

Importance of Ultrasonic Testing in addition to Encircling Eddy Current Testing for Condenser Tubes of Power Stations

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Abstract

With voice for environmental concern rises higher and higher around the world, more countries prefer the choice of “clean energy solution”, like nuclear or thermal power stations. As an evident result, the quality and security of these power stations are more than ever the central concern of this market.

Valtimet, Subsidiary of Vallourec Group, world leader for both straight and special formed welded tubing products, is fully involved in the supplying of tubing products for the 2nd circuit of the cooling process in these power stations; is also the world leader on the premium products of this market, by supplying straight stainless steel welded tubes, straight titanium welded tubes, and straight cooper alloyed welded tubes, to all of the world’s main companies of power stations.

To be able to propose the maximum quality guarantee to our clients, Valtimet has spent a lot of time and energy to study the most efficient quality control on its tubes destined to this condenser market. After years of trials and analysis, Valtimet has concluded that the most dangerous defects of tubing products on this market are the possible longitudinal oriented defects in the weld. Also, Valtimet has arrived at the conclusion that, the encircling ET (Eddy-Current-Testing) alone, as demanded by the Standards for the minimum required NDT (non-destructive-testing) quality control on condenser tubes, is not the most efficient testing technique to stop this kind of longitudinal defects.

While most of the competitors on this market are content with an ET installation alone, which is cheap and easy for maintenance, Valtimet has gone much further beyond the requirements of the Standards, to install a sophisticated and expensive UT (ultrasonic-testing) installation, in addition to the ET installations, and has trained its operators to the best level on utilization of their UT installation.

Camping of samplings of validation had been carried out and analysed, as shown in this paper with photos of defects: only a double NDT control by ET + UT can guarantee a premium quality of the tubing products for the condenser application, therefore the quality of nuclear / thermal power stations, which is in return the guarantee of quality and security of our everyone’s life.

Keywords: Condenser tube, Power station, Ultrasonic Testing, Encircling ET.

1. The Vallourec Group

With more than 50 industrial and commercial companies all over the world, being full or major shareholder of over 50 plants on four continents: Europe, North America, South America and Asia, the Vallourec Group is the world leader of steel tubes products on the world markets of Oil & Gas and Power Generation, with a complete product range for each market. Having a good balance between its main markets and its numerous speciality products, the Vallourec Group is also the world leader on numerous niche markets.

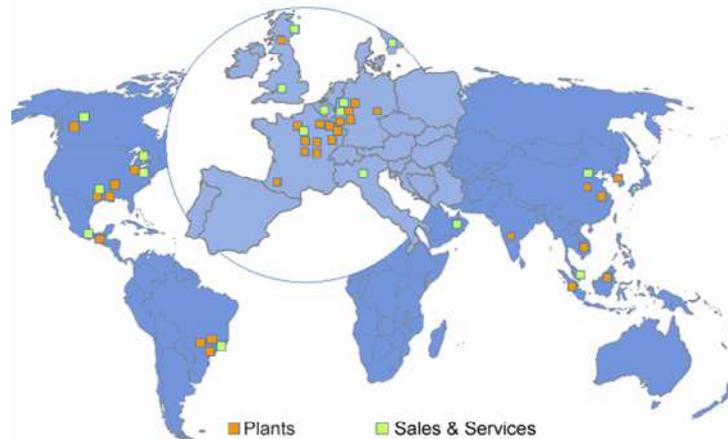


Figure 1: Subsidiaries of Vallourec Group all over the world

Development through innovation is the Vallourec Group's key policy through the past and for the future. The VRA (Vallourec Research Aulnoye) is one of the world's leading research centres for tubing products. Specialised in NDT, Metallurgy, Corrosion, CAD, Surface Treatment, ... represent the basic foundations of VRA's know-how.

2. Valtimet Society of the Vallourec Group

Valtimet is the world leader in the manufacture of specialized welded tubes. Providing a complete range of tubing products for high sophisticated power generation applications: titanium, stainless steel (ferritic, austenitic, duplex), super-stainless steel and copper alloys tubing for condenser, feedwater heater and MSR applications. Not to forget its tubing products for desalination, chemical processing, petrochemical and automotive industries.

Valtimet's philosophy of continuous innovation focuses on delivering quality and broad product range improvements. In power generation, to meet the priorities of increased efficiency and reduced maintenance, Valtimet has aggressively improved its welding technology, offers more sophisticated materials, meets tighter specifications, innovates new extended surfaces, and produces the longest tubes available worldwide.

With plants in France, the United States, China, India and South Korea, Valtimet remains close to its customers and offers a competitive range of products engineered to the highest quality standards.

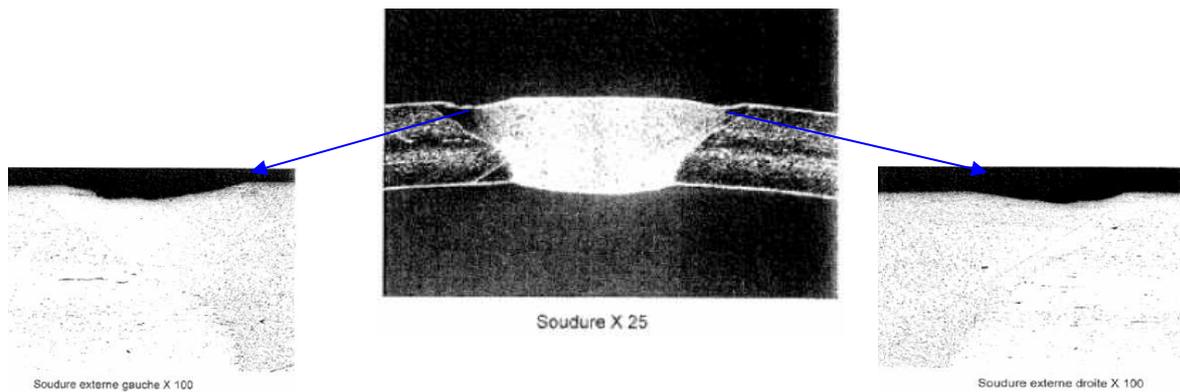
4. Description of defects to detect on condenser tubes

Valtimet is the world leader of premium tubing products for the 2nd Circuit of the Cooling Process in the Power Stations, by supplying straight stainless steel welded tubes, straight titanium welded tubes, and straight cooper alloyed welded tubes, to all of the world's principal power stations companies.

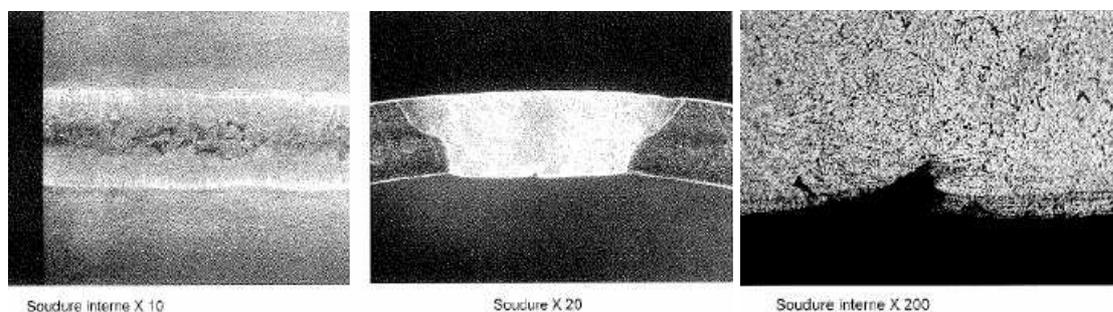
In aim to propose the maximum quality guarantee to clients, Valtimet dedicated a lot of time and energy to study the most efficient quality control on these condenser tubes. Years of trials and analysis have concluded that, the most dangerous defects of tubing products on this market are the possible longitudinal oriented defects in the weld.

Here give some samples of defect detected on our UT bench. Tube dimension 28x0.70mm, grade TP321, with one internal notch and one external, both of depth 0.10mm, width 0.20mm, and length 12mm. Sorting threshold $K \leq 0.5$.

Example N°1: external defects at the connection of weld-strip:



Example N°2: internal defect at the weld:

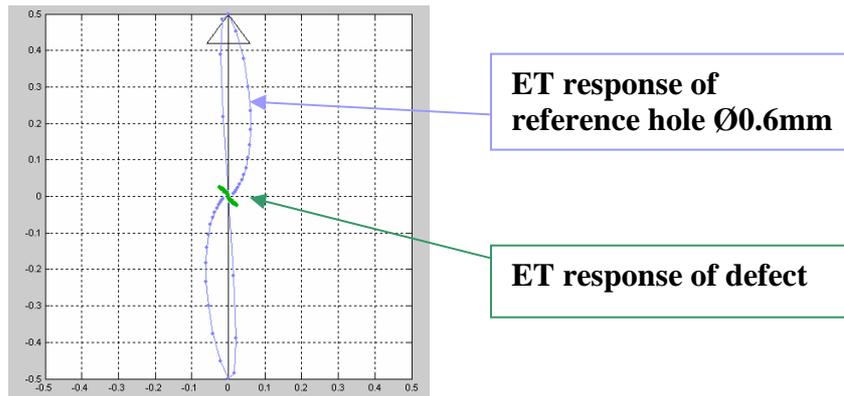


5. Comparison of ET vs UT detection on defects

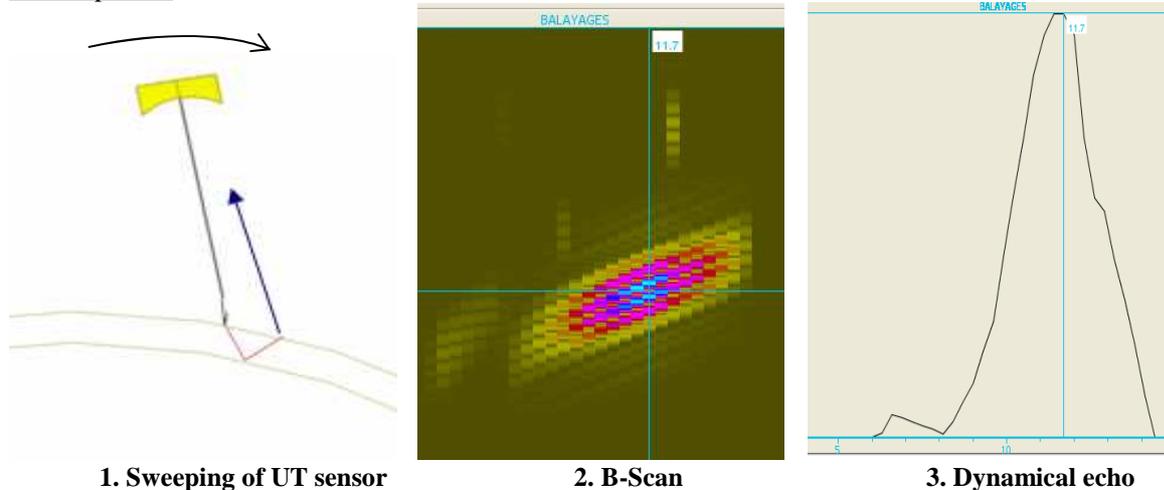
We simulated the detection of the natural defects of Chapter 4, by ET and then by UT, under CIVA simulator. This permits us to see every detail of the ET response then of the UT response, so to understand better the no-detection by ET of these types of defects, and why only UT is the adapted technique to stop these three kinds of defects.

Example N°1: external defects at the connection of weld-strip:

ET response:

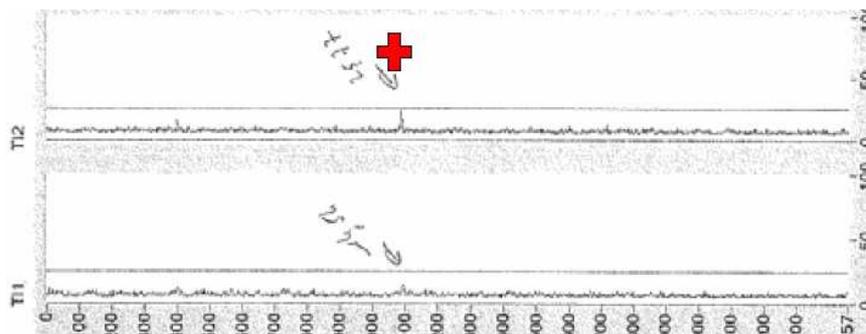


UT response:



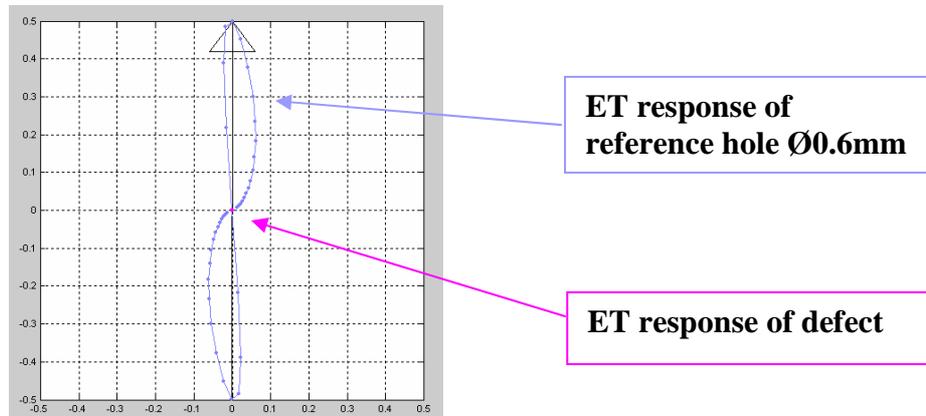
Nota: visual comparison defect – notch not show here, as sorting threshold $K \leq 0.5$.

UT detection of this defect during industrial production by Valtime:

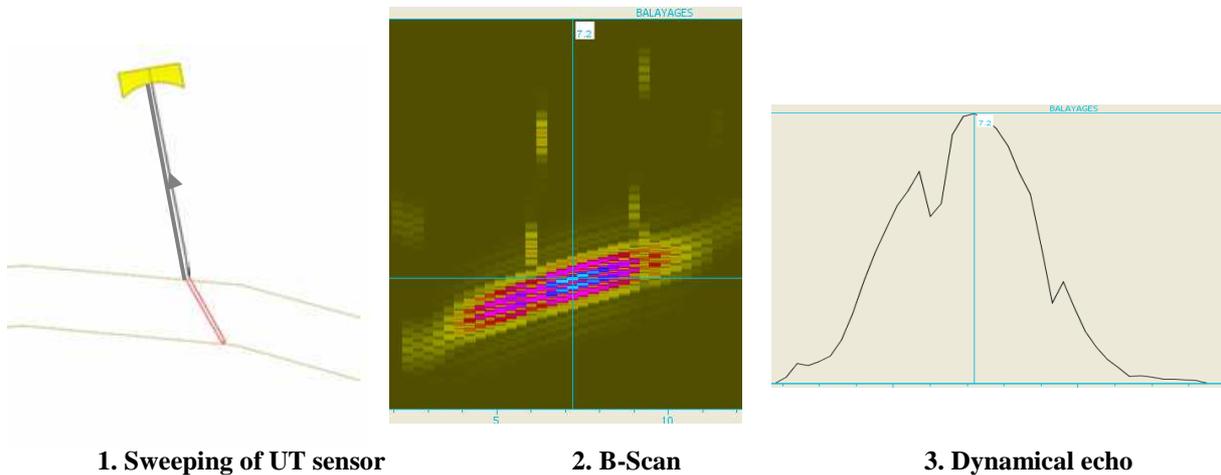


Example N°2: internal defect at the weld:

ET response:

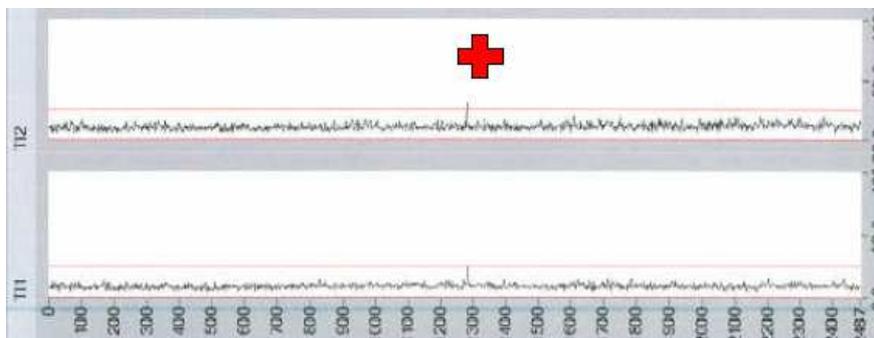


UT response:



Nota: visual comparison defect – notch not show here, as sorting threshold $K \leq 0.5$.

UT detection of this defect during industrial production by Valtime:



6. Conclusion

These three types of defects, as shown in this article, are among the most dangerous defects for condenser tubes. They are, meanwhile, not detectable by a traditional Encircling ET. We can so conclude that, the minimum required NDT by the Standard on condenser tubes, as Encircling ET alone, is not enough to guarantee the best quality of these condenser tubes.

Only a sophisticated UT installation, in addition to the encircling ET installation, as demonstrated by defects samplings on the UT bench at Valtimet, can stop these defects, and guarantee the premium quality of tubing products on condenser markets, which is the quality of nuclear / thermal power stations, therefore the quality and security of everyone's life.