Ultrasonic Phased Array Examination of Roll Joint in PHWR coolant channels

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Abstract

The pressure tube to end fitting roll-joint in pressurized heavy water reactors (PHWRs) is prone to delayed hydride cracking (DHC). In order to avoid any catastrophic failure during operation, the roll-joint is monitored during periodic in-service inspection by ultrasonic angle beam shear wave examination. An ultrasonic phased array technique has been developed with an aim to replace the conventional ultrasonic testing method. Using phased array, the entire roll-joint area (30-40 mm) can be covered from the single probe position. This saves huge amount of inspection time as compared to the conventional approach, wherein one needs to have a raster or a helical scan to examine the entire roll-joint. Secondly, with phased array one can focus the sound beam on ID and OD surfaces for the entire region of interest thereby offering uniform sensitivity for flaw detection. This paper describes in details simulation studies carried out using CIVA to arrive at the aperture size and focal laws for phased array examination of PHWR roll-joint. The paper also discusses the results of experimental work carried out using phased array on roll-joint mock-up with flaws simulating DHC.

Keywords: Phased Array, PHWR, Roll Joint, DHC, Simulation