

NUCLEAR REGULATORY COMMISSION

Proposed Generic Communication

Requirements for Steam Generator Tube Inspections

AGENCY: Nuclear Regulatory Commission.

ACTION: Notice of opportunity for public comment.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is proposing to issue a generic letter (GL) to (1) advise all holders of operating licenses for pressurized-water reactors (PWRs), except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel, that the NRC's interpretation of technical specification (TS) requirements in conjunction with Appendix B to Part 50 of Title 10 of the *Code of Federal Regulations* (10 CFR Part 50) raises questions as to whether steam generator (SG) tube inspection practices ensure compliance with these requirements, (2) request that addressees submit a description of the tube inspections performed at their plants, including an assessment of whether these inspections ensure compliance with the requirements contained in their TS in conjunction with 10 CFR Part 50, Appendix B, (3) request that addressees propose plans for coming into compliance with these requirements if they conclude they are not in compliance, and (4) request that addressees submit a safety assessment addressing any differences from the NRC's position regarding these requirements. The NRC is seeking comment from interested parties on the clarity and utility of the proposed GL under the Supplementary Information heading. The NRC will consider the comments received in its final evaluation of the proposed GL.

This *Federal Register* notice is available through the NRC's Agencywide Documents Access and Management System (ADAMS) under accession number ML031270171.

DATES: Comment period expires **[60 days after FRN is published]**. Comments submitted after this date will be considered if it is practical to do so, but assurance of consideration cannot be given except for comments received on or before this date.

ADDRESSEES: Submit written comments to the Chief, Rules and Directives Branch, Division of Administrative Services, Office of Administration, U.S. Nuclear Regulatory Commission, Mail Stop T6-D59, Washington, DC 20555-0001, and cite the publication date and page number of this *Federal Register* notice. Written comments may also be delivered to NRC Headquarters, 11545 Rockville Pike (Room T-6D59), Rockville, Maryland, between 7:30 am and 4:15 pm on Federal workdays.

FOR FURTHER INFORMATION, CONTACT: Paul Klein at (301) 415-4030 or by E-mail to pak@nrc.gov.

SUPPLEMENTARY INFORMATION:

NRC GENERIC LETTER 2003-XX: REQUIREMENTS FOR STEAM GENERATOR TUBE
INSPECTIONS

Addressees

All holders of operating licenses for pressurized-water reactors (PWRs), except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this generic letter to

- (1) advise addressees that the NRC's interpretation of the technical specification (TS) requirements in conjunction with 10 CFR Part 50, Appendix B, raises questions whether certain licensee steam generator (SG) tube inspection practices ensure compliance with these requirements,
- (2) request that addressees submit a description of the tube inspections performed at their plants, including an assessment of whether these inspections ensure compliance with the requirements contained in their TS in conjunction with 10 CFR Part 50, Appendix B,
- (3) request that addressees that conclude they are not in compliance with the SG tube inspection requirements contained in their TS in conjunction with 10 CFR Part 50, Appendix B, propose plans for coming into compliance with these requirements, and
- (4) request that addressees submit a safety assessment that addresses any differences from the NRC's position regarding the requirements of the TS in conjunction with 10 CFR Part 50, Appendix B.

Background

Steam generator tubes function as an integral part of the reactor coolant pressure boundary (RCPB) and, in addition, serve to isolate radiological fission products in the primary coolant from the secondary coolant and the environment. For the purposes of this generic letter, tube integrity means that the tubes are capable of performing these functions in accordance with the plant licensing basis, including applicable regulatory requirements.

Title 10 of the *Code of Federal Regulations* (10 CFR) establishes the fundamental regulatory requirements with respect to the integrity of the SG tubing. Specifically, the general design criteria (GDC) in Appendix A to 10 CFR Part 50 state that the RCPB shall be “designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage...and of gross rupture” (GDC 14), “designed, fabricated, erected, and tested to the highest quality standards practical” (GDC 30), and “designed to permit periodic inspection and testing...to assess...structural and leaktight integrity” (GDC 32). (There are similar requirements in the licensing basis for plants licensed prior to 10 CFR Part 50, Appendix A.)

Given the importance of SG tube integrity, all current PWR licensees have TS governing the surveillance of SG tubes. These TS typically do not prescribe non-destructive test methods for conducting tube inspections or specify where a particular methodology should be used. For example, current TS may employ the following or similar nonspecific language:

Tube inspection for tubes selected in accordance with Table [xxxx] means an inspection of the steam generator tube from the point of entry (hot leg side) completely around the U-bend to the top support of the cold leg, excluding sleeved areas.

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 respect to the plant TS in conjunction with 10 CFR Part 50, Appendix B.

In addition, the staff notes that not inspecting for cracks with qualified procedures in the lower regions of the tubesheet would allow any such cracks to remain in place. However, most plant TS state that only tubes with imperfections less than 40 percent of the nominal tube wall thickness are acceptable for continued service (there are exceptions specified in some plant TS). While it is not known whether any such cracks actually exist, the staff notes that the acceptance or plugging limit for SG tube inspections is a specific technical specification limit that can only be changed through the license amendment process.

Also, for the instances cited above, the safety basis developed by the licensees for not expanding the scope of the specialized probe inspection beyond a specific distance (x-inches) into the tubesheet was that any cracks below that distance were not detrimental to tube integrity. This was based on analyses indicating that tubes only needed a minimum embedment of x-inches into the tubesheet to exhibit acceptable structural and accident leakage integrity. These analyses have been performed to demonstrate that cracks below this embedment distance do not impair SG tube integrity, even if these cracks cause complete severance of the tube. According to plant final safety analysis reports (FSARs), the SGs were designed in accordance with Section III of the American Society of Mechanical Engineers (ASME) Code. In accordance with Section III of the Code, the original design basis pressure boundary for the tube-to-tubesheet joint included the tube and tubesheet extending down to and including the tube-to-tubesheet weld. The criteria of Section III of the ASME Code constitute the "method of evaluation" for the design basis. In the event licensees are using a different

“method of evaluation” for assessing the steam generator pressure boundary, an evaluation under 10 CFR 50.59 would determine whether a license amendment is required in these cases.

In summary, for the cases discussed above, the TS required a tube inspection for the full length of the tube within the tubesheet (scope), and the findings from this inspection were required to be evaluated against a repair (plugging) criteria. Neither the scope nor the repair criteria in the TS contained provisions for limiting the inspections through a licensee controlled analysis.

Based on these instances, the NRC cannot conclude that addressees that are using such an approach remain in compliance with their TS in conjunction with Criterion IX of 10 CFR Part 50, Appendix B with regard to the inspections they are performing. This concern stems, in part, from the experience with some addressees relying on licensee controlled analyses to limit the scope and therefore the repair or plugging of defective SG tubes contrary to the requirements in the TS in conjunction with Criterion IX of 10 CFR Part 50, Appendix B, which contains no provisions for limiting the inspections in this manner. It is the staff’s position that pending a license amendment clarifying the inspection approach to be followed, licensees are required to employ inspection methods capable of detecting all flaw types which may potentially be present at locations which are required to be inspected pursuant to the TS, as set forth above.

Based on these staff concerns, the NRC is issuing this generic letter, consistent with the requirements in 10 CFR 50.54(f) to obtain information necessary for the staff to determine if addressees are in compliance with the technical specifications in conjunction with 10 CFR 50, Appendix B. In addition, licensees who have not been implementing inspections consistent with

the staff's position should submit a safety assessment that demonstrates their ability to ensure continued safe operation and addresses any differences relative to the staff's position.

For licensees that cannot demonstrate continued compliance with the TS in conjunction with 10 CFR 50, Appendix B, owners group involvement in the development of standard or generic approaches to this issue, including TS and associated Bases wording, could be helpful from the standpoint of minimizing resource impacts for both licensees and the staff.

Requested Information

Within 30 days of the date of this generic letter, addressees are requested to provide to the NRC the following information:

1. Addressees should provide a description of the SG tube inspections performed at their plant during the last inspection. In addition, addressees should provide an assessment of how the tube inspections performed at their plant meet the requirements of the TS in conjunction with Criterion IX of 10 CFR Part 50, Appendix B, if they are not using SG tube inspection methods with capabilities consistent with the NRC's position. This assessment should also address whether the tube inspection practices ensured that the tube plugging or repair limits were implemented for the entire length of tubing required to be inspected per the TS (i.e., discuss whether the techniques employed during the tube inspections ensured flaws could be detected such that the plugging or repair limits could be implemented).

2. If addresses conclude that full compliance with the TS in conjunction with Criterion IX of 10 CFR Part 50, Appendix B, requires corrective actions to be taken, they should discuss their proposed corrective actions (e.g., changing inspection practices consistent with the NRC's position, or submitting a TS amendment request with the associated safety basis for limiting the inspections). If addressees choose to change their TS, the staff has included in Attachment 1 suggested changes to the TS definitions for a tube inspection and for plugging limits to show what may be acceptable to the staff in cases where the extent of the inspection in the tubesheet region is limited.

3. For plants where SG tube inspections have not been or are not being performed consistent with the NRC's position on the requirements contained in the TS in conjunction with Criterion IX of 10 CFR Part 50, Appendix B, the licensee should submit a safety assessment that addresses any differences relative to the NRC's position (i.e., submit the safety basis for not employing inspection methods capable of detecting specific flaw types at specific locations where these flaw types may potentially occur and where a tube inspection is required by the TS), and include an evaluation of whether this safety assessment constitutes a change to the "method of evaluation" (as defined in 10 CFR 50.59) for establishing the structural and leakage integrity of the joint. Licensees should also determine whether a license amendment is necessary pursuant to 10 CFR 50.59.

Required Response

In accordance with 10 CFR 50.54(f), addressees are required to submit written responses to this generic letter. Two options are available:

- (a) Addressees may choose to submit written responses providing the information requested above within the requested time period.

- (b) Addressees who cannot meet the requested completion date are required to notify the NRC in writing as soon as possible but no later than 30 days from the date of this generic letter. The responses must address any alternative course of action proposed, including the basis for the acceptability of the proposed alternative course of action, the basis for finding that the SGs remain operable, and the schedule when the requested information will be submitted.

The required written response should be addressed to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, 11555 Rockville Pike, Rockville, Maryland 20852, under oath or affirmation under the provisions of Section 182a of the Atomic Energy Act of 1954, as amended, and 10 CFR 50.54(f). In addition, submit a copy of the response to the appropriate regional administrator.

Reasons for Requested Information

This generic letter requests that addressees submit information. The requested information will enable the NRC staff to make a determination as to whether licensees are implementing SG tube inspections in accordance with applicable requirements. In cases where licensees are not implementing inspections in such a manner, the requested information will allow the staff to make a determination as to the adequacy of the licensee's inspection program and compliance of the licensee's program relative to existing requirements (the plant TS in conjunction with 10 CFR Part 50, Appendix B).

Backfit Discussion

Under the provisions of Section 182a of the Atomic Energy Act of 1954, as amended, and 10 CFR 50.54(f), this generic letter transmits an information request for the purpose of verifying compliance with applicable existing requirements. Specifically, the requested information will enable the NRC staff to determine whether applicable requirements (plant TS in conjunction with 10 CFR Part 50, Appendix B) are being met. No backfit is either intended or approved in the context of issuance of this generic letter. Therefore, the staff has not performed a backfit analysis.

Federal Register Notification

To be done after the public comment period.

Paperwork Reduction Act Statement

This generic letter contains information collections that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). These information collections were approved by the Office of Management and Budget (OMB), control number 3150-0011, which expires on January 31, 2004.

The burden to the public for these information collections is estimated to average 60 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the

collection of information. The U.S. Nuclear Regulatory Commission is seeking public comment on the potential impact of the collection of information contained in the generic letter and on the following issues:

- (1) Is the proposed collection of information necessary for the proper performance of the functions of the NRC, and will the information have practical utility?
- (2) Is the estimate of burden accurate?
- (3) Is there a way to enhance the quality, utility, and clarity of the information to be collected?
- (4) How can the burden of the collection of information be minimized? Can automated collection techniques be used?

Send comments regarding this burden estimate or on any other aspect of these information collections, including suggestions for reducing the burden, to the Information and Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by Internet electronic mail to INFOCOLLECTS@nrc.gov; and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0011), Office of Management and Budget, Washington, DC 20503.

Public Protection Notification

The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

If you have any questions about this matter, please contact one of the persons listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

Attachments: 1. Sample Changes to the TS for Plants Limiting Inspections
in the Tubesheet Region

Attachment 1

Sample Changes to the TS for Plants Limiting Inspections in the Tubesheet Region

Plugging Limit means the imperfection depth at or beyond which the tube shall be removed from service and is equal to 40% of the nominal tube wall thickness. All tubes with degradation in the portion of the tube from x-inches below the bottom of the expansion transition or the top of the tubesheet to the bottom of the expansion transition or the top of the tubesheet, whichever is lower, shall be removed from service.

Tube Inspection means an inspection of the steam generator tube from x-inches below the hot-leg expansion transition or the top of tubesheet, whichever is lower, completely around the U-bend to the top support of the cold leg.

END

Documents may be examined, and/or copied for a fee, at the NRC's Public Document Room at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland. Publicly available records will be accessible electronically from the Agencywide Documents Access and Management System (ADAMS) Public Electronic Reading Room on the Internet at the NRC Web site, <http://www.nrc.gov/NRC/ADAMS/index.html>. If you do not have access to ADAMS or if you have problems in accessing the documents in ADAMS, contact the NRC Public Document Room (PDR) reference staff at 1-800-397-4209 or 301-415-4737 or by e-mail to pdr@nrc.gov.

Dated at Rockville, Maryland, this 8th day of May 2003.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

William D. Beckner, Program Director
Operating Reactor Improvements
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

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Dated at Rockville, Maryland, this 8th day of May 2003.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

William D. Beckner, Program Director
 Operating Reactor Improvements
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 Office of Nuclear Reactor Regulation

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