



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

January 29, 1992

Docket Nos. 50-348
50-364

Mr. W. G. Hairston, III
Senior Vice President
Southern Nuclear Operating
Company, Inc.
Post Office Box 1295
Birmingham, Alabama 35201-1295

Dear Mr. Hairston:

SUBJECT: STEAM GENERATOR TUBE SUPPORT PLATE ALTERNATE PLUGGING
CRITERIA FOR JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1
AND 2 (TAC NOS. M79818 AND M79819)

By letter dated February 26, 1991, Alabama Power Company (APCO) submitted proposed amendments to the Joseph M. Farley Nuclear Plant, Units 1 and 2 (Farley) Technical Specifications concerning steam generator tube support plate alternate plugging criteria (APC). You requested approval of the amendments by April 25, 1991. In a letter dated March 21, 1991, we responded to your request indicating that due to the technical issues involved and the generic implications of approval, the earliest approval date was estimated to be January 31, 1992.

On August 8, 1991, we sent you a letter requesting additional information (RAI) concerning the requested amendments. By letter dated November 13, 1991, you submitted a revision to the requested amendments and requested approval of the revised amendments by March 1, 1992.

The staff is reviewing the revised amendment request dated November 13, 1991. Based on this review, a need for additional information has been identified (Enclosure 1) that may require another revision of your application. Responses to the enclosed questions are required in order that the staff can continue its review.

Because of the status of this review, as well as the complexity of the technical issues involved and the generic implications of approval, we conclude that we will be unable to complete our review and issue the amendments by your requested date. However, with timely responses to Enclosure 1, we anticipate completion of our review and issuance of the amendments in time to support your next Unit 1 outage scheduled to begin in September 1992.

Should you wish, we are willing to discuss a more timely review of interim plugging criteria which are more conservative than

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your current proposal but less so than your current technical specifications. Use of interim criteria was discussed with your staff, John Garlington, on January 24, 1992.

Sincerely,

Original signed by

Steven A. Varga, Director
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosure:
Questions and Comments

cc: See next page

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Mr. W. G. Hairston, III
Southern Nuclear Operating Company, Inc.

Joseph M. Farley Nuclear Plant

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cc: Plant Service List

QUESTIONS AND COMMENTS

on

J. M. Farley Units 1 and 2
SG Tube Plugging Criteria for
ODSCC at Tube Support Plates

WCAP-12871
Revision 1
SG-91-10-004

and

Additional Information Supporting
SG Tube Support Plate Plugging Criteria
for J. M. Farley Units 1 and 2

WCAP-13103
SG-91-10-040

Introduction

Further review and evaluation of Alabama Power Company's proposed alternate plugging criteria (APC) for the TSP region of Farley 1 and 2 steam generators was performed. The documents cited above were the main items reviewed. In addition, a meeting to discuss these documents was held in Bethesda, Maryland on November 20 with personnel from Westinghouse, Alabama Power Company, Pacific Northwest Laboratory, Oak Ridge National Laboratory, and the NRC.

Many of the questions and comments raised in an earlier Request for Additional Information were answered in one or both of the above documents. The APC has been significantly revised from the initial proposal. Under the revised APC, tubes with bobbin coil indications exceeding 4.0 volts due to ODSCC at TSPs will be plugged or repaired. All other portions of the tube would be governed by the 40% plugging criterion. In addition, tubes with RPC indications not attributable to ODSCC and all circumferential indications will also be evaluated for plugging or repair using the 40% criterion. Inspection requirements for implementation of the APC involve a 100% bobbin coil inspection of all hot leg TSP intersections and all cold leg intersections down to the lowest cold leg TSP with ODSCC indications. Further, all tubes with bobbin coil indications greater than 1.5 volts will be inspected using RPC probes. The RPC results will be evaluated to determine if ODSCC is the main cause of the signal. Indications confirmed to be ODSCC will be reinspected at alternate refueling outages for reconfirmation as ODSCC. The last major feature of the APC involves a decrease in the operating leakage limit. Plant shutdown will be implemented if normal operating leakage exceeds 150 gpd per steam generator.

Based on our review of the above documents and the November 20 meeting the following represents a compilation of our remaining questions, concerns and recommendations.

Questions, Concerns, and Recommendations

1) Trojan Data

Considering the significant quantity of pulled tube information recently generated from the Trojan Nuclear Plant we believe that WCAP-12871, Rev. 1 should be revised to incorporate these data. In other words, do the most recent results from Trojan supplement and support the APC for Farley?

2) IGA

Additional data was furnished on the problem of IGA at St. Lucie and Trojan. The IGA

at these two plants was detected with the differential bobbin probe. The signals were above the level that would require plugging and the RPC inspection. The IGA present at Farley was discussed in more detail. It was stated that the IGA was only a few grains wide. Data from both an active tube and a plugged tube were presented. The plugged tube had about twice the IGA thickness as the active tube. Our main concern is that IGA may be present in Farley 1. Only one tube has been pulled, and this does not establish that IGA will not be present in the generators of this unit. Dan Dobben of Laborelec stated that volumetric IGA in a confined region, with a depth of over 80% may not be detectable with eddy currents. Of four tubes that were pulled (three active, one plugged in 1990) from Doel 4 in 1991, all TSPs had volumetric IGA, with some additional axial IGSCC. The total depth was up to 100% and all contained within the TSP boundaries.

It is recommended that additional tubes from Farley 1 be pulled. These tubes would show if any IGA or circumferential cracking is present in this unit. Burst tests would also show if these defects obey the burst pressure - bobbin coil voltage correlation. Tubes selected for pulling should be those which include a "property variation" (mentioned as a precursor to circumferential cracking by Dan Malinowski).

3) Denting

A dent will distort the eddy current signal. While it can be demonstrated that some defect signals will be visible even when a large dent signal is present, this does not mean that they will always be visible. If the dent signals are on the edge of the TSP and the defect is in the center of the support, then they can be well separated. However, this may not always occur. A distorted dent signal will give some indication that a defect is present, but other signals in this region such as deposits, TSP distortions, and property changes of the Inconel tube, can also confuse the signals. It was stated that in field applications, small to moderate indications typically cannot be separated from dent signals, and that detection of cracks at dented intersections is unreliable when the degradation amplitude is smaller than the dent amplitude. In addition, the stress fields that dents create can lead to initiation of circumferential SCC such as was observed at North Anna.

Given these considerations we believe it is prudent to place a limit on the amount of denting allowed before requiring an RPC inspection. The amount of denting that could cause a 1.5 volt signal to be lost or misread should be estimated. For TSPs with denting voltages exceeding an allowable threshold an RPC inspection should be required, or the APC would not apply.

4) Human factors

The example defect plots shown by Westinghouse were easy to read and there was not much question on where to place the dots on the defect scans in order to measure voltage. However, there will be many cases where this will not be nearly as clear as noise, denting, probe wobble, and deposits become more of a problem. It was stated that uncertainties associated with field crevice conditions and human factors are more significant at the low amplitudes near the detection thresholds than at the proposed plugging voltage. Ostensibly this is because of higher signal to noise ratios for voltages near the APC.

We believe that the analysis guidelines given in Appendix A should be more detailed in order to provide the data analyst with more comprehensive guidance on appropriate procedures to apply for dealing with distorted signals.

Further, what information is available on the variation in measured bobbin coil voltages for several analysts evaluating the same data?

5) Crack Growth Outside the TSP

The primary method for detection of cracking outside the TSP is inspection with a bobbin coil probe. At least two instances of cracking outside the TSP were noted in the report. It is recognized that CDSCC is largely driven by conditions within the TSP crevice, but it is clearly not impossible for cracking to occur outside the TSP. Given the uncertainties in the bobbin coil technique what is the detection and sizing accuracy of the method described in Appendix A for cracks extending beyond the TSP?

6) Probability of Tube Burst Under SLB

Table 12.3 presents an estimate of the probability of tube burst under SLB conditions for a single tube or degraded TSP intersection. Table 12.3 addresses tube burst probabilities at "maximum" uncertainty values for NDE and crack growth. Tube burst may be more likely at lower (but more probable) values of these uncertainties. The probability for tube burst under SLB should be treated in a manner similar to the SLB leakage model. A distribution of voltage indications (which will tend to shift to higher voltages with time) should be combined using Monte Carlo techniques with the voltage growth rate distribution, the eddy current uncertainties distribution and the burst pressure versus voltage correlation to obtain a projected cumulative EOC SLB probability of tube burst. Therefore, it should be demonstrated that the cumulative probability of tube burst for the entire steam generator under SLB is at or below the level given in NUREG-0844.

7) Bobbin Coil Voltage - Leak Rate Correlation

A continuing concern is that the bobbin voltage - leak rate correlation data base is very small. Almost all of the data was obtained from model boiler specimens and the data listed on page 9.6 suggests that these specimens may leak more than comparable pulled tube specimens. Of the two pulled tube specimens with voltages around 10 volts one did not leak at all, and the other leaked at a rate of only 0.11 lph. In contrast, the four model boiler specimens with voltages near 10 volts exhibited leak rates of 0.14, 2.4, 3.9, and 5.12 lph. In addition the one pulled tube sample with a voltage of 7.5 volts did not leak, but the model boiler specimens with voltages ranging from 6.5 to 8.4 volts leaked at rates ranging from 2.69 to 82.5 lph. These data underscore the variability in observed leak rates from SCC flaws due to the presence of small ligaments, irregular fracture faces, residual stresses, and corrosion product buildup within the crack. Thus, predictions of leakage based on the small data base may be significantly in error, and, as noted in the report, the lowering of operational leak limits may not ensure LBB.

8) Calibration and Probe Centering Uncertainty

Calibration correction factors and probe centering uncertainty are minimized by utilizing a four through-wall hole ASME standard. What effect does allowable variations in the fabrication of the four hole standards have on the magnitude of these uncertainties (i.e., at the minimum and maximum tolerances)?

9) Eddy Current Reliability

It was noted that a given voltage amplitude does not define a unique crack geometry. For a particular voltage a range of crack morphologies may occur involving different crack densities, lengths, depths, and ligaments between cracks. This range of crack geometries gives rise to the spread in the voltage - burst, the voltage - leak, and the voltage - growth correlations. In the case of the voltage - burst and voltage - leak correlations this spread is compensated for by selecting the 95% lower confidence band of the test data. Since the bobbin coil voltage does not give a specific crack morphology or size(s) it is not possible to evaluate crack(s) severity using fracture mechanics techniques. Thus, considerable reliance is placed on the various correlations compensating for a large number of uncertainties. A fundamental issue is the reliability of the bobbin coil inspection to detect and size (in terms of volts) "significant" flaws - namely those which lead to a high probability of tube failure under SLB. Therefore, what is the probability of detection of "significant" flaws?

10) Additional RPC Inspections

Due to the uncertainties in the bobbin coil inspection, it is recommended that a sampling inspection of about 100 tubes be performed with the RPC. This would improve the chances of showing any significant crack extension beyond the TSP or the existence of circumferential cracking. In addition, it may detect volumetric IGA that may produce signals under 1.5 volts.

11) Additional Tube Pulls

A general concern is the paucity of relevant pulled tube data available for the voltage - burst and voltage - leak correlations. This concern is especially acute for the voltage - leak correlation as noted in (7). Consequently, what are the licensee's plans to perform future tube pulls at both Units 1 and 2 to strengthen the data bases and validate the various correlations?