Omaha Public Power District

444 South 16th Street Mall
Omaha NE 68102-2247

September 23, 2005
LIC-05-0118

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

Reference: Docket No. 50-285

SUBJECT: Fort Calhoun Station (FCS) Steam Generator Eddy Current Test Report - 2005 Refueling Outage

Pursuant to FCS Unit No. 1 Technical Specification 3.17(5)(ii), Omaha Public Power District (OPPD) submits the attached FCS Steam Generator Eddy Current Test Report, which summarizes testing performed during the Spring 2005 Refueling Outage.

If you have any questions or require additional information, please contact Joe Mathew at (402) 533-6652. No commitments are made to the NRC in this letter.

Sincerely,

H. J. Faulhaber
Division Manager
Nuclear Engineering

HJF/JKM/mle

Attachment: Fort Calhoun Station Steam Generator Eddy Current Test Report, 2005 Refueling Outage

FORT CALHOUN STATION

STEAM GENERATOR EDDY CURRENT TEST REPORT

2005 REFUELING OUTAGE

FORT CALHOUN STATION
STEAM GENERATOR EDDY CURRENT TEST REPORT
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Introduction

This report summarizes steam generator eddy current test results obtained during the Fort Calhoun Station (FCS) 2005 Refueling Outage (RFO). The Omaha Public Power District (OPPD) submitted summaries of results of the two previous eddy current inspections to the NRC in the following documents:

- Fort Calhoun Station (FCS) Steam Generator Eddy Current Test Report - 2002 Refueling Outage, dated December 3, 2002 (LIC-02-0139)
- Fort Calhoun Station (FCS) Steam Generator Eddy Current Test Report - 2003 Refueling Outage, dated March 26, 2004 (LIC-04-0040)

Description of FCS Steam Generators

The OPPD FCS Station is a two-loop Combustion Engineering design nuclear steam supply system (NSSS). Each steam generator contains 5005 vertical tubes fabricated from Alloy 600 material. The tubes are nominally 3/4 inch outside diameter with a nominal tube wall thickness of 0.048 inches, and are installed in the tubesheet in a 1-inch pitch, triangular array. The tube to tubesheet joints are full tubesheet depth explosively expanded and are seal welded at the primary face of the tubesheet. The operating temperature (T_{hot}) is 596°F.

All tube supports in the FCS steam generators are carbon steel material. With the exception of the upper most support, all supports of the vertical tube run are of the eggcrate lattice type with drilled tube hole Drilled Support Plates at the 90 degree and 270 degree orientations. The upper most support at elevation 8 is a partial plate with drilled tube holes. Tube holes in drilled supports are 0.765-inch diameter (nominal) providing a nominal annular clearance around the tubes of 0.0075 inch. Drilled plate support segments include 0.25 inch drilled flow holes nominally in the center of each triangular array of three tubes. Of the 5005 tubes in each steam generator, 975 tubes pass through one or more one-inch thick drilled plate supports. The remainders are supported totally by eggcrate lattice support structures. The eggcrate structures are fabricated from interlocking 0.090-inch thick strips of alternating 2 inch and 1 inch widths. The eggcrate supports provide a robust structure, while at the same time providing an open configuration with minimum flow resistance. Freedom of flow through the area adjacent to the tube increases the flushing capability to reduce potential for deposit loading.

The horizontal sections of the double 90-degree U-bends are supported by three vertical strips welded to diagonal strips, which pass nominally through the center of the 90-degree bends. The vertical and diagonal strip subassemblies serve as spacers between each line of tubes. The vertical and diagonal strips are 0.090 inch thick and 4 inches wide. The vertical strips are connected to three horizontal, structural I-beams, which in turn are connected to the tube bundle shroud. Additionally, 1-inch thick horizontal scalloped bars pass between each row of tubes and interlock with the vertical strips to provide a rigid structure designed to resist postulated accident induced loads.

The FCS steam generators have operated for over 30 years and accumulated 23.33 EFPY by the '05 RFO outage. Before the 2005 RFO, 648 tubes have been plugged or approximately 6.5% of the total number of the original tubes.

Scope of Examination

Westinghouse conducted in-service nondestructive examinations of the steam generator (SG) tubing at Omaha Public Power District's Fort Calhoun Station Nuclear Power Plant in March of 2005. The examinations were performed to assess the condition of the Steam Generators, identify tubes requiring repair, and to provide the necessary information needed to fulfill Technical Specification requirements.

The examination program included multi-frequency bobbin testing for indications of degradation or dents and motorized rotating plus point coil testing for axial and circumferential cracking and further evaluation of detected bobbin indications.

The Eddy Current data was acquired using Westinghouse's ANSER Data acquisition software. The data was reviewed by EPRI Qualified Data Analysts (QDAs) for data quality and converted to Zetec's Eddynet® format for final data analysis.

The converted eddy current data was transmitted from the site by T-1 data lines to the Westinghouse (primary analysis) data room at the Waltz Mill facility in Madison, PA and the ANATEC International (secondary analysis) data room in San Clemente, CA where it was independently analyzed by these two groups of analysts. In addition to the primary and secondary analysis, ANATEC preformed a tertiary analysis on the Bobbin Data by using Computerized Data Screening (CDS). This third analysis was to screen for large indications, which minimizes the possibility of missing a significant flaw due to human error. Analysis results were then transmitted to Fort Calhoun where discrepancies between the production analyses were resolved by two groups of Level III Resolution Analysts representing primary and secondary analysis groups. All data analysts were certified to a minimum of ECT Level IIA, QDA certified (EPRI Qualified Data Analyst). Data Analysts received familiarization training on the Fort Calhoun data during the Data Analyst Indoctrination. The DA Indoctrination included lessons learned from previous exams at Fort Calhoun as well as other relevant industry experience. Optical disks with data from Fort Calhoun, similar CE plants, and Indian Point Unit 2 were also available for review. Data analysts were qualified by a written test and a proficiency examination on Fort Calhoun data and supplementary data from Maine Yankee and Indian Point Unit 2 for damage mechanisms not detected to date at Fort Calhoun.

In addition to OPPD's Steam Generator Program Manager, OPPD was represented by three (3) ECT Level III, two (2) from MoreTech and one (1) from Arizona Public Service. They performed as Independent QDAs (IQDA), who were not part of the Primary, Secondary, or Resolution analysis teams. The number of IQDA's was increased from the two that were used last outage to three to ensure that a rigorous review of the data could be completed in a timely manner These analysts were responsible for review, comments and changes to the Analysis Procedure, and for review of all acquisition and analysis technique sheets. The Independent QDAs reviewed all "I" codes which had been dispositioned to NDD by the Resolution team. They were also responsible for randomly sampling inspection results to ensure proper disposition of resolved indications, to ensure proper reporting, to review repairable indications, and to review and disposition calls which were contested by either the Primary or Secondary analysts. The duties of the Independent QDAs were in accordance with EPRI PWR Steam Generator Examination Guidelines, Revision 6.

In addition to the Eddy Current Data Acquisition and Data Analysis personnel, a Tube Integrity Engineer, a Condition Monitoring Consulting Analyst, a Data Sizing Analyst, and an Independent Technical Reviewer were part of the Steam Generator Inspection Team.

The Inspection Plan listed below was developed from the Degradation Assessment (DA) for the 2005 Outage.

The DA identified the following Existing Degradation Mechanisms at FCS:

- Tube Support Denting (Potential Degradation Precursor)
- Circumferential Outside Diameter Stress Corrosion Cracking (ODSCC) at Drilled Support Plates
- Circumferential ODSCC near Eggcrate / Plate Intersections
- Circumferential ODSCC at Expansion Transitions
- Axial ODSCC at Drilled Support Plate Intersections and Dented Eggcrates
- Axial ODSCC at Free-Span Critical Area
- Axial ODSCC at Free-Span and Undented Eggcrates
- Axial ODSCC at Top of Tubesheet (Sludge Collar)
- Axial Primary Water Stress Corrosion Cracking (PWSCC) at Tube Supports
- Volumetric Indications
- Pitting
- Loose Part Wear / Damage

Potential Degradation Mechanisms include:

- Rows 1 - 4 U-Bend Cracking (ID and OD)
- Axial ODSCC at the 90 Degree Bends
- PWSCC in Tubesheet Expansion Transitions
- Axial and Circumferential ODSCC in Tubesheet Crevices
- Axial and Circumferential PWSCC in the Tubesheet Region of Expanded Tubes
- Mechanical Wear at Tube Supports
- ODSCC at Free Span Dings

Bobbin Probe:

One hundred percent (100%) of all open tubes were tested with a 0.560-inch diameter bobbin probe. Tubes restricted to the 0.560-inch diameter probe were tested from both hot and cold side as far as possible. The restricted region was tested with a plus point probe. If the full length of a tube could not be completely inspected by a combination of the 0.560 bobbin probe and MRPC plus point it would have been plugged. No tubes required plugging for an incomplete inspection. Bobbin testing was conducted to detect Support Denting, Loose Part Wear, Volumetric Indications, Pitting, Axial ODSCC at Non-dented Eggcrates, Free Span, Top of Tubesheet (Sludge Collar), Dings ≤ 5 Volts, Mechanical Wear at Tube Supports and Axial PWSCC at drilled tube supports plates.

Motorized Rotating Probe Coil (Plus Point®):

100% of tubes at the Hot Leg Top of Tubesheet +3"to -12" were tested for; Circ ODSCC, Axial ODSCC, Volumetric, Mechanical Wear from loose parts, Circ PWSCC, and Axial PWSCC

100% of Hot Leg drilled support intersections were tested for: Circ ODSCC, Axial ODSCC, Mechanical Wear from loose parts or support structure and Axial PWSCC.

100% of tubes in the Freespan Critical Area from H5 to DBH were tested for Axial ODSCC, Loose Part Wear.

100% of Hot Leg eggcrate / drilled plate intersections, eggcrate +3" to -6" were tested for freespan Circ ODSCC

100% of Hot Leg eggcrate supports with dents >3 volts were tested for Circ ODSCC, Axial ODSCC, Mechanical Wear from lose parts or support structure and Axial PWSCC.

100% of Vertical Supports V1, V2, V3, and DBH and DBC with dents > 3 volts were tested for Circ ODSCC, Axial ODSCC, Mechanical Wear from support structure and Axial PWSCC.

100% of Hot Leg square bends in Critical Area were tested for Axial ODSCC at 90 degree Bends.

100% of Rows 1-2 U-bends were tested with a high frequency Plus Point for: Circ PWSCC and Axial PWSCC

Rows 1-4 U-bends 77 tubes in SG RC-2A, and 73 tubes in SG RC-2B with medium frequency Plus Point for: Circ ODSCC, Axial ODSCC, and Axial PWSCC to complete 100% inspection in 60 EFPM

100% of Hot Leg Freespan Dings > 5 volts, were tested for: Circ ODSCC, and Axial ODSCC

100% of all Bobbin I-codes were tested for Loose Parts Wear, Volumetric Indications, Pitting, ODSCC at Expansion Transitions, Drilled Plate Supports, Axial ODSCC at Top of Tubesheet (Sludge Collar), Drilled Support Plate Intersections, Dented Eggcrates, Free Span Critical Area, Free Span and Non-dented Eggcrates, and Axial PWSCC at Tube Supports.

20% of indications dispositioned by plus point history for confirmation of the validity of Dispositioned by History (DBH) of bobbin calls that have not changed.

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20% of indications dispositioned by plus point history for confirmation of the validity of Dispositioned by History (DBH) of bobbin calls that have not changed.

Inspection Plan Expansions

1. Expansion of hot leg critical area in SG A due to one indication found in freespan critical area buffer. Twenty-three (23) additional tubes were tested. No additional indications were detected.

2. The H4 tube support plate was one tube line higher than in the NDE plan so a line including 19 tubes was added

Inspection Equipment And Techniques

Westinghouse Electric Company performed the nondestructive examination (NDE) of the steam generator (SG) tubes. The following components are required to perform Eddy Current testing: an Eddy Current tester, a remote positioning device, and an eddy current probe drive control system. The state-of-the-art equipment used at OPPD during the 2003 outage for the Eddy Current Testing (ECT) included the Zetec MIZ-70® digital ECT tester. The Flat Rail GENESIS robot manipulator equipped with the Vision Tube Locating system is used to position the probe at the tubes. Probes are inserted and withdrawn using a Zetec 10D probe pusher equipped with a Westinghouse probe encoders and the Westinghouse Single Probe Pusher Control (SPPC) system. The software that was used for acquisition was the Westinghouse's ANSER Data Acquisition software. The raw data was converted to Zetec's Eddynet98® for data analyst and interpretation.

The ECT probes used included a standard bobbin probe (A560M/ULC), and the beaded combo probe (A560 M/ULC/C) for the full-length and partial length inspections.

The frequencies used for the bobbin examination are as follows:

400 kHz differential and absolute
200 kHz differential and absolute
100 kHz differential and absolute
35 kHz differential and absolute
400/100 kHz differential support ring mix
400/100 kHz absolute support ring mix
400/200/100 kHz differential mix for Tubesheet Expansion Suppression

The primary frequency of 400 kHz satisfies the requirements of the ASME Boiler and Pressure Vessel Code for the examination of nonferromagnetic steam generator tubing. A technique using the differential support mix and a voltage base of 2.75 volts on the 20% OD ASME signal was used to perform dent sizing consistent with current industry techniques. The 100 kHz is provided for the confirmation of flaw indications and as a frequency used in the mixes to eliminate support and OD deposit signals. The 100 kHz absolute detects gradual wall thickness variations. The 200 kHz frequency is for confirmation of flaw indications. The 35 kHz is provided to facilitate locating the probe position in the steam generator. The 400/100 kHz differential mix is used to eliminate the tube support signal and OD tube deposits. The 400/100 absolute mix is used to detect gradual wall loss. Bobbin exams were conducted to conform to EPRI Rev. 6 Appendix H; ETSS #s 96008.1 Rev. 13, 96005.2 Rev. 8, 96012.1 Rev.9, 96004.1 Rev.9, and Westinghouse document # SG-99-03-005. The

400/200/100 differential mix for Tubesheet Expansion Suppression is used to screen the cold leg tubesheet interface for loose part damage.

Three coil motorized rotating coils were used at the hot leg top-of-tubesheet and to investigate bobbin indications. Various versions of the rotating coil probe were used to inspect the vertical runs, horizontal runs, and square bend sections as required. Low row U-bends were also inspected with rotating coil technology.

Top-of Tubesheet exams were conducted to conform to EPRI Rev. 6 Appendix H ETSS #s 21409.1 Rev.2, 21410.1 Rev.3, 20510.1 Rev.4, and 20511.1 Rev. 6 The frequencies used for the 3 coil (P115A, PP11A, P080B), top-of-tubesheet examination are as follows:

700 kHz High-Freq. Pancake coil
400 kHz Pancake, Mid-Freq. Plus PT. coil, and High-Freq. Pancake coil
300 kHz Pancake, and Mid-Freq. Plus PT. coil
100 kHz Pancake, and Mid-Freq. Plus PT. coil
20 kHz Pancake, and Mid-Freq. Plus PT. coil

Plus point exams were conducted to conform to EPRI Rev. 6 Appendix H ETSS #s 21409.1 Rev.2, 21998.1 Rev. 2, 22841.3 Rev. 3, 22842.3 Rev. 3 and 96703.1 Rev. 13. The frequencies for the 2 coil (2-PP11A) modular probe were as follows:

400 kHz High-Freq. Plus PT. coil
300 kHz High-Freq. Plus PT. coil
100 kHz High-Freq. Plus PT. coil
20 kHz High-Freq. Plus PT. coil

Plus point exams were conducted to conform to EPRI Rev. 6 Appendix H ETSS #s 21409.1 Rev.2, 21998.1 Rev. 2, 22841.3 Rev. 3, 22842.3 Rev. 3 and 96703.1 Rev. 13. The frequencies for the 2 coil (P115A, PP11A) Flex probe MRPC examinations were as follows:

400 kHz Pancake, and Mid-Freq. Plus PT. coil
300 kHz Pancake, and Mid-Freq. Plus PT. Coil
200 kHz Pancake, and Mid-Freq. Plus PT. coil
100 kHz Pancake, and Mid-Freq. Plus PT. coil
20 kHz Pancake, and Mid-Freq. Plus PT. Coil

Plus point exams were conducted to conform to EPRI Rev. 6 Appendix H ETSS #s 96511.1, 96511.2 Rev. 13. The frequencies used for the single coil (PP11A) mid-frequency U-bend examinations were as follows:

400 kHz Mid-Freq. Plus PT. coil
300 kHz Mid-Freq. Plus PT. coil
200 kHz Mid-Freq. Plus PT. coil
100 kHz Mid-Freq. Plus PT. coil

20 kHz Mid-Freq. Plus PT. coil

Plus point exams were conducted to conform to EPRI Rev. 6 Appendix H ETSS # 99997.1 Rev. 7. The frequencies used for the single coil (PP9A) high frequency U-bend examinations were as follows:

800 kHz High-Freq. Plus PT. coil
600 kHz High-Freq. Plus PT. coil
400 kHz High-Freq. Plus PT. coil
300 kHz High-Freq. Plus PT. coil

The recorded multi-frequency eddy current data is analyzed by two independent teams of data analysts for the presence of flaw indications and dents. Discrepancies between the two sets of evaluation results are reviewed and dispositioned by the resolution analysts. Primary and Secondary analyst feedback was accomplished through the use of the Analyst Performance Tracking Software. The primary and secondary analysts were required to review all missed calls and a sample of overcalls. If there were any calls which were dispositioned as requiring no further action by the resolution team, which the primary or secondary analyst felt should have remained, that analyst could appeal the call and the appeal was then assigned to the independent Level III QDA for final disposition.

The bobbin probe is used primarily as a screening tool to flag indications for further evaluation by means of historical reviews and/or additional testing with rotating coil technology. All of the data for all examined regions was analyzed. Indications left in service have been determined to be either non-reportable or manufacturing related through the use of diagnostic testing and historical reviews. Indications were not left in service based on depth sizing estimates.

Bobbin testing was performed mainly from the outlet side of each S/G. Bobbin test speeds ranged from 12" to 36" per second and varied depending on presence of dents or low row diameter restrictions. Bobbin test sampling rates were within the requirements of the EPRI Appendix H approved techniques. The .560 diameter probe was used on all open tubes. Some tubes could not be test full length with the bobbin coil because of restrictions (dents). Any tube with a restriction was tested to the extent possible from both, outlet and inlet sides, any area that could not pass the bobbin coil was tested with Plus Point MRPC probe.

MRPC test speeds also varied depending on test location and probe type. Test speeds were from .1" to .7" per second axially with the sampling rate adjusted in accordance with EPRI Appendix H Qualified Techniques as detailed in analysis procedure.

Inspection Results

As a result of the inspection, several conclusions can be derived as follows:

Single Axial Indications (SAI) and *Multiple Axial Indications* (MAI) are linear indications that are parallel to the length of the tube or axially oriented. There were 109 SAI (52 in S/G RC-2A & 57 in S/G RC-2 B) and 3 MAI (all MAI's were in S/G A) for a total of 112 Axial indications. These indications were reported by the data analyst at various elevations of both steam generators. Fiftythree (53) of the Indications were "freespan" (FS) or between supports, 23 indications were at Drilled Support Plates (DSP), 13 indications were at Eggcrate (EC) supports structures and 23 indications were within 2 inches of the top of the hot leg tubesheet (HTS). The majority of the indications reside between H5 and H8 in the critical area where the partial tube support plates are superpositioned. Fifteen (15) indications were greater than 40% (as sized by plus point amplitude). Of these 8 were detected by the bobbin coil. A majority of the indications (89 of 112) were transparent to the bobbin coil and were detected with the more sensitive rotating plus point coil. The deepest indication, which was not detected by the bobbin coil, was 50% (as sized by plus point amplitude). Historical data reviews from the RFO-03 inspection were conducted by the senior analyst during the course of the RFO-05 examination. Of the 112 indications, all were reviewed to determine whether the flaw was present and if so, did it appear to grow. Fifty-seven (57) indications showed no growth, 37 showed growth, 9 showed marginal growths. The remaining 9 indications were detected by the bobbin coil and sized by the plus point coil. They were not reviewed because that area of the tube had not been tested by plus point in 2002 or 2003. The number of indications reported in documents, like the Condition Monitoring Assessment (report # SG-SGDA-05-11) and Operational Assessment for Cycle 23 (report # SG-SGDA-05-26), were adjusted; if the ECT graphics indicated that indications were close together axially and co-linear, then they were considered one indication with a size that enveloped the multiple ECT indications.

Single Circumferential Indications (SCI's) are linear indications perpendicular to the length of the tube or circumferentially oriented. Fourteen (14) SCI indications were reported, (12 in S/G RC-2A & 2 in S/G RC-2B) 12 of the indications were ODSCC and 2 were PWSCC. Five (5) of the indications were at the top of the hot leg tubesheet (HTS), 4 were in S/G RC-2A and 1 indication in S/G RC-2B, of the 4 in S/G RC-2A, 2 were PWSCC. One (1) indication in S/G RC-2A just above the 6th support was considered freespan because it is not encompassed by a support structure. This tube was in the Drilled/Eggcrate support Overlap critical area. The remaining indications were at various hot leg drilled support plates. Several circumferential indications at drilled support plates appeared to be a series of parallel circumferential cracks over an axial distance nearly the length of the support thickness. The maximum circumferential extent of the HTS indications was 67 degrees for the ODSCC indications and 31 degrees for the PWSCC. The maximum indicated depth by plus point phase analysis for the HTS indications was 57% through-wall for the ODSCC and 65% for the PWSCC. The maximum circumferential extent of the drilled support plate indications was 129 degrees and the maximum indicated depth by plus point phase analysis was 85% through-wall. The 1 freespan indication had a circumferential extent of 46 degrees and a max depth of 49%. Of the 8 SCI indications reported at drilled supports, 4 are associated with a dent from the bobbin coil. The dent voltages range from 10.49 volts to 32.54 volts. Nine (9) of the indications show growth from the last cycle, 1 showed marginal growth, and 4 showed no growth.

Single Volumetric Indications (SVI) are band or patch like indications. Two (2) SVI's were reported (1 in S/G RC-2 A and 1 in S/G RC-2 B). Both indications were at eggcrate supports and showed no change from 2003 data. The indication in S/G A was located at the first cold leg support structure on a peripheral tube and is presumed to be wear. The indication in S/G B was located at the 7th hot leg support structure. This is the region where axial ODSCC occurs and the damage mechanism, which produced the ECT indications, is presumed to be a patch of inter-granular attack (IGA)

Circumferential Volumetric Indication (CVI) A circumferential band of wall loss, which occurs at the cold-leg tube sheet expansion transition. Four (4) tubes were reported with CVI indications (2 in S/G RC-2 A and 2 in S/G RC-2 B). The degradation mode is believed to be pitting.
Noisy Tube (NSY): Any undesired signal or signals that may obscure for interpretation those signals that are of interest. Two (2) tubes in S/G RC-2A were plugged because the tube noise was identified as a potential concern for masking critical flaws.

All indications were compared to the respective structural integrity and leakage limits defined in the degradation assessment. All indications were significantly below the limits demonstrating that the condition monitoring limits are satisfied. Based on the NDE inspection results, all tubes in Steam Generators RC-2A and RC-2B met the tube structural and leakage integrity requirements of NEI 97-06 during Cycle 22

All of the tubes with the above indications were repaired by plugging. A total of 52 tubes were plugged in S/G RC-2A and 51 tubes were plugged in S/G RC-2B with indications, there were 2 tubes preventively plugged in S/G RC-2A because of noisy areas that may mask a critical size flaw. A total of 105 tubes were plugged this outage 54 in S/G RC-2A and 51 in S/G RC-2B.

Table 1

Steam Generator										
Indication Listing by Location										
	S/G A					S/G B				
Location	SAI / MAI	SCI	SVI	CVI	NSY	SAI	SCI	SVI	CVI	Totals
HTS	8	4			1	12	1			26
HTS+						3				3
H1	7	1				6				14
H1+										
H2	1					3				4
H2+										
H3	2					4				6
H3+						1				1
H4						4				4
H4+										
H5	2					2				4
H5+	1					3				4
H6	4 / 1	4				5				14
H6+	10	1				6				17
H7	3	1				2		1		7
H7+	13 / 2					2				17
H8	1	1				3	1			6
H8+						1				1
DBH										
DBH+										
V1										
V1+										
V2										
V2+										
V3										
V3+										
DBC										
DBC-										
C8+										
C8										
C7+										
C7										
C6+										
C6										
C5+					1					1
C5										
C4+										
C4										
C3+										
C3										
C2+										
C2										
C1+										
C1			1							1
CTS+										
CTS				2					2	4
TOTALS	52 / 3	12	1	2	2	57	2	1	2	134
	SAI / MAI	SCI	SVI	CVI	NSY	SAI	SCI	SVI	CVI	

Table 2

Spring 2005 Outage S/G RC-2A

	Row	Line	2005 Bobbin call P1 Call	2005 MRPC call	Volts	Deg	%	Circ. Deg	Axial	Layers	Dent	Critical Area	Sup	2003 MRPC/ Change
1	**84**	**27**	**TBP**	**NSY HTS +.76**	1.86					no	no	no	HTS	
2	**24**	**39**	**DSI 1.53V 96D H1-0.67**	**SAI H1 -0.81**	1.16	96	63	n/a	0.45	no	no	no	EC	no test
3	**32**	**41**		**SAI H6 +0.73**	0.42	108	41	n/a	0.2	no	10.8v	no	EC	Yes
4	**89**	**46**	**DFI 0.72 88D H7 +1.59**	**SAI H7 +1.53**	0.23	72	29	n/a	0.32	no	no	yes	DSP	Yes
5	**92**	**51**	**Delta Coil Confirmed**	**SCI H6 +2.97**	0.24	107	49	46	n/a	yes	no	yes	FS	Yes
6	**98**	**51**		**SAI H2 +1.38**	0.21	112	26	n/a	0.48	no	no	yes	DSP	No
7	**87**	**52**		**SAI H7 -0.30**	0.49	107	29	n/a	0.32	no	30.8v	yes	DSP	No
8	**28**	**53**		**SAI HTS +1.17**	0.15	102	25	n/a	0.22	no	no	no	HTS	Yes
	28	**53**		**SAI HTS +1.42**	0.2	77	26	n/a	0.16	no	no	no	HTS	No
	28	**53**		**SAI HTS +1.57**	0.33	108	33	n/a	0.22	no	no	no	HTS	No
9	**94**	**53**		**SAI H6 +21.15**	0.19	107	27	n/a	0.29	no	no	yes	FS	no
	94	**53**		**SAI H6 +21.97**	0.23	102	30	n/a	0.2	no	no	yes	FS	no
	94	**53**		**SAI H7 +14.92**	0.26	103	32	n/a	0.35	no	no	yes	FS	yes
10	**96**	**53**		**SAI H7 +11.10**	0.13	109	24	n/a	0.34	no	no	yes	FS	yes
11	**89**	**54**		**SAI H7 +11.87**	0.3	106	32	n/a	0.28	no	no	yes	FS	yes
	89	**54**		**SAI H7 +13.98**	0.23	112	29	n/a	0.3	no	no	yes	FS	yes
12	**91**	**54**		**SAI H7 +1.15**	0.13	104	24	n/a	0.51	no	15.32v	yes	FS	yes
	91	**54**		**SAI H7 +6.77**	0.18	94	27	n/a	0.39	no	no	yes	FS	yes
13	**86**	**55**		**SCI H8 -0.03**	0.3	82	85	77	n/a	yes	21.1v	yes	DSP	marginal
14	**88**	**55**		**SAI H6 +1.07**	0.34	97	33	n/a	0.54	no	12.73v	yes	FS	yes
15	**98**	**55**		**MAI H7 +15.15**	0.57	115	45	n/a	0.7	no	no	yes	FS	marginal
	98	**55**		**SAI H6 +19.05**	0.19	93	29	n/a	0.39	no	no	yes	FS	yes
	98	**55**		**SAI H7 +10.14**	0.17	115	27	n/a	0.36	no	no	yes	FS	no
	98	**55**		**SAI H7 +9.12**	0.15	110	26	n/a	0.86	no	no	yes	FS	no
16	**24**	**57**	**DFI 0.27V 114D HTS+0.6**	**SAI HTS +0.70**	0.29	103	31	n/a	0.28	no	no	No	HTS	marginal
17	**98**	**57**		**SAI H6 +21.15**	0.61	81	50	n/a	0.69	no	no	yes	FS	yes
	98	**57**	**DFI 0.73V 114D**	**SAI H7 +14.98**	0.25	111	33	n/a	0.98	no	no	yes	FS	yes

Table 2

Spring 2005 Outage

S/G RC-2A

	Row	Line	2005 Bobbin call P1 Call	2005 MRPC call	Volts	Deg	%	Circ. Deg	Axial	Layers	Dent	Critical Area	Sup	2003 MRPC/ Change
			H6+21.18											
18	**103**	**58**	**DSI 0.36V 65D H1+0.17**	**SAI H1 +0.00**	0.2	103	27	n/a	0.59	no	no	no	DSP	yes
19	**70**	**59**	**DSI 1.00V 100D H1+0.96**	**SAI H1+0.88**	0.44	107	35	n/a	0.48	no	no	no	EC	no test
20	**11**	**62**		**SAI HTS +0.39**	0.19	86	27	n/a	0.16	no	no	no	HTS	no
21	**89**	**62**		**SAI H6 +6.66**	0.2	101	30	n/a	0.95	no	no	yes	FS	no
	89	**62**	**DFI 0.54V 58D**	**SAI H6 +8.00**	0.34	86	39	n/a	0.95	no	no	yes	FS	no
	89	**62**	**DFI H6+1.00 to 9.11**	**SAI H6 +9.33**	0.25	95	33	n/a	0.73	no	no	yes	FS	no
22	**93**	**62**		**MAI H7 +2.41**	0.34	103	38	n/a	1.57	no	no	yes	FS	yes
23	**97**	**62**		**SAI H7 +10.24**	0.16	105	25	n/a	0.47	no	no	yes	FS	no
	97	**62**		**SAI H7 +11.00**	0.17	111	26	n/a	0.57	no	no	yes	FS	no
	97	**62**		**SAI H7 +12.18**	0.14	91	24	n/a	0.17	no	no	yes	FS	no
24	**82**	**63**		**SAI H1 +0.02**	0.21	97	28	n/a	0.29	no	no	no	DSP	no
25	**86**	**63**		**SAI H6 +1.39**	0.35	100	27	n/a	0.32	no	no	yes	FS	yes
26	**88**	**63**		**SAI H6 +9.41**	0.19	98	26	n/a	0.47	no	no	yes	FS	no
27	**89**	**64**	DFI 0.67V 67D H6+2.46	**SAI H6 +2.22**	0.22	107	28	n/a	0.44	no	no	yes	FS	no
28	**32**	**65**		**MAI H6 +0.50**	0.82	116	49	n/a	0.19	no	5.2v	no	EC	no
29	**86**	**65**		**SAI H6 +1.41**	0.2	94	21	n/a	0.23	no	38.18v	yes	FS	no
	86	**65**	DFI 0.39V 52D H6+9.19	**SAI H6 +9.19**	0.28	106	27	n/a	0.53	no	no	yes	FS	no
30	**75**	**66**		**SAI H5 +32.57**	0.16	93	28	n/a	0.74	no	no	yes	FS	no
31	**89**	**66**		**SAI H3 +0.17**	0.14	110	23	n/a	0.26	no	no	no	DSP	no
32	**91**	**66**		**SAI H7 +4.11**	0.12	92	21	n/a	0.45	no	no	yes	FS	yes
33	**14**	**67**		**SCI HTS +0.14**	0.18	81	57	67	n/a	no	no	no	HTS	no
34	**32**	**67**	DEI 2.57V 91D CTS+0.33	**CVI CTS +0.02**	0.19	95	29	154	0.29	no	no	no	CTS	no test
35	**102**	**67**		**SCI H6 +0.23**	0.41	118	40	129	n/a	yes	no	yes	DSP	no
36	**91**	**68**		**SAI H5 +0.22**	0.26	101	33	n/a	0.58	no	no	yes	DSP	marginal

Table 2

Spring 2005 Outage

S/G RC-2A

	Row	Line	2005 Bobbin call P1 Call	2005 MRPC call	Volts	Deg	%	Circ. Deg	Axial	Layers	Dent	Critical Area	Sup	2003 MRPC/ Change
	91	**68**		**SAI H7 +15.52**	0.18	104	28	n/a	0.62	no	no	yes	FS	yes
37	**101**	**68**		**SCI H7 +0.29**	0.36	105	53	114	n/a	yes	no	yes	DSP	yes
38	**36**	**69**	DEI 6.64V 89D CTS+0.10	**CVI CTS +0.03**	0.28	86	34	307	0.22	no	no	no	CTS	no test
39	**25**	**70**		**SAI HTS +0.85**	0.14	107	23	n/a	0.34	no	no	no	HTS	marginal
40	**88**	**71**		**SAI H5 +0.81**	0.28	103	27	n/a	0.4	no	5.22v	yes	FS	no
41	**100**	**71**		**SCI H6 +0.22**	0.36	123	21	97	n/a	yes	no	yes	DSP	no
42	**93**	**72**		**SAI H8 -0.65**	0.58	103	44	n/a	0.43	no	29.9v	yes	DSP	no
	93	**72**		**SCI H6 -0.04**	0.89	118	37	32	n/a	yes	29.2v	yes	DSP	no
43	**96**	**73**		**SAI H3 +0.05**	0.14	101	24	n/a	0.23	no	no	no	DSP	no
44	**45**	**74**	TBP	**NSY C5 +19.05**	10.1					no	no	no	FS	
45	**101**	**74**		**SCI H6 +1.84**	0.32	115	38	90	n/a	no	no	yes	DSP	yes
46	**92**	**81**		**SCI H1 +1.69**	0.28	97	62	27	n/a	no	32.5v	yes	DSP	yes
47	**71**	**82**	DSI 0.68V 107D H1+0.47	**SAI H1 +0.37**	0.44	93	36	n/a	0.29	no	no	no	EC	yes
48	**23**	**84**		**SAI HTS +0.68**	0.18	82	27	n/a	0.12	no	no	no	HTS	no
	23	**84**		**SAI HTS +0.79**	0.21	88	30	n/a	0.21	no	no	no	HTS	no
49	**10**	**89**		**SCI HTS +0.10**	0.19	100	57	44	n/a	no	no	no	HTS	
50	**14**	**99**	DSI 0.57V 69D H1-0.53	**SAI H1 -0.63**	0.3	101	31	n/a	0.38	no	no	no	EC	
51	**18**	**101**		**SCI HTS -0.07 ID**	0.46	22	53	31	n/a	no	no	no	HTS	yes
52	**27**	**104**		**SCI HTS -0.11 ID**	0.68	24	65	27	n/a	no	no	no	HTS	yes
53	**6**	**107**	DSI 1.31V 118D H1+0.91	**SAI H1 +0.87**	0.29	63	31	n/a	0.26	no	no	no	EC	no test
54	**6**	**125**	DSI 1.32V 105D C1+0.00	**SVI C1 -0.12**	0.92	75	55	83	0.5	no	no	no	EC	no

Table 3

Spring 2005 Outage S/G RC-2B

	Row	Line	2005 Bobbin call P1 Call	2005 MRPC call	Volts	Deg	%	Circ. Deg	Axial	Layers	Dent	Critical Area	Sup	2003 MRPC/ Change
1	**71**	**22**	DSI 0.66V 90D H3+0.29	**SAI H3 +0.40**	0.54	85	44	n/a	0.48	no	no	no	EC	no test
2	**64**	**23**		**SCI HTS +0.13**	0.34	117	35	53	n/a	no	no	no	HTS	yes
3	**67**	**24**	DSI 1.12V 122D H1-0.53	**SAI H1 -0.64**	0.68	95	48	n/a	0.63	no	no	no	EC	yes
4	**78**	**27**		**SAI H3 +3.04**	0.28	108	33	n/a	0.39	no	no	no	FS	yes
5	**76**	**35**	Retest Delta Coil	**SCI H8 -0.19**	0.42	112	28	94	n/a	yes	no	no	DSP	yes
6	**92**	**43**		**SAI H8 +0.09**	0.14	93	28	n/a	0.38	no	no	yes	DSP	marginal
7	**92**	**49**		**SAI H7 +8.67**	0.27	98	36	n/a	0.63	no	no	yes	FS	yes
8	**100**	**49**		**SAI H3 +0.04**	0.18	82	27	n/a	0.2	no	no	no	DSP	yes
9	**91**	**50**		**SAI H3 +0.14**	0.27	108	34	n/a	0.35	no	no	no	DSP	no
10	**97**	**52**		**SAI H1 +0.19**	0.19	96	28	n/a	0.29	no	no	no	DSP	no
11	**96**	**53**		**SAI H6 +14.77**	0.12	97	21	n/a	0.39	no	no	yes	FS	no
	96	**53**		**SAI H6 +15.33**	0.1	97	20	n/a	0.21	no	no	yes	FS	no
12	**93**	**54**		**SAI H8 -0.02**	0.22	63	21	n/a	0.29	no	16.8v	yes	DSP	no
13	**80**	**55**	DSI 1.68V 81D H1+0.83	**SAI H1 +0.91**	0.74	116	51	n/a	0.57	no	no	no	EC	no test
14	**98**	**55**		**SAI H6 +11.13**	0.21	113	25	n/a	0.39	no	no	yes	FS	no
15	**95**	**56**		**SAI H6 +0.83**	0.17	108	26	n/a	0.34	no	no	yes	FS	yes
16	**16**	**57**	DFI 0.81V 99D HTS+0.58	**SAI HTS +0.69**	0.18	76	25	n/a	0.16	no	no	no	HTS	no
17	**100**	**57**		**SAI H5 +0.08**	0.24	105	30	n/a	0.37	no	no	yes	DSP	no
18	**18**	**59**	DFI 0.67V 127D HTS+1.26	**SAI HTS +0.47**	0.22	85	27	n/a	0.26	no	no	no	HTS	no
19	**22**	**59**		**SAI HTS +0.85**	0.2	81	26	n/a	0.19	no	no	no	HTS	no
20	**23**	**60**		**SAI HTS +1.55**	0.26	101	33	n/a	0.2	no	no	no	HTS	no
21	**85**	**60**		**SAI H6 +0.76**	0.31	98	34	n/a	0.5	no	no	yes	FS	marginal
	85	**60**		**SAI H6 -2.39**	0.16	105	28	n/a	0.16	no	no	yes	FS	yes
22	**95**	**60**		**SAI H4 +0.91**	0.23	96	28	n/a	0.22	no	11.36v	no	FS	no
	95	**60**		**SAI H6 +2.02**	0.18	114	27	n/a	0.29	no	no	yes	FS	no

Table 3

Spring 2005 Outage S/G RC-2B

	Row	Line	2005 Bobbin call P1 Call	2005 MRPC call	Volts	Deg	%	Circ. Deg	Axial	Layers	Dent	Critical Area	Sup	2003 MRPC/ Change
23	**80**	**61**	DSI 0.63V 110D H1+0.24	**SAI H1 +0.22**	0.16	110	30	n/a	0.22	no	no	no	DSP	yes
	80	**61**		**SAI H1 -0.22**	0.27	114	35	n/a	0.46	no	no	no	DSP	no
	80	**61**		**SAI H2 -0.06**	0.26	101	34	n/a	0.52	no	no	no	DSP	no
24	**82**	**61**		**SAI H6 +1.16**	0.53	115	43	n/a	0.72	no	11.30v	yes	FS	no
25	**92**	**61**		**SAI H6 +1.42**	0.18	104	28	n/a	0.15	no	no	yes	FS	yes
	92	**61**		**SAI H7 +1.55**	0.16	107	25	n/a	0.22	no	no	yes	FS	yes
26	**96**	**61**		**SAI H5 +33.77**	0.14	83	25	n/a	0.24	no	no	yes	FS	no
27	**101**	**62**		**SAI H5 +13.23**	0.19	101	29	n/a	0.31	no	no	yes	FS	yes
28	**30**	**63**	DEI 3.58V 118D CTS-0.36	**CVI CTS +0.04**	0.2	108	27	240	0.29	no	no	no	CTS	no test
29	**92**	**63**		**SAI H3 +0.07**	0.24	104	32	n/a	0.24	no	no	no	DSP	yes
	92	**63**		**SAI H4 +0.81**	0.43	120	44	n/a	0.4	no	no	no	FS	marginal
30	**89**	**64**		**SAI H7 +0.12**	0.17	105	27	n/a	0.25	no	no	yes	DSP	yes
	89	**64**		**SAI H6 +0.99**	0.13	88	25	n/a	0.22	no	no	yes	FS	yes
31	**78**	**65**		**SAI H4 -0.09**	0.14	101	24	n/a	0.19	no	no	no	DSP	no
32	**98**	**65**		**SAI H6 +17.03**	0.34	84	38	n/a	0.58	no	no	yes	FS	yes
33	**15**	**66**		**SAI HTS +0.71**	0.37	91	38	n/a	0.22	no	no	no	HTS	no
	15	**66**	DFI 1.11V 131D HTS+0.88	**SAI HTS +0.72**	0.41	102	41	n/a	0.41	no	no	no	HTS	no
34	**19**	**66**		**SAI HTS +0.97**	0.19	92	25	n/a	0.22	no	no	no	HTS	no
	19	**66**		**SAI HTS +1.13**	0.16	111	24	n/a	0.22	no	no	no	HTS	no
35	**97**	**66**		**SAI H6 +21.42**	0.18	109	27	n/a	0.47	no	no	yes	FS	no
36	**18**	**67**		**SAI HTS +0.90**	0.19	106	26	n/a	0.16	no	no	no	HTS	marginal
37	**31**	**68**	DEI 5.94V 98D CTS+0.10	**CVI CTS +0.15**	0.3	82	32	214	0.25	no	no	no	CTS	no test
38	**16**	**69**		**SAI HTS +0.83**	0.21	56	29	n/a	0.16	no	no	no	HTS	no
39	**18**	**69**		**SAI HTS +0.53**	0.24	93	29	n/a	0.2	no	no	no	HTS	no

Table 3

Spring 2005 Outage

S/G RC-2B

	Row	Line	2005 Bobbin call P1 Call	2005 MRPC call	Volts	Deg	%	Circ. Deg	Axial	Layers	Dent	Critical Area	Sup	2003 MRPC/ Change
	18	**69**		**SAI HTS +0.72**	0.15	99	24	n/a	0.2	no	no	no	HTS	no
40	**94**	**69**		**SAI H8 +0.17**	0.22	108	31	n/a	0.31	no	no	yes	DSP	yes
41	**11**	**70**		**SAI HTS +0.48**	0.23	102	29	n/a	0.23	no	no	no	HTS	no
42	**41**	**70**		**SAI H5 +1.55**	0.34	121	33	n/a	0.44	no	no	no	FS	yes
43	**99**	**70**		**SAI H8 +2.05**	0.19	117	27	n/a	0.32	no	no	yes	FS	yes
44	**95**	**72**		**SAI H7 +14.45**	0.15	91	26	n/a	0.46	no	no	yes	FS	no
45	**11**	**74**		**SAI HTS +0.22**	0.17	111	25	n/a	0.23	no	no	no	HTS	yes
46	**77**	**74**		**SAI H4 +0.19**	0.29	130	30	n/a	0.49	no	no	yes	DSP	no
47	**76**	**75**		**SVI H7 -0.33**	0.38	80	12	55	0.43	no	no	yes	EC	no
48	**33**	**78**		**SAI HTS +1.93**	0.37	107	38	n/a	0.36	no	no	no	HTS	marginal
49	**62**	**81**	DSI 2.41V 112D H2+0.86	**SAI H2 +0.82**	1.08	99	59	n/a	0.42	no	no	no	EC	no test
50	**62**	**89**	DSI 1.58V 80D H1-0.89	**SAI H1 -0.84**	0.65	80	48	n/a	0.48	no	no	no	EC	no test
51	**57**	**108**	DSI 1.56V 68D H2+0.19	**SAI H2 +0.22**	0.62	91	47	n/a	0.39	no	no	no	EC	no test

APPENDIX

DEFINITIONS

The acronyms defined below are used in Tables 1 through 3.

CVI: Circumferential Volumetric Indication

DEI: Distorted Expansion Indication

DFI: Differential Freespan Indication – An indication in the freespan that gives a flaw-like response on the bobbin coil (diagnostic/review required)

DSI: Distorted Support Indication (diagnostic/review required)

DSP: Drilled Support Plate

EC: Egg Crate

FS: Free Span

INR: Indication not reportable (diagnostic/review required)

MAI: Multiple Axial Indication – Axial indications in the same plane (pluggable)

NDD: No detectable degradation (no further action required)

NSY: Noisy Tube

SAI: Single Axial Indication – Axially oriented crack-like indication (pluggable)

SCI: Single Circumferential Indication – Circumferentially oriented crack-like indication (pluggable)

SVI: Single Volumetric Indication – Indication which represents that volumetric (non-oriented) degradation is present (pluggable)

TBP: To be plugged

VOL: Volumetric – Indication which is volumetric in nature and generally associated with tube manufacturing (diagnostic/review required)

FORT CALHOUN
STEAM GENERATOR ELEVATION DRAWING

HTE Hot leg Tube End
HTS Hot Leg Tubesheet
H1-H6 Hot Leg Full Supports
H7 Hot Leg Partial Egg Crate
H8 Hot Leg Partial Drilled Support
DBH Diagonal Bar Hot Leg

V1-V3 Vertical Supports

DBC Diagonal Bar Cold Leg
C8 Cold Leg Partial Drilled Support
C7 Cold Leg Partial Egg Crate
C6-C1 Cold Leg Full Supports
CTS Cold Leg Tubesheet
CTE Cold leg Tube End