minute back ground test is done with the reformer at normal working temperature, the operating temperature is then lowered by 25% held at this level for 15 minutes and then increased back to the operating temperature, where the tubes are monitored for a further 15 minutes, this concludes the test for the tubes selected for the test.

The data is then analyzed and the level of AE activity measured and compared to preset values on an Excel spread sheet. The level of activity is proportional to the degree of creep damage found in the tube. The location of the AE activity is easily determined, recent tests have been able to detect the presence of cracks in the weldolet used to attach the tube to the manifold on a Kellogg reformer, with 100% correlation. The values used in determining the tube conditions are propriety information and note available for general information.

Several thousand tubes have been monitored and the data results verified by other NDT methods and destructive tests, enabling us to with a high level of confidence grade the tube condition.

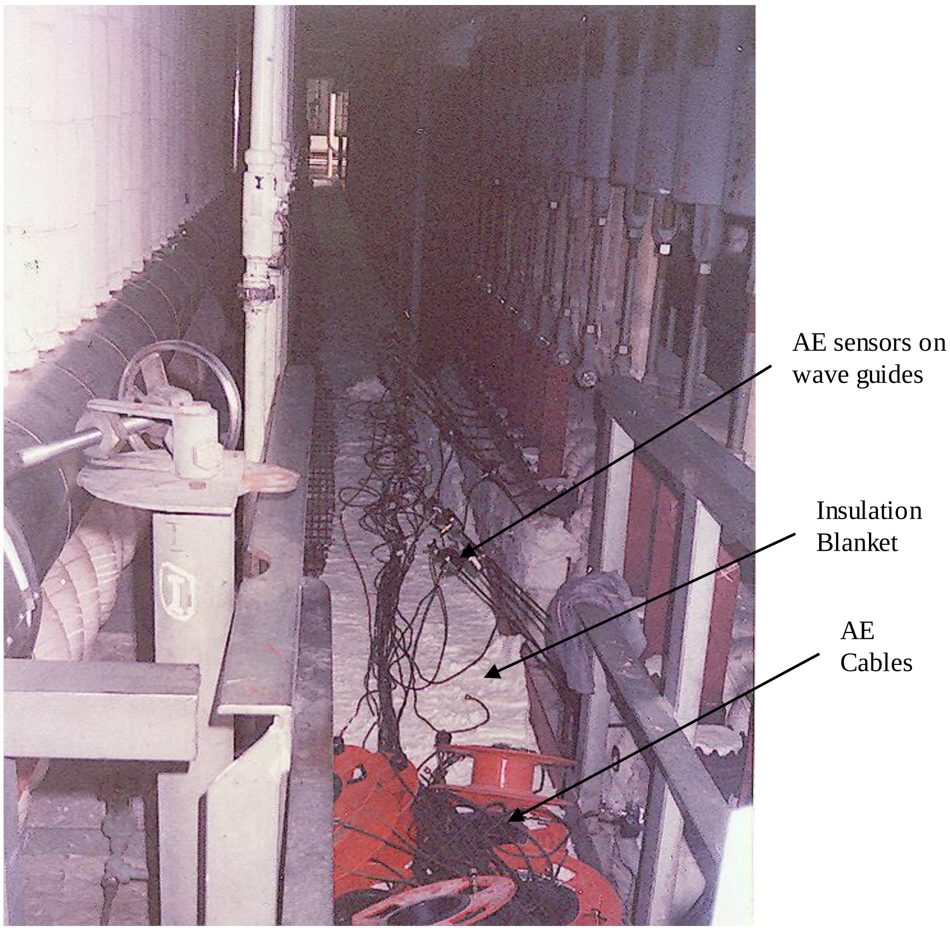

Figure 1 shows a typical sensor arrangement for a Kellogg type reformer, note the use of a thermal blanket on the floor of the walkway to protect the AE sensor cables.

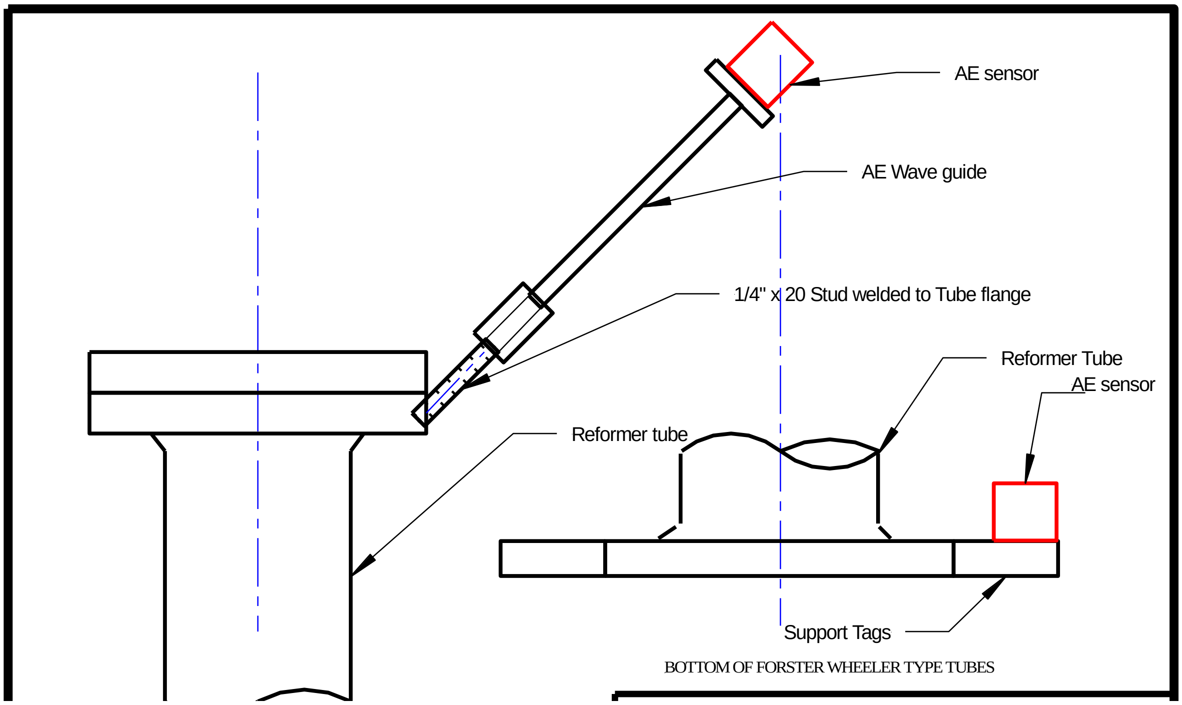

Figure 2 shows a drawing of the typical mounting on the Kellogg & the Forster Wheeler tube system.

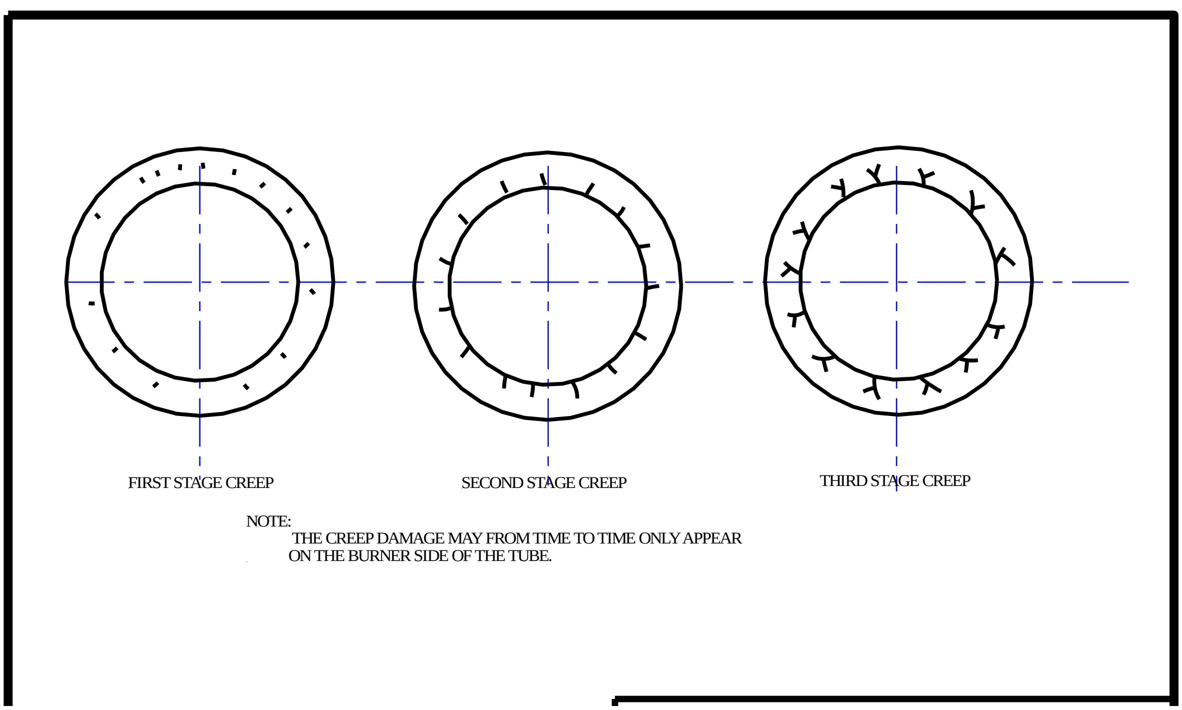

Figure 3 shows the typical creep damage stages for a reformer tube.

For further information about the applications described in this document, or any other application you may require, contact. AMERAPEX NDT LLC. by telephone at 713-263-0900 or Fax 713-263-0922 or by e-mail to info@amerapex.com