Investigating the Potential Benefits of Wide Aperture PA Probes and Phased Coherence Imaging in the Detection and Sizing of Stress Corrosion Cracking in Stainless Steel 316

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Stress corrosion cracking (SCC) is a well-known damage that can occur under specific physical and chemical conditions in the oil and gas, chemical, and nuclear industries. While detection of SCC has proven effective with the use of phased array ultrasound techniques, sizing such cracks remains a challenge, especially in sound attenuating and anisotropic materials, such as the stainless steels used in the nuclear industry. Phase coherence imaging (PCI) is an ultrasonic technique derived from the total focusing method (TFM). PCI relies on the phase rather than the amplitude information in received signals, providing an increased potential to detect low-amplitude signals in noisy materials. This results in improved detection capability of diffracted echoes from crack tips and from crack branches, enabling more comprehensive imaging of the crack. This improved ability to clearly identify crack extremities may also improve the precision of sizing. While recent PCI developments and its deployment on portable instruments are expected to stimulate evaluation of the technique's value across industries, its advantages for crack detection and sizing in stainless steels are still to be clarified. This paper presents an investigation into the benefits of PCI used in conjunction with wide aperture phased array probes in the detection and sizing of SCC in stainless steels compared to established amplitude-based phased array ultrasonic techniques. The samples used for this study were created by The Welding Institute (TWI), using a proven methodology that generates SCC by replicating its natural growth. A numerical sound-field modeling tool was used to obtain guidance in selecting the optimal refracted angle, probe aperture, and frequency. The data acquisition and analysis were performed using a commercially available phased array flaw detector and software.