Improving Boiler Reliability Through NDT

Frank Neil

TesTex Inc.

535 Old Frankstown Road

Pittsburgh, PA 15239

TesTex
State of the Art Products and Services for NDT

Keys to Improving Boiler Reliablity

1) Explain Problems to NDT Company
2) Provide Samples and Drawings
3) Cut-out some findings to verify and to improve calibrations and calls.
4) Make proper repairs
5) Take corrective actions to prevent/reduce future failures.

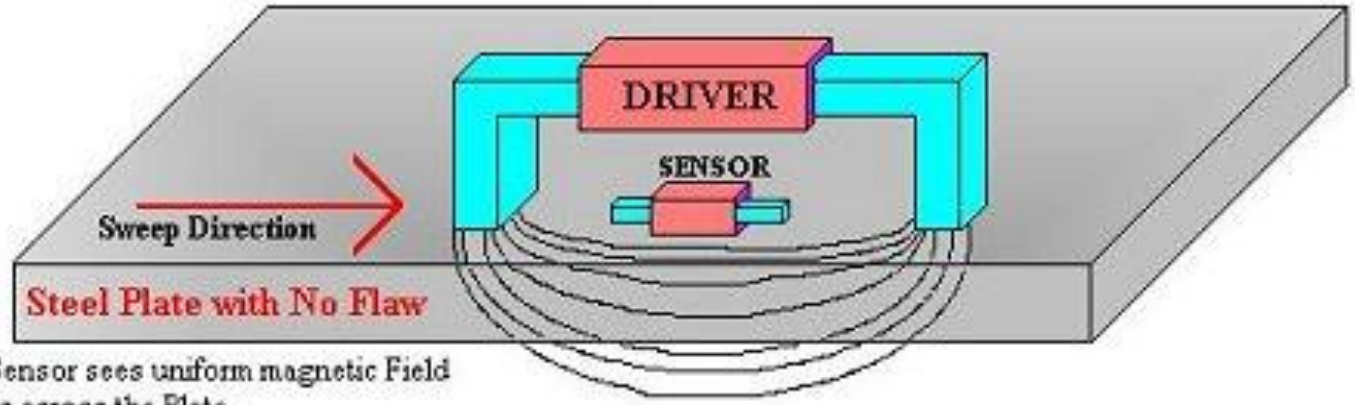
**Please remember that using NDT will improve your Time Between Failures. It will not eliminate all tube failures.

Waterwall, SuperHeater, and Reheater Inspections

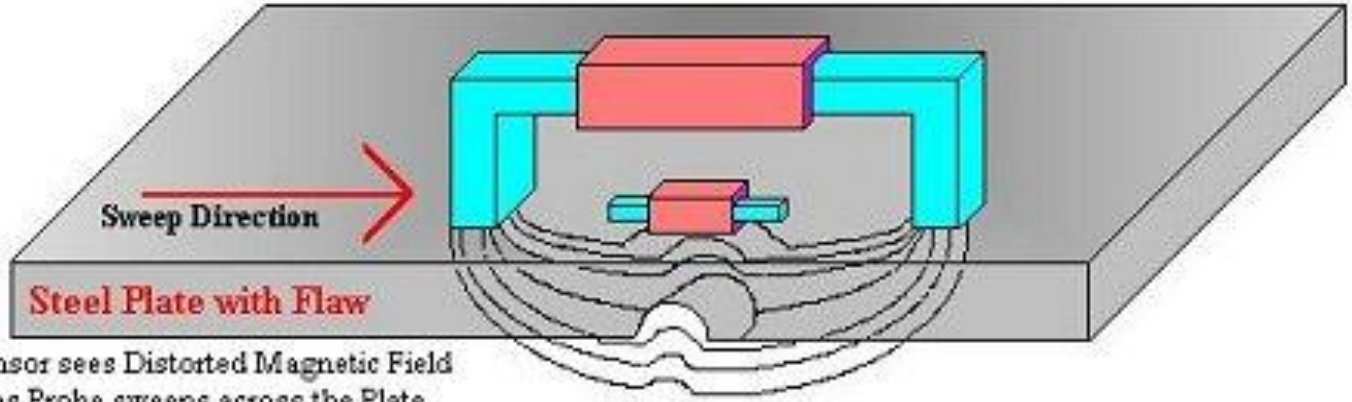
AVAILABLE INSPECTION TECHNOLOGIES

- Standard Ultrasonic Thickness Testing
- Magnetic Particle Inspection of Seam Welds
- Radiography
- EMAT
- Low Frequency Electromagnetic Technique (LFET)

What is LFET?



With no Flaw, Sensor sees uniform magnetic Field as Probe sweeps across the Plate.



With Flaw, Sensor sees Distorted Magnetic Field near the Flaw as Probe sweeps across the Plate.

TS-2000 Scanning System

- The Low Frequency Electromagnetic Technique is used to inspect tubes and pipes from the O.D. It detects and quantifies I.D. and O.D. defects in ferrous and non-ferrous materials.

- The TS-2000 is a multichannel system that uses a dry non-contact method based on electromagnetics. It is forgiving to uniform surface scale and tests at a scanning speed of 10 to 15 ft per minute.

- Furthermore, the system can be adapted to many different applications, such as testing bends, space constricted areas, and small diameter tubing.

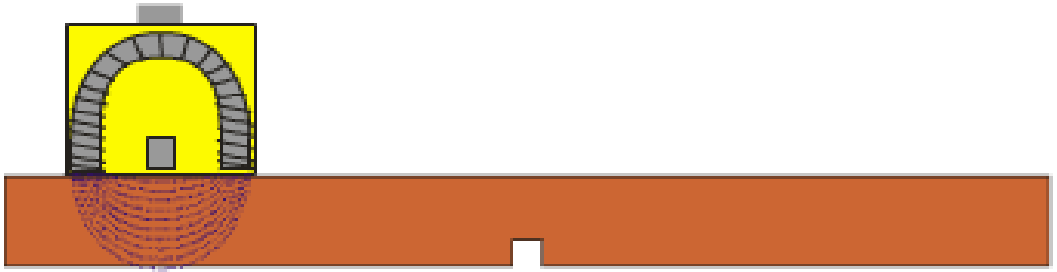
TS-2000 Advantages

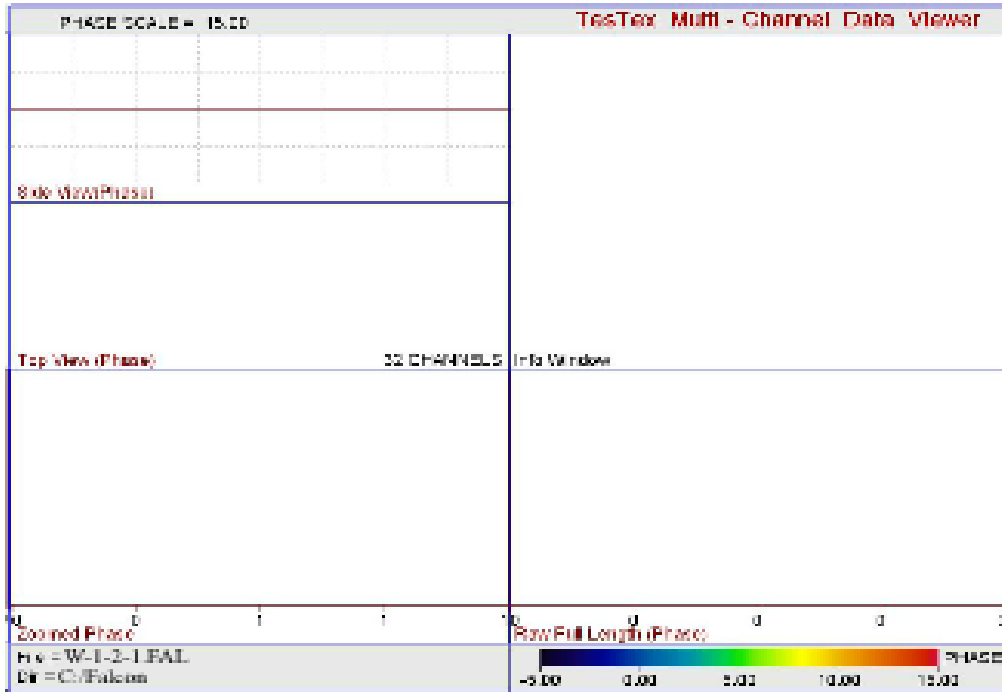
- Dry non-contact method. No couplant necessary
- Forgiving to uniform surface scales, rust and coatings
- Scanning speed up to 10 to 15 feet per minute
- 8 sensors to achieve up to 160 degrees of coverage in a single scan on a furnace wall tube
- Variety of contoured scanners to fit any tube/pipe diameter
- Special application scanners available for many different tasks such as bends, space constricted areas and small diameter tubing
- Light weight, modular, DSP (Digital Signal Processing) based electronics/PC operated
- Real time data display with advanced signal processing
- High resolution color graphics with 3D display

Typical Defects Found

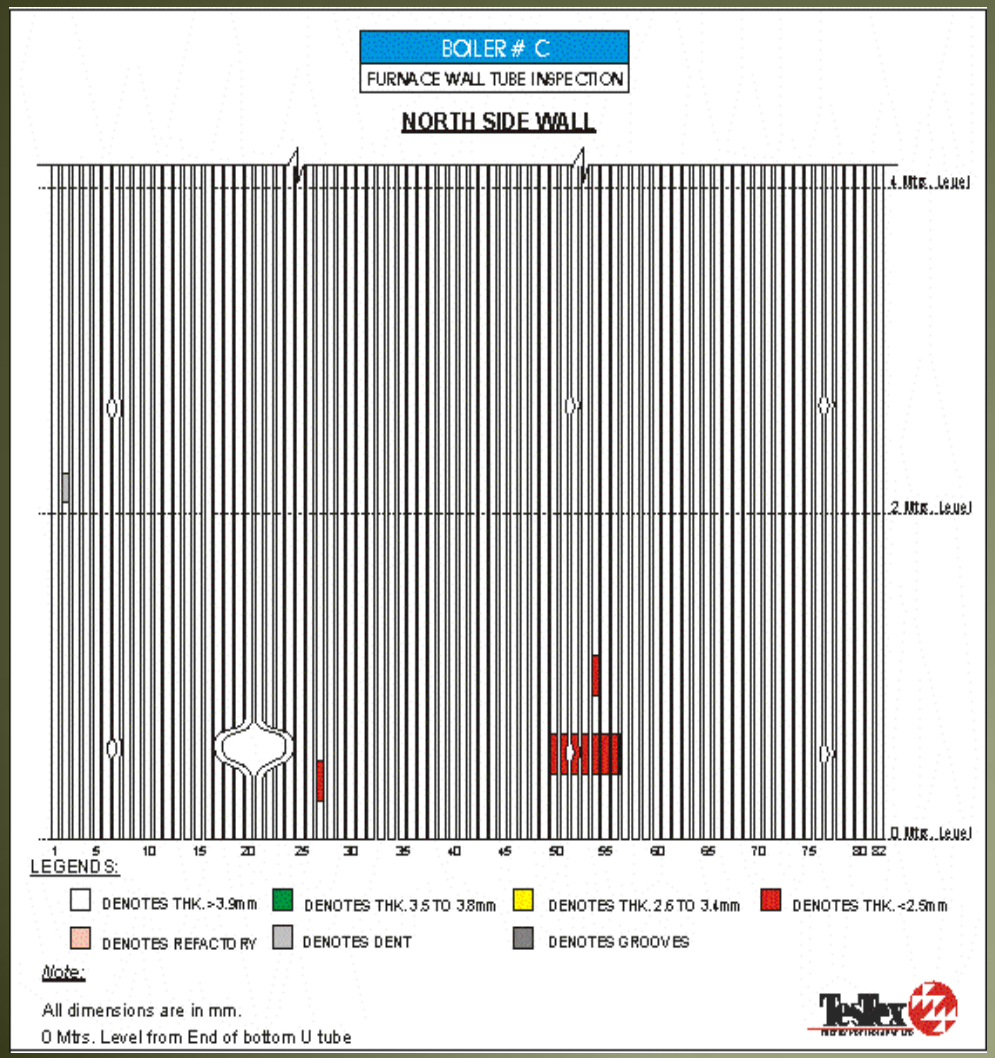
- Caustic and Phosphate gouging
- Hydrogen damage
- Oxygen pitting
- Cracking (including stress corrosion cracking on stainless steel)
- Flu gas/low Nox erosion
- Manufacturing defects (baseline inspections)

LFET Scanning

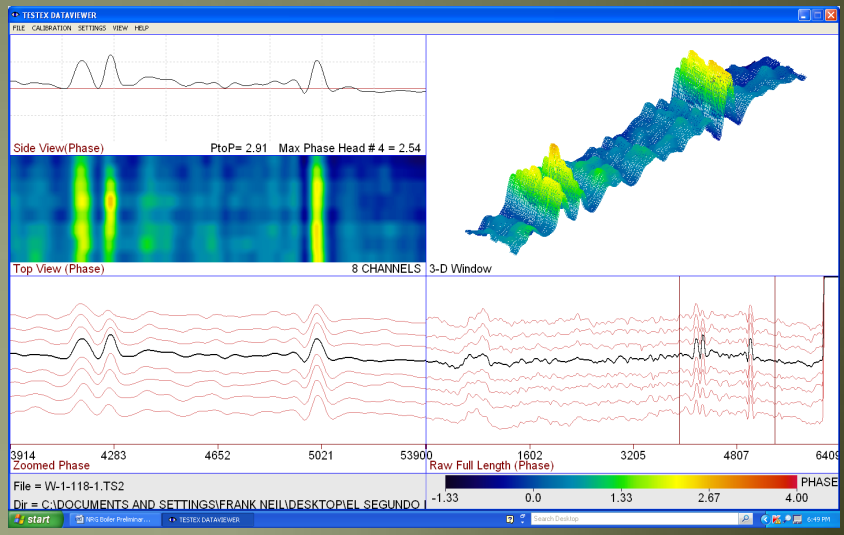




Reporting

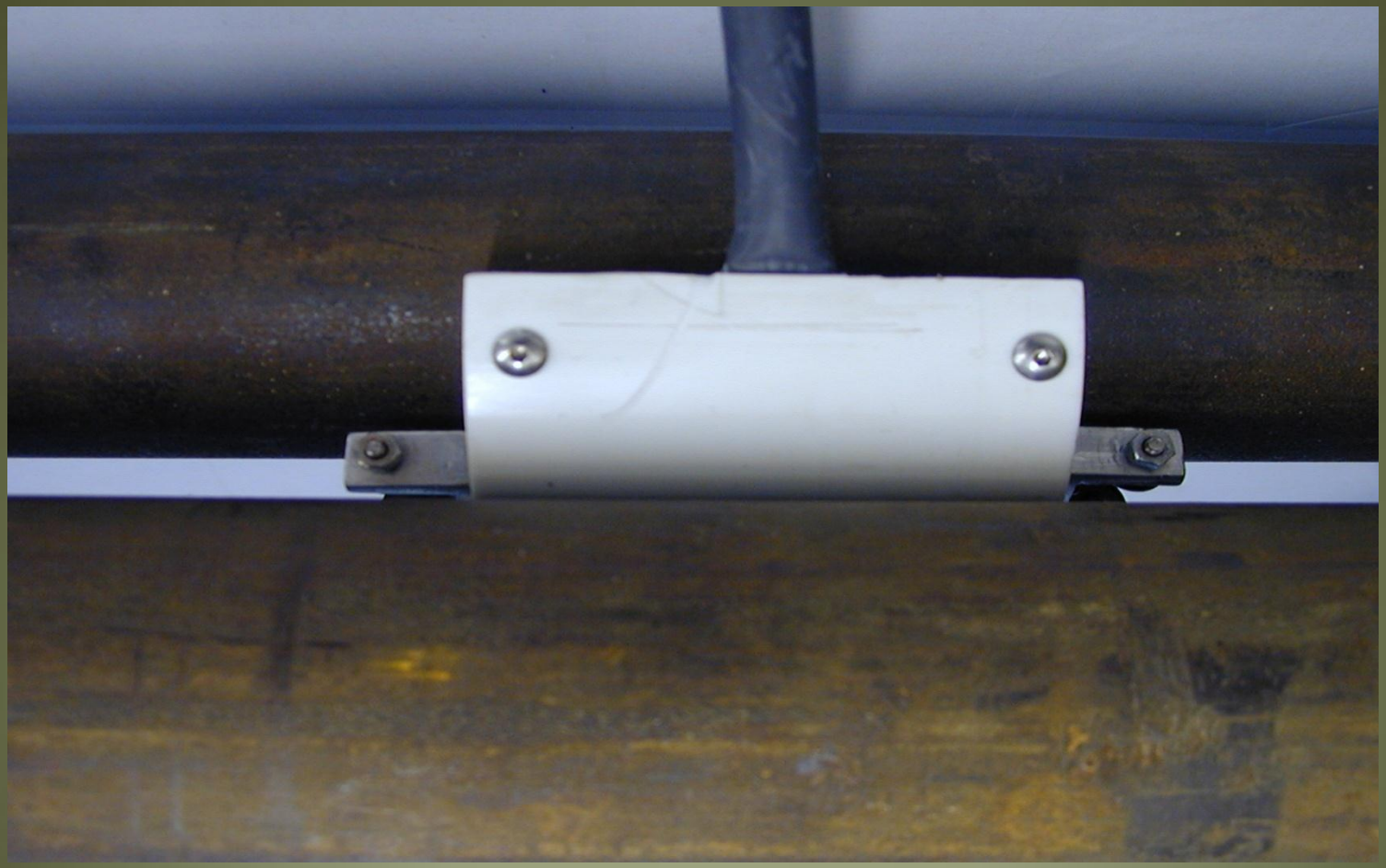

BOILER # C
FURNACE WALL TUBE INSPECTION
NORTH SIDE WALL
4 Mtrs. Level
2 Mtrs. Level
0 Mtrs. Level
1 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 82
LEGENDS:
DENOTES THK.>3.9mm
DENOTES THK.3.5 TO 3.8mm
DENOTES THK.2.5 TO 3.4mm
DENOTES THK.<2.5mm
DENOTES REFACTORY
DENOTES DENT
DENOTES GROOVES
Note:
All dimensions are in mm.
0 Mtrs. Level from End of bottom U tube
TesTex


10/14/2004 20:15


TESTEX DATAVIEWER
FILE CALIBRATION SETTINGS VIEW HELP
Side View(Phase)
PtoP= 2.91 Max Phase Head # 4 = 2.54
Top View (Phase)
8 CHANNELS
3-D Window
3914 4283 4652 5021 53900 1602 3205 4807 6409
Zoomed Phase
Raw Full Length (Phase)
File = W-1-118-1.TS2
PHASE
-1.33 0.0 1.33 2.67 4.00

Various Scanners (Bend)

Various Scanners (Low Profile)



Case Study 1

Problem: Tube failures in the Horizontal Reheater due to oxidation pitting. Access between tubes is .75". Pendants are spaced tightly together.

Western PA

3 – 835 mw coal-fired Foster Wheeler units.

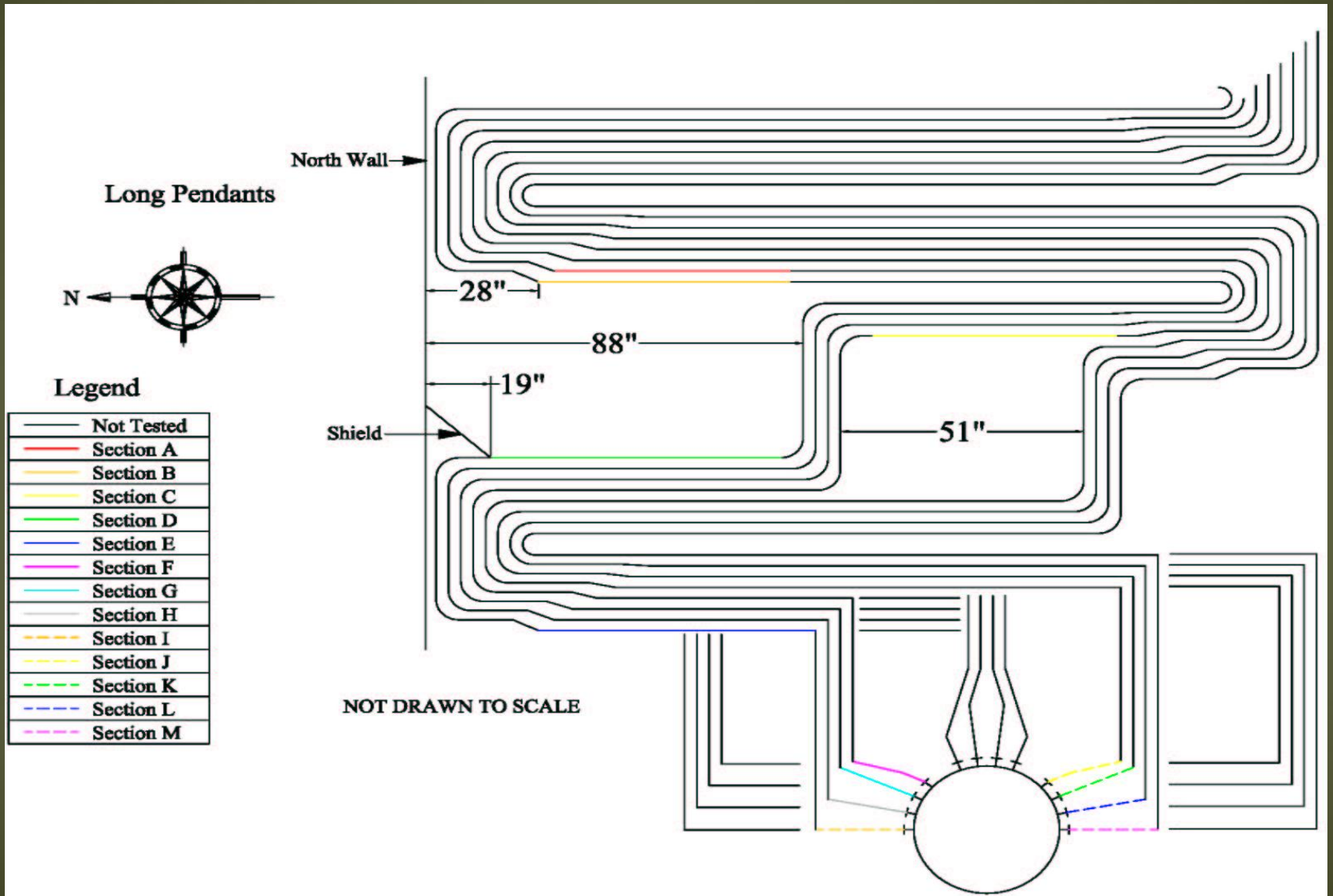
Tube Dimensions:

Tube OD: 2.5" OD

Tube Wall 0.180" wall

Material SA-213 T22

Case Study 1


Long Pendants
N
Legend
Not Tested
Section A
Section B
Section C
Section D
Section E
Section F
Section G
Section H
Section I
Section J
Section K
Section L
Section M
North Wall
28"
88"
19"
Shield
51"
NOT DRAWN TO SCALE

Case Study 1

Western PA Boiler

#3 Boiler

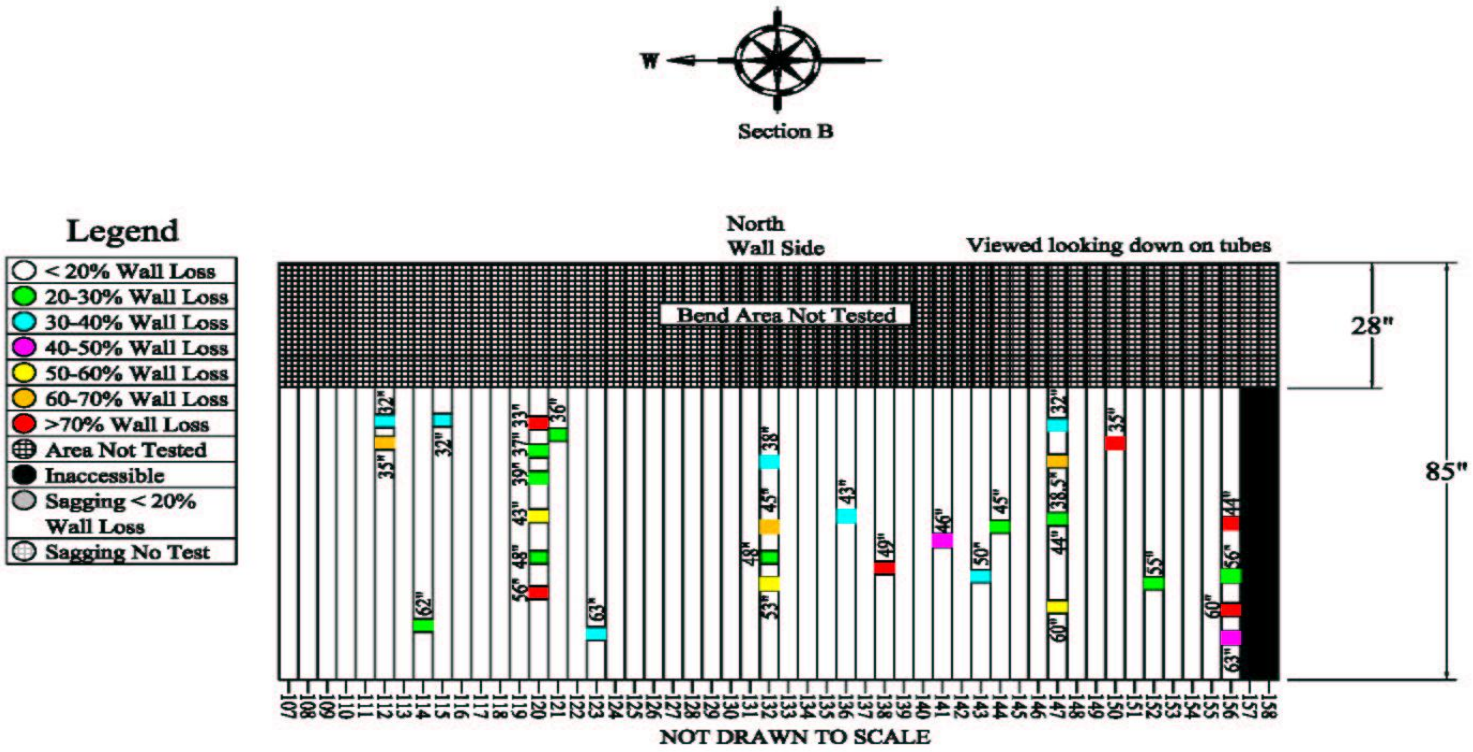
5 Areas Inspected

44 tubes with defects found

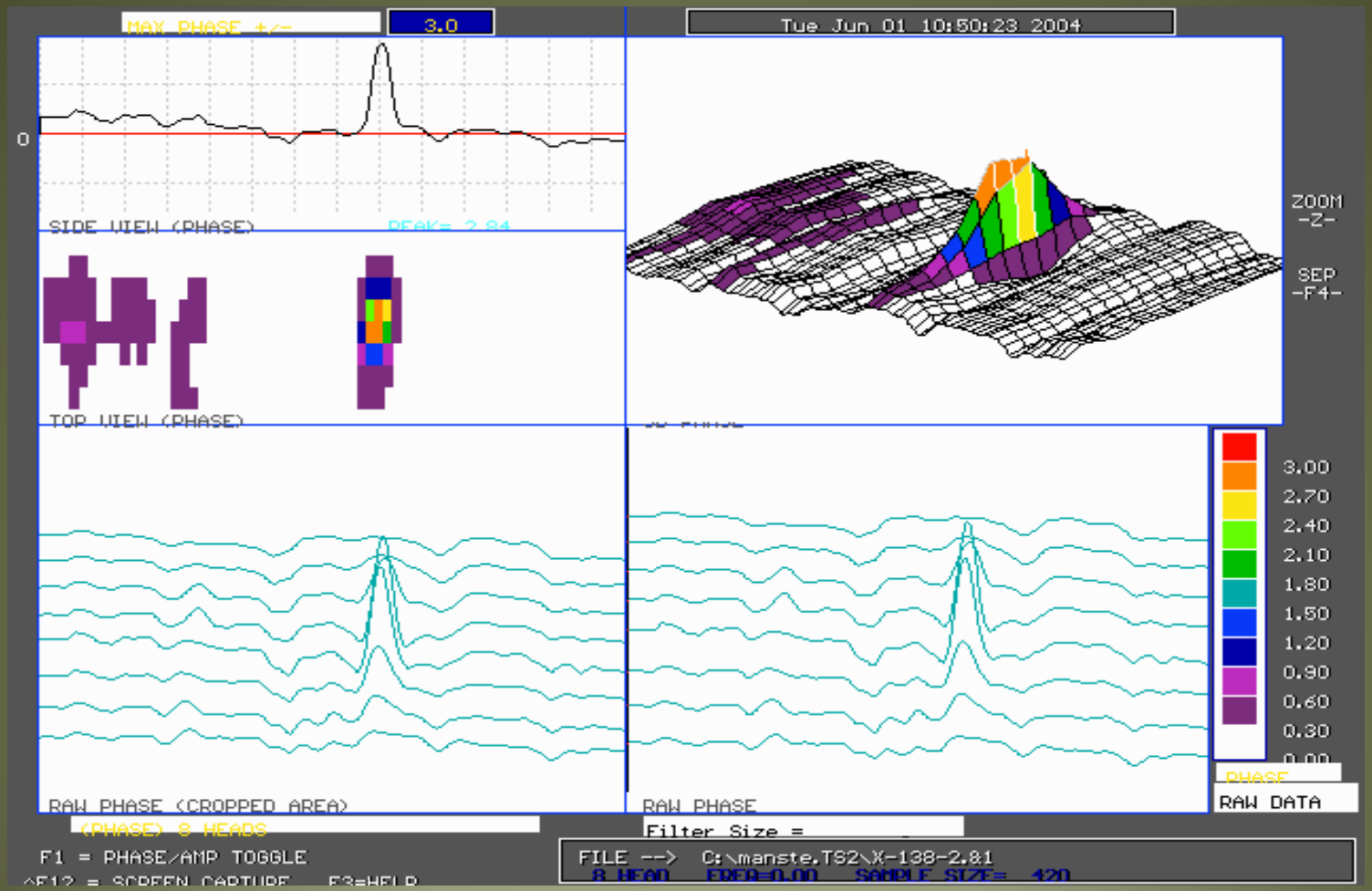
Major flaws found were cut-out and replaced with Dutchmans.

Minor defects were pad welded.

Case Study 1


W
Section B
Legend
< 20% Wall Loss
20-30% Wall Loss
30-40% Wall Loss
40-50% Wall Loss
50-60% Wall Loss
60-70% Wall Loss
>70% Wall Loss
Area Not Tested
Inaccessible
Sagging < 20% Wall Loss
Sagging No Test
North Wall Side
Viewed looking down on tubes
Bend Area Not Tested
28"
85"
NOT DRAWN TO SCALE

Case Study 1


MAX PHASE +/-
3.0
Tue Jun 01 10:50:23 2004
0
SIDE VIEW (PHASE)
TOP VIEW (PHASE)
ZOOM
-Z-
SEP
-F4-
3.00
2.70
2.40
2.10
1.80
1.50
1.20
0.90
0.60
0.30
RAW PHASE (CROPPED AREA)
RAW PHASE
RAW DATA
(PHASE) 8 HEADS
Filter Size =
F1 = PHASE/AMP TOGGLE
FILE --> C:\manste.TS2\X-138-2.&1
8 HEAD EDEA=0.00 SAMPLE SIZE= 420

Case Study 1

Results:

Due to the amount of indications found in unit 3's reheater section, it was determined to also scan units 1 and 2's reheater section

All 3 units' reheater sections were replaced during the next scheduled outage

Case Study 2

Problem:

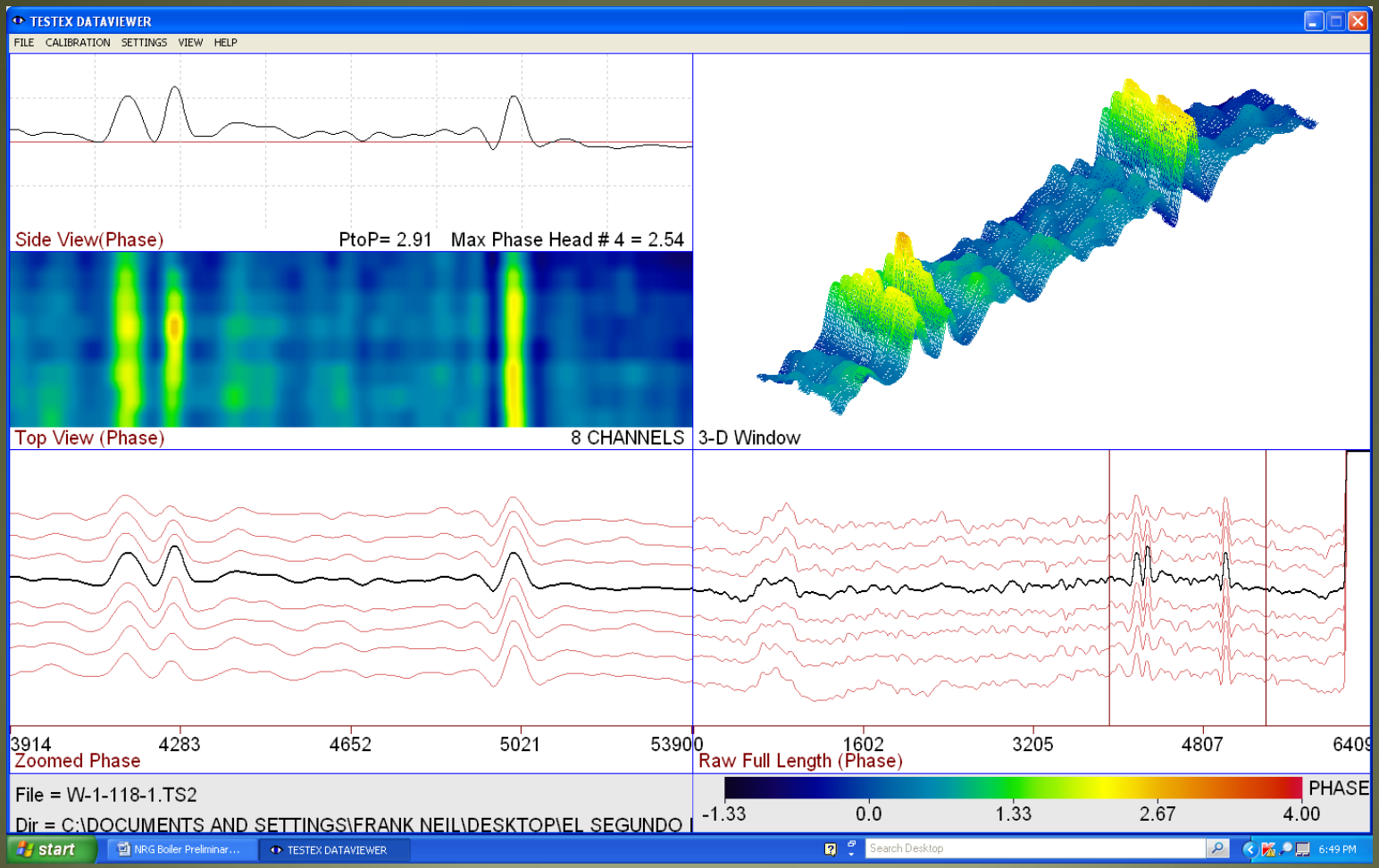
A power plant in southern California was experiencing roof tubes rupturing in their Unit 3 boiler due to hydrogen damage.

Tubes: 1.75” OD

0.180” NWT

A 100% scan of the roof tubes was conducted.

Case Study 2


TESTEX DATAVIEWER
FILE CALIBRATION SETTINGS VIEW HELP
Side View(Phase)
PtoP= 2.91 Max Phase Head # 4 = 2.54
Top View (Phase)
8 CHANNELS
3-D Window
3914
4283
4652
5021
53900
Zoomed Phase
1602
3205
4807
6409
Raw Full Length (Phase)
File = W-1-118-1.TS2
Dir = C:\DOCUMENTS AND SETTINGS\FRANK NEIL\DESKTOP\EL SEGUNDO
PHASE
-1.33
0.0
1.33
2.67
4.00
start
NRG Boiler Preliminar...
TESTEX DATAVIEWER
Search Desktop
6:49 PM

Case Study 2

Results:

14 tubes were found to contain hydrogen damage

All tubes with indications were cut out and verified immediately After detection.

Plant has reported no more problems with roof tubes rupturing

Details needed for a successful inspection

- Tube Dimensions
- Any Available Drawings
- Failure History
- Repair History
- Scaffolding Plans
- Available Time for Inspection

Remember the Keys to Success

- Explain Problem to NDT company
- Provide Samples and Drawings
- Cut-out some findings to verify and to improve calls
- Make proper repairs
- Take collective actions to prevent/reduce future failures

Conclusions

- Results in less plant down time due to equipment failure, unscheduled maintenance, and safety issues
- Provides more efficient boiler operation
- Is backed by the most state of the art, versatile products developed in the industry today
- Insures a method which is fast, accurate, cost effective, and field proven