ADVANCED ELECTROMAGNETIC TESTING
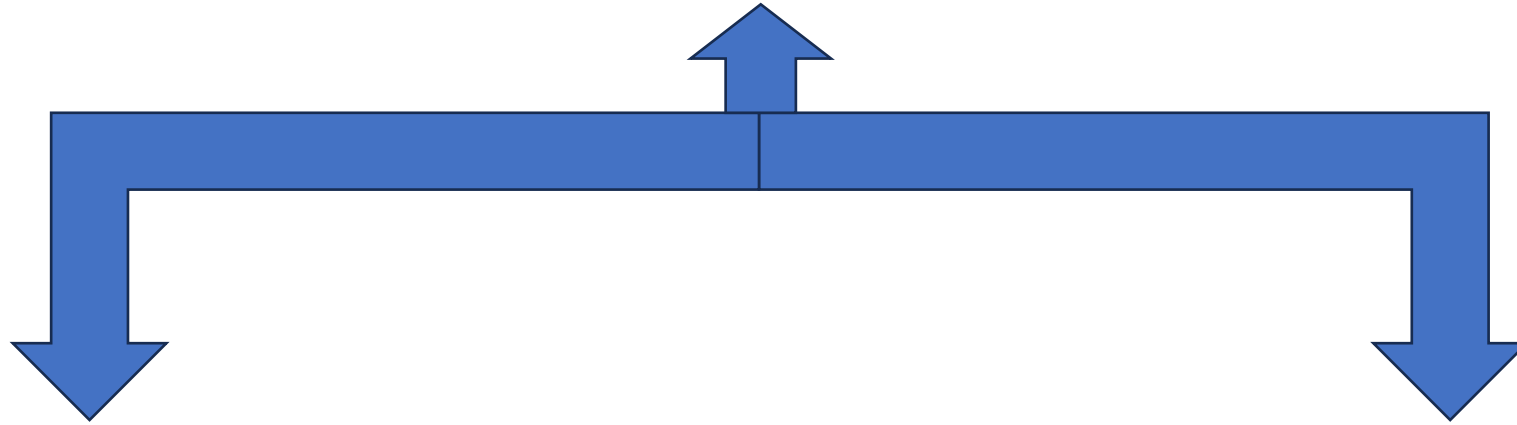
FOR BOILER TUBE INSPECTION

Electromagnetic testing

- Electromagnetic testing method employs electricity and magnetism in the detection and evaluation of pitting, crack, corrosion or other material conditions. The approach here is that both magnetic fields and electric currents (or either of them) are induced within a test FRP composite sample, while the electromagnetic signal is detected.

- Some identified electromagnetic (EM) techniques are Eddy current (EC) inspection, alternating current field measurement (ACFM),near field testing and remote field testing (RFT) etc. They all have different physics as governed by their unique partial differential equations (PDEs).

AET FOR BOILER TUBE INPECTION

- **Remote field testing** (**RFT**) is a method of non-destructive testing using low-frequency AC. whose main application is <mark>finding defects in ferrous tubes.</mark>

- An RFT probe employs an exciter coil to emit an AC current-induced magnetic field through the pipe wall. This magnetic field travels outward along the pipe's interior and also penetrates through the pipe wall. Positioned at a distance of two to three pipe diameters away from the exciter, the receiver coil detects any leakage of the magnetic field caused by defects or metal loss in the pipe's structure.

- **AET** share the same basic principle. Alternating current injected into a coil creates a magnetic field. When the coil is placed over a conductive part, opposed alternating currents (eddy currents, in red) are generated. Defects in the part disturb the path of the eddy currents. This disturbance can be measured by the coil.

- AET technology provides the ability to electronically drive an array of coils (multiple coils) arranged in specific pattern called a topology that generates a sensitivity profile suited to the target defects

REMOTE FIELD TESTING(E-PIT PROBE)

- RFT (E-Pit tool) is primarily used to inspect ferromagnetic tubing since conventional eddy current techniques have difficulty inspecting the full thickness of the tube wall due to the strong skin effect in ferromagnetic materials.

- E-pit tool has two receiver coils: one is absolute for detecting general wall loss in the near field zone, and another is differential for identifying localized defects like pits, cracks & material degradation in the remote field zone.

- E-Pit Tools are designed to inspect tubes & pipes from the outside surface to detect internal (ID) & external (OD) defects. This is useful for situations where a pipe must be inspected before it is taken out of service. E-Pit can inspect upto 12mm thickness through coatings.

- Scanning speed ranges from approximately 0.3 to 8.6 meters per minute, depending on the thickness of the material being inspected.
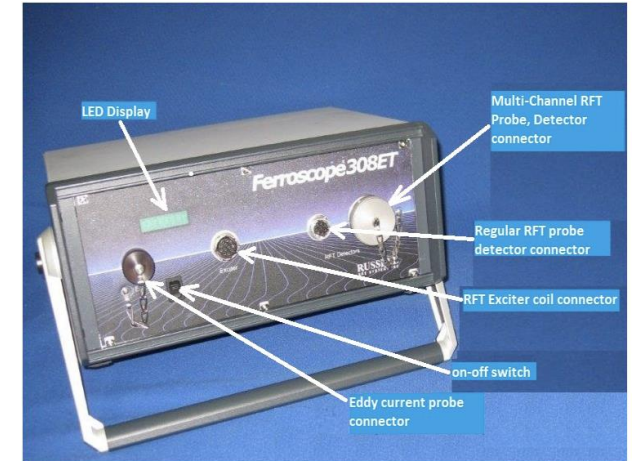
(FERROSCOPE-308ET)

(E-PIT PROBE)

ADVANCED EDDY CURRENT PROBES

- The Flex probes seem to be highly regarded in the non-destructive testing (NDT) industry. They are described as flexible and plug-and-play AET probes, which means they are easy to use and can adapt well to various inspection scenarios.

The key features of the Flex probes include:

1. The probes are highly flexible, conforming to complex geometries and surfaces.

2. The Flex probes maintain excellent performance without compromising accuracy.

3. They allow for efficient one-pass examinations, reducing inspection time and increasing productivity.

4. The probes are equipped with real pancake coils, enhancing their ability to detect surface and subsurface flaws with excellent signal quality.

5. Detection like pitting, crack and mostly metalogical degradation.

RFET

AET

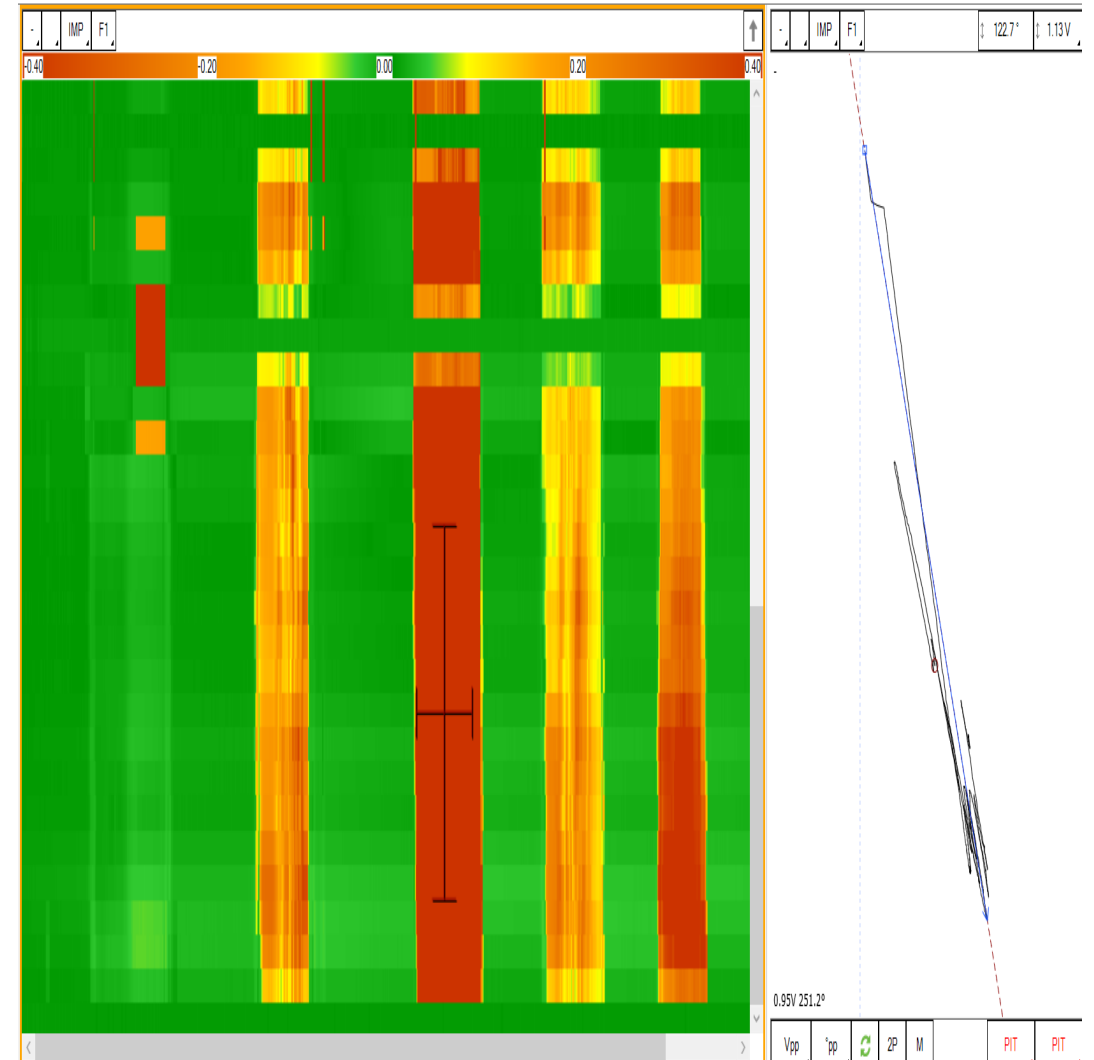The results are displayed as color maps, strip charts and voltage planes.
In the image at right an entire water wall is mapped (every 5th tube)
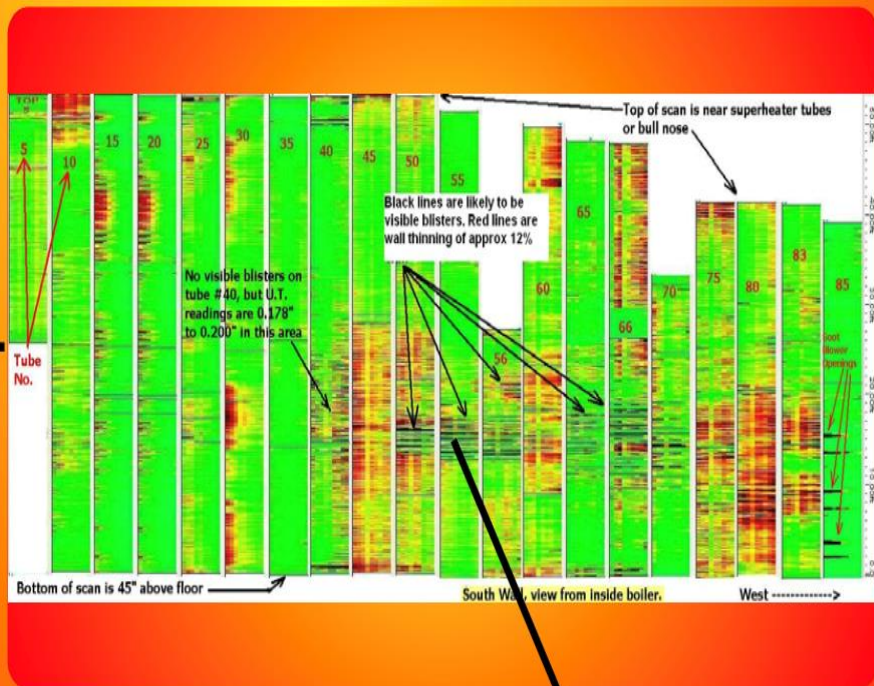
In the sample at right, the internal defect detected was graphitization. Also detectable are: internal pitting; thermal fatigue; soot blower erosion; blisters; flame erosion; hydrogen attack and chelant corrosion.
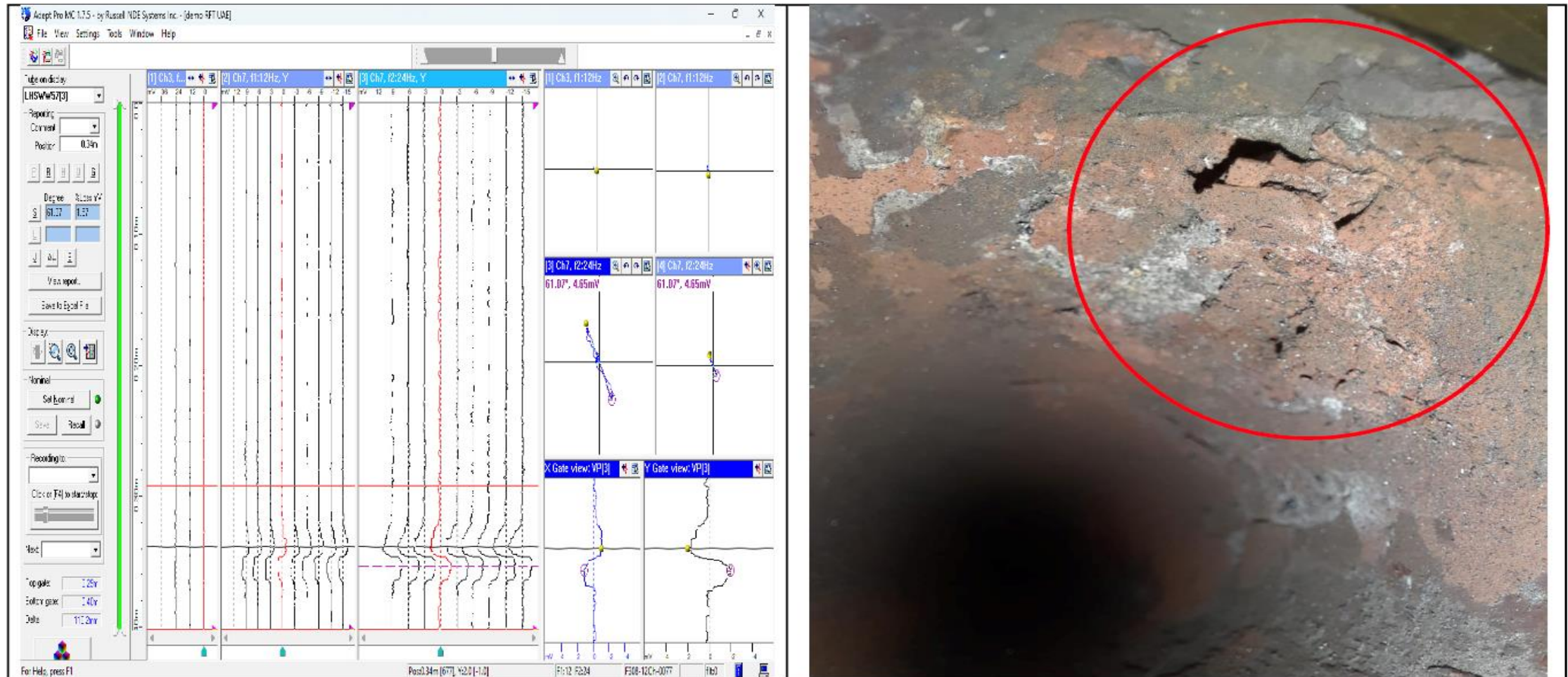
Top of scan is near superheater tubes or bull nose

Black lines are likely to be visible blisters. Red lines are wall thinning of approx 12%

No visible blisters on tube #40, but U.T. readings are 0.178" to 0.200" in this area

Tube No.

Bottom of scan is 45" above floor

South Wall, view from inside boiler.

West ·············>

Graphitization of boiler tube, flame side
Note heavy scaling (0.011" thick)
This defect was detected and sized using E-PIT and wall Crawler

FINDING DURING RFET INSPECTION

Inspection Finding 1 :- Hydrogen Damage

Inspection Finding 2 :- Gradual wallloss
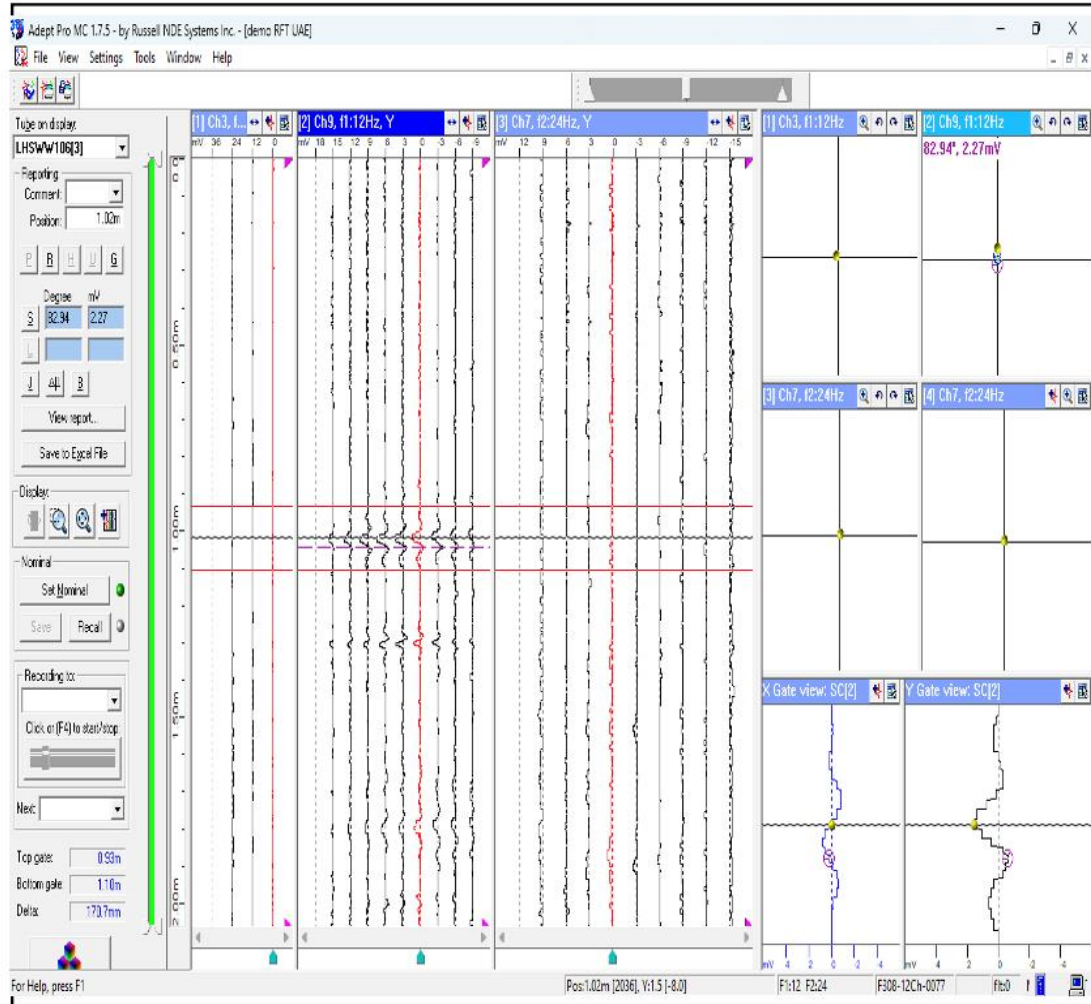
FINDING DURING AET INSPECTION

Finding-1(Material degradation test on Solapur demo blocks)