ABSTRACT

The NRC Generic Letter 2004-01 requires visual inspection of Alloy 82/182/600 penetrations in pressurizers and steam generators to detect the presence of boric acid, which would indicate a primary system leak. If boric acid deposits are detected, then there is an additional requirement to characterize the source of the leak. Effectively, this characterization is to distinguish axial cracking from circumferential cracking, the latter being the larger concern due to possible ejection of the nozzle. Boric acid leakage manifests itself as a white powder where the penetration exits the component shell. There are two associated difficulties in making a determination of localized leakage: the source of the boric acid may be a leak elsewhere that flowed to a lower elevation and accumulated or the white powder may be another substance. There are several materials, such as protective coatings, insulation material and ultrasonic couplant, that also produce white powders.

It is generally difficult to obtain sufficient samples for chemical analysis due to access limitation and high radiation fields. As an alternative, an in situ, non contacting method for analyzing the deposits has been qualified using Raman Spectroscopy. This uses a fiber optic laser to excite the electron shells of the deposit and then analyzing for Raman scattered photons to determine a characteristic spectrum for the various commonly encountered materials. Fortunately, it has been shown that boric acid displays a characteristic spectrum that is readily identifiable.

If locally deposited boric acid is determined, then the next step is to characterize the flaw, which usually is located at the j groove weld on the opposite surface of the shell. For pressurizer heater sleeves, this has typically required draining the component, cutting the seal weld and removing the heater to allow ID access to the sleeve. Then a combination of eddy current testing and/or ultrasonic testing can be performed to detect and characterize the flaw. As an alternative, an ultrasonic method using Lamb waves has been qualified to distinguish axial from circumferential cracking without removing the heater. In this case, the inspection probe is located at the bottom of the sleeve, outside the component shell, and the sound wave propagates several inches up to the j weld. In actual practice, this approach has saved several days and considerable dose while providing compliance with the requirements of the Generic Letter 2004-01.