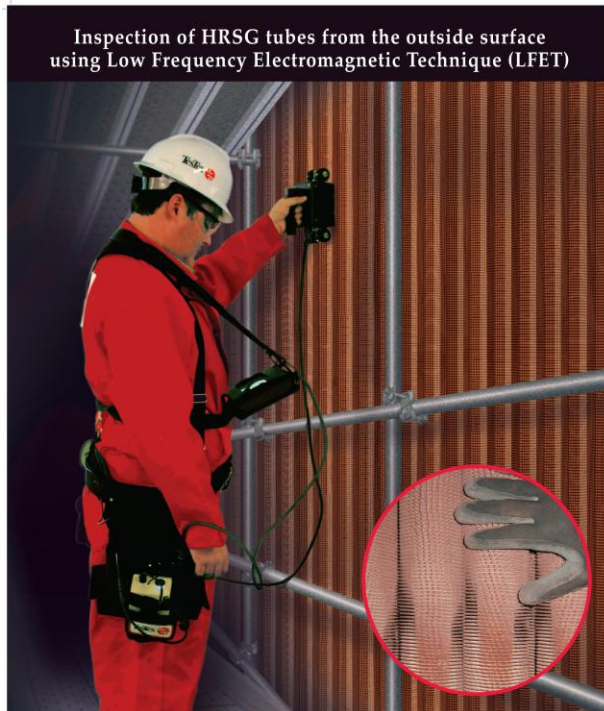


The design of many Heat Recovery Steam Generators (HRSGs) does not allow access to the inside surface of the tubes for examination without cutting open a header and using complex robotics. These finned tubes are also spaced tightly together. TesTex, Inc. uses the Low Frequency Electromagnetic Technique (LFET) to examine HRSG finned tubes from the outside diameter. The Remote Field Electromagnetic Technique is used when access is provided to the inside diameter of the tube. TesTex is currently working with EPRI on two projects to develop additional inspection tools for HRSGs.

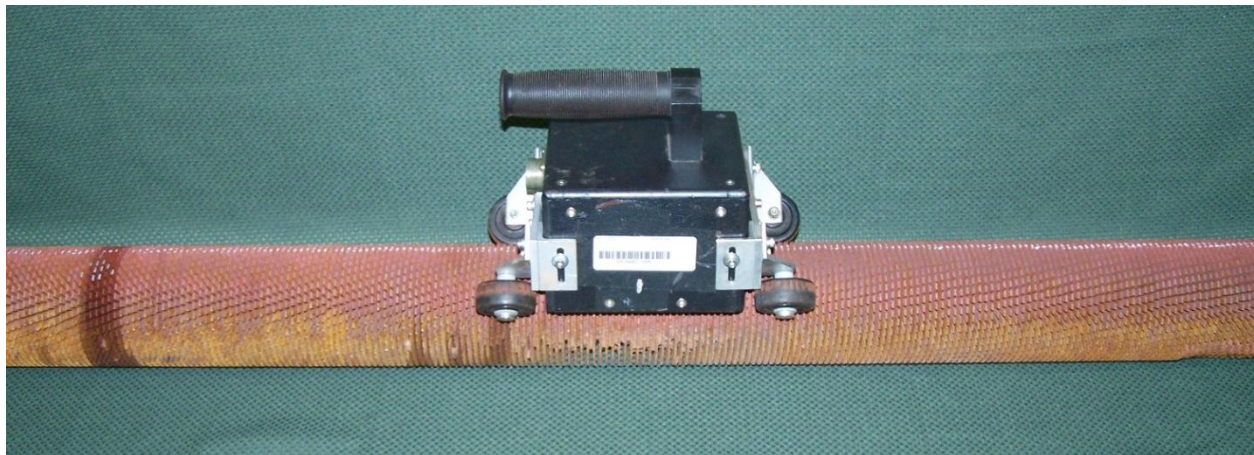


## HRSG INSPECTION TOOLS

### LOW FREQUENCY ELECTROMAGNETIC TECHNIQUE INSPECTION OF HRSG TUBES FROM THE OUTSIDE SURFACE



The Low Frequency Electromagnetic Technique (LFET) is able to detect and quantify wall thinning on HRSG finned tubes from the outside surface through the fins. The LFET scanner moves along the tube as it measures the strength of the return electromagnetic signal that is emitted into the tube by the scanner's exciter coil. The carbon steel fins allow the signal to penetrate into the base material of the tube. EPRI sponsored TesTex to perform an examination of HRSG finned tubes with pitting and general wall losses. The results showed that the LFET can detect localized wall losses such as pitting as well as general wall losses like flow accelerated corrosion.



The picture above shows the LFET scanner on a finned HRSG tube.

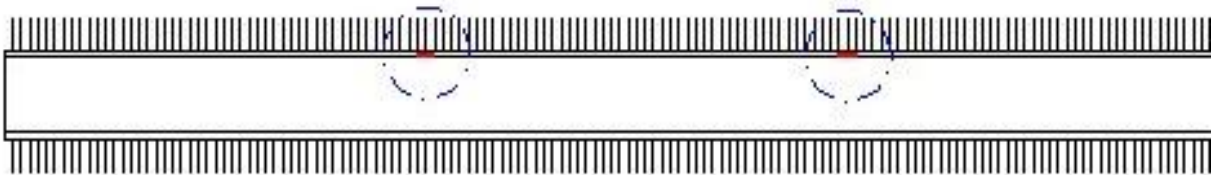


# HRSG INSPECTION TOOLS

## LOW FREQUENCY ELECTROMAGNETIC TECHNIQUE INSPECTION OF HRSG TUBES FROM THE OUTSIDE SURFACE

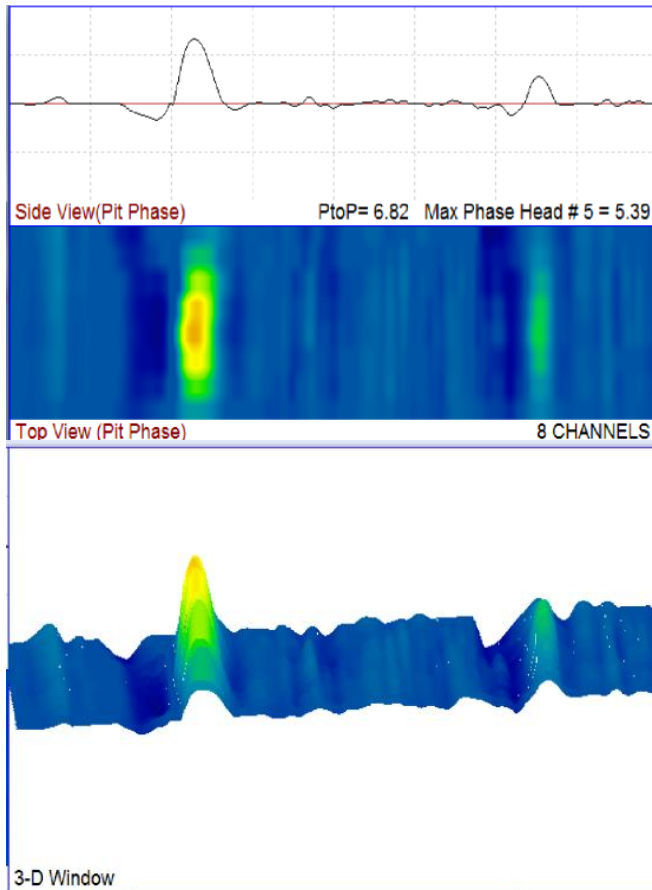
½" Diameter Pit  
60% Deep on  
Inside Surface

½" Diameter Pit  
30% Deep on  
Inside Surface



The drawing above shows the pits that were machined on the inside surface of the carbon steel finned HRSG tube calibration standard. The tube has a 2" OD with a 0.150" wall thickness and 0.75" long fins.

The Low Frequency Electromagnetic Technique waveform from this calibration tube is shown below.



The Side View phase plot shows the responses from the ½" ID pits in the HRSG calibration tube standard. The first rise in the signal is the 60% deep pit and the second rise is the 30% deep pit.

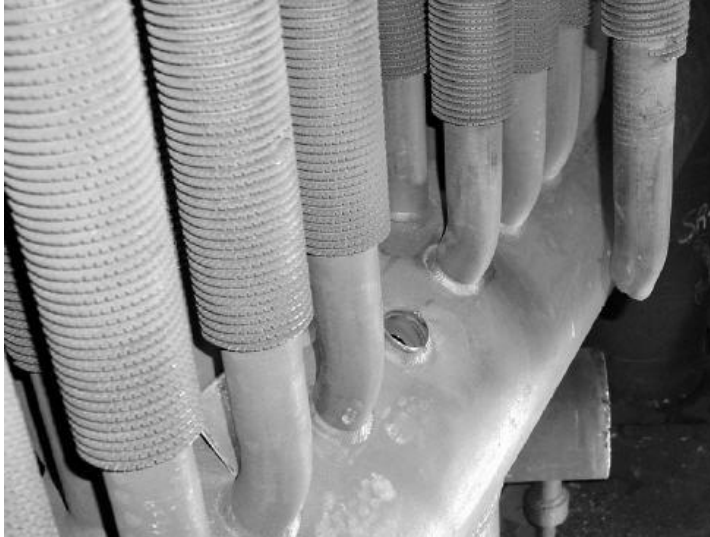
The Top View shows a simulated color B-scan. The 60% deep pit is shown with the yellow to red shades and the 30% deep pit is shaded green.

The 3-D Window displays the pit responses from a side view perspective. The first rise is the 60% deep pit and the second rise is the 30% deep pit.

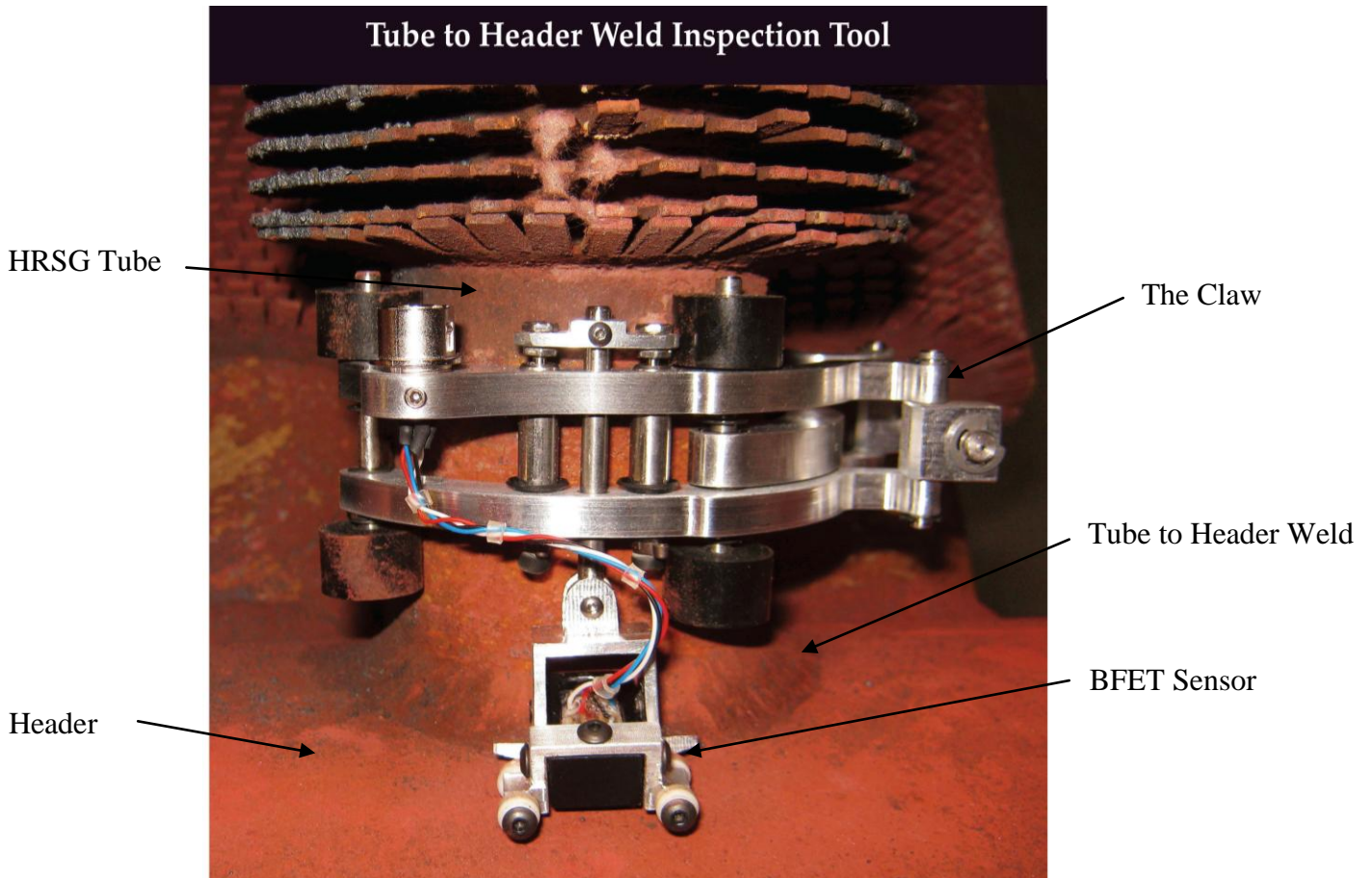


# HRSG INSPECTION TOOLS

## TUBE TO HEADER WELD INSPECTION TOOL



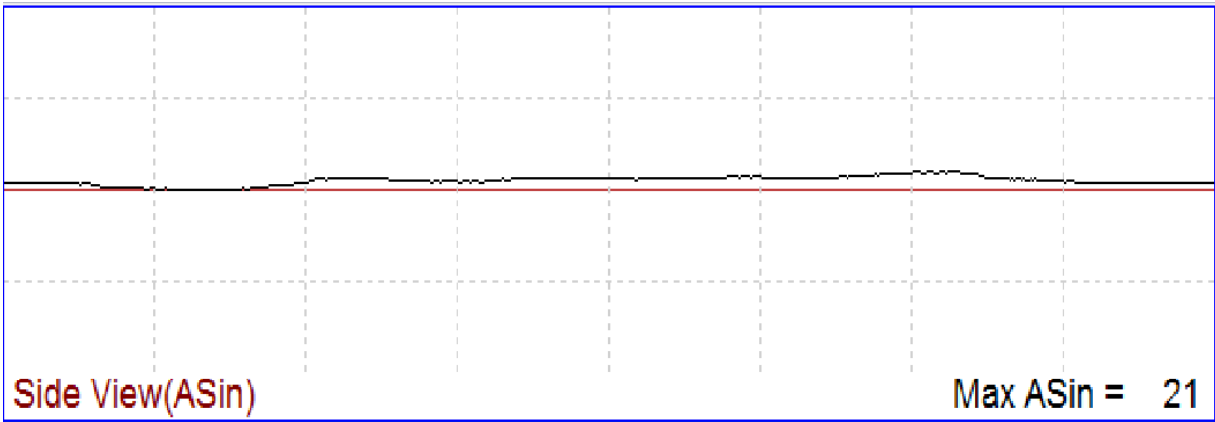
TesTex has worked with EPRI to adapt our Balanced Field Electromagnetic Technique (BFET) to inspect the tube to header welds of HRSG units. The BFET probes and cameras are placed on the welds using a C-clamp housing called “The Claw” that attaches to the tube. Once attached to the tube, the assembly moves circumferentially around the weld to detect cracking, lack of fusion, porosity, and other defects.



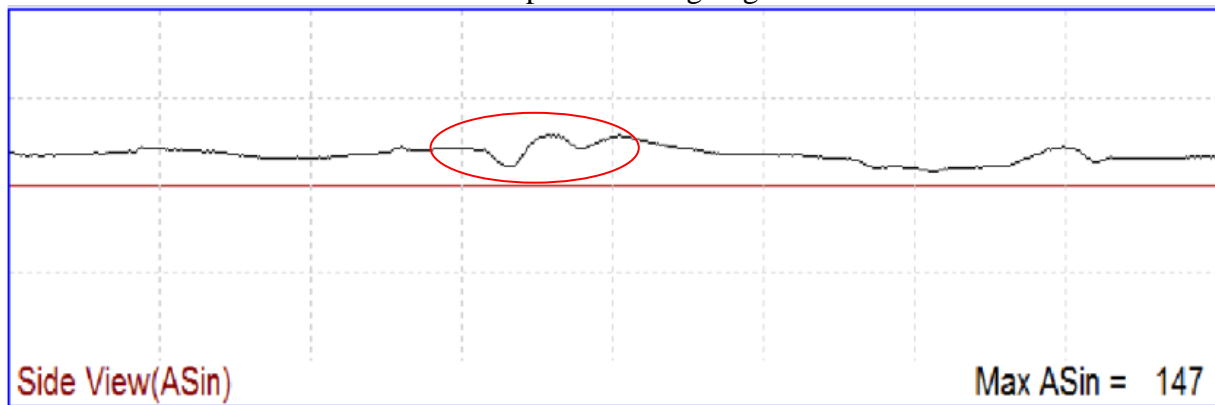


# HRSRG INSPECTION TOOLS

## TUBE TO HEADER WELD INSPECTION TOOL



The BFET waveform above shows the response when going over a clean weld with no defects.



The BFET waveform above shows the response from an EDM notch 0.050" deep in a tube to header weld.



The picture above is from the camera on the Claw as it scans a tube to header weld. An EDM notch is circled.



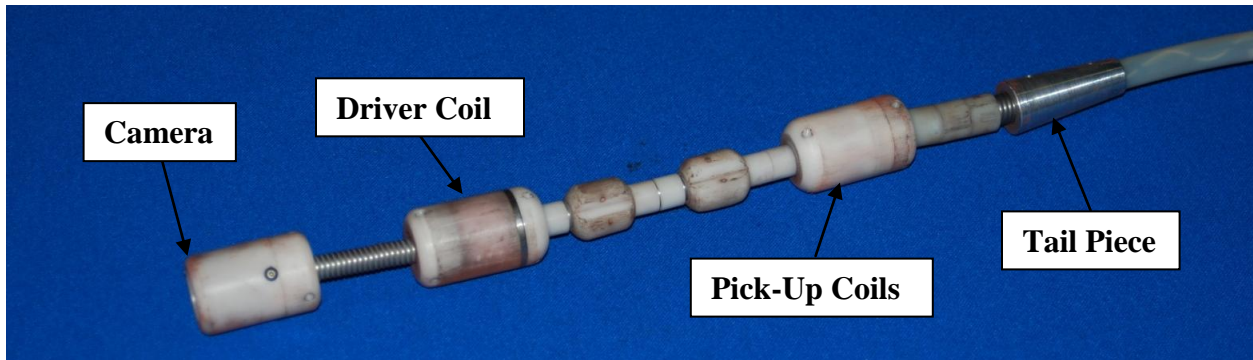
# HRSG INSPECTION TOOLS

## REMOTE FIELD ELECTROMAGNETIC TECHNIQUE INSPECTION OF HRSG TUBES FROM THE INSIDE SURFACE

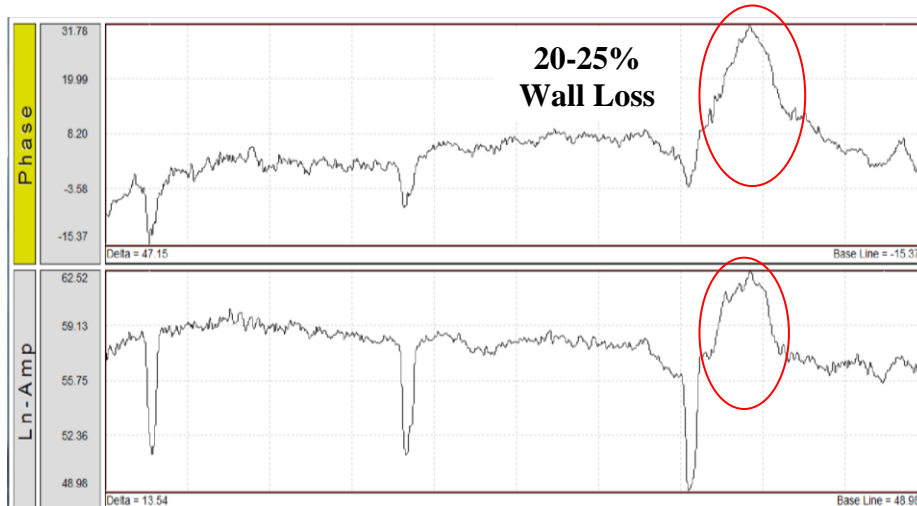


Access hole drilled into a HRSG header

The TesTex developed Remote Field Electromagnetic Technique (RFET) allows for the inspection of HRSG tubes from the inside surface when utilizing access holes cut into the header. The flexible probe is able to go through moderate bends and can test through a modest buildup inside the tube enabling the inspection of select tubes. There is also a camera on the probe end to capture video of the tube's inside surface.



The picture above shows the RFET probe with a camera used to examine HRSG tubes.



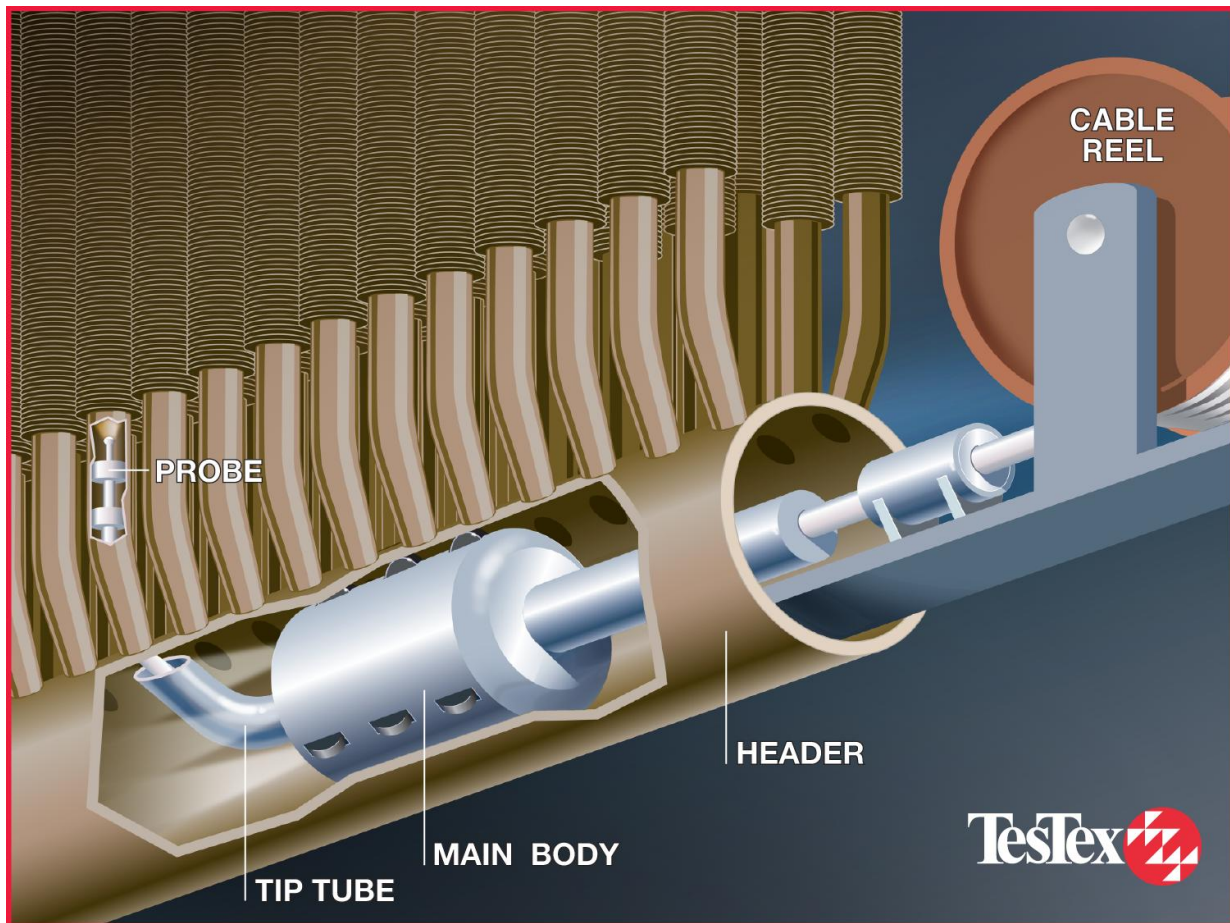
The RFET waveform above shows 20-25% localized wall loss found in a HRSG finned tube.



## HRSG INSPECTION TOOLS

### TUBE INSPECTION TOOL FROM THE INSIDE SURFACE

EPRI contracted TesTex to develop an “Internal Inspection Tool” that can be inserted inside a header to allow a Remote Field Electromagnetic Technique probe to be pushed up the length of HRSG tubes to record thickness readings. Access is provided by removing the endplate from the header.



The illustration above shows the Internal Access Tool inside a header pushing a probe up a HRSG tube for wall thickness measurements.



The end of the header needs to be removed to provide access for the Internal Access Tool to be inserted.

The probe has a video camera on the tip and also contains Remote Field Electromagnetic Technique coils to measure the tube wall thickness.



## HRSG INSPECTION TOOLS

As TesTex is developing tools for the HRSG market, we are looking for mockups to help in the design and trial testing of equipment. Please contact us if you are willing to donate any HRSG headers for this purpose



The picture to the left shows a technician examining a weld in a storage tank.

TesTex also has several NDT tools to examine the Balance of Plant equipment. This includes the inspection of condensers, heat exchangers, pressure vessels, piping, and welds. Please contact us at 412-798-8990 for your Non-Destructive Testing needs.