

AN EXPERIMENTAL STUDY ON THE APPLICATION OF PHASED ARRAY ULTRASONIC TESTING IN TUBES' INTERNAL INSPECTION

Ze Xi¹, Xiangang WANG¹, Xiaowei Luo¹

¹Institute of nuclear and new energy technology, Tsinghua University, China

An in-service inspection system is indispensable for tubes, especially in some vital industrial domains such as steam generator heat exchanger tubes in nuclear power plants. Phased array ultrasonic testing is receiving extensive attention due to its flexibility and high sensitivity. In order to study the possibility of utilizing phased array to inspect the heat exchanger tubes, a circular linear phased array transducer with 64 elements circumferentially, 0.5mm pitch and 10MHz central frequency is fabricated, tested and utilized. Three typical reference reflectors specified by ASME-213 standard are processed on a sample tube, which is used in the High Temperature Gas Cooled Reactors' steam generator. The artificial defects mapped various service-induced volumetric flaws like corrosion, pitting and thickness thinning, 5 of them were used to simulate planar flaws such as crevices. The internal inspection results indicate the circular linear phased array transducer is able to detect all the defects, even the ones smaller than the minimum limitation sizes according to acoustic wave theory. Sensitivity on radial (depth) direction for inner circumferential grooves, outer longitudinal grooves and outer circumferential grooves all reach 0.1mm. The full width at half maximum method is utilized to size volumetric dimensions. Some of the reflectors cannot be measured precisely due to the characterizations are too unsharp.