VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

February 23, 2004

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Serial No.: 03-622
NLOS/MM
Docket Nos.: 50-280
50-281
License Nos.: DPR-32
DPR-37

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
SURRY POWER STATION UNITS 1 AND 2
ANNUAL STEAM GENERATOR INSERVICE INSPECTION SUMMARY REPORT

Pursuant to Technical Specification 4.19.F.b for Surry Power Station Units 1 and 2, Dominion is submitting the results of the steam generator tube inservice inspections performed during 2003. The steam generator tube inspections conducted on Surry Unit 1 "B" steam generator and limited inspections that were performed on Surry Unit 1 "C" steam generator are included in Attachment 1. Steam generator tube inspections performed on Surry Unit 2 "B" steam generator are included in Attachment 2.

This letter does not establish any new commitments. Should you have any questions or require additional information, please contact Mr. Gary Miller at (804) 273-2771.

Very truly yours,

C. L. Funderburk, Director
Nuclear Licensing and Operations Support
Dominion Resources Services, Inc.
for Virginia Electric and Power Company

Attachments

A047

cc: U. S. Nuclear Regulatory Commission
Region II
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW, Suite 23T85
Atlanta, GA 30303-8931

Mr. S. R. Monarque
NRC Project Manager
U. S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Mail Stop 8-H12
Rockville, MD 20852

Mr. G. J. McCoy
NRC Senior Resident Inspector
Surry Power Station

Attachment 1

Annual Steam Generator Inservice Inspection Summary Report

Virginia Electric and Power Company (Dominion)

Surry Power Station Unit 1

Virginia Electric and Power Company (Dominion)
Surry Unit 1
Annual Steam Generator Report

Station	Unit	Outage Date	Generator Examined			Date of Report
Surry	1	April, 2003		B	C	October 20, 2003

SG Design Information						
SG Model	TSP Type.	TSP Mat'l	# TSP	Baffle Mat'l	AVB Mat'l	# AVB
51F	Quatrefoil	Type 405 SS	7	Type 405 SS	Chrome Plated IN-600	2
# Tubes	Tube Dia.	Tube Mat'l	Tube Pitch	Tube Tks	Expansion	Heat X-fer Area
3342	0.875"	Alloy 600TT	1.281"	0.050"	Full Hydraulic	51,500 sq. ft.

Scope of Inspection					
SG	Inspection Program	Planned	Inspected	Inspection Method	Extent
B	Bobbin	3328	3328	Bobbin	TSH-TSC
B	Row 1 U-Bend RC	90	90	+U-Bend Point RC	7H – 7C
B	TTS Hot leg RC	678	678	+ Point RC	TSH +/- 3"
C	Special Interest Bobbin	NA	17	Bobbin	1H-TEH
C	Special Interest Bobbin	NA	3	Bobbin	BPH-TEH
C	Special Interest Bobbin	NA	20	Bobbin	1C-TEC
C	HL Special Interest RC	NA	2	+Point RC	1H - TSH
C	HL Special Interest RC	NA	3	+Point RC	BPH - TSH
C	CL Special Interest RC	NA	2	+Point RC	1C - TSC
C	CL Special Interest RC	NA	1	+Point RC	BPC - TSC

Indications of Imperfections Detected							
SG	NDE Method	Row	Column	Indication Code	Location	Active Yes/No	Measured Wall Penetration
B	Bobbin	35	17	Percent	AV2	No	12%
		35	17	Percent	AV3	No	17%
B	Bobbin	35	18	Percent	AV2	No	13%
B	Bobbin	38	21	Percent	AV1	No	13%
		38	21	Percent	AV2	No	12%
B	Bobbin	38	22	Percent	AV2	No	10%
B	Bobbin	39	25	Percent	AV3	No	10%
B	Bobbin	40	25	Percent	AV2	No	19%
B	Bobbin	41	27	Percent	AV2	No	12%
		41	27	Percent	AV3	No	13%
B	Bobbin	42	29	Percent	AV2	No	16%
B	Bobbin	42	30	Percent	AV4	No	12%
B	Bobbin	34	58	Percent	AV2	No	22%
		34	58	Percent	AV3	No	17%
		34	58	Percent	AV4	No	10%
B	Bobbin	26	61	Percent	AV3	No	13%
B	+Point RC	1	9	VOL (Wear)	TSH + 15.56"	No	39%
		1	9	VOL (Wear)	TSC + 15.49"	No	28%
B	+Point RC	1	28	VOL (Wear)	TSH + 15.51"	No	31%
		1	28	VOL (Wear)	TSC + 16.18"	No	41%
B	+Point RC	1	67	VOL (Wear)	TSH + 15.63"	No	20%
		1	67	VOL (Wear)	TSC + 16.16"	No	18%
B	+Point RC	1	86	VOL (Wear)	TSC + 15.27"	No	36%

Indications of Imperfections Detected							
SG	NDE Method	Row	Column	Indication Code	Location	Active Yes/No	Measured Wall Penetration
C	+Point RC	1	9	VOL (Wear)	TSH + 16.07"	No	16%
		1	9	VOL (Wear)	TSC + 15.81"	No	15%
C	+Point RC	1	28	VOL (Wear)	TSH + 15.92"	No	30%
		1	28	VOL (Wear)	TSC + 16.44"	No	21%
C	+Point RC	1	67	VOL (Wear)	TSH + 16.72"	No	26%
		1	67	VOL (Wear)	TSC + 15.96"	No	35%
C	+Point RC	1	86	VOL (Wear)	TSH + 16.91"	No	34%

Tube Plugging		
SG	Reason/Mechanism	Tubes Plugged
B	Sludge Lance Monorail Wear (VOL)	4
B	Dent (DNT)	2
B	Permeability Variation (PVN)	1
C	Sludge Lance Monorail Wear (VOL)	4
Total Tubes Plugged		(SG B – 7) (SG C – 4)

Plugging Attributions				
SG	Row	Column	Reason/Mechanism	Plugging Method
B	1	9	Wear /Sludge Lance Monorail	Mechanical
B	1	28	Wear /Sludge Lance Monorail	Mechanical
B	1	67	Wear /Sludge Lance Monorail	Mechanical
B	1	86	Wear /Sludge Lance Monorail	Mechanical
B	1	34	Dent Signal/NA	Mechanical
B	21	76	Dent Signal/NA	Mechanical
B	16	50	Permeability Variation Signal/NA	Mechanical
C	1	9	Wear /Sludge Lance Monorail	Mechanical
C	1	28	Wear /Sludge Lance Monorail	Mechanical
C	1	67	Wear /Sludge Lance Monorail	Mechanical
C	1	86	Wear /Sludge Lance Monorail	Mechanical

Repair Attributions				
SG	Row	Column	Reason/Mechanism	Repair Method
NA	NA	NA	NA	NA

Plugging/Repair Record						
SG	Tubes Plugged	Tubes Repaired (Not Plugged)	Percent Plugged	Percent Repaired (Not Plugged)	Percent Plugged or Repaired	Average Plugging Limit (See Note 1)
A	16	0	0.48	0	0.48	15%
B	7	0	0.21	0	0.21	
C	17	0	0.51	0	0.51	

Note 1: As described in the safety evaluation and plant LOCA analyses, steam generators are restricted to an equivalent plugging limit of 15% average and 15% in any one steam generator with no greater than a 5% differential between any two steam generators expressed in number of tubes per generator.

TUBE INTEGRITY ASSESSMENT

1.0 Summary

Overall condition assessments are documented in the Surry Steam Generator Monitoring and Inspection Program Plan, SPS-SGMIPP-001, Rev. 4 (Program Plan). The assessments provided in the Program Plan are consistent with the requirements of the Nuclear Energy Institute Guideline NEI 97-06. A Pre-Outage Assessment was performed to identify any potentially relevant conditions that may be applicable to Surry Unit 1 that were not addressed in the Program Plan. The eddy current inspection scope, probes to be used during the inspection, and detection and sizing information for the anticipated mechanisms were also determined during the assessment.

Performance Criteria are established in three areas:

- Structural Integrity – Margin of 3.0 against burst under normal steady state power operation and a margin of 1.4 against burst under the most limiting design basis accident.

- Operational Leakage – RCS operational primary-to-secondary leakage through one steam generator shall not exceed 150 gpd.

- Accident Induced Leakage – Leakage shall not exceed 1 gpm per steam generator during Main Steam Line Break (MSLB).

The inspections performed were consistent with the Program Plan. Revision 5 of the EPRI Steam Generator Examination Guideline was used as the basis for inspection requirements and frequencies. The results from the current and previous inspections formed the basis of the condition monitoring and operational assessment performed for this outage.

A condition monitoring evaluation of the steam generator tube bundles is required to verify that the condition of the tubes, as reflected in the inspection results, is in compliance with the plant licensing basis. Structurally significant indications, if found, are evaluated to confirm that the safety margins against leakage and burst were not exceeded at the end of this operating cycle using a bounding structural limit calculation. The results of the condition monitoring evaluation are used as a basis for the operational assessment which demonstrates that the anticipated performance of the steam generators will not exceed the performance criteria margins against leakage and tube burst during the next operating period.

An operational assessment of the steam generator tube bundles is required to determine if tube structural or leakage integrity will be challenged prior to the next scheduled inspection for that steam generator. In addition, an assessment is made to verify the structural and leakage integrity for the steam generators that have not been inspected based upon the inspection findings for the inspected steam generator. This report conforms to the March 2000 EPRI Steam Generator Integrity Assessment Guidelines, Revision 1 (TR-107621-R1) and the requirements of NEI 97-06.

No corrosion mechanisms were observed in "B" steam generator. The only tube degradation mechanisms observed in "B" steam generator during this inspection were tube mechanical

wear at anti-vibration bar (AVB) intersections and Row 1 freespan mechanical wear that was induced by the sludge lance monorail during a prior sludge lance operation. In the pre-outage assessment for "B" steam generator, an expansion protocol was established that required inspection of Row 1 tubes in "C" steam generator if wear caused by the sludge lance monorail in "B" steam generator exceeded expectations. The Row 1 tubes were inspected in "C" steam generator at Columns 7 through 11, 26 through 30, 65 through 69, and 84 through 88. The inspections of "C" steam generator identified seven (7) locations in four (4) tubes with sludge lance monorail induced wear.

A total of seven (7) tubes were plugged in "B" steam generator and four (4) tubes were plugged in "C" steam generator. All indications were evaluated against the tube integrity performance criterion, and all were found to have burst capabilities well in excess of the performance criterion. The reasons for the tubes plugged in the "B" and "C" steam generators are detailed as follows:

Steam Generator B

R1C9 was plugged due to sludge lance monorail induced wear. The depth estimate from the +Point (+Pt) probe was 39% HL and 28% CL.

R1C28 was plugged due to sludge lance monorail induced wear. The wear exceeded TS limits. The depth estimate from the +Pt probe was 31% HL and 41% CL.

R1C34 was plugged due to a 108 volt dent in the area of the tube expansion transition.

R1C67 was plugged due to sludge lance monorail induced wear. The depth estimate from the +Pt probe was 20% HL and 18% CL.

R1C86 was plugged due to sludge lance monorail induced wear. The depth estimate from the +Pt probe was NDD HL and 36% CL.

R16C50 was plugged due to a permeability signal that could possibly mask a potential flaw indication. No evidence of degradation was noted in this tube.

R21C76 was plugged due to the inability to inspect a 55-volt dent with a "qualified" +Pt probe.

Steam Generator C

R1C9 was plugged due to sludge lance monorail induced wear. The depth estimate from the +Pt probe was 16% HL and 15% CL.

R1C28 was plugged due to sludge lance monorail induced wear. The depth estimate from the +Pt probe was 30% HL and 21% CL.

R1C67 was plugged due to sludge lance monorail induced wear. The depth estimate from the +Pt probe was 26% HL and 35% CL.

R1C86 was plugged due to sludge lance monorail induced wear. The depth estimate from the +Pt probe was 34% HL and NDD CL.

The condition of the Surry Unit 1 steam generators as indicated by the results of this inspection continue to satisfy the safety margin requirements with respect to structural and leakage integrity. Evaluation of the indications identified in "B" and "C" steam generators concluded that acceptable tube integrity will exist at the end of the current operating cycle (REOC 13), hence condition monitoring requirements are met.

The results of the inspection of "B" steam generator and the focused Row 1 inspection in "C" steam generator were consistent with prior operational assessments. The only operational degradation mechanism identified during the inspection of "B" steam generator was tube wear at the AVB contact points. The AVB wear rates were less than those measured for prior Unit 1 outages. Projection of AVB wear indications for the next planned operating interval of approximately 49 EFPM (Fall 2007) for "B" steam generator does not indicate that conditions exceeding structural and leakage margin requirements would occur before the end of the next planned operating interval. No projection is required for the Row 1 freespan wear indications since all the indications were plugged and all the indications were related to a maintenance process and not operating conditions. Therefore, there is no operating mechanism to cause new wear indications at these locations during the next planned operating cycle. Thus, operational assessment requirements are satisfied.

The results of the Replacement End of Cycle 13 (REOC–13) inspection of "B" and "C" steam generators confirm that the existing Operational Assessment for the Unit 1 "A" and "C" steam generators are valid since no new degradation mode was identified.

2.0 Condition Monitoring Assessment – Tube Integrity Evaluation

The condition of the Surry Unit 1 steam generators, as indicated by the results of the planned inspection performed on "B" steam generator and the limited Row 1 focused inspection in "C" steam generator, satisfy the structural and leakage integrity margin for the recently completed operating period. A discussion of the inspection results and the evaluations performed is provided in the following sections.

2.1 Primary Side Inspection

No corrosion related degradation was noted during the planned eddy current inspection of "B" steam generator and the limited Row 1 inspection of "C" steam generator. The results of the completed inspection are consistent with prior findings and no new conditions were identified.

2.1.1 Bobbin Program

AVB Wear Indications

Sixteen (16) AVB intersections, in eleven (11) tubes, were identified with tube wear in "B" steam generator. The maximum indicated wear depth [22% through-wall (TW)] (22% TW) was reported at R34C58. Tube integrity for "B" steam generator for the last operating interval was not challenged by any of the wear indications observed, since the indications are below the tube repair limit and well below the structural limit. The average growth rate per cycle since the last inspection (1998 – approximately 49 EFPM) is 0.23 % with the last cycle maximum being 2.3 % TW. This growth rate is lower than the values observed from prior inspections.

There were nine AVB related tube wear indications reported this inspection that were not reported during the previous inspection in 1998. Re-analysis of the 1998 data with the voltage normalized to the current calibration standard was performed and all the indications were confirmed to exist in 1998. Table 1 lists all tubes with AVB wear "calls" identified during the current outage. Included in the table are the associated "growth" rates for each location. None of the indications required plugging of the affected tubes.

The appropriate NDE technique performance data used for detection and sizing of AVB wear with a bobbin probe is obtained from the EPRI database technique ETSS # 96004.1. Using the EPRI database, an adjusted NDE parameter and a technique uncertainty was determined. The analyst uncertainty for wear measurements was obtained from the document "Capabilities of Eddy Current Data Analysts to Detect and Characterize Defects in SG Tubes", D. H. Harris. The value obtained for analyst variability is 7.04 %. As discussed in EPRI Report TR-107621, R1, "Steam Generator Integrity Assessment Guidelines", dated March 2000, the total NDE uncertainty is equal to the square root of the sum of the squares of measuring uncertainty and the analyst uncertainty. The total NDE uncertainty of 9.08% was employed in Table 2 to obtain the Condition Monitoring values. As can be seen in Table 1, all AVB indications identified during the current inspection effort are expected to meet the structural limit of 60% TW at the end of the next operating period for "B" steam generator.

Table 1 - Summary of AVB Reported Indications Identified in "B" Steam Generator (ETSS #96004.1 Rev. 9 Utilized For Sizing)

Row / Column	Inspection Date	2003 % TW	Volts	Adjusted NDE % TW y=0.97x + 3.49	Condition Monitoring % TW
R35 C17	4/2003	12% (AV2)	0.26	15.1	24.2
		17% (AV3)	0.48	20.0	29.1
	10/1998	12% (AV2)*	-	-	-
		16% (AV3)	0.41	-	-
R35 C18	4/2003	13% (AV2)	0.28	16.1	25.2
	10/1998	11% (AV2)	-	-	-
R38 C21	4/2003	13% (AV1)	0.29	16.1	25.1
		12% (AV2)	0.27	15.1	24.1
	10/1998	16% (AV1)	0.44	-	-
		16% (AV2)*	-	-	-
R38 C22	04/2003	10% (AV2)	0.21	13.2	22.3
	10/1998	11% (AV2)*	-	-	-
R39 C25	04/2003	10%(AV3)	0.21	13.2	22.3
	10/1998	9% (AV3)	-	-	-
R40 C25	04/2003	19% (AV2)	0.61	21.9	31.0
	10/1998	20% (AV2)	0.61	-	-
R41 C27	04/2003	12% (AV2)	0.27	15.1	24.1
	04/2003	13% (AV3)	0.29	16.1	25.1
	10/1998	14% (AV2)	0.29	-	-
	10/1998	15% (AV3)*	-	-	-
R42 C29	04/2003	16% AV2)	0.42	19.0	28.1
	10/1998	15% (AV2)	0.33	-	-
R42 C30	04/2003	12% (AV4)	0.27	15.1	24.1
	10/1998	14% (AV4)	-	-	-
R34 C58	04/2003	22% (AV2)	0.72	24.8	33.9
		17%(AV3)	0.50	20.0	29.1
		10% (AV4)	0.22	13.2	22.3
	10/1998	15% (AV2)	0.38	-	-
		17%(AV3)	-	-	-
		14% (AV4)	-	-	-
R26 C61	04/2003	13% (AV3)	0.31	16.1	25.1
	10/1998	11% (AV3)	-	-	-

* %Through-wall depth based on re-analysis of the 1998 eddy current data

Dent (DNT) Signals

Consistent with the inspection scopes for all Surry steam generators, dent signals continue to be monitored for potential degradation. During the bobbin inspection programs, a total of 416 locations spread throughout the generator in 340 tubes were identified with dent signals greater than 2.00 volts. Of this total, 356 dent signals between 2.00 and 4.99 volts were reported in 304 tubes, 54 dent signals between 5 and 19.99 volts were reported in 46 tubes, and 6 dent signals greater than 20 volts were reported in 6 tubes. It should be noted that the dent signal analysis protocol has been to assign a DNT call if the signal does not rotate into the flaw plane. As specified in the "Surry Site Specific Eddy Current Analysis Guidelines," SRY-SGPMS-002 Rev. 7, dents (DNT) or bulges (BLG) > or = to 2 volts without a history confirmation must be inspected with a rotating (+Pt) surface riding coil. Historical

confirmation for resolution requires a previous bobbin inspection on the dent with supporting rotating coil data or two previous bobbin inspections that show no change in the dent signal.

A total of 120 DNT signals were selected for +Pt inspection which included all dents with voltages > 5.0 (60 locations). Included in this population were 3 locations that required +Pt inspection due to no history confirmation. The balance of the inspections consisted of a random sample on signals that exhibited no change. No degradation was noted as a result of this inspection. During the +Pt inspection of DNT locations, it was not possible to pass a 0.720 diameter probe through a DNT in R21C76 even though a 0.720 diameter bobbin probe was able to pass the DNT location. The DNT (54.7volts) was located 22.2 inches above the 1st cold leg support plate. The DNT had been reported from bobbin inspection during the previous two inspections of "B" steam generator (Fall-98 and Spring-94) and had not grown in voltage. The DNT had not been previously examined with a rotating probe. It is believed that the geometry of the rotating probe assembly (motor unit) prevented passage of the probe by the DNT. A 0.680 diameter Plus point probe was able to pass the DNT location. No degradation was noted. Since the 0.680 diameter U-bend Plus Point probe is not an "EPRI" qualified technique for straight leg inspection, this tube was preventively plugged.

Permeability Variation (PVN)

During the inspection a 23.93-volt signal caused by a localized variation in permeability was detected above the third hot leg support plate with a +Pt rotating coil. The signal extended from 3H + 0.64" to 3H +17.69". A PVN signal is the result of a change in the coil impedance due to a variation in the tubing material and is not indicative of degradation. Based on the axial and circumferential extent of the PV effect observed in R16C50, this tube location was preventively plugged.

Sludge Lance Monorail Wear Indications

During the Fall 2001 eddy current inspection of "A" steam generator, wear indications were found on three (3) Row 1 tubes. Tapered wear-like indications were identified in Column 9, Column 28, and Column 67. The indications were located between 15.5 and 16.5 inches above the tubesheet. These indications were caused by contact of the latches on the monorail sections of the sludge equipment during sludge lance operations that were performed during the Spring 2000 refueling outage. Under the dynamic loading and oscillation that occurs during sludge lance operations, the monorail is deflected enough to allow the metal latches to cause wear to the adjacent Row 1 tubes. The tube wear was not discovered until the following outage due to the sequence of sludge lance and eddy current operations. Steam generator "A" was evaluated during the 2001 inspection and three tubes were preventively plugged at that time.

During the Spring 2003 eddy current inspection of the "B" steam generator, tapered wear-like indications were identified in four Row 1 tubes (Column 9, Column 28, Column 67, and Column 86). The indications were located between 15.5 and 16.5 inches above the secondary side tubesheet surface and were consistent with the observed indications on "A" S/G. These indications were initially called under the bobbin program but were included in the non-quantifiable indications (NQI) list to be examined by a rotating coil for characterization and sizing. Based upon experience with inspections on other units affected by this condition, Westinghouse recommends using an amplitude-depth curve based upon

the ASME flat bottom holes for sizing monorail induced wear with a +Pt rotating probe. Dominion concurs with the sizing methodology recommended by Westinghouse.

Upon completion of the eddy current inspection of "B" steam generator, a limited inspection of the Row 1 tubes was conducted to address any concerns relative to the existence of potential wear in "C" steam generator. Bobbin and subsequent +Pt inspections were performed on twenty (20) selected Row 1 tubes in both legs of "C" steam generator.

Results of the Row 1 inspections for the "B" and "C" steam generators, along with the prior results for "A" steam generator are shown in the following table. Table 2 summarizes the inspections results associated with tube wear related to the sludge lance monorail for all three of the steam generators.

Table 2. Surry Unit 1 Row 1 Monorail Induced Wear Results

Location	Leg	S/G A(2001)		S/G B(2003)		S/G C(2003)	
		Bobbin	+Pt	Bobbin	+Pt	Bobbin	+Pt
R1C9	Hot	NDD	NR	28%	39%	*	16%
	Cold	Poor Signal	18%	18%	28%	*	15%
R1C28	Hot	28%	20%	Poor signal	31%	*	30%
	Cold	16%	23%	23%	41%	*	21%
R1C67	Hot	25%	32%	19%	20%	*	26%
	Cold	NDD	NR	Poor signal	18%	*	35%
R1C86	Hot	Poor Signal	NDD	NDD	NR	*	34%
	Cold	NDD	NR	25%	36%	NDD	NR

NDD – No detectable degradation
NR-Not required
*All run with bobbin for detection but no sizing performed, NQI's requiring rotating coil characterization and sizing.

To support the industry in performing integrity assessments related to monorail induced wear, Westinghouse evaluated laboratory wear samples to determine the general structural acceptability of wear indications identified in Row 1 tubes. These samples included a milled slot rotated 20 degrees about the tube axis (thus producing a check-mark shape), a 0.063" wide milled slot with a 45-degree runout to the tube OD surface, and milled slots of 0.063", 0.094", 0.125", and 0.250" width. Based on the geometry of the Row 1 tube configuration, the sludge lance rail must swing through a radius of at least 1.75" to contact the tube OD surface. Thus, the wear scar profile at the elevation of the center of the rail should be similar to the milled slots. Depth sizing of the laboratory notch samples using an amplitude-depth curve based on the flat bottom holes of the ASME standard produced excellent sizing capabilities. The maximum error between destructive versus nondestructive results obtained from the 20% through-wall sample was found to be 5% through-wall. For the 40% and 60% through-wall samples, the depths were conservatively estimated by NDE. As a bounding limit (95/50), amplitude sizing of sludge lance monorail indications based on the ASME flat bottom hole calibration is set at 8%. Axial length sizing capability using Plus Point was established for the lab samples discussed above. For all cases axial length estimation was conservative by at least 0.25".

The maximum depth of the Row 1 sludge lance monorail wear indications in the Surry Unit 1 steam generators was 41% in R1C28 of "B" steam generator. Using a bounding limit of 8% for the total NDE uncertainty, the adjusted measured depth was 49% through-wall. A structural limit of 71% at a lower 95% prediction limit using 95/95 LTL mechanical properties was calculated based on Surry Unit 1 operating conditions. This value is considered conservative since it uses cold leg thinning burst test data that includes circumferential involvement angles greater than obtained from a projected tapered wear scar.

Other Signals

Top-of-Tubesheet (TTS) Dent Signal - During bobbin inspection of the hot leg side of the tube at R1C34 in "B" steam generator, a 108 volt dent signal was reported at the top of the tubesheet. Review of the 1994 and 1998 inspection data, revealed that the signal was present in 1998, but not in 1994. The signal was not reported in 1998 due to its close proximity to the expansion transition. Due to the magnitude of the DNT voltage and the lack of required history confirmation, this location was inspected with a +Pt rotating probe. The location was not able to pass a 0.720 inch diameter +Pt rotating probe. A 0.700 inch +Point probe was able to pass the DNT location, and no degradation was seen. Even though, the 0.700 inch probe is a "qualified" technique and no degradation was noted, R1C34 was preventively plugged. The decision was based on the potential for increased susceptibility to corrosion induced degradation because of the location of the DNT, the potential for secondary side sludge buildup, and an increase in stress near the expansion transition as a result of the DNT.

2.1.2 Focused Rotating Coil Programs

Hot Leg Top-of-Tubesheet

Plus point inspection of the top of the hot leg tubesheet location was performed for 678 tubes. This program focused primarily on the low velocity region in the middle of the bundle. All signals were resolved in accordance with the Analysis guidelines. No degradation was noted.

Row 1 U-bends

All of the Row 1 U-bends (90 open tubes) were inspected with a 0.680 diameter single coil +Pt Ubend probe. No indications were noted. During this inspection, signal-to-noise measurements were taken for a 20 tube sample. The results of these measurements were compared with the EPRI qualification data used in developing ETSS #96511 for both 300kHz and 400kHz. The average values obtained were within acceptable limits.

2.2 Condition Monitoring Conclusion

In order to demonstrate condition monitoring structural integrity, it is necessary to account for various uncertainties, which are subtracted from the structural limit. The result is then compared with the largest flaw measured.

Two (2) degradation mechanisms, (AVB related tube wear and Row 1 freespan wear due to the sludge lance monorail) were identified during the Unit 1 inspection of "B" steam generator. The maximum depth of the Row 1 sludge lance monorail wear indications in Surry Unit 1 steam generators was 41% in R1C28 of "B" steam generator. Using a bounding limit of 8% for the total NDE uncertainty, the adjusted measured depth was 49% through-wall. This value is well below the structural limit of 71% at a lower 95% prediction limit that was calculated based on Surry Unit 1 operating conditions using 95/95 LTL mechanical properties. The largest AVB related tube wear measured during the current inspection was a 22% AVB wear in R34C58 at AV2. As referenced in the Surry Steam Generator Program Plan, the structural limit using the ASME Code equation for uniform wear of a 7/8" diameter x 0.050" thick tube is 60% through-wall, that is, 0.020 inch remaining wall. Adjusting the measured indication using ETSS #96004.1 Rev. 9 regression equation ($y = 0.97x + 3.49$ ETSS; where x = measured and y = adjusted) results in a 2.8% TW adjustment and a total NDE uncertainty of 9.08% TW. The 22% AVB indication identified for REOC-13 is 33.9% TW following adjustment for these uncertainties. This value is well below the bounding structural limit of 60% TW as determined by the ASME Code equation.

Based on the evaluations of this report, the indications found in the REOC-13 inspection on "B" and "C" steam generators satisfy the condition monitoring requirements for structural and leakage integrity. Ten (10) out of the eleven (11) tubes plugged had depths less than the Technical Specification 40% through-wall (TW) repair limit. Of those sized with TW depth extents, the size ranged from 15 to 35% TW. Three (3) tubes were conservatively plugged with no evidence of degradation. A bounding structural analysis was performed for the tube that was plugged due to a freespan wear scar measuring 41%. The projected burst capability was well in excess of the performance criteria of three times normal steady state power operation.

3.0 Operational Assessment: Tube Integrity and Leakage

NEI 97-06 requires a "forward looking" operational assessment to determine if the steam generator tubing will continue to meet the structural and leakage integrity requirements at the end of the upcoming cycle. The operational assessment is based upon the degradation mechanisms observed in the plant. The assessment includes site-specific degradation growth rates and NDE uncertainties for the largest flaw that remains in service. The following sections summarize the growth rate evaluation and the NDE sizing uncertainty evaluations performed for the observed degradation mechanism, AVB wear, to support the Operational Assessment.

Based on information contained in Dominion's fuel management document the past operating interval between inspections of "B" steam generator was approximately 49 EFPM. The projected operating interval until the next inspection of S/G "B" is approximately 49 EFPM.

The only operationally related indication reported during the REOC-13 eddy current inspection programs was mechanical tube wear at AVB locations. The results seen were consistent with prior inspection results. As typically seen, the indications begin to be reported at approximately 10% through-wall depth and are slow growing. The data to date indicates this mechanism to be "inactive" as defined by the EPRI Rev. 5 Examination Guideline. A total of 11 tubes (16 AVB locations) exhibited mechanical wear. The overall findings are

consistent with the improved performance of the 51 Series (original and F-type replacements) as compared to the Model F units.

3.1 AVB Wear Depth Projections

The guidance provided in EPRI Steam Generator Integrity Assessment Guidelines, Revision 1 (TR-107621-R1) states that structural integrity should be demonstrated at the next inspection by showing that the tube meets the performance criteria with an overall uncertainty based on a probability of 0.90, evaluated at 50% confidence. The guideline also indicated that growth rates should be based on a 95/50 basis. This evaluation addressed all AVB wear conditions relative to tube integrity requirements at the end of the next planned operating interval (49.0 EFPM) for "B" steam generator. The AVB indications identified during the REOC–13 were included in the recently completed statistical analysis of the AVB data for both Surry Units 1 and 2. The Surry Unit 1 average AVB wear rate was updated with the current "B" steam generator data. An updated summary for Surry Unit 1 is provided in Table 3. Based on the limited number of wear sites in the individual Unit 1 steam generators, the AVB growth rate used for the operational assessment projection was based on the statistical mean of the combined wear rate for the three Unit 1 steam generators. The projection included data obtained at this inspection. Based on a 95/50 CL, the AVB wear rate used in the operational assessment was 6.43%/Cycle.

The technique uncertainty utilized for the operational assessment was obtained from ETSS #96004.1 (Rev 9). The total NDE uncertainty was 9.08% and the adjusted %TWD was based on $y = 0.97x + 3.49$. Table 4 lists the projected %TW at REOC 16 (Fall 2007) for all AVB wear sites left in service in "B" steam generator. All indications are projected to be below the structural limit of 60%.

Table 3 - Surry Unit 1 AVB Statistical Summary

a) Steam Generator 'A"

Number of Tubes with AVB Wear Indications	24
Number of AVB Wear Indications	29
Average Wear Rate	2.217 %TWD / Cycle
Number of Data Points	44
Standard Deviation	2.268 % TWD / Cycle
90/50 Wear Rate = Mean + 1.28 x Standard Deviation	5.12 %TWD / Cycle
95/50 Wear Rate = Mean + 1.65 x Standard Deviation	5.96 % TWD / Cycle
Number of Tubes Plugged	4

b) Steam Generator "B"

Number of Tubes with AVB Wear Indications	19
Number of AVB Wear Indications	26
Average Wear Rate	1.68 %TWD / Cycle
Number of Data Points	42
Standard Deviation	2.00 % TWD / Cycle
90/50 Wear Rate = Mean + 1.28 x Standard Deviation	4.24 % TWD / Cycle
95/50 Wear Rate = Mean + 1.65 x Standard Deviation	4.98 % TWD / Cycle
Number of Tubes Plugged	4

c) Steam Generator "C"

Number of Tubes with AVB Wear Indications	17
Number of AVB Wear Indications	34
Average Wear Rate	3.72 %TWD / Cycle
Number of Data Points	40
Standard Deviation	2.127 % TWD / Cycle
90/50 Wear Rate = Mean + 1.28 x Standard Deviation	6.44 % TWD / Cycle
95/50 Wear Rate = Mean + 1.65 x Standard Deviation	7.23 % TWD / Cycle
Number of Tubes Plugged	9

d) Steam Generators "A", "B", and "C" Combined

Number of Tubes with AVB Wear Indications	60
Number of AVB Wear Indications	89
Average Wear Rate	2.50 %TWD / Cycle
Number of Data Points	126
Standard Deviation	2.29 % TWD / Cycle
90/50 Wear Rate = Mean + 1.28 x Standard Deviation	5.43 % TWD / Cycle
95/50 Wear Rate = Mean + 1.65 x Standard Deviation	6.43 % TWD / Cycle
Number of Tubes Plugged	17

Table 4 - Surry Unit 1 – April 2003
Steam Generator Eddy Current Inspection Summary – AVB Indications

• Number of Tubes With AVB Indications:	11 Tubes
• Number of AVB Wear Sites:	16 Intersections
• Number of New Indications Not Existing in 1998:	0
• "B" S/G Average Wear Rate For Current Inspection(%TW / Cycle)	0.23 % / Cycle
• "B" S/G Historical Average Wear Rate (% TW / Cycle):	1.68 % / Cycle
• 95%/50% Wear Rate Based on Unit 1 Historical Data :	6.43 % / Cycle
• Sizing Technique:	ETSS # 96004.1 Rev. 9
• Adjusted NDE Parameter:	y = 0.97x +3.49
• Technique Uncertainty @ 90/50CL: (Based on Standard Error of Regression @90/50 CL)	5.74%
• Analyst Uncertainty @ 90/50 CL: (15th Steam Generator NDE Workshop titled "Capabilities of Eddy Current Analysts to Detect and Characterize Defects in Steam Generator Tubes")	7.04%
• Total NDE Uncertainty @ 90/50CL: (Square root of the sum of the squares of the individual uncertainties)	9.08%
• 2007 Projection % TW	Adjusted 2003 % TW + [6.43 x 3 cycles] + 9.08 %

Row / Column	2003 % TW	Adjusted NDE % TW y=0.97x + 3.49	Wear Rate (% TW / Cycle)	Projected Fall 2007 (% TW)
R35 C17	12% (AV2)	15.1	0	43.5
	17% (AV3)	20.0	0.33	48.4
R35 C18	12% (AV2)	15.1	0.0	43.5
R38 C21	13% (AV1)	16.1	0	44.5
	12% (AV2)	15.1	0	43.5
R38 C22	10% (AV2)	13.2	0	41.6
R39 C25	10%(AV3)	13.2	0.33	41.6
R40 C25	19% (AV2)	21.9	0.0	50.3
R41 C27	12% (AV2)	15.1	0	43.5
	13% (AV3)	16.1	0	44.5
R42 C29	16% AV2)	19.0	0	47.4
R42 C30	12% (AV4)	15.1	0	43.5
R34 C58	22% (AV2)	24.8	2.33	53.2
	17%(AV3)	20.0	0	48.4
	10% (AV4)	13.2	0	41.6
R26 C61	13% (AV3)	16.1	0.67	44.5

3.2 Operational Leakage

Although there are no indications of primary-to-secondary leakage that indicate a concern, these indications will continue to be monitored using conservatively based monitoring procedures. Revision 2 of the EPRI Primary-to-Secondary Leakage Guideline has been implemented as part of an assessment of the current procedures compared to those guidelines and related commitments to the NEI 97-06 S/G Program Guideline Document.

3.3 Projected Accident Leakage

There were no inspection findings that indicated leakage would occur during the ensuing operating cycle since the findings revealed no operative degradation mechanisms.

3.4 Conclusion

Based on the results of the current and past eddy current inspection, selected secondary side inspections, and current chemistry operating practices, "B" steam generator meets the performance criteria to operate for at least three cycles before the next planned tubing inspection. If other issues are identified on other Surry steam generators during ensuing inspections or other relevant industry findings are noted during the inspection of similar model steam generators, review of the planned inspection intervals will be conducted in accordance with the Program Plan requirements. The results of the REOC-13 routine inspection of the "B" steam generator and the limited expanded inspection on the "C" steam generator indicate the existing Operational Assessments for the Unit 1 "A" and "C" steam generators are valid. No change to their currently planned tubing inspections in the Fall of 2004 and Spring 2006, respectively, is necessary.

Results of secondary side inspections continue to demonstrate reliable operation. Continuing diligence in chemistry and FME control will support long term performance. Evaluation and monitoring will continue as planned and as further detailed in the Monitoring and Inspection Program Plan. Continuing awareness of any related industry issues will be considered when planning future inspections.

Similar chemistry controls are expected to exist throughout the next cycle. The impact on planned inspection cycles and scopes as a result of chemistry excursions or significant changes to treatment programs will be evaluated on a case-by-case basis. Due to the low amounts of sludge being removed and the continued low corrosion product transport, sludge lancing or other enhanced methods will continue to be planned on an every other outage basis. The laboratory analysis of scale samples and subsequent review of results will be continued and those results will be evaluated with respect to the required frequency of sludge lancing operations. Supplemental inspections and enhanced cleaning methods are being pursued consistent with these evaluations with application of advanced scale conditioning being evaluated in the long term plan.

Corrective Actions Planned
None

Evaluation (If SG condition does not meet previous cycle operational assessment)
Not Applicable

ATTACHMENTS:

Attachment 1 – Letter Codes
Attachment 2 – Series 51F Steam Generator - Sketches

ATTACHMENT 1
Letter Codes

General Codes

ANF - ANOMALY NOT FOUND -Indicates that a previously reported anomaly cannot be found within .50" of the location where the anomaly was previously called.

ANR - ANOMALY NOT REPORTABLE - Indicates that a previously reported anomaly does not meet the present reporting criteria.

BDA - BAD DATA (retest) – Indicates that the data for the specified tube is not acceptable for analysis due to poor signal quality. The tube will be re-tested to the required extent.

INF - INDICATION NOT FOUND - Indicates that a previously reported INDICATION has not been found in the data being analyzed or that a tube/signal is being re-tested for positive identification (PID) and no signal is present in the retest data.

INR - INDICATION NOT REPORTABLE - Indication called in previous inspections that are still detectable but fall below current reporting criteria.

NDD - NO DETECTABLE DISCONTINUITY – The recorded data has no signal responses meeting the criteria established in the Site Specific Analysis Guidelines for degradation, damage precursors or anomalies.

NDF - No Degradation Found - Used to address a special interest location where no signal meeting the RC criteria (MBM, DNT, etc) is present. Location of rotating coil data verses the bobbin coil shall be verified to ensure correct location was inspected.

NT - NO TEST (re-test) – Indicates that the tube ROW, COLUMN was encoded on the tape; however, no inspection data was recorded for analysis.

OBS - OBSTRUCTED – Blockage of a tube that prevents passage of a defined minimum size probe through the tube.

PID - POSITIVE IDENTIFICATION - Verification of a signal at the same reported ROW/COL and at the same reported tube location.

PLG - PLUG – Indicates that the tube at the specified location has been plugged.

PVN - PERMEABILITY VARIATION – Condition where the test coil impedance changes due to a change in the tubing materials inherent tendency to conduct magnetic flux lines.

PLP – POSSIBLE LOOSE PART – Indicates the possible presence of a loose part in the generator.

RST - RESTRICTED - Blockage of a tube that prevents passage of a probe beyond a specified location within the tube.

TIU - TUBE I.D. UNCERTAIN (re-test) - Indicates that the ROW and/or COL identifier for a given tube is in doubt.

LAR - Lead Analyst's Review - Condition not directly covered by the guidelines, ETSS, or other documentation that the data analyst feels should be brought to the attention of the resolution and/or job lead analyst. Diagnostic testing or PID verifications that the analyst believes are not the correct tube number and/or the correct tube location shall be identified as LAR.

BOBBIN CODES

BLG - BULGE - An area along the tube where the diameter of the tube has been abruptly deformed in an outward direction as compared to the nominal tube diameter.

CUD - COPPER DEPOSIT - The presence of copper deposits on the outside of the tube.

DNT - DENT – An area along the tube where the diameter of the tube has been abruptly reduced compared to the nominal tube diameter.

LGV - LOCAL GEOMETRIC VARIATION - A local reduction in tube diameter usually associated with a localized change in conductivity of the tube. LGV signals are caused by dings introduced during manufacturing/installation process and do not represent a discernible wall loss. The signals must be verified by history review to be called with bobbin (See rotating probe DNG code).

MBM - MANUFACTURING BURNISH MARK – A tubing condition where localized tubing imperfections were removed by buffing and are detectable due to the effects of cold working and minor localized wall thinning. The signal must be verified by history review to be called with bobbin.

MMB - MULTIPLE MANUFACTURING BUFF MARK - Multiple MBM signals in close proximity over a length of tube. The signals must be verified by history review to be called with bobbin.

NQI – NON-QUANTIFIABLE INDICATION – A bobbin signal requiring rotating coil examination for disposition.

NQN – NON-QUANTIFIABLE NONDEGRADED – A bobbin signal which was formally classified as NQI but has been determined to be anomalous or of a type which does not represent degradation.

PDS - POSTIVE DRIFT SIGNAL –Long (several inches to several feet) drift signals evident on absolute channels caused by variations in tube concentricity associated with the pilgring process. The signals may be located at random elevations and are generally only in one leg of the tube.

PTE – PARTIAL TUBE EXPANSION –. Code used when only some portion of parent tube has been expanded into the carbon steel tube sheet. PTE shall be reported at the axial location(s)where nominal tube expansion ends and the partial begins, from the 400/100 mix channel. Bobbin and/or rotating coil data shall be carefully analyzed in the non-expanded crevice region.

NTE – NO TUBE EXPANSION – Code used when the parent tube has NOT been expanded into the carbon steel tube sheet from the top of the tube sheet to approximately 2.5" from the tube end. NTE shall be reported from the 400/100 mix channel, location as TSH +0.00. Bobbin and/or rotating coil data shall be carefully analyzed in the non-expanded crevice region.

ROTATING PROBE CODES

DNG - DING – A localized inward displacement of the tube caused by a mechanical impact on the OD surface.

MAA - MULTIPLE AXIAL ANOMALY - Multiple axially oriented signals located at the top of the tube sheet that the rotating coil data shows to result from an anomalous condition in the tube.

MCA - MULTIPLE CIRCUMFERENTIALLY ORIENTED ANOMALY - Multiple circumferentially oriented signals located at the top of the tube sheet that the rotating coil data shows to result from an anomalous condition in the tube.

MAI - MULTIPLE AXIAL INDICATION - Multiple axially oriented signals that the rotating coil data shows to result from flaws in the tube.

MBM - MANUFACTURING BURNISH MARK – A tubing condition where localized tubing imperfections were removed by buffing and are detectable due to the effects of cold working and minor localized wall thinning.

MCI - MULTIPLE CIRCUMFERENTIALLY ORIENTED INDICATION - Multiple circumferentially oriented signals reported from rotating probe data that the rotating coil data shows to result from flaws in the tube.

MMB - MULTIPLE MANUFACTURING BUFF MARK - Multiple MBM signals in close proximity over a length of tube.

NQN – NON-QUANTIFIABLE NONDEGRADED – A bobbin NQI signal which is determined to be anomalous or not to represent degradation.

PIT - PIT – Localized attack on tubing resulting from non-uniform corrosion rates caused by the formation of local corrosion cells. At Surry, the condition produces small volumetric indications with approximately the same axial and circumferential extent.

SAA - SINGLE AXIAL ANOMALY – A single axially oriented signal located at the top of the tube sheet that the rotating coil data shows to result from an anomalous condition in the tube.

SCA - SINGLE CIRCUMFERENTIALLY ORIENTED ANOMALY – A single circumferentially oriented signal located at the top of the tube sheet that the rotating coil data shows to result from an anomalous condition in the tube.

SAI - SINGLE AXIAL INDICATION – A single axially oriented signal that the rotating coil data shows to result from a flaw in the tube.

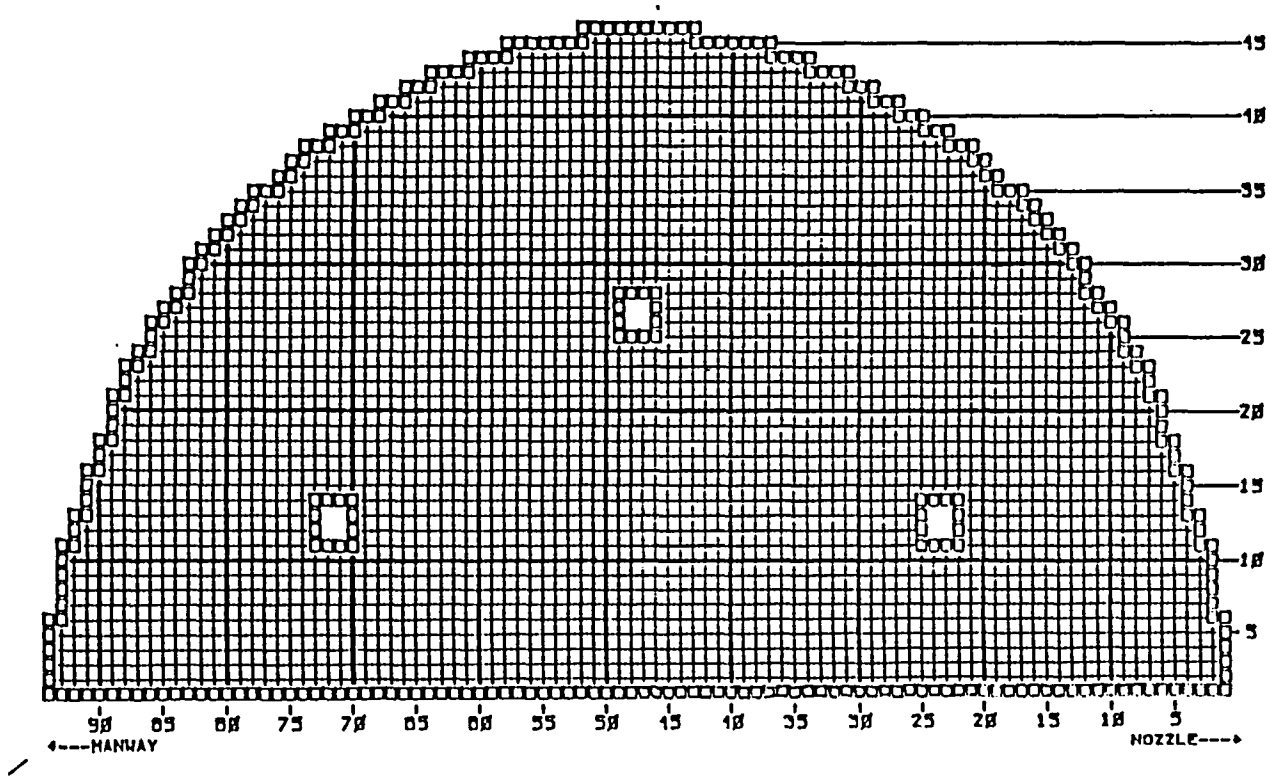
SCI - SINGLE CIRCUMFERENTIALLY ORIENTED INDICATION – A single circumferentially oriented signal that the rotating coil data shows to result from a flaw in the tube.

VOL – VOLUMETRIC – Indications of volumetric wall loss indicative of general localized thinning, wear or impingement.

SVI/MVI – SINGLE VOLUMETRIC INDICATION/MULTIPLE VOLUMETRIC INDICATIONS – Indications of volumetric wall loss indicative of general local inter-granular attack (IGA or IGA/SCC).

SERIES 51-F

MASTER



Attachment 2

Annual Steam Generator Inservice Inspection Summary Report

Virginia Electric and Power Company (Dominion)

Surry Power Station Unit 2

Virginia Electric and Power Company (Dominion)
Surry Unit 2
Annual Steam Generator Report

Station	Unit	Outage Date	Generator Examined			Date of Report
Surry	2	September, 2003		B		October 21,2003

SG Design Information						
SG Model	TSP Type.	TSP Mat'l	# TSP	Baffle Mat'l	AVB Mat'l	# AVB
51F	Quatrefoil	Type 405 SS	7	Type 405 SS	Chrome Plated IN-600	2
# Tubes	Tube Dia.	Tube Mat'l	Tube Pitch	Tube Tks	Expansion	Heat X-fer Area
3342	0.875"	Alloy 600TT	1.281"	0.050"	Full Hydraulic	51,500 sq. ft.

Scope of Inspection					
SG	Inspection Program	Planned	Inspected	Inspection Method	Extent
B	Bobbin	3055	3055	Bobbin	TSH-TSC
B	Bobbin	188	188	Bobbin	7H-TEC
B	Bobbin	92	92	Bobbin	7C-TEC
B	Bobbin	280	280	Bobbin	7H-TEH
B	Row 1 U-Bend RC	92	92	+Point U-Bend RC	7H – 7C
B	TTS Hot leg RC	2380	2380	+ Point RC	TSH +/- 3"

Indications of Imperfections Detected							
SG	NDE Method	Row	Column	Indication Code	Location	Active Yes/No	Measured Wall Penetration
B	Bobbin	38	51	Percent	AV4	No	13%
B	Bobbin	24	57	Percent	AV1	No	19%
B	Bobbin	31	58	Percent	AV2	No	23%
B	Bobbin	33	60	Percent	AV3	No	15%
B	Bobbin	32	69	Percent	AV2	No	12%
B	Bobbin	38	74	Percent	AV2	No	17%
B	+ PT RC	21	10	Percent	2C + 0.54	No	20%
B	+ PT RC	22	10	Percent	2C + 0.88	No	17%
B	+ PT RC	22	11	Percent	2C + 0.65	No	16%
B	+ PT RC	22	82	Percent	TSH + 0.31	No	30%
B	+ PT RC	23	82	Percent	TSH + 0.06	No	6%

Tube Plugging		
SG	Reason/Mechanism	Tubes Plugged
B	Foreign Object/ Wear	3
Total Tubes Plugged		3

Plugging Attributions				
SG	Row	Column	Reason/Mechanism	Plugging Method
B	21	10	Wear (Foreign Object)	Mechanical
B	22	10	Wear (Foreign Object)	Mechanical
B	22	11	Wear (Foreign Object)	Mechanical

Repair Attributions				
SG	Row	Column	Reason/Mechanism	Repair Method
B	NA	NA	NA	NA

Plugging/Repair Record						
SG	Tubes Plugged	Tubes Repaired (Not Plugged)	Percent Plugged	Percent Repaired (Not Plugged)	Percent Plugged or Repaired	Average Plugging Limit (See Note 1)
A	16	0	0.48	0	0.48	15%
B	10	0	0.30	0	0.30	
C	17	0	0.51	0	0.51	

Note 1: As described in the safety evaluation and plant LOCA analyses, steam generators are restricted to an equivalent plugging limit of 15% average and 15% in any one steam generator with no greater than a 5% differential between any two steam generators expressed in number of tubes per generator.

TUBE INTEGRITY ASSESSMENT

1.0 Summary

Overall condition assessments have been documented in the Surry Steam Generator Monitoring and Inspection Program Plan (Program Plan) and are consistent with the requirements of the NEI 97-06 Guideline. A Pre-Outage Assessment was performed to identify any relevant condition to be considered for the Surry Unit 2 steam generators that was not included in Revision 4 of the Program document. The assessment also identified the appropriate eddy current inspection scope, probes to be utilized during the inspection, and the appropriate detection and sizing information for degradation mechanisms that may be detected during the upcoming inspection based upon the assessment.

As required by NEI 97-06, Performance Criteria are established in three areas:

- Structural Integrity – Margin of 3.0 against burst under normal steady state power operation and a margin of 1.4 against burst under the most limiting design basis accident.

- Operational Leakage – RCS operational primary-to-secondary leakage through one steam generator shall not exceed 150 gpd.

- Accident Induced Leakage – Leakage shall not exceed 1 gpm per steam generator during Main Steam Line Break (MSLB).

The inspections performed were consistent with the Program Plan and Revision 6 of the EPRI Steam Generator Examination Guidelines, including the Interim Guidance issued by EPRI. The interim guidance addressed technical concerns raised by the industry regarding the effect of noise on tube integrity parameters (POD, sizing uncertainties). The interim guidance requires a trial application of noise measurement. The consensus of the industry committee overseeing this issue is that the most appropriate parameter to record for signal noise is signal amplitudes (peak to peak and vertical maximum). Accordingly, the interim guidelines recommended the selection of a sample population of tubes for measurement and recording of noise. The objective of this activity was to ensure that the expected capabilities of site-qualified techniques to detect and size tube degradation was valid for each active, relevant or potential damage mechanism identified under the conditions encountered during the inspection. This sampling was conducted and the results confirmed that no degradation of the inspection results was introduced by noise. Other requirements of Revision 6 relative to data quality verification were implemented by way of an automated on-line data quality verification system. In addition, the data analysis team performed manual verification for each tube and/or each calibration set as required. The Surry Site Specific Eddy Current Analysis Guidelines (Analysis Guidelines) and Westinghouse eddy current data analysis and data acquisition technique sheets were used for system calibration and data analysis.

A condition monitoring evaluation of the steam generator tube bundles is performed to verify that the condition of the tubes, as reflected in the inspection results, is in compliance with

plant licensing basis and meet the required performance criteria. Structurally significant indications, if found, are evaluated to confirm that the safety margins against leakage and burst were not exceeded at the end of the current operating cycle using a bounding structural limit calculation. The results of the condition monitoring evaluation are used as a basis for the operational assessment. The operational assessment must demonstrate that the anticipated performance of the steam generators will not exceed the performance criteria margins against leakage and tube burst during the ensuing operating period.

This report documents the condition monitoring and operational assessment of the inspection results from the Surry Unit 2 "B" steam generator. It conforms to the March 2000 EPRI Steam Generator Integrity Assessment Guidelines, Revision 1 (TR-107621-R1) and the requirements of NEI 97-06.

No corrosion mechanisms were observed during the inspection of "B" steam generator. The only tube degradation mechanisms found in "B" steam generator this inspection were mechanical wear at anti-vibration bar (AVB) intersections, wear caused by a foreign object at the top of the tubesheet, and wear caused by a foreign object at the cold leg 2nd tube support plate. None of the AVB wear indications exceeded the plugging limit and the depths observed were consistent with historical performance and structural integrity expectations. The wear indications seen on two tubes at the tubesheet was attributed to interaction with a foreign object that was likely present during past operating cycles and removed during sludge lancing operations. The wear seen on three cold leg tubes at the 2nd tube support plate was also attributed to the interaction with a foreign object. A detailed integrity discussion of these indications is provided in Section 3.5. All indications were evaluated against the tube integrity performance criterion. All were found to have burst capabilities well in excess of the performance criterion. A total of 3 tubes were stabilized and plugged based upon low-level freespan wear in conjunction with the presence of an unretrieved foreign object. The measured wear depths are shown below:

Location	% TW
R21C10	20
R22C10	17
R22C11	16

A subsequent visual inspection of the cold leg tubes at the 2nd tube support plate confirmed the presence of a foreign object. One end of the object was positioned between R21C10 and R22C10 and extended across Column 10. The other end was positioned between R21C11 and R22C11. The object did not extend into Column 9 or Column 11. These findings were consistent with the eddy current results for the above tubes.

A total of 43 tubes have been plugged in this unit with 16 tubes ("A"-1, "B"-5, "C"-10) being plugged for mechanical tube wear at AVB contact points and 12 tubes ("A"- 11; "B" – 0; "C"-1) being plugged for pitting. All generators on this unit have been inspected twice with the "pit" screening criteria with no additional "pit" indications detected. Both the AVB wear and pitting are classified as "inactive" for all steam generators as defined by the EPRI Rev. 6 Steam Generator Examination Guidelines. No corrosion related cracking degradation has been identified on this unit.

Based on the results of the inspection of "B" steam generator, the condition of the Surry Unit 2 steam generators continue to satisfy the safety margin requirements with respect to structural and leakage integrity. Evaluation of the indications identified in "B" steam generator indicate that acceptable tube integrity was maintained at the end of the current operating cycle Replacement End of Cycle 14 (REOC-14), hence the condition monitoring requirements are met.

The results of the inspection of "B" steam generator were consistent with prior operational assessments. In addition to the foreign object wear, the only other operational degradation mechanism identified was tube wear at the AVB contact points. The AVB wear rates were less than those measured for prior Unit 2 outages. Projection of AVB wear for the next planned operating interval, approximately 48 EFPM (Spring 2008), for "B" steam generator indicates that conditions exceeding structural and leakage margin requirements will not occur before the end of the next planned operating interval.

The results of the REOC–14 inspection of "B" steam generator confirm that the Operational Assessments for Unit 2 "A" and "C" generators are valid since no new degradation mode was identified.

2.0 Condition Monitoring Assessment – Tube Integrity Evaluation

The condition monitoring assessment is an evaluation of the past operating cycle (REOC 14) relative to the structural and leakage integrity margins, in light of the current inspection results. The condition of the Surry Unit 2 steam generators, as indicated by the results of the inspection performed on "B" steam generator, satisfy the structural and leakage integrity margin at the end of REOC 14. The inspection results and the evaluations performed are discussed in the following sections.

2.1 Primary Side Inspection

No corrosion related degradation was noted during the eddy current inspection of "B" steam generator. The results of the inspection are consistent with prior findings and no new degradation modes were identified.

2.1.1 Bobbin Program

<u>AVB Wear Indications</u>

Six (6) AVB intersections, in 6 tubes, were identified to have tube wear in "B" steam generator. The maximum wear depth measured was 19% TW in the tube at R24C57. The observed wear indications did not challenge the tube integrity for "B" steam generator over the last operating interval because the indications were below both the tube repair limit and the structural limit. The average growth rate per cycle since the last inspection (1997 – approximately 65 EFPM) is 0.8 % with the last cycle maximum being 1.8 % TW. This growth rate is lower than the values derived from prior inspections.

There were 5 AVB related tube wear indications reported this inspection that were not reported in the previous 1997 inspection. Re-analysis of the 1997 data with the calibration normalized to the current setup was performed and all the indications were confirmed to exist in 1997. Table 1 lists all tubes with AVB wear "calls" identified during the current outage. Included in the table are the associated "growth" rates for each location. Based on the plugging evaluation, none of the indications required that the affected tubes be plugged.

The NDE technique performance data for detection and sizing of AVB wear with a bobbin probe is based on the EPRI database (ETSS # 96004.1). Using the EPRI database, an adjusted NDE parameter and a technique uncertainty was determined. The analyst uncertainty for wear measurements was obtained from the document "Capabilities of Eddy Current Data Analysts to Detect and Characterize Defects in SG Tubes", D. H. Harris. The value obtained for analyst variability is 7.04 %. According to EPRI Report TR-107621, Rev. 1, "Steam Generator Integrity Assessment Guidelines", dated March 2000, the total NDE uncertainty is equal to the square root of the sum of the squares of the measuring uncertainty and the analyst uncertainty. The total NDE uncertainty of 9.08% was employed in Table 1 to obtain the CML (Condition Monitoring Limit) value. As can be seen in Table 1, all AVB indications identified in "B" steam generator during the current inspection are expected to meet the structural limit of 60% through-wall at the end of the next operating period.

Table 1 Summary of AVB Reported Indications Identified in "B" Steam Generator (ETSS #96004.1 Rev. 9 Utilized For Sizing)

Row / Column	Inspection Date	2003 Results	Volts	Adjusted NDE % TW y=0.97x + 3.49	CML % TW
R38C51	09/01/2003	13% (AV4)	0.33	16.1	25.2
	10/01/1997	11% (AV4)*	0.22	14.2	23.3
R24C57	09/01/2003	19% (AV1)	0.56	21.9	31.0
	10/01/1997	16% (AV1)*	0.37	19.0	28.1
R31C58	09/01/2003	15% (AV2)	0.35	18.0	27.1
	10/01/1997	8% (AV2)*	0.17	11.7	20.8
R33C60	09/01/2003	15% (AV3)	0.36	18.0	27.1
	10/01/1997	10% (AV3)*	0.22	13.2	22.3
R32C69	09/01/2003	12% (AV2)	0.23	15.1	24.2
	10/01/1997	12% (AV2)	0.20	15.1	24.2
R38C74	09/01/2003	17% (AV2)	0.41	20.0	29.1
	10/01/1997	16% (AV2)*	0.38	19.0	28.1

* % Through-wall depth based on re-analysis of the 1997 eddy current data

Bobbin Non – Quantifiable Indications (NQI's)

During the bobbin coil inspection program a total of 85 indications were identified that required rotating coil (+Pt) confirmation. Of this total, 43 were located in the H/L, 41 in the C/L, and 1 in the U-bend AVB area. The signals for all but 3 of the indications were confirmed to represent no detectable degradation (NDD). The signals for tube locations R21C10, R22C10, and R22C11 were confirmed to represent volumetric indications (VOL). In addition, a potential loose part (PLP) was identified at locations R22C10 and R22C11. Subsequent inspection of these locations with a 20 kHz rotating coil probe, confirmed the presence of a foreign object. In accordance with the Analysis Guidelines, the 13 surrounding

tubes were also inspected with both a normal and low frequency rotating probe setup. The presence of a potential foreign object was identified at R22C10 and R22C11, but not at R21C10. No additional volumetric indications or foreign objects were identified in any of the surrounding tubes.

The indication found at location R21C10 was also reported during the 1997 and 1993 inspections. This indication was sized with a bobbin probe as 34% TW in 1993 and 38% TW in 1997. No evidence of a PLP (potential loose part) was reported during either inspection. In 1993 the indication was identified as less than 40% through-wall depth and left in service. In accordance with the plugging protocol in place in 1997, if an indication was below the plugging limit and no appreciable growth from the previous inspection was seen, the tube was left in service. No indications were reported in R22C10 and R22C11 in either 1993 or 1997. The 1993 and 1997 bobbin data was reviewed during the current outage and no indications or potential foreign objects were identified at either of these locations.

Bobbin (ETSS #96001.1) and +Pt (ETSS #21998.1) techniques were utilized to obtain wear depths for the three indications. The signal attributes (length and width) of the wear indications appeared to be closest to that of the ASME flat bottom hole standard. Due to the influence of the tube support structure, a 400/100 kHz (bobbin) and a 300/100 kHz (+Pt) suppression mix were created. For the bobbin calibration, an amplitude wear scar curve was created at 0%, 20%, and 40%. For the +Pt calibration, the 0.187" flat bottom holes were used to create a 0, 20% and 40% amplitude curve. Each flaw location was measured at the point providing the greatest amplitude. In order to determine the estimated wear rate, the 1993 and 1997 data was re-evaluated after being normalized to the current sizing methods. The results of the 2003 inspection and the re-evaluation of the 1993 and 1997 data are provided in Table 2.

Table 2 Summary of Foreign Object Wear Indications – 2nd Tube Support Plate

Location	2003 Inspection		Re –analysis of 1997 Bobbin Data	Re- analysis of 1993 Bobbin Data
	Bobbin (ETSS #96001.1)	Rotating coil (ETSS #21998.1)	Bobbin (ETSS #96001.1)	Bobbin ETSS #96001.1
R21C10 @ 2c + 0.55"	28% TW (amplitude wear scar curve)	20 % (+Pt) (ASME flat bottom hole amplitude curve)	29 % TW (amplitude wear scar curve)	25 % TW (amplitude wear scar curve)
R22C10 @ 2c + 0.88"	18% TW (amplitude wear scar curve)	17 % (+Pt) (ASME flat bottom hole amplitude curve)	NDD	NDD
R22C11 @ 2c + 0.67"	16% TW (amplitude wear scar curve)	16 % (+Pt) (ASME flat bottom hole amplitude curve)	NDD	NDD

Dent Signals (DNT)

Consistent with the inspection scopes for all the Surry steam generators, DNT signals continue to be monitored for potential degradation. During the bobbin inspection programs dent signals were reported as follows:

- Four hundred and seventy-nine (479) DNT signals in three hundred and thirty-five (335) tubes with voltages between 2.00 and 4.99 volts;

- Two hundred and eight (208) DNT signals in one hundred and eight (108) tubes with voltages between 5 and 19.99 volts; and

- Two (2) DNT signals in two (2) tubes with voltages greater than 20 volts.

Recording of DNT signals at the 3-volt level was instituted prior to the Spring 1999 inspection of Unit 2. The DNT reporting level has since been reduced to 2-volts beginning with the Fall 2000 inspection of Unit 2. As specified in the Analysis Guidelines, dents or bulges with amplitudes $\geq$ to 2 volts without a history confirmation must be re-inspected with a rotating coil to insure that the signal voltage and phase attributes are essentially unchanged from the previous inspections. Historical confirmation for resolution requires a prior bobbin inspection supported by rotating coil inspection or two prior bobbin inspections with no change in signal attributes.

Based on the analysis protocol, 41 dent indications required +Pt rotating coil inspection. A 20% sample consisting of a total of 140 DNT indications was inspected with a +Pt probe. The 20% sample population included the previously mentioned 41 DNT/NQI calls. No degradation was noted.

Recent inspection results from the Unit 1 and 2 "C" steam generators have shown an apparent pattern of denting on peripheral tubes at the 6th and 7th tube support plates. Of the 689 dents reported this outage, 92 were reported at 7H, 26 at 7C, 1 at 6H, and 5 at 6C. As was the case for the "C" steam generators, the dents being reported are predominantly located in upper elevations of periphery tubes and tend to be located near the tube support wedge locations. The progression of the dent signals in the Unit 1 and 2 steam generators will continue to be monitored during the course of routine inspections.

Bulge Signals (BLG)

During the bobbin inspection program, a total of 37 bulges were reported in Row 1 and 2 tubes near the U-bend tangent point. The BLG indications are most likely related to the manufacturing or fabrication practices used to produce the U-bend. The eddy current characteristics of these signals have not changed from past inspections. All the row 1 U-bends (including the tangent area) were inspected during the row-1 U-bend +Pt inspection program, and no degradation was noted. In addition, tubes with bulges near the tangent point in row 2 tubes were included in the 20% DNT sample program and no degradation was found.

2.1.2 Focused Rotating Coil Programs

Hot Leg Top-of-Tubesheet

Five hundred and forty-five (545) tubes in the Critical Area (CA) and 1835 tubes outside of the CA region were included in the hot leg top-of-tubesheet program. The tubes inspected outside of the CA was a one-time program to capture all the hot leg transition zone tubes that were not previously inspected using a rotating probe. No corrosion degradation was noted. Two (2) locations (R22C82 @ TSH + 0.31" and R23C82 @ TSH + 0.06") were identified with volumetric indications. Based on the rotating coil signal attributes (length and width) of the wear indications, the flat bottom hole standard and ETSS #21998.1 was used for sizing. Using this technique, the indication in the tube at R22C82 was sized at 30% and the indication in the tube at R23C82 was sized at 6%. All the surrounding tubes were inspected using the standard +Pt technique as well with a low-frequency 20 kHz +Pt technique. No evidence of wear or foreign objects was identified in or near any of the surrounding tubes. All tubes with previously reported anomaly indications at the tubesheet were also included in the top-of-tubesheet +Pt inspection program. No evidence of degradation was observed in these tubes.

Row 1 U-bends

All of the Row 1 U-bends (92 open tubes) were inspected with a 0.680 diameter single coil +Pt U-bend probe. No indications were noted. Signal-to-noise measurements were taken on a 20 tube sample set and the results compared with the EPRI qualification data used in developing ETSS #96511 for both the 300 kHz and 400 kHz data sets. The average signal-to-noise values obtained on the tubes in the sample set were within acceptable values.

2.1.3 Data Quality

The inspections performed were consistent with the Program Plan and Revision 6 of the EPRI Steam Generator Examination Guidelines, including the Interim Guidance issued by EPRI. The interim guidance addressed technical concerns raised by the industry regarding the effect of noise on tube integrity parameters (POD, sizing uncertainties). The interim guidance requires a trial application of noise measurement. The consensus of the industry committee overseeing this issue is that the most appropriate parameter to record for signal noise is signal amplitudes (peak to peak and vertical maximum). Accordingly, the interim guidelines recommended the selection of a sample population of tubes for measurement and recording of noise. The objective of this activity was to ensure that the expected capabilities of site-qualified techniques to detect and size tube degradation was valid for each active, relevant or potential damage mechanism identified under the conditions encountered during the inspection. This sampling was conducted and the results confirmed that no degradation of the inspection results was introduced by noise. Other requirements of Revision 6 relative to data quality verification were implemented by way of an automated on-line data quality verification system. In addition, the data analysis team performed manual verification for each tube and/or each calibration set as required. The Surry Site Specific Eddy Current Analysis Guidelines (Analysis Guidelines) and Westinghouse eddy current data analysis and data acquisition technique sheets were used for system calibration, and data analysis.

A sampling program was used during this outage to obtain "noise" related data. Vertical maximum (Vvm) voltage and peak-to-peak voltage (Vpp) measurements were obtained in potentially susceptible areas that were free of flaw signals. This is similar to the approach that was implemented during the Surry Unit 1 Spring 2003 outage. The areas selected were (1) Tubesheet Expansion, (2) Freespan above Top-of-Tubesheet, (3) Tube Support Plate Intersection, (4) AVB Intersection, (5) U-bend, and (6) Freespan. The average noise amplitude from these locations was compared to the average noise amplitude documented in the EPRI technique qualification database. Both the Vvm and Vpp voltage measurement was used. A summary of the results is presented in Table 3. The plant average noise values and the 95/50 confidence noise values are acceptable compared to corresponding values documented in the EPRI technique qualification database. No modifications to the probability of detection (POD) values documented in the EPRI database are necessary.

Table 3 Summary of Surry Unit 2 Noise Measurements – Steam Generator B

Location	ETSS Noise Measurements					Surry 2 – SG B Noise Measurements			
	Number and (Probe)	Vvm		Vpp		Vvm		Vpp	
		Avg.	95/50	Avg.	95/50	Avg.	95/50	Avg.	95/50
Row 1 U-bend	96511.1 Rev 12 (+ Pt)	0.40	0.71	1.09	1.62	0.37	0.44	0.93	1.18
Expansion Transition	21410.1 Rev 2 (+Pt)	0.21	0.41	0.41	0.94	0.17	0.27	0.41	0.65
1 Inch Above TS	21409.1 Rev 2 (+Pt)	0.42	-	2.02	-	0.09	0.18	0.14	0.28
Freespan (5" Above TS)	96008.1 Rev 12 (Bobbin)	0.6	-	1.37	2.11	0.11	0.16	0.34	0.53
TSP	96008.1 Rev 12 (Bobbin	0.6	-	1.37	2.11	0.18	0.25	0.69	1.01
AVB	96004.1 Rev 9 (Bobbin)	No ETSS data available – Surry 2 data shows that AVB wear indications of approximately 10% can be detected				0.09	0.13	1.22	2.59

2.2 Condition Monitoring Conclusion

In order to demonstrate structural integrity for condition monitoring, it is necessary to account for various uncertainties, which are then subtracted from the structural limit. The result is compared with the largest flaw measured.

Two (2) degradation modes, AVB related tube wear and foreign object wear, were identified during this Unit 2 inspection. The largest AVB related tube wear measured during the current inspection was 19% at AV2 in tube R24C57. The largest foreign object wear indication was located at the hot leg top-of-tubesheet transition of the tube at R22C82 and was sized at 30% using ETSS #21998.1 Rev 2 and the ASME flat bottom hole standard. The structural limit

using the ASME Code equation for uniform wear of a 7/8" diameter x 0.050" thick tube is 60% through-wall, that is, 0.020 inch remaining wall.

Adjusting the measured wear indication at AV2 in tube R24C57 using ETSS #96004.1 Rev. 9 regression equation (y = 0.97x + 3.49; where x = measured and y = adjusted) results in a measurement adjustment of 2.8% TW. With a total NDE uncertainty (technique + analyst) of 9.08% TW, adding the measurement adjustment and total NDE uncertainty to the 22% measured depth results in a condition monitoring value of 33.9% TW. This value is well below the Bounding Structural limit of 60% TW.

Adjusting the measured wear indication at the hot leg top-of-tubesheet transition of R22C82 using ETSS #21998.1 Rev. 2 regression equation (y = 1.02x + 5.81; where x = measured and y = adjusted) results in a measurement adjustment of 6.4% TW. With a total NDE uncertainty (technique + analyst) of 10.7% TW, adding the measurement adjustment and total NDE uncertainty to the 30% measured depth results in a condition monitoring value of 47.1% TW. This value is well below the Bounding Structural limit of 60% TW.

Based on the evaluations of this report, all indications found in the REOC-14 inspection satisfy the condition monitoring requirements for structural and leakage integrity. The projected burst capability was well in excess of the performance criteria of three times normal steady state power operation.

3.0 Operational Assessment: Tube Integrity and Leakage

3.1 Discussion

NEI 97-06 requires a "forward looking" operational assessment to determine if the steam generator tubing will continue to meet the structural and leakage integrity requirements at the end of the next cycle based upon the degradation mechanisms observed in the plant. This assessment includes site-specific degradation growth rates and NDE uncertainties for the largest flaw remaining in service. The following sections summarize the growth rate evaluation and the NDE sizing uncertainty evaluations performed to support the Operational Assessment.

Based on information contained in Dominion's fuel management document, the last operating interval between inspections of "B" steam generator was approximately 65.0 EFPM. The projected operating interval until the next inspection of S/G "B" is approximately 48.0 EFPM.

The only operationally related indications that were reported during current inspection programs was mechanical tube wear at AVB locations and freespan wear due to interaction with foreign objects. The AVB wear indications seen were consistent with prior inspection results. Typically, AVB wear indications begin to be reported at approximately 10% through-wall depth and are slow growing. The data to date indicates the AVB wear at Surry to be "inactive" as defined by the EPRI Rev. 6 Examination Guideline. A total of 6 tubes (6 AVB locations) exhibited mechanical wear. The overall findings are consistent with the improved performance of the 51 Series (original and F-type replacements) as compared to the Model F units.

The indications noted at the 2nd cold leg tube support for locations R21C10, R22C10, and R22C11 were the result of interaction with a foreign object in this area. Rotating coil inspection revealed the presence of a foreign at locations R22C10 and R22C11, but not at R21C10. Visual examination confirmed the presence of a foreign object in this area. The appearance of the object is shown below.

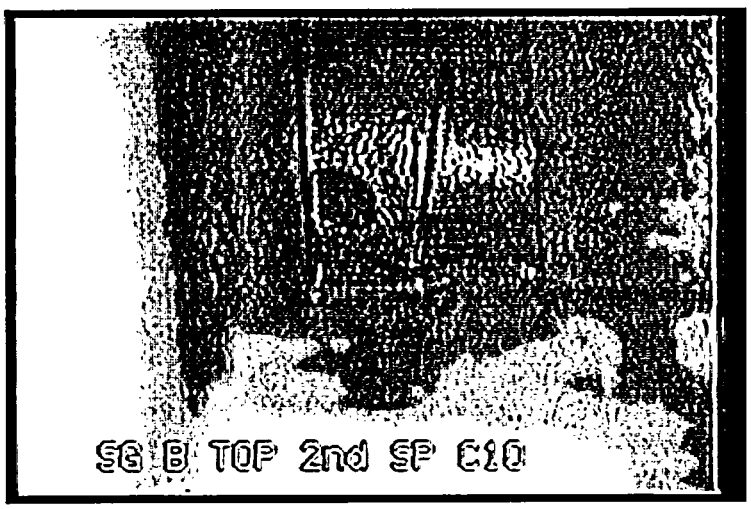


Figure 1 Appearance of Foreign Object at 2nd TSP on the Cold Leg of SG "B" Surry Unit 2

One end of the object was positioned between R21C10 and R22C10 and extended across Column 10. The other end was positioned between R21C11 and R22C11. The object did not extend into Column 9 or Column 11. The foreign object has apparently been located this position since at least 1993. This conclusion is based on the fact that a "volumetric" indication was reported on R21C10 during the 1993 inspection. Subsequent bobbin inspections in 1997 and 2003 showed minimal change in the indication (Table 2). The 1993 and 1997 bobbin inspections identified no other tubes in this area. During the 2003 inspection, wear-like indications were identified at R22C10 and R22C11. Rotating coil inspection in 2003 confirmed the indications. Since the foreign object was not removed, an evaluation was performed to support continued operation until the next schedule inspection of "B" steam generator in the Spring of 2008.

The guidance provided in EPRI Steam Generator Integrity Assessment Guidelines, Revision 1 (TR-107621-R1) states that structural integrity must be demonstrated at the next inspection by showing that the steam generator tubes meet the performance criteria. R21C11 is the only location that requires evaluation since R21C10, R22C10, and R22C11 were plugged this outage. Cable stabilizers were installed in the cold legs prior to plugging the tubes at R21C10, R22C10, and R22C11 to address the potential for continued wear at these locations. Even though, no wear was observed on R21C11, it is necessary to evaluate the possibility that the foreign object could interact with the tube during subsequent plant operation. Movement of the object from its current position is considered unlikely based on observation of the object and the fact that the object has been at this position since 1993.

One approach for the evaluation of R21C11 would be to use the wear rate observed on R21C10 since 1993 and apply this wear rate to the projected depth for R21C11 at the end of the next planned inspection of "B" steam generator (Spring 2008). This approach is considered non-conservative, since this rate was virtually zero. The alternate approach selected was to obtain the wear rate for R22C10 and R22C11 and apply this rate to R21C11. Two wear rates were developed and used in the evaluation. One rate was based on the wear of R22C10 and R22C11 starting after the 1997 restart to their current depths based on 4 cycles of operation (approximately 65 EFPM). The 95/50 growth rate based on this approach is 4.4%/cycle. The second wear rate was developed based on the wear starting half-way thorough the operating period, i.e., 32.5 EFPM. This approach is often employed for wear projections whenever multiple inspections are not available to develop a growth rate. The 95/50 growth rate based this approach is 8.8%/Cycle. A total NDE uncertainty of 10.4% and an existing wear depth of 10% are assumed. Using a growth rate of 4.4%/cycle, the projected wear depth for R21C11 in the Spring of 2008 is 33.6%. If the 8.8%/cycle growth rate is used, the resulting projected depth is 47.2%.

Based on the above evaluation, the structural integrity of R21C11 is demonstrated for the next planned operating period of 48 EFPM should wear begin on this tube. The projected wear depth for R21C11, including measurement adjustment and total NDE uncertainties would be well below the bounding structural limit of 60%.

The indications noted at the top of the tubesheet for hot leg locations R22C82 and R23C82 were likely caused by interaction with a foreign object. The identification of these indications resulted from the +Pt inspection performed for the first time this outage at these locations. Bobbin inspections did not identify the indications due to the close proximity of the indications to the expansion transition and the top of the tubesheet. The bobbin and +Pt inspections performed this outage did not show the presence of a foreign object in this area. Since the object which produced the wear is apparently no longer in this area, it is not necessary to include growth rate in order to demonstrate structural integrity at the end of the next planned inspection interval, i.e., 48 EFPM. Therefore, the current condition monitoring depth of 47.1% becomes the operational assessment depth. This value is well below the bounding structural limit of 60%.

3.2 AVB Wear Depth Projections

The guidance provided in EPRI Steam Generator Integrity Assessment Guidelines, Revision 1 (TR-107621-R1) states that structural integrity must be demonstrated at the next inspection by showing that the steam generator tubes meet the performance criteria based upon the overall uncertainty at a probability of 0.90, evaluated at 50% confidence. The guideline also indicates that growth rates should be based on a 95/50 confidence. This evaluation addresses all the AVB wear conditions found during the REOC-14 inspection projected to the end of the next planned operating interval (48.0 EFPM) for "B" steam generator. The AVB indications identified were included in the recently completed statistical analysis of the AVB data for both Surry Unit 1 and 2. An updated summary for Surry Unit 2 is provided in Table 4. Based on the limited number of wear sites in Unit 2 "B" steam generator, the AVB growth rate used for the operational assessment projection was based on the statistical mean of the combined wear rate for all three Unit 2 steam generators including data obtained during this

inspection. Based on a 95/50 CL, the AVB wear rate used in the operational assessment was 5.26 %/Cycle.

The technique uncertainty utilized for the operational assessment was obtained from ETSS #96004.1 (Rev 9). The total NDE uncertainty was 9.08% and the adjusted %TWD was based on $y = 0.97x + 3.49$. Table 5 lists the projected %TW at REOC-17 (Spring 2008) for all AVB wear sites left in service in "B" steam generator. All indications are projected to be below the structural limit of 60%.

Table 4 – Surry Unit 2 AVB Statistical Summary

a) Steam Generator 'A"

Number of Tubes with AVB Wear Indications	11
Number of AVB Wear Sites	14
Average Wear Rate	1.35%TWD / Cycle
Number of Data Points	30
Standard Deviation	1.31% TWD / Cycle
90/50 Wear Rate = Mean + 1.28 x Standard Deviation	3.02%TWD / Cycle
95/50 Wear Rate = Mean + 1.65 x Standard Deviation	3.50% TWD / Cycle
Number of Tubes Plugged	0

b) Steam Generator "B"

Number of Tubes with AVB Wear Indications	11
Number of AVB Wear Sites	16
Average Wear Rate	2.99%TWD / Cycle
Number of Data Points	17
Standard Deviation	2.10% TWD / Cycle
90/50 Wear Rate = Mean + 1.28 x Standard Deviation	5.68% TWD / Cycle
95/50 Wear Rate = Mean + 1.65 x Standard Deviation	6.46% TWD / Cycle
Number of Tubes Plugged	5

c) Steam Generator "C"

Number of Tubes with AVB Wear Indications	43
Number of AVB Wear Sites	73
Average Wear Rate	2.75%TWD / Cycle
Number of Data Points	111
Standard Deviation	1.55% TWD / Cycle
90/50 Wear Rate = Mean + 1.28 x Standard Deviation	4.74% TWD / Cycle
95/50 Wear Rate = Mean + 1.65 x Standard Deviation	5.31% TWD / Cycle
Number of Tubes Plugged	10

d) Steam Generators "A", "B", and "C" Combined

Number of Tubes with AVB Wear Indications	65
Number of AVB Wear Sites	103
Average Wear Rate	2.51%TWD / Cycle
Number of Data Points	158
Standard Deviation	1.67% TWD / Cycle
90/50 Wear Rate = Mean + 1.28 x Standard Deviation	4.64% TWD / Cycle
95/50 Wear Rate = Mean + 1.65 x Standard Deviation	5.26% TWD / Cycle
Number of Tubes Plugged	15

Table 5 Surry Unit 2 – Spring 2003
Steam Generator Eddy Current Inspection Summary – AVB Indications

- Number of Tubes With AVB Indications: 6 Tubes
- Number of AVB Wear Sites: 6 Intersections
- Number of New Indications Not Existing in 1997: 0
- "B" S/G Average Wear Rate For Current Inspection (%TW / Cycle) 0.8 % / Cycle
- "B" S/G Historical Average Wear Rate (% TW / Cycle): 2.99 % / Cycle
- 95%/50% Wear Rate Based on Unit 2 Historical Data : 5.26 % / Cycle
- NDE Total Sizing Uncertainty at 90% CL 9.08 %
- 2008 Projection % TW Adjusted 2003 % TW + [5.26 x 3 cycles] + 9.08 %

Row / Column	2003 % TW	Adjusted NDE % TW y=0.97x + 3.49	Wear Rate (% TW / Cycle)	Projected Spring 2008 (%TW)
R38C51 @ AV4	13	16.1	5.26	41
R24C57 @ AV1	19	21.9	5.26	46.8
R31C58 @ AV2	15	18.0	5.26	42.9
R33C60 @ AV3	15	18.0	5.26	42.9
R32C69 @ AV2	12	15.1	5.26	40
R38C74 @ AV2	17	20.0	5.26	44.9

3.3 Operational Leakage

Although there are no indications of primary-to-secondary leakage that indicate a concern, these indications will continue to be monitored using conservatively based monitoring procedures. Revision 2 of the EPRI Primary-to-Secondary Leakage Guideline has been implemented as part of an assessment of the current procedures compared to those guidelines and related commitments to the NEI 97-06 S/G Program Guideline Document.

3.4 Projected Accident Leakage

There were no inspection findings that indicated leakage would occur during the ensuing operating cycle since the findings revealed no operative degradation mechanisms.

3.5 Conclusion

Based on the results of the current and past eddy current inspections, selected secondary side inspections, and the present chemistry operating practices, Unit 2 "B" steam generator meets the performance criteria to operate for at least three cycles before the next planned tubing inspection. If other issues are identified on other Surry steam generators during ensuing inspections or other relevant industry findings are noted during the inspection of similar model steam generators, review of the planned inspection intervals will be conducted. The results of the REOC-14 routine inspection of "B" steam generator indicate that the existing Operational Assessments for the Unit 2 "C" and "A" steam generators are valid. No change to their currently planned tubing inspections in the Spring of 2005 and the Fall of 2006, respectively, is necessary.

Results of secondary side inspections continue to demonstrate reliable operation. Continuing diligence in chemistry and FME control will support long term performance. Evaluation and monitoring will continue as planned and is further detailed in the Monitoring and Inspection Program Plan. Continuing awareness of any related industry issues will be considered when planning future inspections.

Similar chemistry controls are expected to exist throughout the next cycle. The impact on planned inspection cycles and scopes as a result of chemistry excursions or significant changes to treatment programs will be evaluated on a case-by-case basis. Due to the low amounts of sludge being removed and continued low corrosion product transport, sludge lancing or other enhanced methods will continue to be planned on an every other outage basis. The laboratory analysis of scale samples and subsequent review of results will be continued and those results will be evaluated with respect to the required frequency of sludge lancing operations. Supplemental inspections and enhanced cleaning methods will be pursued consistent with the evaluation nearing completion on scale conditioning processes and associated removal techniques.

Corrective Actions Planned

None

Evaluation (If SG condition does not meet previous cycle operational assessment)

Not Applicable

ATTACHMENTS:

Attachment 1 – Letter Codes
Attachment 2 – Series 51F Steam Generator - Sketches

ATTACHMENT 1
Letter Codes

General Codes

ANF - ANOMALY NOT FOUND -Indicates that a previously reported anomaly cannot be found within .50" of the location where the anomaly was previously called.

ANR - ANOMALY NOT REPORTABLE - Indicates that a previously reported anomaly does not meet the present reporting criteria.

BDA - BAD DATA (retest) – Indicates that the data for the specified tube is not acceptable for analysis due to poor signal quality. The tube will be re-tested to the required extent.

INF - INDICATION NOT FOUND - Indicates that a previously reported INDICATION has not been found in the data being analyzed or that a tube/signal is being re-tested for positive identification (PID) and no signal is present in the retest data.

INR - INDICATION NOT REPORTABLE - Indication called in previous inspections that are still detectable but fall below current reporting criteria.

NDD - NO DETECTABLE DISCONTINUITY – The recorded data has no signal responses meeting the criteria established in the Site Specific Analysis Guidelines for degradation, damage precursors or anomalies.

NDF - No Degradation Found - Used to address a special interest location where no signal meeting the RC criteria (MBM, DNT, etc) is present. Location of rotating coil data verses the bobbin coil shall be verified to ensure correct location was inspected.

NT - NO TEST (re-test) – Indicates that the tube ROW, COLUMN was encoded on the tape; however, no inspection data was recorded for analysis.

OBS - OBSTRUCTED – Blockage of a tube that prevents passage of a defined minimum size probe through the tube.

PID - POSITIVE IDENTIFICATION - Verification of a signal at the same reported ROW/COL and at the same reported tube location.

PLG - PLUG – Indicates that the tube at the specified location has been plugged.

PVN - PERMEABILITY VARIATION – Condition where the test coil impedance changes due to a change in the tubing materials inherent tendency to conduct magnetic flux lines.

PLP – POSSIBLE LOOSE PART – Indicates the possible presence of a loose part in the generator.

RST - RESTRICTED - Blockage of a tube that prevents passage of a probe beyond a specified location within the tube.

TIU - TUBE I.D. UNCERTAIN (re-test) - Indicates that the ROW and/or COL identifier for a given tube is in doubt.

LAR - Lead Analyst's Review - Condition not directly covered by the guidelines, ETSS, or other documentation that the data analyst feels should be brought to the attention of the resolution and/or job lead analyst. Diagnostic testing or PID verifications that the analyst believes are not the correct tube number and/or the correct tube location shall be identified as LAR.

BOBBIN CODES

BLG - BULGE - An area along the tube where the diameter of the tube has been abruptly deformed in an outward direction as compared to the nominal tube diameter.

CUD - COPPER DEPOSIT - The presence of copper deposits on the outside of the tube.

DNT - DENT – An area along the tube where the diameter of the tube has been abruptly reduced compared to the nominal tube diameter.

LGV - LOCAL GEOMETRIC VARIATION - A local reduction in tube diameter usually associated with a localized change in conductivity of the tube. LGV signals are caused by dings introduced during manufacturing/installation process and do not represent a discernible wall loss. The signals must be verified by history review to be called with bobbin (See rotating probe DNG code).

MBM - MANUFACTURING BURNISH MARK – A tubing condition where localized tubing imperfections were removed by buffing and are detectable due to the effects of cold working and minor localized wall thinning. The signal must be verified by history review to be called with bobbin.

MMB - MULTIPLE MANUFACTURING BUFF MARK - Multiple MBM signals in close proximity over a length of tube. The signals must be verified by history review to be called with bobbin.

NQI – NON-QUANTIFIABLE INDICATION – A bobbin signal requiring rotating coil examination for disposition.

NQN – NON-QUANTIFIABLE NONDEGRADED – A bobbin signal which was formally classified as NQI but has been determined to be anomalous or of a type which does not represent degradation.

PDS - POSTIVE DRIFT SIGNAL –Long (several inches to several feet) drift signals evident on absolute channels caused by variations in tube concentricity associated with the pilgring process. The signals may be located at random elevations and are generally only in one leg of the tube.

PTE – PARTIAL TUBE EXPANSION –. Code used when only some portion of parent tube has been expanded into the carbon steel tube sheet. PTE shall be reported at the axial location(s)where nominal tube expansion ends and the partial begins, from the 400/100 mix channel. Bobbin and/or rotating coil data shall be carefully analyzed in the non-expanded crevice region.

NTE – NO TUBE EXPANSION – Code used when the parent tube has NOT been expanded into the carbon steel tube sheet from the top of the tube sheet to approximately 2.5" from the tube end. NTE shall be reported from the 400/100 mix channel, location as TSH +0.00. Bobbin and/or rotating coil data shall be carefully analyzed in the non-expanded crevice region.

ROTATING PROBE CODES

DNG - DING – A localized inward displacement of the tube caused by a mechanical impact on the OD surface.

MAA - MULTIPLE AXIAL ANOMALY - Multiple axially oriented signals located at the top of the tube sheet that the rotating coil data shows to result from an anomalous condition in the tube.

MCA - MULTIPLE CIRCUMFERENTIALLY ORIENTED ANOMALY - Multiple circumferentially oriented signals located at the top of the tube sheet that the rotating coil data shows to result from an anomalous condition in the tube.

MAI - MULTIPLE AXIAL INDICATION - Multiple axially oriented signals that the rotating coil data shows to result from flaws in the tube.

MBM - MANUFACTURING BURNISH MARK – A tubing condition where localized tubing imperfections were removed by buffing and are detectable due to the effects of cold working and minor localized wall thinning.

MCI - MULTIPLE CIRCUMFERENTIALLY ORIENTED INDICATION - Multiple circumferentially oriented signals reported from rotating probe data that the rotating coil data shows to result from flaws in the tube.

MMB - MULTIPLE MANUFACTURING BUFF MARK - Multiple MBM signals in close proximity over a length of tube.

NQN – NON-QUANTIFIABLE NONDEGRADED – A bobbin NQI signal which is determined to be anomalous or not to represent degradation.

PIT - PIT – Localized attack on tubing resulting from non-uniform corrosion rates caused by the formation of local corrosion cells. At Surry, the condition produces small volumetric indications with approximately the same axial and circumferential extent.

SAA - SINGLE AXIAL ANOMALY – A single axially oriented signal located at the top of the tube sheet that the rotating coil data shows to result from an anomalous condition in the tube.

SCA - SINGLE CIRCUMFERENTIALLY ORIENTED ANOMALY – A single circumferentially oriented signal located at the top of the tube sheet that the rotating coil data shows to result from an anomalous condition in the tube.

SAI - SINGLE AXIAL INDICATION – A single axially oriented signal that the rotating coil data shows to result from a flaw in the tube.

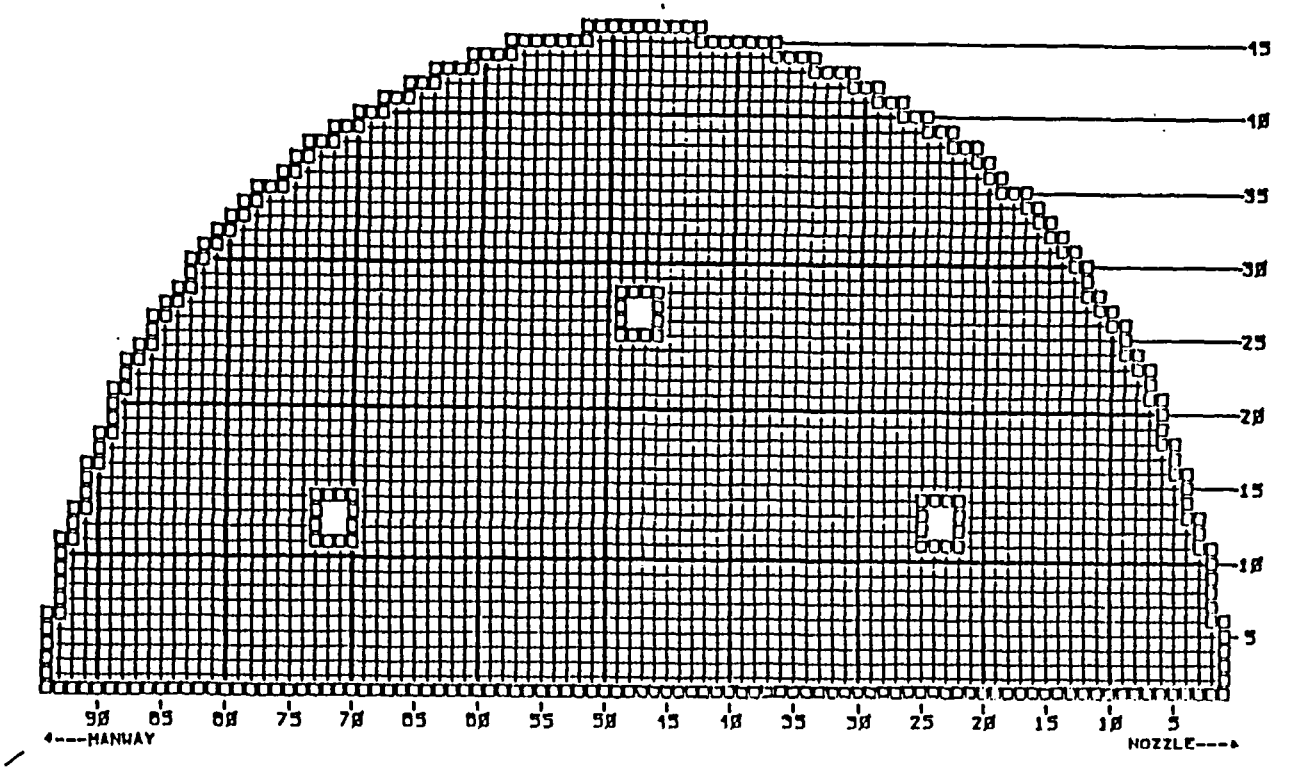
SCI - SINGLE CIRCUMFERENTIALLY ORIENTED INDICATION – A single circumferentially oriented signal that the rotating coil data shows to result from a flaw in the tube.

VOL – VOLUMETRIC – Indications of volumetric wall loss indicative of general localized thinning, wear or impingement.

SVI/MVI – SINGLE VOLUMETRIC INDICATION/MULTIPLE VOLUMETRIC INDICATIONS – Indications of volumetric wall loss indicative of general local inter-granular attack (IGA or IGA/SCC).

SERIES 51-F

MASTER



Attachment 2
Surry Steam Generator Sketches