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Abstract

In the first and second stage nuclear program of Department of Atomic Energy (DAE), technologies are matured for Pressurised Heavy Water Reactors (PHWRs) and Sodium-Cooled Fast Breeder Reactors (FBRs). Pre-service-Inspection (PSI), In-Service-Inspection (ISI) and Post-Irradiation-Examination (PIE) procedures are carried out for mechanical components and structures/assemblies of these reactors, conforming to ASME, ASTM and IIW standards. Non-Destructive Evaluation (NDE) of vital components of nuclear reactors is carried out for pressure vessels, heat exchangers, storage tanks, turbines, coolant channels, primary and secondary cooling systems, nuclear Fuel and fuel handling mechanisms etc. Ultrasonic testing (UT) is one of the safest and renowned NDE techniques adopted worldwide for NDE of major components of nuclear reactors. Ultrasonic techniques with Pulse-Echo or pitch-catch

angle-beam methods are utilised for contact and immersion modes of inspection, by using piezo-electric transducers of typically 1-25 MHz frequency. Conventional ultrasonic instrumentation for UT consists of a flaw detector and transducer(s) which are employed for flaw detection, thickness gauging and estimation of flaw sizes. The rapid advancements in the field of high speed semiconductor technologies and computational capabilities have made significant impact on the design and development of automated ultrasonic imaging required for PSI/ ISI and PIE applications in the nuclear industry. Automated ultrasonic C-Scan imaging technique is employed to generate high resolution cross-sectional images of the interiors of the mechanical components and thus enables flaw detection, flaw sizing and flaw characterization for - assessment of structural integrity, structural health monitoring and life expectancy. Automated, precision mechanical scanners, high speed digitizers, ultrasonic multichannel high speed pulsers and wide-band high-gain multichannel receivers, focused and damped single element transducers or linear/ phased array transducers and user-friendly GUI software for data/image acquisition-storage-display-measurement and analysis are major building blocks of modern C-Scan imaging systems. This paper provides description of the building blocks required for an automated advanced C-Scan imaging system. Two case studies have been discussed in the paper namely inspection of pressure tubes which are vital components of coolant channels which contain fuel of PHWR and under-sodium viewing of core of a Prototype FBR (PFBR).

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Index Terms

Computer Science

Applied Sciences

Keywords

Ultrasonic Testing Ultrasonic Instrumentation Ultrasonic Imaging Pulser Ultrasonic Transducer

Phwr

Pfbr.