ADVANCES IN TECHNOLOGIES FOR CANDU REACTOR PRESSURE TUBE INSPECTIONS

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All CANDU reactor designs employ Zirconium-Niobium Pressure Tubes (PT) as the pressure boundary component within the core of the reactor. Rigorous inspection of these key components is a fundamental input to Fitness For Service assessments in support of continued reactor operation. The inspection strategy currently applied by the majority of CANDU operators utilizes a series of highly optimized UT transducers in fixed configurations. The transducer sets are optimized for detection of volumetric, ID and OD surface damage and surface breaking indications on both inner and outer surfaces of the PT. Configurations in both circumferential and axial orientations are accommodated. The transducer package is rotated as the inspection head traverses the length of the PT creating a helical B scan. Operational and design challenges have become apparent with aspects of the inspection system over time. These challenges include equipment/instrument obsolescence, repeat failure of key system components, adverse conditions affecting data quality and reduction in data quality arising from changes in PT geometry due to long term reactor operation. Ontario Power Generation (OPG) has been successfully deploying FMC/TFM since 2010 for inspection of Primary Heat Transport (PHT) system components. As part of continuous improvement initiatives at OPG, a programme was initiated to evaluate the potential of applying this solution to the inspection of pressure tubes. The proposed system incorporates some 5000 elements distributed in discrete arrays. The arrays are mounted in a delivery package approximately 84 mm in diameter. The delivery package is immersed in heavy water at 40 C and is exposed to radiation fields exceeding 1.4 MRad/hr in the course of the inspection. The system will inspect over 6.5 m of PT material to the requirements of the Inspection Specification in under 30 minutes. The system will acquire over 19 TBytes of data per PT. The system will reduce the inspection campaign window from 10 days to less than 3 arising from improved inspection speed and reliability. Extending the existing FMC system to ambitious goals of the PT application presents numerous challenges requiring innovative solutions. Some of the innovations found in the delivery package include: • High element count ‘connectorized’ transducers, less the conventional cable connections • Multiplexed transmission of UT signals over optical fibre • Local array control via rad hardened custom pulser/switch ICs This paper describes both the proposed system and the development programme. The progress to date is presented.