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Southern Nuclear Operating Company

*the southern electric system*

Dave Morey  
Vice President  
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October 24, 1995

Docket No.: 50-348

10 CFR 50.73

U. S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, DC 20555

Joseph M. Farley Nuclear Plant - Unit 1  
Licensee Event Report No. 95-009-00  
Steam Generator Inspection

Ladies and Gentlemen:

Joseph M. Farley Nuclear Plant Licensee Event Report No. 95-009-00 is being submitted in accordance with Technical Specification 4.4.6.5 a and c. If you have any questions, please advise.

Respectfully submitted,

Dave Morey

REM/ct:LER95-09.DOC

Enclosure

cc: Mr. S. D. Ebnetter, Region II Administrator  
Mr. B. L. Siegel, NRR Senior Project Manager  
Mr. T. M. Ross, FNP Resident Inspector

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LICENSEE EVENT REPORT (LER)

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001 AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503

FACILITY NAME (1)

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TITLE (4)

Steam Generator Tube Degradation and Tube Status

Table with columns for EVENT DATE (8), LER NUMBER (6), REPORT DATE (7), and OTHER FACILITIES INVOLVED (8). Includes sub-columns for MONTH, DAY, YEAR and SEQUENTIAL NUMBER, REVISION NUMBER.

Table for regulatory requirements (11) with columns for OPERATING MODE (9), POWER LEVEL (10), and various CFR sections (20.2201(b), 20.2203(a)(1)-(4), 50.38(c)(1)-(2), 50.73(a)(2)(i)-(vii)).

LICENSEE CONTACT FOR THIS LER (12) table with columns for NAME and TELEPHONE NUMBER (AREA CODE).

Table for component failures (13) with columns for CAUSE, SYSTEM, COMPONENT, MANUFACTURER, and REPORTABLE TO NPRDS.

SUPPLEMENTAL REPORT EXPECTED (14) table with YES/NO options and EXPECTED SUBMISSION DATE (15) columns for MONTH, DAY, YEAR.

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-space typewritten lines) (16)

This report is being submitted in accordance with Technical Specification 4.4.6.5.a to report the number of tubes plugged or repaired in each steam generator (S/G), and in accordance with Technical Specification 4.4.6.5.c to report the results of steam generator tube inspections which fall into Category C-3.

During the Unit 1 Thirteenth Refueling Outage (U1RF13), eddy current inspections were performed on one hundred percent of the non-plugged tubes in all three steam generators. As a result of this inspection a total of 328 tubes in service during Cycle Thirteen (3.34 percent of the total number of tubes inspected) were found to be defective, which requires inspection results to be classified as Category C-3. All of the remaining Inconel 600 mechanical plugs (47) were removed and replaced with Inconel 690 mechanical plugs. Following these actions, the equivalent tube plugging percentage of tubes plugged in each steam generator is: 8.10 percent in 1A, 4.92 percent in 1B, and 7.74 percent in 1C. This results in an overall equivalent tube plugging of 6.92 percent.

A section of a tube with a support plate defect was removed from SG 1B for laboratory analysis. In addition to the required tube plugging, several ongoing programs have been established to reduce the probability of future tube degradation.

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TEXT (If more space is required, use additional NRC Form 366) (17)

Plant and System Identification

Westinghouse -- Pressurized Water Reactor

Energy Industry Identification System codes are identified in the text as [XX].

Description of Event

This report is being submitted in accordance with Technical Specification 4.4.6.5.a to report the number of S/G tubes [AB] that have been plugged or repaired, and in accordance with Technical Specification 4.4.6.5.c to report the results of S/G tube inspections which fall into Category C-3.

The S/G tube plugging was completed on October 20, 1995. The results of the S/G inspections were determined to be category C-3 on October 8, 1995.

During U1RF13, all remaining Inconel 600 mechanical plugs (47) were removed and replaced with Inconel 690 mechanical plugs.

Prior to the U1RF13, SNC developed an eddy current inspection plan to inspect all non-plugged tubes in all three S/Gs. The eddy current inspection plan included:

- one hundred percent full length bobbin probe inspection of all tubes (except Row 1 and Row 2 U-bends)
- one hundred percent rotating pancake (RPC) probe inspection of all hot leg roll transitions.
- twenty percent RPC probe inspection of all cold leg roll transitions.
- RPC inspection of all row 1 and row 2 U-bends.
- RPC inspection of all distorted indications.
- Cecco probe inspection of all sleeves.
- RPC inspection of all sludge pile and freespan indications.

In addition, as part of a 2.0 volt voltage repair criteria for tube support plates, an RPC inspection was performed on the following tube support plate bobbin signals: all support plate indications greater than 2.0 volts, all dents greater than 5.0 volts, and support plate residual signals including all greater than 5 volts. In addition, bobbin indications between 1.5 and 2.0 volts in S/G 1C were inspected by RPC to assist in future degradation projections.

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As a result of pit type defective indications identified above the top of the cold leg tubesheet by RPC at a height that makes detection by the bobbin probe difficult, the above the cold leg top of the tubesheet RPC program was expanded in all three S/Gs.

In accordance with the requirements of the tube support plate voltage repair criteria, a tube pull of three tube support plate intersections was performed in S/G 1B. A indication of 4.09 volts by bobbin probe inspection which was characterized as a multiple axial indication by RPC was located at the first tube support. No indications were identified at the second and third tube supports.

The following is a summary of the tube status for each S/G:

	S/G - 1A	S/G - 1B	S/G - 1C
Tubes plugged prior to U1RF13	158	87	120
Sleeved tubes in-service prior to U1RF13	60	37	119
Percent plugging equivalent prior to U1RF13	4.74	2.61	3.70
Tubes determined defective during U1RF13	114	77	137
Tubes returned to service during U1RF13	0	0	0
Total in-service sleeves after U1RF13	67	42	149
Total in-service sleeved tubes after U1RF13	56	37	115
Total plugged tubes after U1RF13	272	*165	257
Percent plugging equivalent after U1RF13	8.10	4.92	7.74

\* One non defective tube was inadvertently plugged on the 1B S/G cold leg. The tube was then plugged on the hot leg.

There were several active degradation mechanisms for the tubes found defective during this inspection. These were: primary water stress corrosion cracking (PWSCC) in the hot leg tubesheet, PWSCC in the Wextex transition zone of the tubesheet, PWSCC in the row 1 U-bends, outer diameter stress corrosion cracking (ODSCC) in the hot leg sludge pile region, ODSCC at the hot leg tube support plates, pitting in the cold leg sludge pile, ODSCC in the hot leg free span, and volumetric type indications in the hot leg sludge pile and hot leg freespan that could not be characterized as either ODSCC or pitting. Table 1, under Additional Information, provides a summary of the tubes with defective indications.

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Tubesheet (below the Wextex transition)

There were 7 tubes with defective indications within the hot leg tubesheet: 2 in S/G 1A and 5 in S/G 1B.

Wextex Transition

There were 46 tubes with defective indications in the hot leg due to degradation related to the Wextex expansion process: 22 in S/G 1A, 8 in S/G 1B, and 16 in S/G 1C. 25 of these tubes had circumferential indications, 14 in S/G 1A, 2 in S/G 1B, and 9 in S/G 1C. Based on an engineering evaluation, five of the tubes with circumferential indications were stabilized on the hot leg: 3 in S/G 1A and 2 in S/G 1C. This area was inspected by a one hundred percent bobbin inspection and on the hot leg by a one hundred percent RPC inspection. On the cold leg a 20 percent RPC inspection was planned. Due to pitting indications just above the tubesheet within the sludge pile, approximately 40 % of the tubes in SG 1A and SG 1B, and 60 % of the tubes in SG 1C were inspected by RPC with no cold leg Wextex transition defective indications identified.

Sludge Pile

There were 212 tubes with defective indications in the hot leg sludge pile area which is generally defined as being above the Wextex transition and extending to 10 inches above the top of the tubesheet. There were 72 defective tubes in S/G 1A, 49 in S/G 1B, and 91 in S/G 1C. These indications were ODSCC or volumetric. There were 17 tubes with defective indications in the cold leg sludge pile area: 3 in S/G 1A, 3 in S/G 1B, and 11 in S/G 1C. All of these indications were pits. 100% of the critical area for cold leg pitting was inspected by RPC in S/G 1C, and approximately 70% of the critical area in S/G 1A and S/G 1B.

Freespan

There were 20 tubes with defective indications in the hot leg free span area which is defined as being above the hot leg sludge pile or between hot leg support plates: 4 in S/G 1A, 8 in S/G 1B, and 8 in S/G 1C. The indications were ODSCC and volumetric.

Tube Support Plates

There were 36 tubes with defective indications identified at hot leg tube support plates: 14 in S/G 1A, 5 in S/G 1B, and 17 in S/G 1C utilizing the 2 volt tube repair criteria.

Row 1 U-bends

There was one tube with a defective indication in a row 1 U-bend in S/G 1B.

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Cause of Event

Investigations and evaluations performed identified several tube defect mechanisms. These were PWSCC in the hot leg tubesheet area, PWSCC in the Wextex transition area, PWSCC in the row 1 U-bends, ODSCC above the top of tubesheet within the hot leg sludge pile area, pitting above the top of the tubesheet within the cold leg sludge pile area, ODSCC at the hot leg tube support plates, ODSCC in the hot leg free span, and volumetric indications in the hot leg sludge pile and hot leg free span area.

A root cause determination of the degradation mechanisms identified above are consistent with those identified in the Draft Revision 4 of the EPRI PWR Steam Generator Tube Examination Guidelines.

Reportability Analysis and Safety Assessment

This event is being reported in accordance with Technical Specifications 4.4.6.5.a and 4.4.6.5.c.

The health and safety of the public was not affected.

Corrective Action

1. A program of boric acid addition is being continued to reduce the potential for ODSCC.
2. A program of morpholine, monoethanolamine (ETA) or other advanced amines, per EPRI guidelines, is being continued to reduce the potential for sludge accumulation. Also, hydrazine addition to reduce Oxygen concentration in the secondary side of the S/Gs has been increased per new EPRI guidelines.
3. The Westinghouse pressure pulse cleaning process has been used in all three S/Gs during several outages to remove contaminants from the crevices between the tubes and support plates. Pressure pulse cleaning was not performed during U1 R13 but is planned for U1 R14.
4. The Westinghouse U-bend heat treat process was performed on all Row 1 and 2 tubes in service during U1RF10 to reduce the potential of U-bend PWSCC.
5. During the Unit 1 Fifth and Sixth Refueling Outages, many of the secondary components containing copper were replaced with components containing stainless steel.

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Additional Information

Similar events were reported in LERs 86-004-00(Unit 2), 87-004-02(Unit 2), 90-005-01(Unit 2), 92-005-00(Unit 1), 93-003-00(Unit 2), 94-002-00(Unit 1), and 95-001-00(Unit 2).

No components failed during this event.

**TABLE 1**  
Summary of Defective Indications for U1 R13

	S/G - 1A	S/G - 1B	S/G - 1C
Number of Tubes Probed, Tech Spec Inspection	3230	3301	3268
Number of Inservice defective tubes as found	114	77	137
Tubes with defective indications in the tubesheet	2	5	0
Tubes with defective indications in the Wextex area	22	8	16
Tubes with defective indications in the sludge pile	75	52	102
Tubes with defective indications in the free span	4	8	8
Tubes with defective indications at support plates	14	5	17
Tubes with defective indications at row 1 U-bends	0	1	0

NOTE: Some tubes have defective indications in more than one area.