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"Detection of Creep Damage in Weld Joints of High Chrome Alloy Steel by Phased Array Ultrasonic Technology"

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Abstract

High energy piping systems in ultra-supercritical coal-fired power plant boilers typically operate at elevated temperatures and pressures that are sufficient to initiate creep damage. Type IV creep damage generally occurs near weld joints in high chrome alloy steel, typically in the heat affected zone of the base metal in seam welded pipe. Once the damage has progressed to macro-cracking and a crack grows to the critical depth and becomes unstable at some point, it tends to cause sudden, catastrophic failure of the seam.

Ultrasonic examination is one technique that helps detect creep damage at stages early enough to implement corrective measures. Current ultrasonic methods range from traditional pulse echo techniques, that requires a traditional raster scan, to the Time of Flight Diffraction technique, that requires a traditional pulse echo technique performing traditional raster scans. Although generally viewed as a higher-cost inspection method, ultrasonic imaging methods continue to improve, both in terms of cost and the amount of quality information they provide. With recent technological improvements, a promising phased array system can be used for detection of type IV creep damage.

This paper will discuss the phased array ultrasonic technology that can play a key role in improving ultrasonic detection levels of Type IV creep damage. CRIEP has developed a compact and two-axis encoded motorized scanner and an imaging technique of internal configuration in weld joints. The scanner has a built-in rotation mechanism in order to run directly on irregular curvatures and makes it possible to improve efficiencies in a more stable inspection of not only typical weld joints of pipe but saddle-shaped weld joints than is provided by manual scanners. Since the imaging technique provides the areas of heat-affected zone, it helps ultrasonic testing practitioners analyze whether ultrasonic indications are derived from type IV creep damage or the others such as geometries of weld joint, crystal grains of weld material and acceptable manufacturing defects.