

Heat Exchanger and Boiler Tube Inspection Using APRIS

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Acoustic Pulse Reflectometry (APR) has been applied extensively to tubular systems in research laboratories, for purposes of measuring input impedance, bore reconstruction, and fault detection. Industrial applications have been mentioned in the literature, though they have not been widely implemented. Academic APR systems are extremely bulky, often employing source tubes of six meters in length, which limits their industrial use severely. Furthermore, leak detection methods described in the literature are based on indirect methods, by carrying out bore reconstruction and finding discrepancies between the expected and reconstructed bore. Here, we describe an APR system which is named APRIS designed specifically for detecting faults commonly found in industrial tube systems such as heat exchangers, condensers and boilers: leaks, increases in internal diameter caused by wall thinning, and constrictions (i.e.,) blockages or deposits or scales. The system employs extremely short source tubes, on the order of 20cm, making it extremely portable, but creating a large degree of overlap between forward and backward propagating waves in the system. A series of patented algorithmic innovations enable the system to perform the wave separation mathematically, and then identify the above faults automatically, with a measurement time on the order of 10 seconds per tube. We present several case studies of tube inspection, showing how different faults are identified and reported.