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Case Study- Comparison of existing tube inspection technology (ECT) with Acoustic Pulse Reflectometry (APR)

Date of inspection : [redacted]

Inspection Site : [redacted]

End Customer : [redacted]

Inspected Equipment: Condensate Stablizer Reboiler

Configuration of tubes: U type

Total No. of tubes inspected: 154 (U); 308(Holes)

Tube Outer Diameter (OD):19.5mm

Tube Thickness: 2.11m

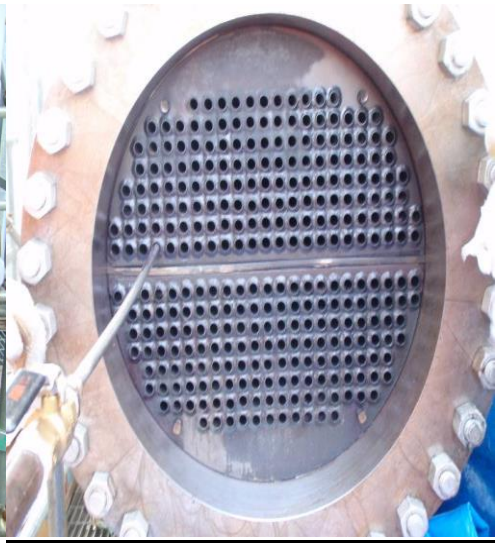
Average Exposed Length of the tube: 10m

Inspection 1: **Acoustic Pulse Reflectometry (APR)**

APR claims that they could inspect the tube less than 10 second and they don't have any restriction on tube material and configuration of tube. In addition, they don't want to inspect on both top and bottom half unlike ECT or IRIS because it uses sound waves and could take measurement either top or bottom of the U tube bundle.

These are the reasons to proceed with APR inspection at first. As a pre requisite, the tube bundle was cleaned and blow dried prior to the inspection.

Before Cleaning



After cleaning & blow dry

The total time duration took for APR to perform the inspection of this bundle

Time of Start: 10:00 am

- Initial Setup time :15 minutes
- Measurement : 60 minutes
- Total duration :75 minutes (1 hr 15 mins)

Time of End: 11:15 am

Once the measurement was taken, the data was copied to flash disk for analysis. Personnel performing inspection informed did preliminary analysis and sent the data to supervisor for detailed analysis.

After 2.5 hr duration, inspection personnel informed that report was ready to be issued. The defect table from the report was highlighted as follows:

Tube No	Faults								Row	Tube No
	Hole		Blockage		Erosion		Pitting		1	1 to 11
	Position	Diameter	Position	Reduction	Position	Reduction	Position	Reduction	2	12 to 28
	[m]	[mm]	[m]	[%]	[m]	[%]	[m]	[%]	3	29 to 47
1	9.66	3.3							4	48 to 66
64							3.46	21.7	5	67 to 87
89							5.95	28.4	6	88 to 108
100							1.11	21.1	7	109 to 131
105							5.91	24.6	8	132 to 154
110							5.48	27.8		
112							7.56	44.7		
117							6.88	28.3		
120							8.15	57.2		
126							6	29.4		
138							5.85	26.9		
140							6.29	27.2		
144							5.89	32.1		

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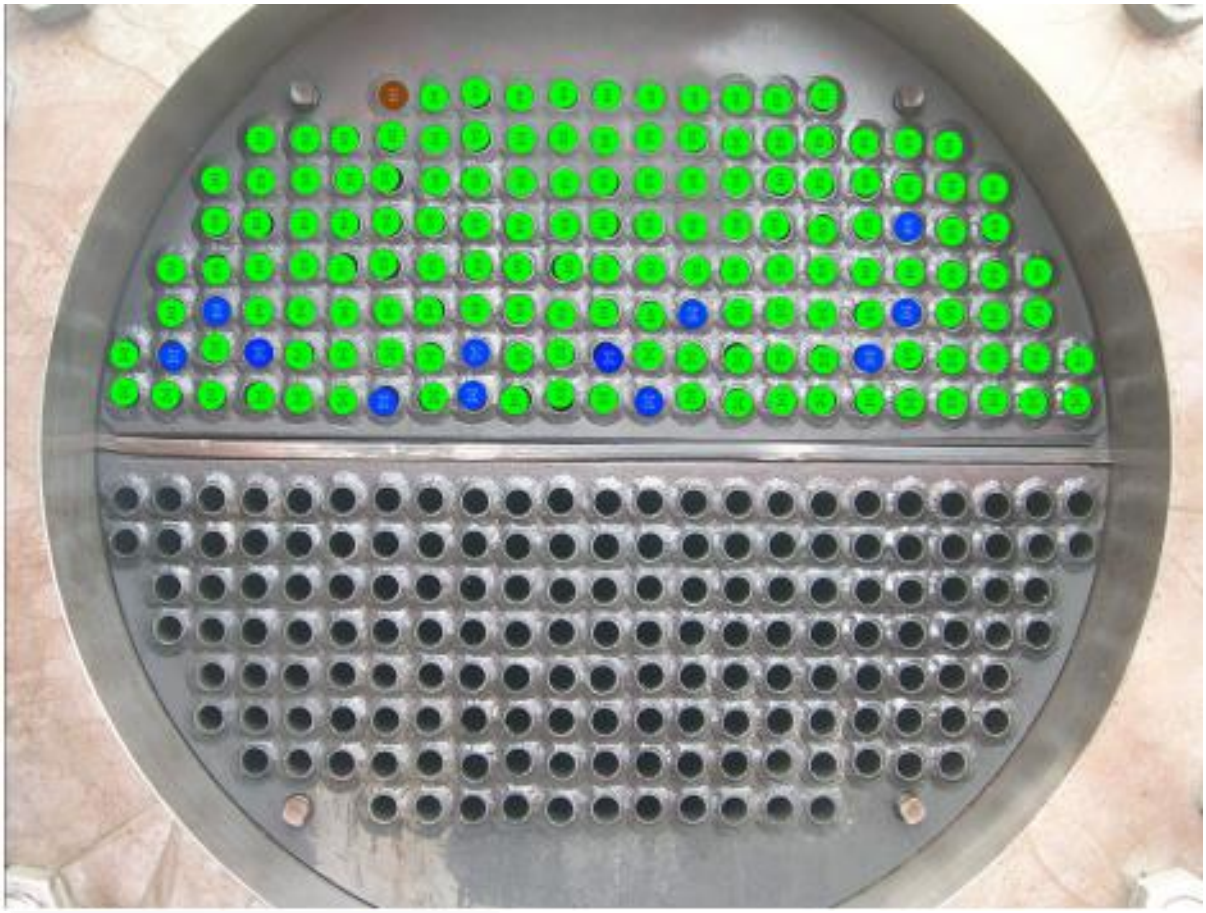

Name	Value
Holes	
Blockages	
Erosions	
Pittings	
Unknown	
No faults detected	
Not inspected	

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Inspection 2: Eddy Current Testing (ECT)

Tube Material: Duplex Stainless Steel Tube

In house NDT contractor of the plant was at stand by to inspect the same U tube bundle by ECT on following day. Based on the report from APR inspection, end user decided to cross check the defect and it's accuracy with ECT.

They tested 13 tubes (26 holes), which were indicated as defective by APR. The total time took to inspect as follows:

Time of start: 10:00 am (26 March 2011)

- Initial set up time : 30 minutes.
- Measurement of 26 holes: 45 minutes

End time: 11:15 am

The in house NDT contractor was pressured by end user to give the report asap and it was issued on the same day evening at 5 pm. The defect table given by ECT is as follows:

Tube	Wall loss
R[1] C[1]	60-80%
R[7] C[3]	40-60%
R[7] C[12]	40-60%

End user tried to co relate the ECT nomenclature with APR inspection, the following are their findings:

APR Tube Numbering	APR Defect indication	ECT Tube Numbering	ECT defect indication
1	Hole/leak of 3.3mm at 9.66m	R[1] C[1]	60-80%
112	Pitting of 44.7% wall loss at 7.56m	R[7] C[3]	40-60%
120	Pitting of 57.2% wall loss at 8.15m	R[7] C[12]	40-60%

Highlights:

1. It's well renowned that one NDT technology could not give entire health of the tubes in the bundle.
2. It was surprise, when leak of 3.3mm was reported by APR was reported as 60-80% wall loss by ECT.
3. The defects reported by APR in other tubes were located at U bend area and that was the reason for ECT to indicate those tubes as non-defective/flawless.

4. End user decided to proceed with visual inspection using flexible video scope to confirm the leakage and other defects indicated by APR in bend area.
5. The pictures from the video scope are attached below.

Fig 1: Leakage at 9.66m in R[1]C[1]

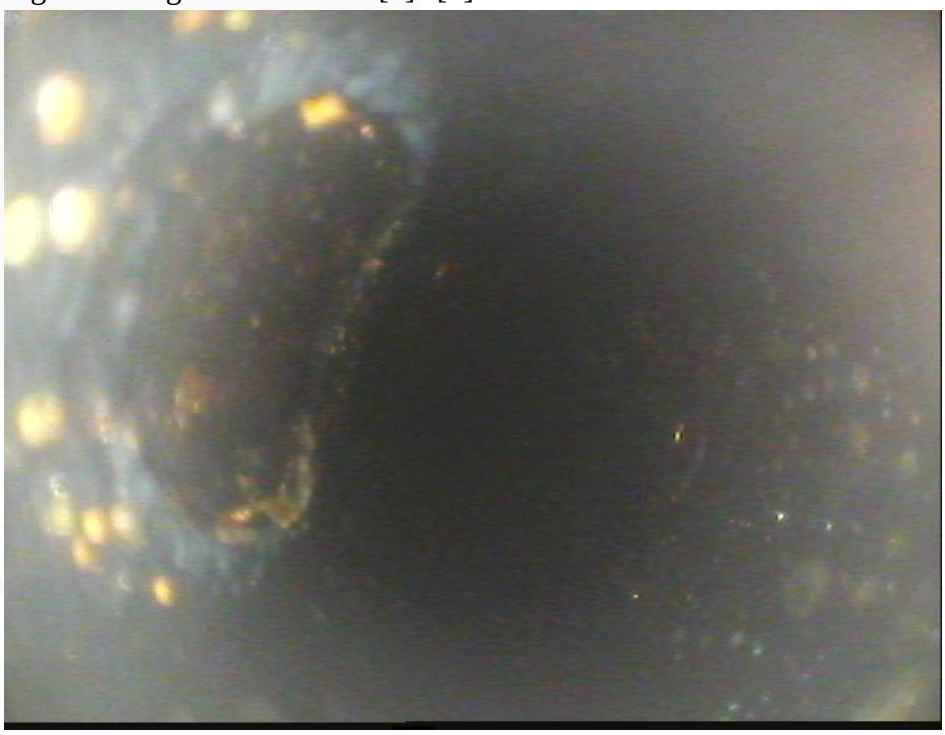

Fig 2: Wall loss at 7.56m in R[7]C[3]

Fig 3: Wall loss at 8.15m in R[7]C[12]

Fig 4: Wall loss at 6m in R[7]C[18]

Summary:

Overall, it was a good experience to compare one technology with other to know the reliability and accuracy. Though, each technology has pros and cons, it's better to apply based on the application that fulfil the needs of the end users/plant in terms of minimum preparation, short time for inspection, high reliability and confidence.