Advanced Electromagnetic Technique (AET)

1. SCOPE

This document is designed to provide the guidance on the use of Advanced Electromagnetic technique for Final Re-heater Coil in Boiler This document is aimed at service inspection providers, inspection personnel, inspection planners, maintenance and operation engineers and asset managers.

2. REFERENCES

The following documents provide information relating to Boiler Inspection approaches

Sr. no.	Title	Standard
1	Pressure Vessel	API 510
2	ASME Boiler & Pressure Vessel Code - Non Destructive Examination	ASME Sec V Article 18 & 9
3	American Society for Non-destructive Testing	SNT-TC-1A

3. INSPECTION PERSONNEL

For the inspection of boilers there needs to be a team of operators. This inspection team should consist of at least 3 individuals. The roles required of the inspection team can be described as:

- ET/ RVI Technician (Level II)
- ET/ RVI Assistant (Level I)
- Supporting Staff

4. AET TECHNICIAN

The AET Technician is responsible for the operation and application of the AET equipment. He must be NDT Level II in Eddy Current Testing with minimum experience of 5 years in ECT. General theory in ET inspection Certificated training in the operation, use and application of the specific instrument to be used. This is likely to be provided by a technology developer.

5. -VOID-

6.1 AET EQUIPMENT

AET equipment should be capable of operating in the differential modes, together with suitable probes and a device for recording the AET data in a format suitable for evaluation and archival storage are all essential parts of the system. The means of displaying signals shall be on a Voltage Plane (also known as an Impedance Plane, a Voltage Plane, Polar Plot, and an X-Y Display). Equipment should have Dual frequency technique for examination.

6.2 AET PROBE

A flexible probe of minimum 8 channel array to maximum 48 channel array will be used for the inspection of tubes. It's a multichannel probe specially designed for inspection which is having a penetration of maximum 25mm.

6. PRINCIPLES OF AET

AET testing is based on electromagnetic principle. The technique uses Electromagnetic waves generated in the material wall by exciter coils at high frequencies for detecting the material property changes caused due to the service defects, i.e. any change in the structure of the material can be detected by Advanced Electromagnetic Technique. AET/ AET is independent on material of composition and can be used on any metal, i.e. both Ferrous and Non-ferrous material.

7. KEY FEATURES AND TECHNICAL ADVANTAGE OF AET INSPECTION

- Little to no surface preparation required, so inspection can be done with minimum cleaning
- Highly sensitivity to any material property change
- Array probe with maximum 48 number of detectors for maximum area coverage
- Maximum material penetration of 25m
- Equally sensitive to ID and OD defects
- Immediate reading/ interpretation of scan
- High scanning speed of 0.2meter/sec

8. PREPARATION FOR SITE WORKING

Suitable risk assessments must be carried out prior to the arrival of any inspection team at the inspection site. Such risk assessments should be performed in consultation with the asset owners; personnel involved in the day to day running of the pressure vessels; inspection operators and their management. Before entering any pressure vessel this risk assessment should be reviewed by the inspection team leader. If there are any new risks identified or inadequate provision to mitigate identified risks then these must be addressed to the satisfaction of the inspection team leader, prior to the commencement of any inspection. At all times during an inspection the safety of the inspection personnel will be the responsibility of the inspection team leader. It should be noted that AET equipment is generally not intrinsically safe and should not be operated in a potentially explosive environment.

9. WORKING PRECAUTION

The equipment being used should be shifted in the yard & should set the machine where there is no disturbance. Further to these considerations it is necessary to ensure that adequate breaks are taken during the inspection to ensure operator fatigue does not become an issue. This can be a particular problem in hot environments.

10. VOID

11.1 NUMBERING SYSTEM

Bends are numbered from as per client specification. During the inspection as operators exit from the site during routine movements they should ensure that they have scanned, measured and recorded details correctly from each area in relation to the global reference mark and/or external reference. This check should also be performed at the end of the inspection.

11.2 LEVEL OF CLEANLINESS

As AET technique is a non-contact method of inspection, it does not need high-end cleaning.

11. VOID

12.1 THRESHOLDING / SENSITIVITY

A sensitivity level should be set using the reference tube prior to commencing an inspection, to minimize false calls and to set the value required for defect reporting.

12.2 SCANNING

1. Tube Inspection probe will be used for tube inspection.

2. Bend Inspection probe will be used for bend inspection.

12.3 ASSESSMENT OF INDICATION

AET technique indication areas will be marked with an additional length of 100mm for further examination.

12.4 REPORTING OF INDICATION

- **After AET inspection all reportable indications above 5% of intensity will be confirmed by the technician using Ultrasonic technique (UT) and then the TUBE or BENDS will be confirmed for repair or renewal.**
- At the end of the inspection, the team should ensure that defect markings are visible and can thus be easily cross checked.
- The easy handling of the reporting software enables the setting up of the required color levels for the defect severity display.
- An interim or site inspection report may be produced by the inspection team which will allow recorded indications to be easily cross checked prior to the use.
- All reports should be presented in a clear and concise manner following the outline for presentation.
- A description of the tube inspected and details of the tubes numbering / labeling systems should be included within an introductory section, as details of reference values.
- Details of the inspection procedure or method statement should be included along with reporting and justification of any non- compliance.

12.5 INSPECTION PROCEDURE

When performing inspection with AET, the operators should follow a procedure to ensure that all required steps have been completed. This outline is only a guide and should be adjusted and added to an appropriate by an inspection organization. Each area will be scanned covering 360 degree. Scanner is special designed as per metallurgy and application requirement.

13. OH & S INSTRUCTIONS

The inspection engineers engaged for inspection at client site / premises must follow these OH&S work instructions at the time of inspection.

- **SAFETY PERMIT / CONFINED SPACE PERMIT:**

At the client side, where safety permit is required for access, the concerned inspection engineer shall ensure that required permission is taken before starting the work.

- **COMPLYING WITH CUSTOMERS' SAFETY PROTOCOLS:**

The inspection engineer must consult the concerned Safety Officer of the Client organization and understand the safety protocols to be followed. Thereafter he should brief other members of his inspection team (if applicable) about the safety protocol.

- **PERSONAL PROTECTIVE EQUIPMENT:**

Inspection engineers must carry the necessary personal protective equipment (HMR-H-MPR-10) to the work site and wear them when required. If site have specific requirement as per there safety standard and if its suit their application it should be followed.

LOCK-OUT / TAG OUT OF AREAS (IF APPLICABLE):

At the work site, the area in which the work will be carried out shall be cordoned off with the safety tapes and a Notice board stating "MEN AT WORK".

- **ELECTRICAL AND MACHINERY SAFETY:**

Proper safety measures must be taken to ensure electrical safety. Inspection equipment must be checked for proper electrical system, joints and insulation.

- **MATERIAL HANDLING SAFETY:**

Proper care shall be taken while handling of equipment / machines to avoid any accident and injury due to fall or release of weight on body parts / limbs. Mechanical aids like- forklift, utility vehicles, cart & pallets must be used for safe lifting / shifting of equipment and accessories.

- **FIRE EMERGENCY:**

At the work site, the inspection engineer shall understand the fire emergency procedures and act accordingly.

- **FALL PROTECTION FOR WORK AT HEIGHT (IF APPLICABLE):**

Work shall be carried out on platform or scaffolding with green tag which is permitted safe to use, kindly check for preliminary safety of scaffold before working on it. While working on ladder or platforms, scaffoldings higher than 6feet, Full body harness with double lanyards shall be used by team members.

- **WORK IN CONFINED SPACE:**

Inspection team / engineer must ensure the Valid Confined space work permit and its safety compliances as follows:
a. Cleaning / Purging of vessel is completed by the client.
b. Lockout / blinding of the pipeline inlet & outlet connection is completed by client.
c. Gas level is checked for minimum parameters like LEL, H2S, Oxygen, CO2, NO2 etc.
d. Attendant is available.
e. High Visibility Jacket
f. Exhaust and Oxygen inlet is provided g. Lamp of 24 volt is provided.

- **EMERGENCY ESCAPE ROUTE:**

Inspection team / engineer must know or familiar with the client emergency procedure, escape routes, emergency assembly area, First / Medical center, security control center, nearby manual call point etc.