APR INSPECTION ON CONDENSER

- Mr. Jeff Lew

DATE OF INSPECTION	4-8 Oct 2019
LOCATION	Malaysia Power Plant

TOTAL NO. OF TUBES INSPECTED	11,264
CONFIGURATION	Straight Tube
TUBE OUTER DIAMETER	25.4mm
TUBE THICKNESS	0.711mm
TUBE LENGTH	8.256m

THE CHALLENGE

The client's condensers have thin wall tubes that cannot withstand high pressure cleaning as it will damage the tubes. The only solution for cleaning is to use rubber scrubbers. One of the drawbacks of using the rubber scrubbers is that they get stuck in the tubes. The client wanted to identify which tubes contained the stuck scrubbers.

Figure 1: *Rubber scrubber*

THE SOLUTION

Acoustic pulse reflectometry technology (APR) can identify blockages and holes in a tube of regardless of tube configuration and material. It is quick as it takes only 10 seconds per tube for measurement and can give the location and size of the defects. Stuck scrubbers will show up as blockages in a tube.

APR was used to identify tubes with blockage and at the same time, our client could determine the cleanliness and health condition of the tubes. After measurement, all signatures are overlaid (Figure 2) and tubes with blockages are immediately identified.

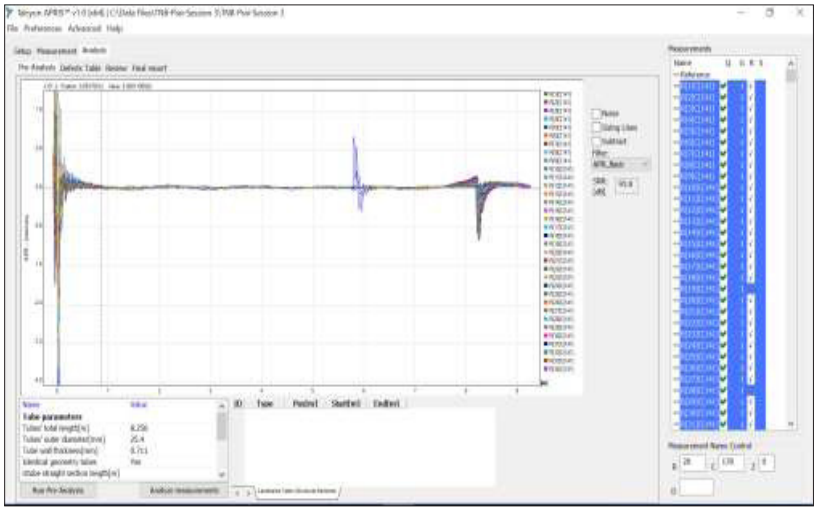

Figure 2: *Signals overlay for immediate identification of tubes with blockage.*

A report was generated with the distribution fault as shown in Figure 3.

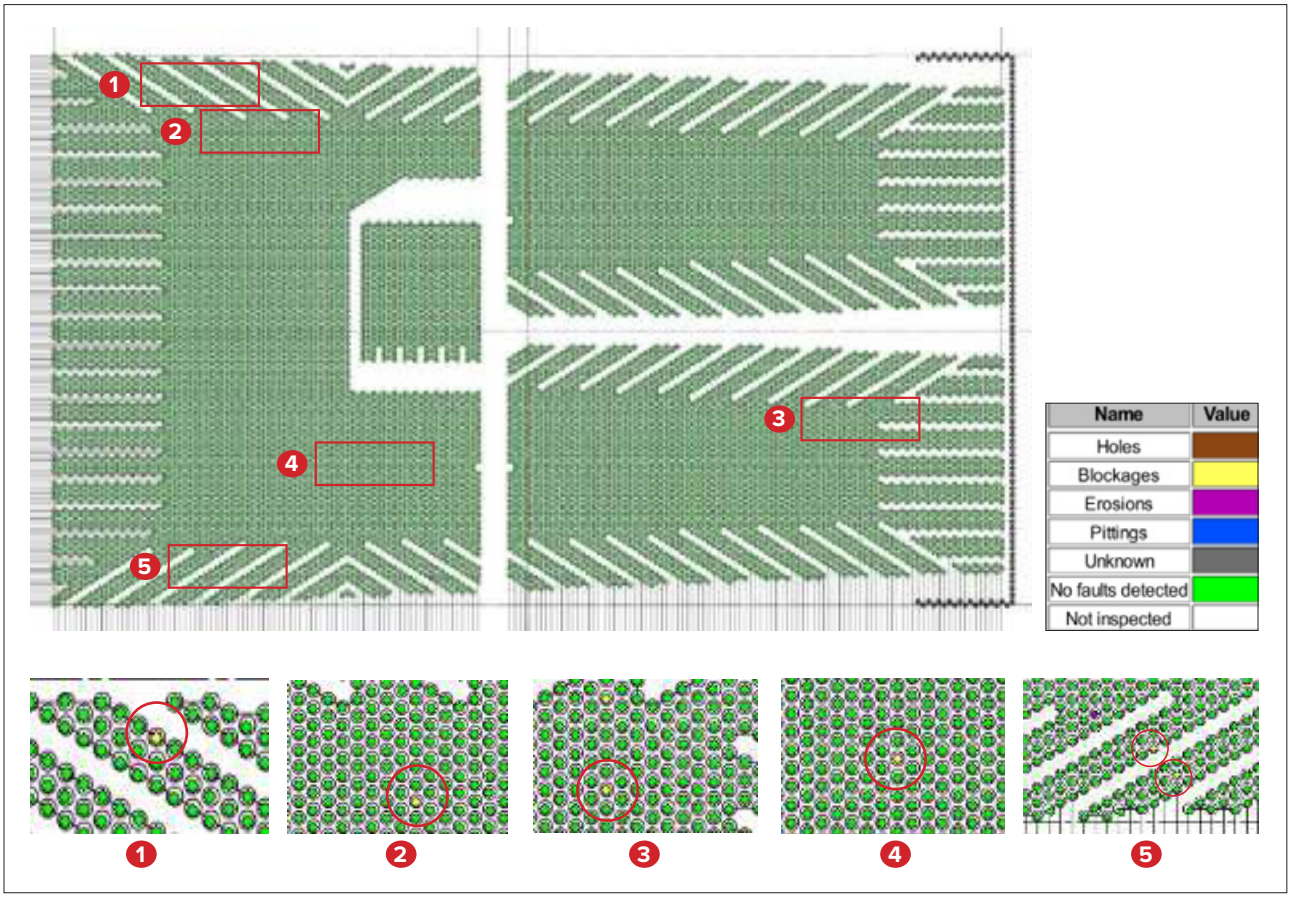

Figure 3: *Fault distribution on face place with yellow dots showing blockage.*

Blockages

Fault ID	Tube ID	Pos[m]	Cross Section Reduction[%]	Cross Section Reduction[mm]	Comments	Graph
328	R[61]C[5]	1.52	3	0.72		Link
338	R[73]C[36]	4.3	50	11.99		Link
340	R[75]C[38]	0.79	50	11.99		Link
342	R[13]C[42]	7.84	5	1.2		Link
344	R[1]C[46]	0.45	50	11.99		Link
346	R[49]C[63]	7.73	5	1.2		Link
347	R[33]C[76]	3	5.2	1.25		Link
363	R[42]C[145]	5.92	49.5	11.87		Link
364	R[37]C[145]	5.89	49.3	11.82		Link

Table 1: *Blockage position and size.*

Wall loss

Fault ID	Tube ID	Pos[m]	Wall Reduction[%]	Wall Reduction[mm]	Comments	Graph
326	R[18]C[3]	1.25	13.5	0.1		Link
330	R[15]C[12]	3.12	12.5	0.09		Link
332	R[48]C[16]	2.29	18.2	0.13		Link
334	R[48]C[16]	3.38	16	0.11		Link
336	R[72]C[31]	1.94	15	0.11		Link
348	R[18]C[73]	6.94	10.2	0.07		Link
349	R[23]C[73]	1.62	12.3	0.09		Link
350	R[30]C[73]	5.56	13.6	0.1		Link
351	R[35]C[75]	3.12	10.6	0.08		Link
352	R[59]C[75]	4.06	11.2	0.08		Link
353	R[63]C[73]	3.81	12.6	0.09		Link
354	R[39]C[77]	2.56	12.2	0.09		Link
355	R[50]C[77]	6.08	11.8	0.08		Link
356	R[30]C[82]	4.84	11.7	0.08		Link
357	R[32]C[88]	5.4	10.3	0.07		Link
358	R[56]C[93]	1.1	11.9	0.08		Link
359	R[2]C[104]	4.01	12.5	0.09		Link
360	R[9]C[105]	5.31	10.6	0.08		Link
361	R[33]C[115]	4.11	10.4	0.07		Link
362	R[54]C[122]	4.26	11.7	0.08		Link
365	R[7]C[154]	4	10.4	0.07		Link
366	R[6]C[157]	1.22	14.5	0.1		Link
367	R[26]C[175]	0.99	12.8	0.09		Link
368	R[18]C[176]	4.02	12.9	0.09		Link

Table 2: *Position and size of wall loss.*

CONCLUSION

APR technology is a perfect solution examining numerous tubes with thin walls. The advantages of APR were demonstrated in the following aspects:

1. Speed of measurement : APR can quickly assess the condition of the tube bundle with just 10 seconds per tube. Examining over 10,000 tubes with alternative technologies is prohibitively time consuming.
2. Material and thickness : APR can detect defects regardless of material thickness and type of material such as ferrous and non-ferrous.
3. Sizing and Location indicated : APR indicated the size and location of the defects.

APR technology is recommended for applications such as condenser, reboilers, heat exchanger which have defects originating from the inner diameter of the tubes. **APR has proven to be useful in quickly detecting inner diameter surface defects.**