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SUBJECT: Forwards util response to GL 95-03 re circumferential cracking of SG tubes.

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June 27, 1995

U.S. Nuclear Regulatory Commission
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Washington, D.C. 20555

Subject: McGuire Nuclear Station
Docket Nos. 50-369, 370
Catawba Nuclear Station
Docket Nos. 50-413, 414
Oconee Nuclear Station
Docket Nos. 50-269, 270, 287
Response to Generic Letter 95-03:
Circumferential Cracking of Steam Generator Tubes

Gentlemen:

On April 28, 1995, the NRC issued Generic Letter 95-03 in response to concerns regarding the recent tube inspections at the Main Yankee Atomic Power Station and to obtain information from licensess which will enable the NRC to assess the degree of compliance with regulatory requirements regarding steam generator tube examinations.

Accordingly, Attachments A, B, C to this letter provide the required information for McGuire, Catawba, and Oconee Nuclear Stations, respectively.

I declare under penalty of perjury that these statements are true and correct to the best of my knowledge.

Should you have any questions or require any additional information regarding this submittal, please contact D. Mayes at (704) 382-4211.

Very truly yours,

M.S. Tuckman

M.S. Tuckman
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A001

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ATTACHMENT A
McGUIRE NUCLEAR STATION'S RESPONSE TO
GENERIC LETTER 95-03

The WOG has prepared a generic response and safety assessment. The draft of the document was used in preparing this response.

McGuire Nuclear Station Generic Letter 95-03 assessment

I. Evaluate recent operating experience to determine applicability of circumferential cracking.

Background
The McGuire Units 1 and 2 steam generators are Westinghouse models D2 and D3 respectively. The tubing in both units is alloy 600 low temperature mill annealed. The units have currently operated 8.16 and 8.25 EFPY's as of the last refueling outage. The hot leg temperature is 618 degrees Fahrenheit. The tubesheets are full depth expanded by hard rolling. The secondary side chemistry program at McGuire is high hydrazine (100 ppb), ethanolamine for pH control, and boric acid addition. Both units are also currently adding ammonium chloride for molar ratio control. Both units are also presently using methoxypropylamine on a trial basis as an alternative to ethanolmine for pH control.

Areas of the steam generator susceptible to circumferential cracking
The McGuire steam generators are susceptible to circumferential cracking at the top of the tubesheets, in inner row U-bends, and at dents. No sleeved tubes are in service.

Past Inspection Scope
The hot leg tubesheet has been 100% inspected from plus one inch to minus three inches at the secondary face for the past four refueling outages by MRPC. The cold leg tubesheets were 100% MRPC inspected in 1991 for Unit 1 and 1992 for Unit 2. All row 1, 2, and 3 (inner row) U-bends have been inspected by MRPC. A 20 % random sample of the row 4 U-bends was performed at the last refueling outage. All dents greater than 4 volts have been inspected by MRPC at the last refueling outage. A 100 % bobbin coil inspection is performed at each refueling outage.

Past inspection results
The McGuire steam generators do not have abnormal geometry variations or conductive deposits that have interfered with the eddy current analysis.

No circumferential indications have been identified in the inner row U-bends or at dents. There have been less than 20 tubes per outage identified with circumferential indications at the top of tubesheet. None of these indications

were structurally significant. All indications of circumferential cracking have been plugged.

Other relevant Information
Shot peening was performed on Unit 1 hot leg tubesheets in 1986 and the cold leg tubesheets in 1990. Shot peening was performed on Unit 2 hot leg tubesheet in 1987 and the cold leg in 1989.

U bend stress relief was performed on Unit 1 in 10/88 and on Unit 2 in 6/88.

Both units at McGuire have been analyzed for high cycle fatigue by evaluating the position of the anti-vibration bars (AVB's).

Tube 40-47 was pulled for a circumferential indication at the top of the tubesheet in the January 1990 refueling outage. The tube had a burst pressure of 9400 psi and bent over prior to bursting. The fracture initiated on the outside of the tube and was intergranular. The fracture was through wall for 90 degrees and less than forty percent through wall for the remaining part of the circumference.

The chemistry contaminant levels in the steam generator water have been well below industry guidelines and improving with time. There have been a few contaminant excursions due to condenser leaks or other contaminant ingress but these have been rare and corrective actions have been taken in a timely manner.

The McGuire units have been routinely sludge lanced to remove accumulated deposits on the secondary face of tubesheet. As a result of alternate amine chemistry, the quantity of material removed has decreased in recent years. Sludge lancing is effective at removing corrosion products at the top of the tubesheet and at controlling the build up of conductive deposits which might interfere with the eddy current analysis.

Tube leak outages have occurred at McGuire, but none have occurred because of circumferential cracking in tubes without sleeves.

Growth
Since indications of circumferential degradation are plugged or repaired upon detection, determination of circumferential growth rate is inherently difficult. In an effort to determine such growth rates, McGuire has contracted Westinghouse to develop a program. This program uses reevaluation of 1992, 1993, and 1994 eddy current data for 17 indications. Preliminary results of a growth study of these 17 indications from McGuire Unit 2 indicate that the arc length growth from 1993 to 1994 was essentially zero. The average arc lengths for all indications in 1993 was 211.8 degrees and 214.5 degrees in 1994, while the maximum arc length growth for this period was 60 degrees. Average indication depths for the

same period increased from 64% TW to 78% TW, with the maximum average depth increase being 52% TW.

II. Justification for continued operation

McGuire has experienced circumferential cracks at the top of hot leg tubesheet. The growth of the indications has been slow. The population of tubes identified has not increased significantly. None of the cracks identified at McGuire have been structurally significant. The top of the tubesheet has been inspected at each refueling outage for the last four outages. The last inspection was performed with 3 coil MRPC which is qualified for detection of circumferential cracks.

III. Future Inspection Plans

The next refueling outage (EOC-10) is scheduled for Unit 1 in 12/95. The next refueling outage for Unit 2 is schedule for 4/96. The steam generators are currently scheduled to be replaced in 1/97 and 8/97 respectively. The inspection scope for the next refueling will be the same as identified in Item I above except a 20 % random inspection of the cold leg tubesheets will be performed with three coil MRPC. DPCo, as well as the industry, is currently evaluating the technology for detection and sizing of circumferential cracks.

The minimum equipment utilized is Zetec MIZ-18 with Eddynet analysis software.

Eddy Current analysis guidelines are consistent with EPRI letter dated February 23,1995. Analysis techniques in place utilize zoom and scroll and terrain mapping for the detection of indications.

Eddy current analysts are given site specific guidelines training and testing. They are also briefed on defect mechanisms.

ATTACHMENT B
CATAWBA NUCLEAR STATION'S RESPONSE TO
GENERIC LETTER 95-03

The WOG has prepared a generic response and safety assessment. The draft of the document was used in preparing this response.

Catawba Nuclear Station Generic Letter 95-03 assessment

I. Evaluate recent operating experience to determine applicability of circumferential cracking.

Background
The Catawba Units 1 and 2 steam generators are Westinghouse models D3 and D5 respectively. The tubing in Unit 1 is alloy 600 low temperature mill annealed. The tubing in Unit 2 is alloy 600 thermally treated. The units have currently operated 7.11 and 5.62 EFPY's as of the last refueling outage. The hot leg temperature is 618 degrees Fahrenheit. Unit 2 will implement a hot leg temperature reduction of three degrees after the next refueling outage. The tubesheets are full depth expanded by hard rolling in Unit 1. Unit 2 tubesheets are full depth hydraulically expanded. The secondary side chemistry program at Catawba is high hydrazine (100 ppb), ethanolamine for pH control, and boric acid addition. Methoxypropylamine has been initiated on a trial basis as an altermative to ethanolamine for pH control.

Areas of the steam generator susceptible to circumferential cracking
The Catawba Unit 1 steam generators are susceptible to circumferential cracking at the top of the tubesheets, in inner row U-bends, and at dents. There are no sleeved tubes in service.

The Catawba Unit 2 steam generators are susceptible to circumferential cracking at the top of the tubesheets, and in low row U-bends. Unit 2 has no sleeved tubes in operation.

Past Inspection Scope
For Unit 1, the hot leg tubesheet has been 100% inspected from plus one inch to minus three inches at the secondary face for the past five refueling outages by three coil MRPC. The cold leg tubesheets were inspected in 1992. All rows 1, 2, and 3 (inner row) U-bends have been inspected by MRPC. A 20% random sample was performed on row 4 U-bends. All dents greater than 4 volts have been inspected by MRPC at the last refueling outage. A 100% bobbin coil inspection is performed at each refueling outage.

For Unit 2 the hot leg tubesheet has been 100% inspected from plus one inch to minus three inches at the secondary face for the past four refueling outages. A 100 % bobbin coil inspection was performed at the last refueling outage.

Past inspection results
The Catawba steam generators do not have abnormal geometry variations or conductive deposits that have interfered with the eddy current analysis.

For Unit 1, no circumferential indications have been identified in the inner row U-bends. There have been less than 20 tubes per outage identified with circumferential indications at the top of hot leg tubesheet. None of these indications were structurally significant. All indications of circumferential cracking have been plugged.

For Unit 2, no circumferential indications have been identified at the top of tubesheet.

Other relevant Information
Shot peening was performed on Unit 1 hot leg tubesheets in 1987 and the cold leg tubesheets in 1991.

U bend Stress relief of rows 1 and 2 was performed in 12/88 for Unit 1.

Both units at Catawba have been analyzed for high cycle fatigue by evaluating the position of the anti-vibration bars (AVB's).

Tube 20-46 was pulled from Unit 1 for a circumferential indication at the top of the tubesheet in the April 1991 refueling outage. The tube had a burst pressure of 9200 psi. The corrosion was initiated from the outside of the tube and was intergranular. The corrosion was characterized as a 360 degree band of circumferential IGA less that 15 percent through wall.

The chemistry contaminant levels in the steam generator water have been well below industry guidelines and improving with time. There have been a few contaminant excursions due to condenser leaks or other contaminant ingress but these have been rare and corrective actions have been taken in a timely manner.

The Catawba units have been sludge lanced to remove accumulated deposits on the secondary face of tubesheet. As a result of alternate amine chemistry, the quantity of material removed has been low. Sludge lancing is effective at removing corrosion products at the top of the tubesheet and at controlling the build up of conductive deposits which might interfere with the eddy current analysis.

Tube leak outages have occurred at Catawba Unit 1, but none have occurred because of circumferential cracking.

Growth

Since indications of circumferential degradation are plugged or repaired upon detection, determination of circumferential growth rate is inherently difficult. In an effort to determine such growth rates, McGuire has contracted Westinghouse to develop a program. This program uses reevaluation of 1992, 1993, and 1994 eddy current data for 17 indications. Preliminary results of a growth study of these 17 indications from McGuire Unit 2 indicate that the arc length growth from 1993 to 1994 was essentially zero. The average arc lengths for all indications in 1993 was 211.8 degrees and 214.5 degrees in 1994, while the maximum arc length growth for this period was 60 degrees. Average indication depths for the same period increased from 64% TW to 78% TW, with the maximum average depth increase being 52% TW.

II. Justification for continued operation

Catawba Unit 1 has experienced circumferential cracks at the top of the hot leg tubeeheet. The growth of the indications has been slow. The population of tubes identified has not increased significantly. None of the cracks identified at Catawba have been structurally significant. The top of the hot leg tubesheet has been inspected at each refueling outage for the last five outages. The last inspection was performed with 3 coil MRPC which is qualified for detection of circumferential cracks.

No circumferential cracking has been observed on Unit 2. Unit 2 is inspected in its susceptible regions to detect circumferential cracks.

III. Future Inspection Plans

The next refueling outage (EOC-9) is scheduled for Unit 1 in 6/96. The next refueling outage (EOC -7) for Unit 2 is schedule for 10/95. The Unit 1 steam generators are currently scheduled to be replaced in 6/96. There is no inspection planned for the Unit 1 steam generators during the replacement outage. The Unit 2 inspection scope for the next refueling outage will be a >50% sample of the hot leg tubesheets by MRPC and a 20% sample of the row 1 and 2 U-bends. DPCo, as well as the industry, is currently evaluating the technology for detection and sizing of circumferential cracks.

The minimum equipment utilized is Zetec MIZ-18 with Eddynet analysis software.

Eddy Current analysis guidelines are consistent with EPRI letter dated February 23,1995. Analysis techniques in place utilize zoom and scroll and terrain mapping for the detection of indications.

Eddy current analysts are given site specific guidelines training and testing. They are also briefed on defect mechanisms.

ATTACHMENT C
OCONEE NUCLEAR STATION'S RESPONSE TO
GENERIC LETTER 95-03

Oconee Nuclear Station Generic Letter 95-03 assessment

The BWOG has prepared a generic response (letter to the USNRC dated June 13,1995 from John A. Selva) to Generic Letter 95-03. In general Duke Power supports the position of the BWOG generic response except to provide specific information about Oconee and to commit to the inspection plans in the BWOG response.

I. Evaluate recent operating experience to determine applicability of circumferential cracking.

Background

The Oconee Units 1, 2, and 3 steam generators are Babcock and Wilcox designed Once Through Steam Generators (OTSG) The tubing in all units is sensitized alloy 600. The units have currently operated 15.19, 15.01 and 14.15 EFPY's as of the last refueling outage respectively. The hot leg temperature is 602 degrees Fahrenheit. The tubesheets are partial depth expanded by hard rolling. The secondary side chemistry program at Oconee is hydrazine (50 ppb) for oxidant control, and ethanolamine for pH control.

Areas of the steam generator susceptible to circumferential cracking

The Oconee steam generators are susceptible to circumferential cracking as outlined in the BWOG generic response. In addition there are three other areas as identified in the BWOG generic response of concern. The first concern are three tubes explosively expanded in Oconee unit 3 and two tubes with hydraulically expanded sleeves at the 15th and upper tubesheet in Oconee Unit 1. Another area of concern are the sleeves installed at the 14th TSP in Oconee Unit 1.

Past Inspection Scope

The lane and wedge region has been inspected at the 15 and UTSF for high cycle fatigue by MRPC as a minimum at the last two refueling outages. Sleeves have been inspected since their installation. The sleeves installed in the lane and wedge have been 100% inspected at the upper rolls with MRPC. The sleeves installed in the lane and wedge have also been 100 % inspected with bobbin and cross wound at the last two refueling outages. The rerolled tubesheet joints have been 100% inspected for at least the last two refueling outages. Larger voltage dents have been inspected by MRPC at the last refueling outage. A 60% bobbin coil inspection is performed at each refueling outage.

Past inspection results

The Oconee steam generators do not have abnormal geometry variations or conductive deposits that have interfered with the eddy current analysis.

No circumferential cracks have been identified in sleeves or rerolled non-stress relieved expansion transitions. Circumferential cracks have been identified in the lane and wedge region.

Other relevant Information
The lane and wedge region was sleeved at Oconee Unit 1 in 10/87 with alloy 600 thermally treated sleeves. Thirty two 14th TSP sleeves were also installed in Oconee Unit 1 at that time. Oconee Unit 2 was initially preventatively sleeved in 9/90 with alloy 690 thermally treated sleeves. Oconee Unit 2 was again sleeved in 10/94 to finish the recommended 288 sleeving zone. Oconee Unit 3 was initially sleeved in 8/88 with alloy 600 thermally treated sleeves. Oconee Unit 3 is again being sleeved in 6/95 to finish the 288 recommended sleeving zone.

Oconee units 1 and 2 were chemically cleaned and sludge lanced in 10/87 and 2/88 to remove accumulated deposits on the tubes and the secondary face of tubesheet. As a result of alternate amine chemistry the quantity of material introduced into the steam generator has been significantly reduced. Chemical cleaning has been effective at removing conductive deposits which might interfere with the eddy current analysis.

A number of tubes have been removed from the Oconee OTSG 's to determine the root cause of circumferential cracks. The cause was identified as environmental assisted high cycle fatigue.

The chemistry contaminant levels in the steam generator water have been well below industry guidelines and improving with time. There have been a few contaminant excursions due to condenser leaks or other contaminant ingress but these have been rare and corrective actions have been taken in a timely manner.

Tube leak outages have occurred at Oconee from circumferential cracking in the lane and wedge region in all three units.

Growth
The growth rates for circumferential cracks in the lane and wedge can be high, but the units have been sleeved to prevent leaks.

No other cracks have been observed.

II. Justification for continued operation
Oconee has experienced circumferential cracks in the lane and wedge region. The region has been preventatively sleeved to preclude this failure mechanism.

The areas susceptible to circumferential cracking have been inspected at the last refueling outages.

III. Future Inspection Plans

The next refueling outage (EOC-16) is scheduled for Unit 1 in 10/95. The next refueling outage (EOC-15) for Unit 2 is schedule for 4/96. The next refueling outage (EOC-15) for Unit 3 is schedule for 6/95. The inspection scope for the next refueling outages will be the same as identified in the BWOG generic response except for the following items. If there are indication found in the rerolled non-stress relieved transitions, the inspection will be expanded to 20% of the stress relieved transitions. The sleeves installed in the lane and wedge will be inspected in accordance with the BWOG response with the plus point coil. The three explosively expanded tubes in Unit 3 will be inspected or removed from service. The two tubes with hydraulically expanded sleeves will be inspected or removed from service. The thirty two 14th TSP sleeves will be inspected or removed from service. These inspections are typically performed with three coil MRPC. DPCo, as well as the industry, is currently evaluating the technology for detection and sizing of circumferential cracks.

The minimum equipment utilized is the Zetec MIZ-18 with Eddynet analysis software.

Eddy Current analysis guidelines are consistent with EPRI letter dated February 23,1995. Analysis techniques in place utilize zoom and scroll and terrain mapping for the detection of indications.

Eddy current analysts are given site specific guidelines training and testing. They are also briefed on defect mechanisms.