FPL Energy
Seabrook Station

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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Seabrook Station
Steam Generator Inservice Inspection

FPL Energy Seabrook, LLC encloses pursuant to Seabrook Station Technical Specification Surveillance Requirement 4.4.5.5b, a report documenting the results of inservice inspections conducted on the Steam Generators during the ninth refueling outage that occurred in October 2003.

Should you require further information regarding this matter, please contact Mr. Paul Freeman, Manager of Engineering, at (603) 773-7452.

Very truly yours,

FPL Energy Seabrook, LLC

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cc:
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ENCLOSURE TO SBK-L-04040

FPL Energy Seabrook, LLC

SEABROOK STATION

STEAM GENERATOR INSERVICE INSPECTION

October, 2003

OR09

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1.0 Introduction

In October 2003, Seabrook's ninth refueling outage; Steam Generators A, B, C, and D were inspected. This was accomplished in accordance with Seabrook Station Technical Specification 4.4.5. This report presents the results of the inspection pursuant to Technical Specification 4.4.5.5.b. and NEI 97-06. The following results are presented:

- Scope of inspections performed.
- Active degradation mechanisms found.
- NDE Techniques used for each degradation mechanism.
- Number of tubes plugged or repaired during the inspection outage for each active damage mechanism. Repair methods used and the number of tubes repaired by each repair method.
- Total number and percentage of tubes plugged and/or repaired to date and the effective plugging percentage in each steam generator.
- Description of the tube integrity assessment.
- Description of corrective actions implemented, if any.
- Evaluation of circumstances if condition monitoring results exceeded the previous cycle of operational assessment.

Seabrook Station is a Westinghouse four-loop pressurized water reactor with Model F steam generators. The generators are U-bend heat exchangers, with tube bundles fabricated using thermally treated Inconel 600 tubing. A row and column number identifies each tube. There are 59 rows and 122 columns in each steam generator, for a total of 5,626 tubes. Nominal tube OD is 0.688" with a 0.040" nominal wall.

The Technical Specifications require a tube to be plugged when tube wall-loss equals or exceeds 40% of nominal wall. Twelve tubes required plugging as a result of eddy current inspection results. There were also three tubes that did not exceed the plugging limit, but were preventively plugged.

2.0 Scope of Inspections Performed

Westinghouse Electric Corp. conducted the inservice inspection of steam generators. The data acquisition and analysis was conducted in accordance with the ASME Code; Seabrook Station Technical Specifications and procedures, EPRI Steam Generator Examination Guidelines, and the Seabrook Steam Generator Eddy Current Data Analysis Guidelines Manual. The acquisition and analysis techniques were all qualified in accordance with Appendix H of the EPRI PWR Steam Generator Examination Guidelines.

Pre-Outage Inspection Plan

The pre-outage inspection plan included all four Steam Generators (SGs). Reference 5 identifies Anti Vibration Bar (AVB) wear as an active degradation mechanism, based on OR08 inspection data, in SGs A, B and D. This is based on the definition of active degradation mechanisms contained in the EPRI PWR Steam Generator Examination Guidelines, revision 6 and an ongoing degradation mechanism in SG C.

The Final Operational Assessment for OR08 provided justification of the operability of the SGs during Cycle 9.

EPRI PWR Steam Generator Examination Guidelines, revision 6, defines the inspection intervals. For Alloy 600 Thermally Treated (TT) tubing, the first inspection interval is up to 120 Effective Full Power Months (EFPM); the second inspection interval is 90 EFPM, the third and subsequent inspection intervals are 60 EFPM. Seabrook had accumulated 116 EFPM through OR08; therefore, the OR09 inspection defines the beginning of the second inspection interval for Seabrook. The requirement for the second inspection interval is that 50% of the tubes must be inspected by the midpoint of the interval. The approximate midpoint of the second inspection interval is projected to be OR11.

The Seabrook base inspection for OR09 included:

- 100% full length bobbin inspection of Steam Generators A, B, C and D (except R1, R2 U-bends)
- 20% hot leg Top of Tube Sheet (TTS), ± 3", +Point inspection of Steam Generators A, B, C and D.
- 20% small radius (Row 1 and Row 2) U-bend +Point inspection of Steam Generators A, B, C and D
- 20% sample HL straight section dings and dents > 5 volts by bobbin with + Point[1]
- +Point examination of all "I-code" indications that were new or not resolved after history review
- Visual inspection of installed plugs in both the hot and cold leg, utilizing remote video techniques

The base inspection performed at OR09 met both the technical specification requirements and the requirements of the EPRI examination guidelines (Reference 3).

Seabrook had committed to expansion of the RPC inspection program to 100% of the sludge pile region and 100% of the tubes in the buffer zone in all 4 SGs if circumferential cracking was identified in the sludge pile region of the scheduled SGs. (The buffer zone was defined as the tubes within the flow distribution baffle cutout.) Further, if circumferential cracking was identified in a tube outside the sludge pile region, 100% of the tubes in all four steam generators were to be inspected for circumferential cracking using qualified techniques.

[1] Dings and dents are considered the same population in the Model F SG, since the use of stainless steel TSPs obviates the potential for denting. A dent is considered a ding that coincidentally occurs at a structure such as a TSP or an AVB.

Similarly, if circumferential cracking was reported in the Row 1 tubes in the Seabrook SGs, 100% of the U-bend in Rows 1 and 2 of all 4 SGs were to be examined for circumferential cracking using qualified techniques. If a circumferential crack was detected in Row 2, a 20% sample of Row 3 tubes was to be inspected in all four SGs. U-bend inspections were to continue to be expanded in a like manner until the region of cracking was bounded.

If axial cracking were reported, the expansion criteria of Reference 3 were to be applied.

Additional inspection was performed to bound the tubes exhibiting possible loose parts (PLP) signals during the inspection. (See discussion of PLP below).

Inspection Expansion

No expansion of the inspection plan was required. For AVB wear, a 100% inspection of the affected tubes was performed in the base bobbin program. For Outside Diameter Stress Corrosion Cracking (ODSCC) no expansion was required because the defined critical area for ODSCC (the tubes identified as containing the Absolute Drift Signal (ADS) signals) was 100% inspected using the bobbin probe and 100% of the buffer zone was inspected with the bobbin probe. No other operational degradation was detected that required expansion of the inspection sample.

Root Cause Analysis

An evaluation was performed to determine the root cause of the cracking observed at the TSPs in OR08. The principal cause of cracking was determined to be elevated residual stresses in the degraded tubes that made them more susceptible to corrosion in the operating environment. A characteristic shape in the bobbin signal trace was identified that correlated with the degraded tubes and which showed that there were an additional six undegraded low row tubes that exhibit the elevated residual stresses. The reported ODSCC is not considered to be a new and generic degradation mechanism for the model F SGs.

3.0 Active Degradation Mechanisms

The EPRI Examination Guidelines, Rev. 6, (Reference 3) define "Active Damage Mechanism" as:

A combination of 10 or more new indications (≥20% through wall) of thinning, pitting, wear (excluding loose part wear), or impingement and previous indications that display an average growth rate equal to or greater than 25% of the repair limit in one inspection to inspection interval in any one steam generator,

One or more new or previously identified indications (≥ 20% through wall) which displays a growth equal to or greater than the repair limit in one inspection to inspection interval, or

Any crack indication (outside diameter intergranular attach/stress corrosion cracking or primary side stress corrosion cracking).

ODSCC

Since ODSCC was confirmed at several TSP locations, and no acceptable sizing technique is available for this degradation mechanism, the tubes with these indications must be plugged. Consequently ODSCC at the TSPs meets the definition for an active degradation mechanism in SG-D at Seabrook. The ODSCC was confined to three of the six tube critical area that was identified in the root cause analysis.

AVB Wear

Table 4, AVB Wear, summarizes the current data with regard to AVB wear to evaluate if AVB wear is an active degradation mechanism in the Seabrook SGs. Neither of the definitions of an active degradation mechanism is met for any of the Seabrook SGs; therefore, AVB wear is not an active degradation mechanism as defined by the EPRI examination guidelines. However, AVB wear is clearly an ongoing degradation mechanism, and planning of future inspections should consider the continuing nature of AVB wear.

4.0 NDE Techniques for Damage Mechanisms

All damage mechanisms associated with OR09 were grouped according to their likelihood of occurrence:

Active

The following damage mechanisms and previous indications of degradation that were considered active for OR09:

- Tube Wear @ AVB's. EPRI ETSS #96004
- ODSCC @ TSP EPRI ETSS 96008.1 for bobbin and #21409 for RPC

Relevant

Defined as degradation found in similar plants with the same tubing material and similar design features, as well as mechanisms observed at Seabrook, which do not meet the active definition. Degradation relevant to Seabrook are:

- Loose Part Wear EPRI ETSS #96001 for Bobbin and # 21998 for RPC
- Baffle/ Support Plate Wear EPRI ETSS #96004 for bobbin; #21998 for RPC

Potential

Defined as degradation not found in similar plants but judged to have meaningful potential to occur based on historical or lab data. The following damage mechanisms were considered potential for OR09:

- U-Bend PWSCC EPRI ETSS #96511
- Ding SCC EPRI ETSS #20510 for RPC-ID and #21409 for RPC-OD
- Sludge Pile ODSCC EPRI ETSS #96008 for bobbin and 21409
- ODSCC @ transition zone TSH EPRI ETSS # 21409 and 21410 for RPC
- PWSCC @ transition zone TSH EPRI ETSS # 20510 and 120511 for RPC
- Pitting in the presence of Copper EPRI ETSS #96005 for bobbin

5.0 Plugging

Table 1, Tube Plugged List: OR09, lists the tubes that were plugged and summarizes the degradation attribution of tubes plugged during OR09 at Seabrook. In all SGs, tubes plugged for AVB wear included at least one indication that equaled or exceeded the 40% TW Technical Specification plugging criterion. Other tubes with significant AVB wear were examined for unusual wear patterns and growth rates; none was judged to have growth rates or wear patterns that indicated administrative plugging was warranted.

In SG-D, a critical area of tubes was defined (see Table 3) as those tube identified at OR08 with the Absolute Drift Signal (ADS) which identifies tubes with elevated residual stress that may cause the tubes to be more susceptible to ODSCC (Reference 4). Among the tubes in the critical area, seven indications (MAI/SAI) were detected in three tubes. These three tubes were plugged. In addition, as a preventive measure, the remaining three tubes in the critical area were also plugged.

Table 1
Tubes Plugged List: OR09

SG	Tube	Attribution	Notes
A	R49C96	AVB Wear	40% TW at AVB4
B	R18C64	AVB Wear	41% TW at AVB6
C	R42C72	AVB Wear	40% TW at AVB4
	R40C39	AVB Wear	40% TW at AVB4
D	R40C80	AVB Wear	40% TW at AVB4
	R49C69	AVB Wear	43% TW at AVB4
	R42C49	AVB Wear	41% TW at AVB5
	R42C52	AVB Wear	41% TW at AVB5
	R47C44	AVB Wear	43% TW at AVB6
	R4C64	SCC (MAI/SAI)	Confirmed SCC at 02H, 03H and 05H
	R9C25	SCC (SAI)	Confirmed SCC at 02H, 03H and 04H
	R5C87	SCC (SAI)	Confirmed SCC at 04H
	R7C91	Preventive	Tube in critical area defined by presence of ADS signal; no degradation
	R9C28	Preventive	Tube in critical area defined by presence of ADS signal; no degradation
	R10C22	Preventive	Tube in critical area defined by presence of ADS signal; no degradation

There are a total of 140 tubes plugged in all four steam generators; 31 in SG A, 23 in SG B, 28 in SG C, and 58 in SG D. The percentage plugged on average is .62% with a current limit of 8%. The total number of tubes plugged is well below the plugging limit.

6.0 Eddy Current Testing Results

Table 2, Summary of OR09 Inspection Results, summarizes the indications reported during OR09. Among these indications, only the SAI/MAI and PCT (AVB) indications represent tube degradation mechanisms related to the operation of the steam generators. Other indications of degradation may be related to the presence of foreign objects at some time or to maintenance operations that were performed at a prior time. The disposition of other indications was determined in accordance with the guidelines of the Degradation Assessment (Reference 5).

Disposition of all bobbin I-codes was accomplished either through +Point examination to confirm the presence or absence of crack-like degradation, or through a review of the history of the indications to verify that the signals had not changed from prior verification of absence of degradation. The history review was based on the data from the OR05 and OR06 inspections.

6.1 OD Cracking at the Tube Support Plates (TSP)

Nine indications, at seven Tube Support Plate (TSP) intersections, of ODSCC were confirmed by +Point examination in three of the six tubes in the defined critical area. The critical area was defined as those tubes that displayed the ADS signals (see Table 3) that characterize the tubes with elevated residual stress (Reference 4). No cold leg indications were reported by bobbin, except R9C25, where distorted support plate indications were reported at TSPs 03C and 05C. Only hot leg indications were confirmed by +Point in these tubes.

No cracking indications were detected in the tubes outside the critical area in SG-D or in all of SGs A, B and C. Each of the SGs was 100% inspected with the bobbin probe, and all I-codes were tested with the +Point coil to confirm the absence of any degradation.

All indications of ODSCC degradation were evaluated against the in-situ selection criteria to determine if any of them required testing; none were found to require in-situ testing.

6.2 AVB Wear

Prior to OR09, AVB wear was classified as an active degradation mechanism in SG D and as an ongoing degradation mechanism in SGs A, B and C, based on the Reference 3 definition for active degradation mechanism. As noted in Table 1, Tubes Plugged List: OR09, AVB indications were detected in all 4 SGs as expected. Table 4, AVB Wear, summarizes the current inspection results for AVB wear. The total number of AVB indications is typical of the population of Model F SGs.

Table 2
Summary of OR09 Inspection Results [1]

Indication	Description	SG A	SG B	SG C	SG D
SAI/MAI	OD Axial Cracks (SAI/MAI)	0	0	0	5/2
PCT [2]	AVB % Wear (Bobbin Sizing)(Total/≥40%)	322/1	198/1	222/2	570/5
DNG/DNS	Freespan Ding (Total / >5V)	166/31	205/38	152/31	128/36
DNT[3]	Dents at Structures (Total / >5V)	181/27	982/366	560/143	169/32
PLP	Possible Loose Parts (Number of Tubes)	5	18	4	13
PVN	Permeability Variation (>2V, >1V @ AVBs)	1	0	0	0
VOL	Volumetric Indications - +Point	5	2	6	2
WAR	Wear (non-crack-like) at FDB and TSP	1	0	0	1
BLG	Bulge	0	0	0	2[4]
OXP	Over expansion	0	0	0	1[4]

1. Numbers are by location and may differ from EC database due to duplicate entries in database.
2. PCT calls at non-AVB locations included in other categories.
3. The dent reporting criteria were set at 2 Volts compared to 3Volts at OR08. As a result, the number of reported DNT signals is greater at OR09 than it was at OR08.
4. These indications were also reported at OR08, but were not included in the CM assessment.

Table 3
OR09 Inspection Results for Tubes in the Critical Area in SG-D
(Indications for each tube ordered by +Point voltage)

Row	Col.	Location	Inch	Bobbin			+Point		
				Call	Volts	Rank	Call	Volts	Rank
Confirmed SCC in the Critical Area									
4	64	05H	-0.31	DSI	0.13	4	SAI	0.75	1
		02H	+0.10	DSI	0.16	2*	MAI	0.37	3
		03H	-0.08	DSI	0.10	5	MAI	0.34	4
5	87	04H	+0.14	DSI	0.04	7	SAI	0.31	5
9	25	03H	+0.03	DSI	0.16	2*	SAI	0.30	6
		02H	-0.18	DSI	0.08	6	SAI	0.26	7
		04H	+0.25	DSI	0.81	1	SAI	0.62	2
Un-Degraded Tubes in the Critical Area									
9	28	No indications HL or CL							
10	22	No indications HL or CL							
7	91	No indications HL or CL							

Table 4
AVB Wear

SG	Number of Indications	Number ≥40% TW	New Indications[1]		New Tubes[2]
			Number	Max Depth	
A	322	1 (1 tube)	47	22%	26
B	198	1 (1 tube)	28	22%	19
C	222	2 (2 tubes)	8	32%	3
D	570	5 (5 tubes)	85	33%	50

1. Includes indications on tubes without prior indications
2. New tubes are tubes reported with indications that had no prior history of indications.

6.3 Wear at the Flow Distribution Baffle

In each of SG A and D, a single non-crack-like wear indication (WAR) was observed at the Flow Distribution Baffle (FDB) as summarized in Table 5, Wear Indications at the Flow Distribution Baffle. Originally detected with the bobbin probe as distorted support plate signals (DSS), retesting with the +Point probe showed that these indications are non-crack-like and are wear indications. The locations of these signals are believed to be related to a prior pressure pulse cleaning (PPC) of the SGs based on the location of the indications relative to the PPC pulser locations. Similar indications have been observed in other Model F SGs at other plants that have applied PPC. These indications are seen consistently in Row 1 at Columns 31-33 and Columns 91-93 at the FDB, and depth typically from 5%TW to 25%TW.

A review of the signal from the OR08 inspection indicates that the same signals were present at that time. The indications were sized using the technique of ETSS 96004 for wear at structures based on the bobbin probe.

Table 5
Wear Indications (WAR) at the Flow Distribution Baffle

Row	Col.	Location	Field Sizing per ETSS 21998.1 (% TWD)	
			OR08	OR09
SG-A				
1	91	01C-0.28	18	16
SG-B None				
SG-C None				
SG-D				
1	32	01H+0.25	25	26

6.4 Wear (Volumetric) Indications at or Above the TTS

During OR09, volumetric, wear-like indications were detected as summarized in Table 6, Volumetric Indications, below.

Indications were reported in SGs A, B and C at several tubes in row 1 at several columns at about 19" above the TTS with approximately the same depth. Five of the seven indications were previously reported and sized at OR08; the remaining two were not reported as wear at OR08, but look-back analysis of the data from OR08 showed that the indications were present at that time, and unchanged at OR09. These indications are consistent with similar indications reported at other plants, and have been attributed to interaction with the sludge lance rail (Reference 6).

In SG A, two volumetric indications just above the TS, previously detected at OR06, and retained in service at OR08 were again detected in OR09. During OR09, these indications were sized for depth using the procedure of ETSS 21998.1, the same technique used at OR08. These indications have not grown as shown in Table 6, Volumetric Indications, and are not expected to grow since no foreign object is resident at this location.

In SG D, an indication previously detected in OR08 just above TSP 01C was detected again in OR09. This indication is adjacent to a tube that was plugged during OR08 due to foreign object wear greater than 40% TW, sized by the method of ETSS 21998.1. Examination of these and the surrounding tubes revealed no evidence of a resident foreign object, thus the tube was retained in service. The OR09 inspection showed that the indication has not grown, verifying that no foreign object wear is ongoing. The tube was retained in service.

Table 6
Volumetric Indications

SG	Row	Col.	Location	Call	Depth (%TW) per ETSS 21998.1	
					OR08	OR09
A	1	87	TSC+18.8"	VOL	27%	22%
	1	36	TSC+18.2"	VOL	Note 1	19%
	49	29	TSH+0.09"	VOL	27%	18%
	50	29	TSH+0.08"	VOL	12%(Note3)	8%(Note3)
B	1	87	TSH+18.2"	VOL	37%	36%
	1	87	TSC+19.1"	VOL	37%	35%
C	1	87	TSH+18.33"	VOL	32%	33%
	1	87	TSC+18.4"	VOL	31%	28%
	1	112	TSH+18.24"	VOL	Note 1	21%
	43	26	TSH+0.15	VOL	Note 2	20%
	44	26	TSH+0.16	VOL	Note 2	10%
	3	113	O5C-0.56	VOL	Note 2	29%
D	13	4	01C+0.32"	VOL	30%	23%

1 +Point testing was not performed at OR08. Comparison of bobbin signals from OR08 and OR09 shows no change in the signal.
2. New indications associated with non-resident foreign objects.
3. Re-analysis was performed to confirm depth sizing based on the method used at OR09. The OR08 value was reported at 23% in reference 5.

6.5 Non-Degradation Indications

Possible loose part indications (PLP) were reported at Seabrook during OR09 as noted in Table 7, Non-Degradation Indications. The tubes surrounding these locations were tested using the RPC probe to confirm the presence or absence of a loose part and to bound any detected PLP. No loose parts were identified. These tubes were kept in service.

Most of the PLP indications detected were also reported at both OR08 and a prior inspection. No degradation was detected at any of these locations.

Most of the PLP indications were reported in the interior of the bundle, and, in some cases, well above the tubesheet. These indications are attributed to hardened sludge (sludge rocks) or loose scale near the tube, which has insignificant potential to damage the tube.

Table 7
Non-Degradation Indications (PLP)

SG	Row	Col.	Location	OR08	OR09
A	1	9	TSH+.12"	No degradation; PLP@ OR06	No degradation; NDD
	1	10	TSH+.18"	No degradation; PLP@ OR06	No degradation; NDD
	1	11	TSH+.11"	No degradation	No degradation; NDD
	16	63	TSH+1.51"	No degradation	NR
	16	67	TSH+1.41"	No degradation	NR
	17	63	TSH+1.01"	No degradation	NR
	23	23	02C+17.49	No degradation	NR
	48	63	TSH+0.97	NR	No degradation; NDD
	55	41	TSH+0.88	NR	No degradation; NDD
B	11	72	TSH+1.38	NR	No degradation; NDD
	13	66	TSH+1.87	NR	No degradation; NDD
	13	70	TSH+1.81	NR	No degradation; NDD
	14	66	TSH+1.05	NR	No degradation; NDD
	14	70	TSH+0.94	NR	No degradation; NDD
	22	6	TSC+8.11"	No degradation; PLP@ OR07	No degradation; NDD
	23	6	TSC+8.08"	No degradation; PLP@ OR07	No degradation; NDD
	24	11	TSC+3.93"	No degradation; NDD@ OR07	No degradation; NDD
	24	12	TSC+3.93"	No degradation; NDD@ OR07	No degradation; NDD
	27	15	TSC+0.82"	No degradation; PLP@ OR07	No degradation; NDD
	27	16	TSC+0.81"	No degradation; PLP@ OR07	No degradation; NDD
	39	17	TSC+11.06"	No degradation; NDD@ OR07	No degradation; NDD
	39	31	TSH+1.04	NR	No degradation; NDD
	39	32	TSC+1.22"	No degradation; PLP@ OR07	No degradation; NDD
	40	17	TSC+10.94"	No degradation; NDD@ OR07	No degradation; NDD
	52	33	TSC+5.7	NR	No degradation; NDD
	53	33	TSC+4.85"	No degradation; NDD@ OR07	No degradation; NDD

NR- not reported

(Table 6, continued)

SG	Row	Col.	Location	OR08	OR09
C	5	52	TSC+2.28	NR	No degradation; NDD
	5	82	TSC+2.9"	No degradation; NDD@ OR07	NR
	12	61	TSH+0.96	NR	No degradation; NDD
	13	61	TSH+1.31	NR	No degradation; NDD
	17	62	TSH+1.12"	No degradation; NDD@ OR07	NR
	18	62	TSH+0.63"	No degradation; NDD@ OR07	NR
D	8	61	TSC+2.23	No degradation; NDD	No degradation; NDD
	9	60	TSC+1.44	NR	No degradation; NDD
	9	61	TSC+1.76	No degradation; NDD	No degradation; NDD
	14	71	TSH+1.41	NR	No degradation; NDD
	20	28	TSC+0.36	No degradation; PLP@ OR06	No degradation; NDD
	20	29	TSC+1.03	INR; PLP@ OR06	No degradation; NDD
	21	28	TSC+0.35	INR; PLP@ OR06	No degradation; NDD
	21	29	TSC+0.56	NR	No degradation; NDD
	21	61	TSH+0.19	NR	No degradation; NDD
	41	27	TSH+0.16	No degradation; NDD	No degradation; NDD
	42	26	TSH+0.39	No degradation; NDD	No degradation; NDD
	42	27	TSH+0.25	No degradation; NDD	No degradation; NDD
	47	91	TSH+0.14	No degradation; NDD	No degradation; NDD
	47	92	TSH+0.17	No degradation; NDD	No degradation; NDD

NR – not reported

6.6 Geometric Anomalies

Bulge (BLG) indications were reported in R22C75 in SG D at about 2.2 and 3.5 inches above the tubesheet on the cold leg. These indications have been reported at prior inspections. +Point examination of these indications shows that no degradation is present at these locations.

An over expansion (OXP) was reported in SG D at R34C42. This signal was reported in prior inspections. Examination of the signal and its location shows that the tube expansion does not extend above the tubesheet, but that the signal is, in fact, a bulge at about 1" above the tubesheet.

+Point examination of these bobbin indications did not confirm any degradation at these locations.

7.0 Description of Tube Integrity Assessment

AVB wear is an ongoing operational degradation mechanism that has been observed at Seabrook. Based on application of conservative prior AVB wear growth rates, the condition of the Seabrook steam generator tubes has been analyzed with respect to continued operability of the steam generators until the end of cycle 11 without exceeding the structural integrity requirements of draft Reg. Guide 1.121 or NEI 97-06. Conservative projection of the AVB wear to OR11 indicates that all structural criteria will continue to be satisfied until that time.

All new foreign objects identified in OR09 in the steam generators were removed in addition to a known fixed foreign object in Steam Generator B. Wear due to the presence of a foreign object in SG A, at the fifth support plate is expected to continue; however, a boundary zone was established by plugging all of the tubes adjacent to the tube experiencing wear. The presence of the boundary zone provides adequate margin against potential damage propagation from the foreign object for continued operation for the life of the steam generator.

Wear at the Flow Divider Baffle intersections has been shown to have no growth by comparing the signal from OR09 to those from OR08. Since there is no growth of these indications, and the indications are currently structurally acceptable, these indications will continue to be structurally acceptable until the next scheduled inspection at OR11.

There were three tubes with nine indications of ODSCC reported in OR09. These three tubes are part of the six tubes identified in the root cause report as being susceptible to ODSCC. The other three tubes did not have any indication of ODSCC. All six of these tubes were plugged. All tubes in the low row critical area are now removed from service, a total of 21 tubes. One tube, R29C97, in steam generator B was left in service in the high row critical area as the tube was identified post outage. This tube had no precursor signals (DSI) and therefore can remain in service until its next scheduled inspection in OR11. The initiation rate of ODSCC in the critical area was less than predicted by the Operational Assessment for OR08. There was no cracking detected in any of the tubes in rows greater than 10 at either OR08 or OR09. Probabilistic simulation of the ODSCC at Seabrook shows that the performance criterion for burst, 3774 psid, is met for a cycle length of 1022 EFPD. The predicted 90/50 burst pressure at 1022 EFPD is 3778 psi. The burst probability guidelines at SLB and 3delta P are satisfied by both the single cycle and multi-cycle analysis models. The probabilistic simulation of the ODSCC shows that the leakage performance criteria are satisfied for an operating period of 1022 EFPD. The predicted 90/50 leak rate at the end of cycle 11 is approximately 0.13 gpm for the single cycle model and no leakage for the multi-cycle model.

The remnants of the tubes that were removed for analysis in OR08 were analyzed and were shown to have no potential to damage any active tubes. Therefore, the tube remnants do not restrict continued operation of the steam generator for the life of the steam generator.

Overall, it is concluded that the Seabrook steam generators can operate for 1022 EFPD to OR11.

8.0 REFERENCES

1. Seabrook Station Technical Specification 3/4.4.5, "Steam Generators"
2. NEI 97-06, rev 1, "Steam Generator Program Guidelines"
3. EPRI PWR Steam Generator Examination Guidelines, Revision 6, October 2002
4. SG-SGDA-02-35 rev.2, "Seabrook Tube Cracking Root Cause Report," April 2003
5. SG-SGDA-03-35 rev. 2, "SG Degradation Assessment for Seabrook OR09 Refueling Outage," September 2003, (proprietary)
6. NSAL –03-5, "Steam Generator Sludge Lance Tube Wear," July 2003
7. SG-SGDA-03-47 rev.1, "Seabrook OR09 Condition Monitoring Assessment," October 2003
8. SG-SGDA-04-10 rev.1, "Seabrook OR09 Final Operational Assessment," April 2004