

The surveillance requirements do, however, specify acceptance limits for SG tubes (often called plugging or repair limits). The surveillance requirements seek to ensure that enough information is obtained about imperfections (flaws) in the tubes to determine if TS plugging limits are being met. Tube imperfections are defined in the TS and include circumferential and axial cracks.

SG tube inspections are also subject to the quality assurance requirements of 10 CFR part 50, Appendix B. Specifically, SG tube inspections must be performed in accordance with Criterion IX of 10 CFR part 50, Appendix B, which requires that "measures shall be established to assure that special processes, including welding, heat treating, and nondestructive testing, are controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements."

Licensees currently employ an eddy current test bobbin probe, at least, to inspect the entire length of tubing required by the TS. The bobbin probe is a high-speed probe which the industry has demonstrated to be qualified for and capable of detecting volumetric flaws and axially oriented cracks in the absence of significant masking signals. Masking signals may be produced by tube geometry variations or irregularities along the tube axis (such as small-radius U-bends, dents and dings, and expansion transitions) or by tube surface irregularities. Masking signals can also be produced by deposits on the tube surface, adjacent support structures (such as the tubesheet), probe wobble, cold working, permeability variations, or electrical noise.

While the bobbin probe generally provides an effective means of SG tube inspection over much of the tube length, experience has shown that the bobbin probe may not be effective at locations where significant masking signals are present. In addition, the bobbin probe generally cannot detect circumferential cracks. Circumferential cracks can occur at locations of high axial stress (*e.g.*, small-radius U-bends and the tubesheet expansion region).

Plant TS for virtually all PWRs require inspection of the entire length of hot leg tubing within the tubesheet. With some exceptions where specified in the plant TS, the acceptance limits (plugging limits) for these inspections apply to all imperfections along the full length of the tube in the tubesheet on the hot leg side, including axial and circumferential cracks. Criterion IX, "Control of Special Processes," of 10

CFR part 50, Appendix B, requires in part that nondestructive testing is to be accomplished by qualified personnel using qualified procedures in accordance with applicable criteria. The bobbin probe has not been qualified for and is not capable of reliably detecting axial or circumferential cracks in the expanded region of tubing inside the tubesheet; however, specialized probes are available which have been qualified for this application.

As a result of these limitations, the industry practice is to supplement the bobbin probe inspection with inspections by specialized probes, such as the rotating pancake coil or plus point probe, that are qualified for and capable of detecting degradation that is not detectable with the bobbin probe. However, inspecting tubes with these specialized probes is slower than with the bobbin probe. Therefore, these slow-speed probes are typically not applied over the entire length of a tube that is subject to inspection, but only at tube locations where degradation which cannot be detected with the bobbin probe (*e.g.*, circumferential cracks, axial cracks in U-bends and expansion transitions) is known to be present or considered to have a potential to occur. This practice involves a degree of engineering judgment to determine the locations in which potential degradation mechanisms may exist that could lead to degradation that is not detectable using a bobbin probe. The EPRI Steam Generator Examination Guidelines provide guidance on assessing the potential for degradation to occur at various locations.

In 2002, the staff learned of several instances in which licensees were not fully implementing inspection methods capable of detecting circumferentially oriented cracks at all locations where the potential for such cracks exists and where, based on available evidence, there is reason to believe such cracks may be present. These licensees were conducting full-length bobbin probe inspections of the tubes, and were performing additional inspections using specialized probes to inspect for axial and circumferential cracks at certain locations, including the tube expansion transitions near the top of the tubesheet. The licensees conducted the specialized probe inspections at the tube expansion transitions in an area that extended from 2 inches above the top of the tubesheet to about 5 inches below the top of the tubesheet. At several facilities, circumferential cracks were identified at tube expansion transitions, as well as below the transitions near the bottom of the zone being inspected. These results indicate a potential for circumferential

cracks to exist in the tubing below the zone inspected with the specialized probe. However, each licensee also performed an analysis indicating that circumferential cracks below the zone being inspected would not be detrimental to tube structural and leakage integrity. These licensees concluded, therefore, that inspections for circumferential cracks with the specialized probe were unnecessary below the zone already inspected with the probe. These analyses had not been provided to the NRC staff.

The staff became aware of these activities during the licensees' SG inspections conducted during refueling outages and asked the licensees to submit TS amendment requests or safety analyses to obtain NRC approval of their inspection approaches. The staff reviewed the resulting submittals on a one-cycle basis before the plants restarted. Subsequent to these plant-specific actions, the staff evaluated the appropriate method to interact with licensees on this issue. Given the potentially generic nature of the issue, the staff decided to communicate this issue to addressees through issuance of this generic letter.

Discussion

In the aforementioned instances, tube inspections with a specialized probe near the top of the tubesheet clearly indicated the potential for circumferential cracks to occur deeper into the tubesheet beyond the region inspected with the specialized probes. In each instance the licensee was aware of the potential for such cracks to exist deeper into the tubesheet, but the licensee did not employ techniques qualified for detecting such cracks based on the licensee's analysis that such cracks did not have safety implications.

The staff acknowledges that there may be circumstances under which certain flaws at certain locations may not pose a safety concern. However, it is the staff's position that pending the submission of a license amendment request clarifying the acceptability of a more limited inspection approach, licensees are required under existing requirements (TS in conjunction with 10 CFR part 50, Appendix B) to employ inspection techniques capable of detecting all flaw types which may potentially be present at locations which are required to be inspected pursuant to the TS. The staff is concerned that in instances similar to those cited above, failure to expand the scope of the specialized probe inspection deeper into the tubesheet to detect cracks likely to be present poses a potential compliance issue with