

January 3, 2002

Alex Marion  
Nuclear Energy Institute  
1776 I Street NW, Suite 400  
Washington, DC 20006-3708

SUBJECT: STEAM GENERATOR DEGRADATION SPECIFIC MANAGEMENT DATABASE  
ADDENDUM 4

Dear Mr. Marion:

By letter dated September 17, 2001, you submitted Addendum 4 to the Steam Generator Degradation Specific Management Database. This addendum contains the most recent update of the databases for assessing the significance of outside diameter stress corrosion cracking at the tube support plate elevations as discussed in Generic Letter 95-05. It also provides a new data exclusion criteria for NRC review and approval. The net effect of this new exclusion criteria is to remove the pulled tube data from France from the 7/8-inch diameter databases.

In early December, the technical staff was informed by the licensee for Beaver Valley of your September 17, 2001 submittal and of the preliminary destructive examination results from a tube pull performed by the licensee during the fall. The preliminary evaluation of the results from the Beaver Valley testing indicated that the leakage database for 7/8-inch diameter tubes may no longer satisfy the criterion for demonstrating a correlation exists between voltage and leakage (i.e., leak rate is independent of the voltage). In a subsequent phone call in mid-December, the technical staff was informed by various industry representatives that the review of the new data exclusion criteria should be considered a high priority in its review of the Addendum 4 databases.

Based on a preliminary review of the new data exclusion criteria, my staff developed the attached questions/comments. Responses to these questions are needed prior to completing the review of the exclusion criteria.

With respect to the generic implications of the Beaver Valley pulled tube results, the technical staff expects the industry will follow the established protocol for updating the databases. This protocol would require an update of the databases within 90-days of finalization of the tube pull results if the data results in a significant and non-conservative shift in the correlation predictions. Finalization of the data is normally considered submission of the tube pull results via the licensee's (i.e., Beaver Valleys) 90-day report. Furthermore, it is expected that licensees which implement GL 95-05 and have 7/8-inch diameter tubes will assess the results to ensure primary-to-secondary leakage limits are not exceeded during the present cycle.

CONTACT: Ken Karwoski, EMCB/DE  
301-415-2752

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If you have any questions or comments, please contact Mr. Ken Karwoski of my staff at 301-415-2752.

Sincerely,

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

If you have any questions or comments, please contact Mr. Ken Karwoski of my staff at 301-415-2752.

Sincerely,

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

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## Questions/Comments on Data Exclusion Criteria 2c

Proposed data exclusion criteria 2c would eliminate datasets with atypical crack morphologies from all correlations in which they appear. The 3 datasets included in the correlations are: domestic pulled tubes, foreign (French and Belgian) pulled tubes, and laboratory (i.e., model boiler) specimens. The foreign pulled tube dataset and/or the laboratory specimen dataset would be considered atypical if flaws above 5 volts have depths that are not comparable to that of domestic pulled tubes. For the domestic pulled tubes, flaws with voltage above 5 volts are nearly 100% through-wall. If the other data-sets do not also exhibit this behavior (i.e., flaws with voltages greater than 5 volts are not nearly through-wall), they would be excluded from all correlations. The quantitative requirement to exclude a dataset (foreign pulled tube or model boiler dataset) is that the fraction of indications above 5 volts with depths greater than 95% must be greater than a similar fraction for domestic pulled tubes evaluated at the lower 95% confidence band.

In support of this exclusion criteria, the domestic 3/4-inch and 7/8-inch pulled tube data points were combined. There were nine 3/4-inch specimens and three 7/8-inch specimens above 5 volts for a total of 12 data points. All of these data exhibited depths greater than 95% through-wall (i.e., 100% were greater than 95% through-wall). For other datasets to satisfy criterion 2c and be included in the ARC database, the mean fraction of indications above 5 volts having depths greater than 95% through-wall must then be greater than 0.78 (the domestic data evaluated at the lower 95% confidence).

1. Separate correlations for burst pressure, probability of leakage, and leakage exist for 3/4-inch and 7/8-inch diameter tubes. The correlations for the two diameter tubes are maintained separate, in part, because of differences in voltage response for a given severity of flaw. For a given voltage, the 3/4-inch diameter tube has more severe degradation (in terms of burst pressure, probability of leakage, and leakage) indicating a difference in the morphology of a flaw in 3/4-inch and 7/8-inch diameter tubes as a function of voltage. As a result, please discuss the appropriateness of combining the 3/4-inch and 7/8-inch pulled tube data points in applying data exclusion criteria 2c.
2. The net effect of applying the data exclusion criteria 2c is that the French pulled tube data would be eliminated from the 7/8-inch database. Possible reasons cited for the differences in the morphology which contribute to the higher French voltages for depths less than 95% through-wall included: 1) French tubes with cracks are left in service for very long periods due to high voltage repair limits and develop deeper oxide films on the crack faces which increases the voltage and 2) French pulled tubes tend to have more extensive deep cracking around the circumference of the tube than domestic tubes, which may also be due to their extended time in service. As a result of the above, please address the following:
  - a) Please provide a comparison between the amount of time the French pulled tubes were left in service prior to being removed for destructive examination to the amount of time the domestic pulled tubes were left in service prior to being

Attachment

removed for destructive examination. Discuss if the results are consistent with the theory discussed above.

- b) Please describe whether the oxide films for the French pulled tubes is greater than that in the domestic pulled tubes and model boiler specimens.
  - c) Please provide a comparison of the number of cracks around the circumference between domestic and French pulled tubes. Discuss if the results are consistent with the theory discussed above.
  - d) Many of the factors discussed above were related to the amount of time flaws were left in service. Please discuss why these conditions can not occur domestically and/or discuss the need to place restrictions on the amount of time the alternate repair criteria is applicable.
  - e) For the 7/8-inch leak rate correlation, the two French data points that leaked were greater than 95% through-wall and exhibited voltages greater than 5 volts (i.e., they would not meet the exclusion criteria if they were analyzed by themselves). The leak rate from one of these specimens was in the middle of the correlation, and the other was below the correlation. Some of the French data excluded from the leakage correlation (presumably because an accurate leakage value could not be determined) but for which a lower bound estimate was available appear to lie above the mean correlation indicating that some of the French data do not necessarily consistently provide high voltages for "shallow flaws". The specimens the staff evaluated were R5C28-1 and R10C15-1 for which the leakage was cited as greater than 30 liters per hour. Given the above observations, discuss if any additional information is available from the French pulled tubes which would indicate that French tubes consistently leak less (compared to domestic pulled tubes) for a given voltage.
3. There is a very weak correlation between leak rate and voltage for 7/8-inch diameter tubes with, or without, the French data. Furthermore, there are only approximately 30 data points covering a voltage range from 3 to 50 volts. In looking at the voltage range from 0.1 to 10 volts (the range encompassing most domestic projected end-of-cycle voltage distributions for 7/8-inch diameter plants), there are approximately 10 data points. Of these, five are from domestic pulled tubes. These 10 data points have leakage values which range from 0.1 liters per hour to over 10 liters per hour (over 2 orders of magnitude) for the 0.1 to 10 volt range. Given the weak correlation and the scatter in the data for the low voltage range (the area of concern), discuss whether the current methodology with (or without) the French data properly accounts for the potential variability in the leak rate in this range.
4. The industry's primary objective for pulling tubes is to increase the leak rate database. As a result, there is a potential that large indications (e.g., > 5 volts) believed to be near through-wall (e.g., >95%) would be preferentially removed for destructive examination in the U.S. In addition, the domestic tube pull selection criteria indicates that "selected intersections should include a representative number of intersections with RPC signatures of a single dominant crack as compared to intersections with two or more

dominant RPC signatures around the circumference". As a result of these selection criteria, discuss the extent to which the domestic portion of the database is biased and the implications to data exclusion criterion 2c.