

January 28, 2000

David J. Modeen, Director
Engineering, Nuclear Generation Division
Nuclear Energy Institute
1776 I Street, NW., Suite 400
Washington, DC 20006-3708

SUBJECT: INDUSTRY RECOMMENDED STEAM GENERATOR TUBE PULL PROGRAM

Dear Mr. Modeen:

By letter dated September 22, 1999, you submitted Addendum 3 to the Steam Generator Degradation Specific Management Database, as well as the associated correlations for use by the industry in alternate repair criteria applications, for NRC review and approval. As part of that letter, you also included an industry recommended program for steam generator tube pulls in support of the voltage-based alternate repair criteria.

In your letter you state that the pulled tube database supporting the voltage-based repair limits has been significantly increased since the issuance of Generic Letter (GL) 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking," dated August 3, 1995. Therefore, you stated, it is appropriate to update the requirements for pulling steam generator tubes in support of the alternate repair criteria.

As stated in GL 95-05, one of the purposes of the tube removal program is to provide additional data to enhance the conditional leak rate, burst pressure, and probability of leakage correlations. In your recommended program, a licensee could delay tube removal by one outage if no pullable tube indications are found that would satisfy the industry target indications. Therefore, the maximum interval between tube removals would be four operating cycles. You also recommend that if the requirement to pull a tube specimen coincides with the plant's last scheduled outage before steam generator replacement, the requirement for a tube pull be waived. The staff finds this change acceptable except for the situation where tube pull specimens have not been obtained either during the plant steam generator inspection outage that implements the voltage-based repair criteria or during an inspection outage preceding initial application of these criteria.

With regard to the examination and testing portion of the program, the staff does not agree with your proposal that for small indications, leak tests do not need to be performed if the field and post-pull non-destructive testing data clearly show crack depths not greater than 85%. The NRC staff's complete review of the proposed tube pull program, including the above mentioned positions, are contained in the attached table.

David J. Modeen

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After reviewing the staff's comments, please contact Jim Andersen of my staff (301 415-1437) in order that we may discuss them further. If you find the staff's comments acceptable, please provide the revised steam generator tube pull program for NRC review.

Sincerely,

/ra/

Jack R. Strosnider, Director
Division of Engineering
Office of Nuclear Reactor Regulation

Attachment: As stated

David J. Modeen

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After reviewing the staff's comments, please contact Jim Andersen of my staff (301 415-1437) in order that we may discuss them further. If you find the staff's comments acceptable, please provide the revised steam generator tube pull program for NRC review.

Sincerely,

Jack R. Strosnider, Director
Division of Engineering
Office of Nuclear Reactor Regulation

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STAFF COMMENTS ON INDUSTRY PROPOSED STEAM GENERATOR TUBE PULL PROGRAM

<u>Generic Letter 95-05 Guidance</u>	<u>Industry Proposal</u>	<u>NRC Staff Comments</u>
Number and Frequency of Tube Pulls		
<p>Two pulled tube specimens with an objective of retrieving as many intersections as is practical (a minimum of four intersections) should be obtained for each plant either during the plant SG inspection outage that implements the voltage-based repair criteria or during an inspection outage preceding initial application of these criteria.</p>	<p>Same as GL 95-05 with the following addition:</p> <p>However, if no pullable tube indications are found in this inspection that would satisfy the industry database target indications, the tube removal may be delayed (utility option) to the next planned inspection with the goal of obtaining indications satisfying the database target. The tube pulls may not be delayed more than one planned outage following implementation of the repair criteria.</p>	<p>The staff finds this change acceptable.</p>
<p>Additional tube pulls with an objective of retrieving as many intersections as is practical (minimum of two intersections) should be obtained at the refueling outage following accumulation of 34 EFPMs of operation or at a maximum interval of three refueling outages, whichever is shorter, following the previous tube pull.</p>	<p>Same as GL 95-05 except for the timing, the industry proposal is three operating cycles following the previous tube pull. In addition, the industry proposal would add:</p> <p>However, if no pullable tube indications are found in this inspection that would satisfy the industry database target indications, the tube removal may be delayed (utility option) to the next planned inspection with the goal of obtaining indications satisfying the database target. The tube pulls may not be delayed more than one planned outage following the required time for an additional pulled tube specimen. Consequently, the maximum interval between tube removals is four operating cycles to provide a periodic confirmation of crack morphology.</p>	<p>The staff finds this change acceptable.</p>
<p>Or participate in an industry sponsored tube pull program endorsed by the NRC that meets the objectives (1) to confirm the degradation mechanism for plants utilizing the GL for the first time, (2) to continue monitoring the ODSCC mechanism over time, (3) to enhance the burst pressure, probability of leakage, and conditional leak rate correlations, and (4) to assess inspection capability.</p>	<p>Industry has proposed a tube pull program which is the subject of this letter.</p>	<p>N/A</p>

<u>Generic Letter 95-05 Guidance</u>	<u>Industry Proposal</u>	<u>NRC Staff Comments</u>
Number and Frequency of Tube Pulls (cont.)		
	<p>If the above time requirements for a pulled tube specimen coincide with the plant's last scheduled outage before SG replacement, the requirement for a tube pull is waived.</p>	<p>The staff finds this change acceptable, except for the situation where tube pull specimens have not been obtained either during the plant SG inspection outage that implements the voltage-based repair criteria or during an inspection outage preceding initial application of these criteria.</p>
	<p>If indications with unanticipated voltage levels substantially higher than the structural limit (for example, >10 volts) from the burst correlation are found in an inspection, the indication should be considered for removal and destructive examination if the test results are likely to determine whether or not condition monitoring or operational assessment results would satisfy acceptance limits.</p>	<p>The staff finds this change acceptable.</p>
<u>Selection Criteria</u>		
<p>Should be an emphasis on removing tube intersections with large voltage indications.</p>	<p>The following would replace the current criteria:</p> <p>The primary emphasis for selecting an intersection for removal should be an indication that satisfies the target indication voltages of Table 8-3, "Summary of Current Number and Target Number for Pulled Tube Intersections with Leakage." If the target voltage range cannot be satisfied, the emphasis should be on intersections with large voltage indications.</p>	<p>The staff finds this change acceptable.</p>

<u>Generic Letter 95-05 Guidance</u>	<u>Industry Proposal</u>	<u>NRC Staff Comments</u>
<u>Selection Criteria (cont.)</u>		
Where possible, the removed tube intersections should cover a range of voltages, including intersections with no detectable degradation.	No change.	N/A
As a minimum, selected intersections should ensure that the total data set include a representative number of intersections with RPC signatures indicative of a single dominant crack as compared to intersections with RPC signatures indicative of two or more dominant cracks about the circumference.	The following would replace the current criteria: For selection between indications of comparable voltage levels, the preference for removal should be intersections with RPC (or equivalent probe) signatures of a single dominant crack as compared to intersections with RPC signatures indicative of two or more dominant cracks about the circumference.	The staff finds this change acceptable.
<u>Examination and Testing</u>		
Removed tube intersections should be subjected to leak and burst tests under simulated MSLB conditions to confirm that the failure mode is axial and to permit enhancement of the supporting data sets for the burst pressure and leakage correlations. The systems for future test should accommodate, and permit the measurement of, as high a leak rate as is practical, including leak rates that may be in the upper tail of the leak rate distribution for a given voltage. Leak rate data should be collected at temperature for the differential pressure loadings associated with the maximum postulated MSLB. When it is not practical to perform hot temperature leak tests, room temperature leak rate testing may be performed as an alternate. Burst testing may be performed at room temperature. The burst and leak rate correlations and/or data should be normalized to reflect the appropriate pressure and temperature assumptions for a postulated MSLB.	The following would be added: For small indications (<1.5 volt for 3/4" tubing and 2.5 volt for 7/8" tubing), leak tests do not need to be performed if the field and post-pull NDE data clearly show crack depths not greater than 85%. These indications may be included in the probability of leakage correlation as non-leakers if the destructive examination results show maximum crack depths $\leq 95\%$.	The generic letter guidance should continue to be followed. NRC analysis shows that a 0.25 inch crack, 95% through wall, can pop through and leak under MSLB conditions. In addition, it is unclear whether the 85% number allows for eddy current uncertainties.

<u>Generic Letter 95-05 Guidance</u>	<u>Industry Proposal</u>	<u>NRC Staff Comments</u>
<u>Examination and Testing (cont.)</u>		
<p>Subsequent to burst testing, the intersections should be destructively examined to confirm that the degradation morphology is consistent with the assumed morphology for ODSCC at the tube-to-TSP intersections. The destructive examinations should include techniques such as metallography and scanning electron microscope (SEM) fractography as necessary to characterize the degradation morphology (e.g., axial ODSCC, circumferential ODSCC, IGA involvement, cellular IGA, and combinations thereof) and to characterize the largest crack networks with regard to their orientation, length, depth, and ligaments.* The purpose of these examinations is to verify that the degradation morphology is consistent with the assumptions made in Section 1.a of this attachment. This includes demonstrating that the dominant degradation mechanism affecting the tube burst and leakage properties is axially oriented, ODSCC.</p>	<p>The following would be added at the *:</p> <p>For uncorroded ligaments, the following information should be reported: location within the elevation of the overall macrocrack; angular orientation (approximate degrees) relative to the primary direction of the macrocrack; and size of the ligament such as uncorroded ligament area.</p>	<p>The staff finds this change acceptable.</p>