VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

February 21, 1992

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Serial No. 92-115
NL&P/JBL: R4
Docket No. 50-338
License No. NPF-4

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNIT 1
RESPONSE TO NRC COMMENTS ON THE
STEAM GENERATOR INSPECTION AND STARTUP ASSESSMENT

North Anna Power Station Unit 1 shut down on December 23, 1991 for a mid-cycle steam generator tube inspection outage. On January 6, 1992, Virginia Electric and Power Company met with the NRC to provide our steam generator tube inspection plan, provide our tube plugging criteria, and discuss the requirements for the unit's return to service. In a conference call held on January 9, 1992, the NRC provided several comments on our inspection plan and our proposed methodology for evaluating the results of the inspection. A written version of these comments was telecopied to us later that same day. The attachment to this letter provides our response to the NRC's comments.

The final inspection results and our technical evaluation of those results will be reviewed with the NRC on March 2, 1992 along with the basis for resumption of power operation as required by Technical Specification 3/4.4.5.

Should you have any questions or require additional information, please contact us.

Very truly yours,

W. L. Stewart
Senior Vice President - Nuclear

Attachment

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cc: U.S. Nuclear Regulatory Commission
Region II
101 Marietta Street, N.W.
Suite 2900
Atlanta, Georgia 30323

Mr. M. S. Lesser
NRC Senior Resident Inspector
North Anna Power Station

Comment No. 1

The need for a random sample of RPC inspections, for purposes of validating the adequacy of 8x1 probe inspection as a screening inspection, should be evaluated. The key consideration in making this determination is whether tubes exhibiting PIs with a bobbin coil are as likely to contain circumferential crack indications as those without bobbin PIs. This can be determined from the 1991 inspection results.

Response

As discussed in our meeting on January 6, 1992, we consider use of the Bobbin and the 8x1 probes as screening tools for the detection of axially and circumferentially oriented flaws, respectively, as an adequate steam generator inspection plan. The RPC probe is then used to re-examine any Bobbin Distorted Indications (DIs) and 8x1 Possible Indications (PIs) to confirm and characterize the nature of any actual defects. The NRC staff suggested that a random sample of tubes be examined with the RPC probe during the current inspection outage to validate the adequacy of the 8x1 probe as a screening tool. We responded that a review of the January 1991 inspection data for those intersections "called" by the Bobbin probe could be performed and serve to verify the adequacy of the 8x1 probe.

We performed the review of the January 1991 inspection data to determine if tube support plate intersections with axially oriented cracking (i.e., found to have DIs by the Bobbin probe) were as likely to exhibit circumferentially oriented cracking as every other intersection. Based upon this data review, two (2) of the tube support plate intersections with Bobbin DIs also exhibited circumferential indications, which represents 1% of the population of intersections with axial indications. In total, the January 1991 inspection program identified 92 circumferential indications at the tube support plate intersections. This represents approximately 1% of the tubes in the three steam generators. The comparison of these populations tends to indicate that the circumferential indication distribution is consistent across the total population of intersections without regard to the distribution of axial indications.

In addition, a direct comparison of 8x1 probe to RPC probe inspection results was performed during the 1992 mid-cycle inspection on a sample of 180 tubes in the "A" steam generator. This sample program encompassed direct comparison of approximately 1200 tube support plate intersections. The 8x1 data used in this comparison was collected at the rate of 6 inches per second. The 8x1 inspection utilized the following interpretation guidelines to identify PIs:

- All vertical excursions were evaluated.
- Any flaw-like vertical excursions (20-140 degrees) reported by either of two analysts were identified as a PI.

From this sample, 634 8x1 PIs were identified. 270 of the 634 indications were reported by both analysts and the remainder of the population were reported by one analyst only. Direct comparison with the RPC inspection data resulted in the following:

- 93% (39/42) of the RPC-found circumferential indications were identified by the 8x1 screening.
- The circumferential arc lengths missed by both analysts ranged from 95° to 132°.
- 74% (29/39) of the RPC-found axial indications were also identified by the 8x1 screening.
- The false call rate from the 8x1 screening was approximately 8 times the confirmed (by RPC) call rate.

Because the circumferential indications missed by the 8x1 probe in the study are bounded by the analysis presented in WCAP-13034, it is concluded that the 8x1 probe is an adequate screening tool for circumferential indications at North Anna. Additionally, the 8x1 probe had good success in identifying intersections which contained axial indications. Many of these axial indications are found within the areas around the support plates affected by denting. The Bobbin probe is expected to have a high success rate in identifying axial cracks beyond the dented areas. It should be noted, however, that any axial indication identified by the 8x1 probe is plugged. Therefore, in our evaluation, the 8x1 probe is an adequate screening tool for circumferential indications and provides an additional level of assurance in our ability to detect axial indications.

Comment No. 2

It appears to the staff that probe lift off effects make it more difficult to identify crack indications at the support plates than would otherwise be the case. Please provide your assessment of whether a reduced probe speed could improve lift off performance and improve the sensitivity of the test. Confirm that the current inspection is utilizing appropriate probe speeds.

Response

In order to assess the pull speed for the 8x1 probe, a speed test comparison was performed on 100 tubes in the "C" steam generator. The data collected from the 8x1 probe at pull speeds of 6.0 inches, 3.0 inches, and 1.5 inches per second was directly compared with results of data collected from RPC probe testing. Additionally, the 8x1 data collected during the 1992 inspection outage prior to the probe pull speed test was compared with the RPC inspection results. This data was also taken at 6 inches per second and is identified in the table below as "6R".

The speed test data taken at 3 inches per second had a resolution factor which was twice that of the data taken at 6 inches per second (i.e., twice as many data points were obtained in the same linear tube space). However, due to a computer overload, attempts to interpret the 1.5 inches per second data failed because 4 times as many

data points per linear inch of tube space were being collected. Therefore, the resolution of the data collected at 1.5 inches per second was adjusted to be the same as the resolution of the data collected at 6.0 inches per second.

The following are the results of the 8x1 probe pull speed test:

	6.0 In/sec	3.0 In/sec	1.5 In/sec	6R
Number of PIs called	52	37	46	50
Number circ. indic. called	38	31	37	35
Number axial indic. called	14	6	9	15
Number circ. indic. missed	1	8	2	4
Number axial indic. missed	3	11	8	2
Largest circ. indic. missed	67°	166°	98°	110°

Based upon this data, it was concluded that, for axial indications, the 6.0 inches per second data provided better detection capability than the reduced probe pull speeds. As expected, circumferential flaws were detected better than axial flaws at all pull speeds. However, no real difference in detectability of circumferential flaws is seen between the data taken at 6 inches per second and 1.5 inches per second. Therefore, based on the data resulting from this test, we can find no advantage to slowing the probe speed to less than 6 inches per second.

A potential explanation for this result is that the higher pull speed provided optimum data quality with respect to analyst sensitivity to changes in the tubing. Axial flaw visibility may have been sharply reduced at the lower pull speeds due to the relative decrease in the rate of vertical signal generation at the lower speed. This causes small flaws to be smeared out on the strip chart and partially displaced on the viewing aperture.

As a side issue, one of the reasons for re-testing the sample of tubes at 6 inches per second was to compare the possible effect of probe orientation on detection capability. This comparison presumes that the probe would not pass through the intersection at exactly the same orientation as the previous test. As can be seen in the above table, the second test at 6 inches per second (performed as part of the speed test) resulted in slightly different results than the first test.

Comment No. 3

The staff believes it appropriate to compare the full EOC RPC crack angle projections to the allowable 3 x n.o. pressure and SLB crack angles consistent with the approach to WCAP-13034. The staff has no objection (for purposes of the upcoming cycle) to assuming that 60% of the EOC crack angle is through-wall for purposes of assessing the potential for tube vibration and for estimating potential leakage during SLB, consistent with the approach taken in WCAP-13034.

Response

For the purposes of the upcoming North Anna Unit 1 operating interval assessment, it is planned to compare the full end-of-cycle (EOC) RPC crack angle projections to the Regulatory Guide 1.121 criteria (i.e., $3\Delta P$ and SLB) consistent with the approach used in WCAP-13034 for the assessment of tube integrity. The adjustment (i.e., assuming that 60% of the EOC crack angle is through-wall) will be made to assess the potential leakage during a postulated steam line break (SLB) and potential for tube vibration consistent with WCAP-13034.

Comment No. 4

The Westinghouse response to NRC Question No. 3 (in Westinghouse Report SG-91-12-014) does not resolve the staff concern regarding multiple crack indications (MCIs). Specifically, the staff continues to believe that a rationale needs to be developed to demonstrate that projected EOC multiple cracks will not excessively degrade tube integrity. In the meantime, to support operation through the next planned cycle, MCIs found during the current inspection should be evaluated to ensure that the affected tubes retain adequate integrity per Reg. Guide 1.121. Thus, even if we don't have a projected number and size distribution of MCIs, these should be a basis for concluding that MCIs of the next EOC will be within acceptable limits.

Response

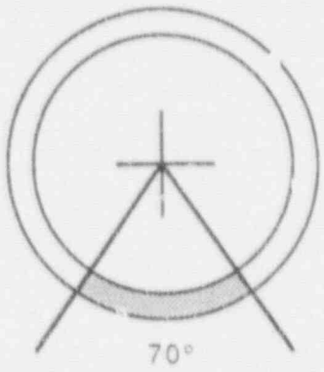
In order to address NRC staff concerns, Virginia Power has authorized Westinghouse to perform a series of tube burst tests to better ascertain the implication of MCI geometries on tube integrity. A total of five (5) different crack geometries are planned for testing using tubes containing simulated MCIs. The specimens will be fabricated from proto-typic tubing using Electric Discharge Machined (EDM) notches to simulate circumferential cracks. A schematic of the planned burst test configurations is attached. A summary report of the test results will be provided to the NRC for review subsequent to the completion of the tests. However, due to the short duration of the remaining cycle of operation (i.e., approximately 9 months), we do not consider the test results to be an issue for North Anna Unit 1 operation through January 1993.

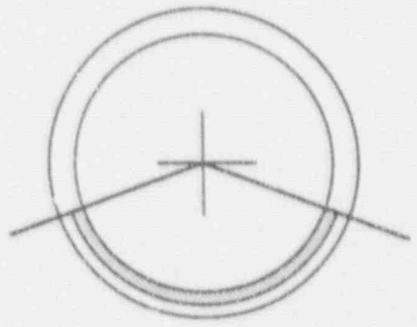
Comment No. 5

The WCAP-13034 methodology for predicting EOC RPC angles includes consideration of RPC vs. 8x1 angle uncertainties, as given in Figures 5-2 and 5-4. These figures should be updated to reflect an RPC vs. 8x1 correlation based in inspection data from the current inspection. This update should reflect the actual calls made in field, and should not be adjusted to reflect a subsequent re-evaluation of this data.

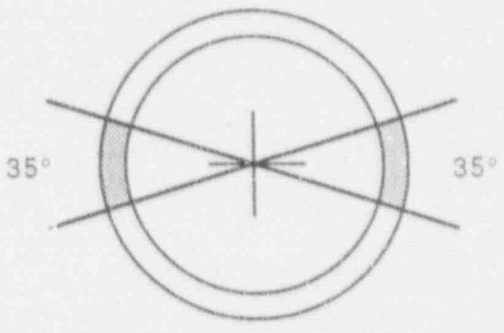
Response

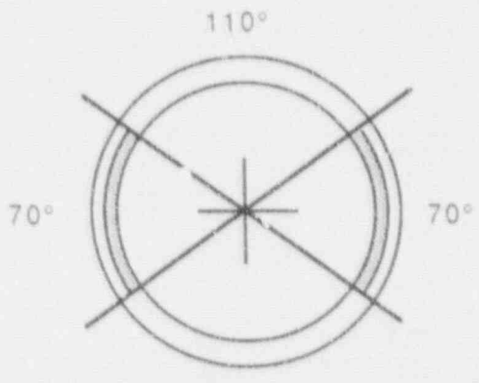
Due to the fact that RPC testing instead of 8x1 testing is being performed, no direct comparison or correlation of RPC and 8x1 data is planned.



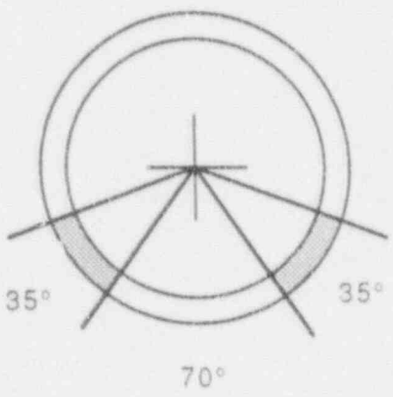


50% of Wall Remaining
over 140°





50% of Wall Remaining
two 70° Ligaments



North Anna Burst
Test Matrix

Indicates Remaining Wall