



April 13, 2009

L-2009-091
10 CFR 50.55a
10 CFR 50.36

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

Re: St. Lucie Unit 1
Docket No. 50-335
Refueling Outage SL1-22
Steam Generator Tube Inspection Report

Attached is the St. Lucie Unit 1 Technical Specification 6.9.1.12 steam generator tube inspection report for the Fall 2008 refueling outage (SL1-22). This submittal was made within 180 days after the initial entry into hot shutdown following the completion of the steam generator inspection that was performed in accordance with TS 6.8.4.1, Steam Generator (SG) Program.

Please contact Ken Frehafer at (772) 467-7748 should you have any questions regarding this submittal.

Very truly yours,

A handwritten signature in black ink, appearing to read "ES Katzman".

Eric S. Katzman
Licensing Manager
St. Lucie Plant

ESK/KWF

Attachment

ACOT
NER

St. Lucie Unit 1
“Steam Generator Tube Inspection Report”
(For SL1-22)

BACKGROUND

The St. Lucie Unit 1 steam generator (SG) tube inspection program for the fall 2008 refueling outage (SL1-22) was conducted in accordance with St. Lucie Unit 1 Technical Specifications Section 6.8.4.1. The SL1-22 examination was the third planned inspection and the sixth refueling outage (RFO) of the first ISI period for the replacement steam generators (RSGs). SL1-22 was the last scheduled inspection in the first period and it occurred at approximately 99.7 effective full power months (EFPM) into the first period of 144 EFPM. The examinations performed during SL1-22 met the inspection requirements of examining 100% of the tubes by the end point of the first period. The examinations also satisfied the minimum requirements of EPRI Final Report 1013706, October 2007 "Steam Generator Management Program: Pressurized Water Reactor Steam Generator Examination Guidelines: Rev 7".

The St. Lucie Unit 1 steam generators were replaced in December 1997 with Babcock & Wilcox Industries Ltd. (BWI) advanced series pressurized water reactor (PWR) RSGs.

The SL1-22 SG tube Eddy Current (ECT) inspections were conducted on both 'A' and 'B' SGs and consisted of the following:

a. The scope of inspection performed on each steam generator

- 100% Bobbin Coil Probe
 - Full length examination of all active tubes in each steam generator.
 - Screening of all dings/dents ≤ 5.0 volts in the freespan straight lengths
 - Screening of peripheral tubes for reduced tube to tube gap spacing (increased tube proximity) in the u-bend region
- +Point™ Rotating Probe
 - All hot leg (H/L) and cold leg (C/L) expansion transitions along the periphery and no-tube lane were examined for foreign object wear to the extent of +3.0" to -2.0", as referenced from the top of the tubesheet.
 - Examination of tight radius u-bends in Row 3 (approximately 50% in each SG).
 - Examination of tight radius u-bends in Row 2 (approximately 72% in 1A SG and 57% in 1B SG).
 - 50% of hot leg Dings/Dents > 5.0 volts in the straight freespan sections were included.
 - All Dings/Dents in the u-bends and at hot leg tube supports were included.
 - Diagnostic examinations were completed as required based on the results of the bobbin test.
 - Approximately 10 tubes in each SG displaying the greatest response indicative of increased tube proximity identified by the bobbin coil probe were completed.

Note: The basis for bobbin and +Point™ tube examinations is given in Table 1.

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The visual examination completed during the SL1-22 refueling outage consisted of:

- Visual examination of the 14 previously installed tube plugs in SG 1A for location and condition assessment was completed.
- Visual examination of the hot leg nozzle inner radius in steam generator SG 1B was completed
- Secondary Side Inspection (SSI) which included Upper Bundle Flush, Sludge Lancing, and FOSAR (Foreign Object Search and Retrieval) was completed in both steam generators (SGs).

TABLE 1
BASIS FOR TUBE EXAMINATIONS

Technique	Examination Sample	Required or Supplemental	Basis	Potential Degradation
Bobbin	100% full length of all active tubes in each SG	Required	Technical Specification 6.8.4.l.d.2	Wear
	Screen all dings/dents ≤ 5.0 volts in the freespan straight lengths	Required (stress unknown)	Degradation Assessment	PWSCC ODSCC
	Screen U-bends periphery tubes for proximity of adjacent tubes	Supplemental	Subject of Vendor Bulletin	None
+Point™	All HL & CL expansion transitions in peripheral high flow regions	Required	Procedure Commitment	Foreign Object Wear
	Tight radius u-bends – <ul style="list-style-type: none"> • 50% of Row 3 in each SG • 72% of Row 2 in SG 1A • 57% of Row 2 in SG 1B 	Supplemental	Supplemental	None
	50% of HL Dings/Dents > 5.0 volts in the straight freespan sections	Required (stress unknown)	Degradation Assessment	PWSCC ODSCC
	All Dings/Dents in the u-bends and at HL tube supports	Required (stress unknown)	Degradation Assessment	PWSCC ODSCC
	Test largest bobbin proximity indications in U-bend	Supplemental	Subject of Vendor Bulletin	None

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b. Active degradation mechanisms found

The SL1-22 examination results for St. Lucie Unit 1 identified mechanical wear degradation at the following locations:

- Fan bar and connector bar tube contact points in the u-bends
- Horizontal lattice grid tube contact points
- Slightly above hot leg top of tubesheet, due to presence of a foreign object (foreign object was removed)

The wear degradation at tube supports is not considered active. Wear indications due to a foreign object is also not considered active because the foreign object was removed from the steam generator.

There were no indications of tube degradation in the +Point™ rotating coil examination of the U-bends and dings/dents. There was no evidence of corrosion degradation. There was also no degradation associated with the visual inspection of tube plugs or the hot leg nozzle inner radius in SG1B.

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c. Nondestructive examinations techniques utilized for each degradation mechanism

Table 2 – St. Lucie Unit 1 Examination Techniques for SL1-22 (October 2008)

Technique		Industry Qualification	Damage Mechanism	Demonstrated Applicability	Extended Applicability	Depth Sizing Technique Applied	Site-Specific Review Deemed Acceptable	
							Detection	Sizing
1	Bobbin	96004.1 Revision 11	Wear	Structures	None	Differential Mix Amplitude Analysis (Using Vert-Max)	Yes	For Service
2	Bobbin	96004.2 Revision 11	Wear	Structures	None	Absolute Mix Amplitude Analysis (Using Vert-Max)	Yes	Contingent Sizing of Wear
3	+Point™	96910.1 Revision 10	Wear	Broached supports	Structures, Freespan PLP Wear (When Part Present)	Differential Mix Amplitude Analysis (Using Vert-Max)	Yes	Contingent Sizing of Wear
4	Bobbin	27091.2 Revision 0	PLP Wear	PLP Wear (part not present)	PLP Wear (When Part Present)	N/A	Yes	Typically Use Technique #11
5	Bobbin	24013.1 Revision 2	Axial ODSCC	Freespan, Dings ≤ 5.00 Volts	None	N/A	Yes	N/A
6	+Point™	21998.1 Revision 4	Volumetric	Freespan	None	Single Frequency Phase Analysis	Yes	Contingent Sizing of Wear
7	+Point™	22401.1 Revision 4	Axial ODSCC	Dented Support Structures	Dent / Ding Freespan & U-bend	Single Frequency Phase Analysis	Yes	For Info
8	+Point™	22842.3 Revision 5	Circ ODSCC	Dented Support Structures	Dent / Ding Freespan & U-bend	Single Frequency Phase Analysis	Yes	For Info
9	+Point™	96701.1 Revision 12	Circ PWSCC	Expansion Transition	Dents Dings	Single Frequency Phase Analysis	Yes	For Info
10	+Point™	96703.1 Revision 17	Axial PWSCC	Dents	Freespan	Single Frequency Phase Analysis	Yes	For Info
11	+Point™	27901.1 27902.1 27903.1 27904.1 27905.1 27906.1 27907.1 (All Rev. 0)	PLP Wear	PLP Wear Morphology Dependent (part not present)	None	PLP Wear Morphology Dependent	Yes	For Service
12	+Point™	96511.2 Revision 16	Axial & Circ PWSCC	Low Row U-bends	None	Single Frequency Phase Analysis	Yes	For Info

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d. Location orientation (if linear) and measured sizes (if available) of service induced indications

**St. Lucie Unit 1 SG 1A SL1-22
Wear at U-bend Fan bar and Lattice grid locations
Indications 1-19% TWD**

ROW	COL	VOLTS	DEG	CHN	IND	%TW	LOCATION	EXT	EXT	UTIL	1	UTIL	2	CAL	#	LEG	PROBE
71	100	0.16	140	P3	TWD	16	F05	+0.82	TEH	TEC				64		COLD	610UL
71	112	0.12	124	P3	TWD	8	F06	-1.63	TEC	TEH				7		HOT	610UL
77	92	0.19	100	P3	TWD	16	F09	-2.31	TEH	TEC				1		COLD	610UL
79	92	0.15	127	P3	TWD	13	F09	-2.16	TEH	TEC				1		COLD	610UL
84	99	0.14	134	P3	TWD	13	F06	+1.29	TEH	TEC				1		COLD	610UL
88	93	0.13	118	P3	TWD	12	F04	-0.60	TEH	TEC				1		COLD	610UL
91	78	0.24	129	P3	TWD	18	CBC	+1.89	TEH	TEC				1		COLD	610UL
92	77	0.12	113	P3	TWD	11	CBC	+0.40	TEH	TEC				1		COLD	610UL
95	92	0.18	104	P3	TWD	15	F09	-1.96	TEH	TEC				1		COLD	610UL
97	92	0.13	120	P3	TWD	12	F09	-1.98	TEH	TEC				1		COLD	610UL
97	144	0.10	155	P3	TWD	7	01C	-1.24	TEC	TEH				15		HOT	610UL
		0.21	76	P3	TWD	14	02C	-1.50	TEC	TEH				15		HOT	610UL
99	78	0.25	161	P3	TWD	19	CBC	+1.93	TEH	TEC				1		COLD	610UL
102	111	0.14	98	P3	TWD	12	F06	-1.06	TEH	TEC				1		COLD	610UL
103	92	0.14	100	P3	TWD	12	F09	-2.02	TEH	TEC				1		COLD	610UL
107	106	0.13	128	P3	TWD	10	F05	+1.30	TEC	TEH				6		HOT	610UL
109	122	0.14	150	P3	TWD	10	F05	+1.55	TEC	TEH				13		HOT	610UL
113	88	0.26	129	P3	TWD	18	F06	+0.75	TEH	TEC				10		COLD	610UL
		0.18	122	P3	TWD	14	F06	+1.10	TEH	TEC				10		COLD	610UL
114	75	0.22	118	P3	TWD	17	F06	-0.93	TEH	TEC				1		COLD	610UL
115	78	0.13	138	P3	TWD	12	F10	+2.07	TEH	TEC				1		COLD	610UL
115	82	0.20	130	P3	TWD	16	F05	+0.91	TEH	TEC				1		COLD	610UL
119	58	0.14	119	P3	TWD	12	F06	-0.68	TEH	TEC				5		COLD	610UL
128	51	0.10	84	P3	TWD	9	F10	+0.58	TEH	TEC				4		COLD	610UL

Total Tubes : 22
Total Records: 24

NOTE: There are no wear indications measuring $\geq 20\%$, or other indications that meet the reporting criteria in SG 1A

**St. Lucie Unit 1 SG 1B SL1-22
Wear at U-bend Fan bar and Lattice grid locations
Indications 1-19% TWD**

ROW	COL	VOLTS	DEG	CHN	IND	%TW	LOCATION	EXT	EXT	UTIL	1	UTIL	2	CAL	#	LEG	PROBE
2	127	0.13	82	P3	TWD	10	05C	+0.69	TEC	TEH				66		HOT	610UL
28	5	0.09	129	P3	TWD	10	F05	+1.56	TEH	TEC				36		COLD	610UL
73	68	0.16	140	P3	TWD	11	F05	-1.03	TEH	TEC				37		COLD	610UL
81	102	0.18	120	P3	TWD	16	F04	-1.98	TEH	TEC				36		COLD	610UL
97	144	0.10	145	P3	TWD	8	05H	+1.42	TEH	TEC				48		COLD	610UL
110	91	0.11	63	P3	TWD	11	F06	-1.37	TEH	TEC				36		COLD	610UL
114	51	0.12	141	P3	TWD	12	F05	-1.32	TEH	TEC				36		COLD	610UL

Total Tubes : 7
Total Records: 7

NOTE: There are no wear indications measuring $> 20\%$ in SG 1B. Other indications (Loose Part Indications) that meet the reporting criteria in SG 1B are listed in the next table.

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St. Lucie Unit 1 SG 1B SL1-22

Loose Part Indications (LPI) (Confirmed as WAR by +Point™ rotating probe)

ROW	COL	VOLTS	DEG	CHN	IND	%TW	LOCATION	EXT	EXT	UTIL	1	UTIL	2	CAL	#	LEG	PROBE	
137	78	0.26	101	2	WAR		TSH	+0.42	TSH	TSH	29%		27901.1	62		HOT	610PP	
		0.28	123	P1	LPI		TSH	+0.44	TEH	TEC	LAR				17		COLD	610UL
		0.69	49	7	PLP		TSH	+0.64	TEH	TEC	LAR				17		COLD	610UL
138	77	0.58	99	2	SVI		TSH	+0.12	TSH	TSH				62		HOT	610PP	
		0.22	83	7	PLP		TSH	+0.24	TSH	TSH	LAR				62		HOT	610PP
		0.68	75	2	WAR		TSH	+0.72	TSH	TSH	49%		27901.1		62		HOT	610PP
		0.90	269	7	PLP		TSH	+0.73	TEH	TEC	LAR				16		COLD	610UL
		0.37	116	P1	LPI		TSH	+0.75	TEH	TEC	LAR				16		COLD	610UL
139	78	0.14	103	2	WAR		TSH	+0.62	TSH	TSH	22%		27901.1	62		HOT	610PP	
		0.20	142	P1	LPI		TSH	+0.53	TEH	TEC	LAR				17		COLD	610UL
		0.35	247	7	PLP		TSH	+0.70	TEH	TEC	LAR				17		COLD	610UL

Note: The Util 1 field shows the estimated loose part wear depth using the qualified rotating +Point™ sizing technique shown in the Util 2 field.

St. Lucie Unit 1 SG 1B SL1-22

Tubes Plugged Listing

ROW	COL	VOLTS	DEG	CHN	IND	%TW	LOCATION	EXT	EXT	UTIL	1	UTIL	2	CAL	#	LEG	PROBE	
138	77	0.58	99	2	SVI		TSH	+0.12	TSH	TSH				62		HOT	610PP	
		0.22	83	7	PLP		TSH	+0.24	TSH	TSH	LAR				62		HOT	610PP
		0.68	75	2	WAR		TSH	+0.72	TSH	TSH	49%		27901.1		62		HOT	610PP
		0.90	269	7	PLP		TSH	+0.73	TEH	TEC	LAR				16		COLD	610UL
		0.37	116	P1	LPI		TSH	+0.75	TEH	TEC	LAR				16		COLD	610UL

Note: Tube 138-77 was plugged due to foreign object wear. A metallic foreign object was located adjacent to this tube and removed.

- e. Number of tubes plugged during the SL1-22 inspection for each active degradation mechanism

Table 3

Degradation Mechanism	SG A	SG B	Total
Wear at U-bend Fan bar tube contacts	0	0	0
Wear at Lattice grids	0	0	0
Loose Part Wear	0	1	1
Total	0	0	0

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f. Total number and percentage of tubes plugged to date

Table 4

St. Lucie Unit 1 Steam Generator Cumulative Tube Plugging Summary SL1-22		
SG	# Plugged	% Plugged
1A	14	0.16
1B	1	0.01

g. The results of condition monitoring including the results of the tube pulls and in-situ testing

Wear indications at fan bar, connector bar and horizontal lattice grid locations were evaluated relative to structural limits as shown in Figures 1 through 4. These wear indications were shallow in depth and well below the calculated structural limits for burst and leakage. Wear indications shown as solid data points in Figures 1 to 4 were conservatively modeled with lengths and depths based on the +Point™ profiles. Open data points are based on the maximum bobbin probe depth, which is assumed for a conservative length of 0.5 inches. Note that some data points in Figures 1 to 4 overlap and, thus, the number of points shown may not match the number of indications listed in Section d of this report.

Four wear indications due to a foreign object were reported in three tubes at the hot leg tubesheet of SG 1B. A metallic foreign object was located adjacent to these tubes and was removed. One tube (SG 1B R138 C77) contained two wear indications that met the repair criteria and was plugged. The calculated 95% lower bound burst pressure of each indication based on +Point™ profile analysis is given in Table 5.

The structural integrity for all indications reported met the NEI 97-06 structural performance criteria. None of the indications were predicted to leak under limiting accident conditions. Thus, the PSL-1 steam generators met the structural and leakage performance criteria.

There were no tube pulls or in-situ pressure testing required/performed during SL1-22.

Upper bundle flushing and sludge lancing removed approximately 211 pounds of material from the steam generators. Deposit accumulations are considered low, and the tube support lattice design is expected to mitigate buildup within supports. Other than the foreign object that was removed as discussed above, no abnormalities were noted during the secondary side inspections.

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Table 5
Summary of Profile Analysis Results for Loose Part Wear in S/G B

Row	Line	Loc	Max NDE Depth (%TW)	NDE Length (inches)	95% Lower Bound Burst Pressure (psi)	Sizing ETSS
137	78	TSH + 0.42	29	0.31	7320	27901.1 Rev 0
138	77	TSH + 0.12	43	0.45	5300	21998.1 Rev 4
138	77	TSH + 0.72	49	0.33	6740	27901.1 Rev 0
139	78	TSH + 0.62	22	0.38	7770	27901.1 Rev 0

Note: The depth for the indication in SG 1B R138 C77 at TSH + 0.12” is provided for condition monitoring purposes only. This indication is listed in Section d as a single volumetric indication (SVI). This tube was removed from service.

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PSL-1 S/G A Fan Bar Wear Screening Limits
October 2008

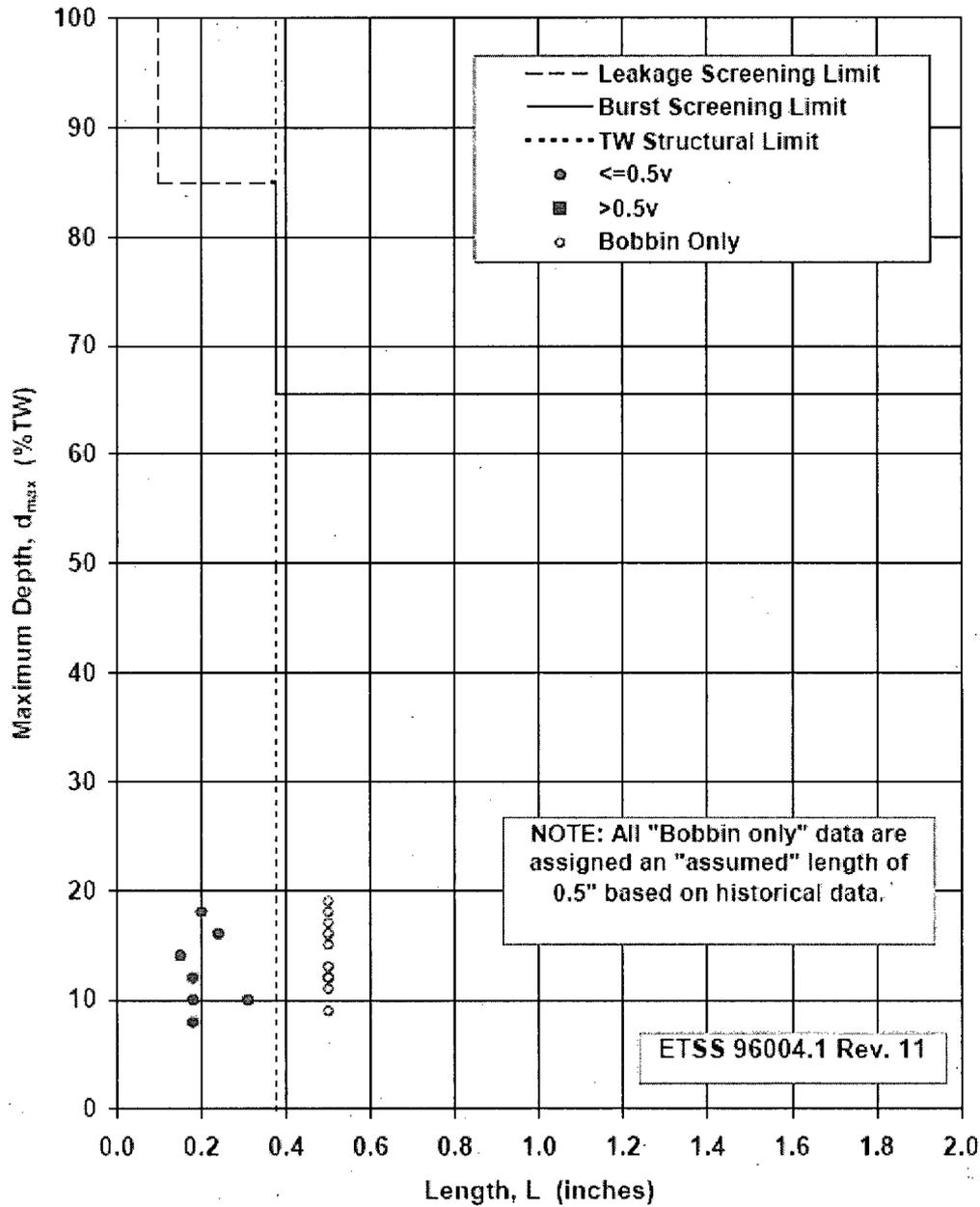
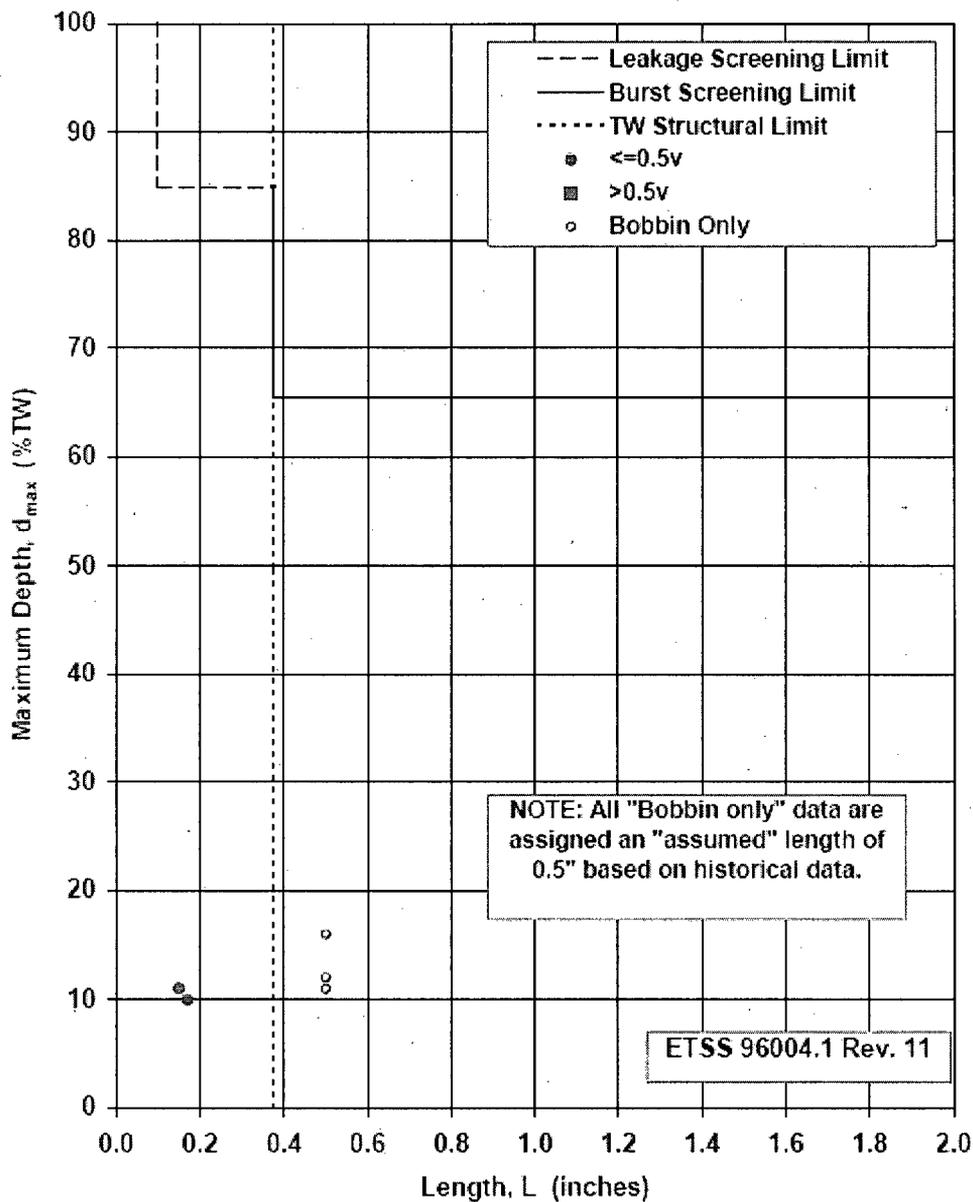


Figure 1 — Condition Monitoring Results for Fan Bar Wear PSL-1 S/G A
October 2008 (SL1-22).

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PSL-1 S/G B Fan Bar Wear Screening Limits
 October 2008



**Figure 2 — Condition Monitoring Results for Fan Bar Wear
 PSL-1 S/G B - October 2008 (SL1-22).**

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PSL-1 S/G A Horizontal Lattice Grid Wear Screening Limits
October 2008

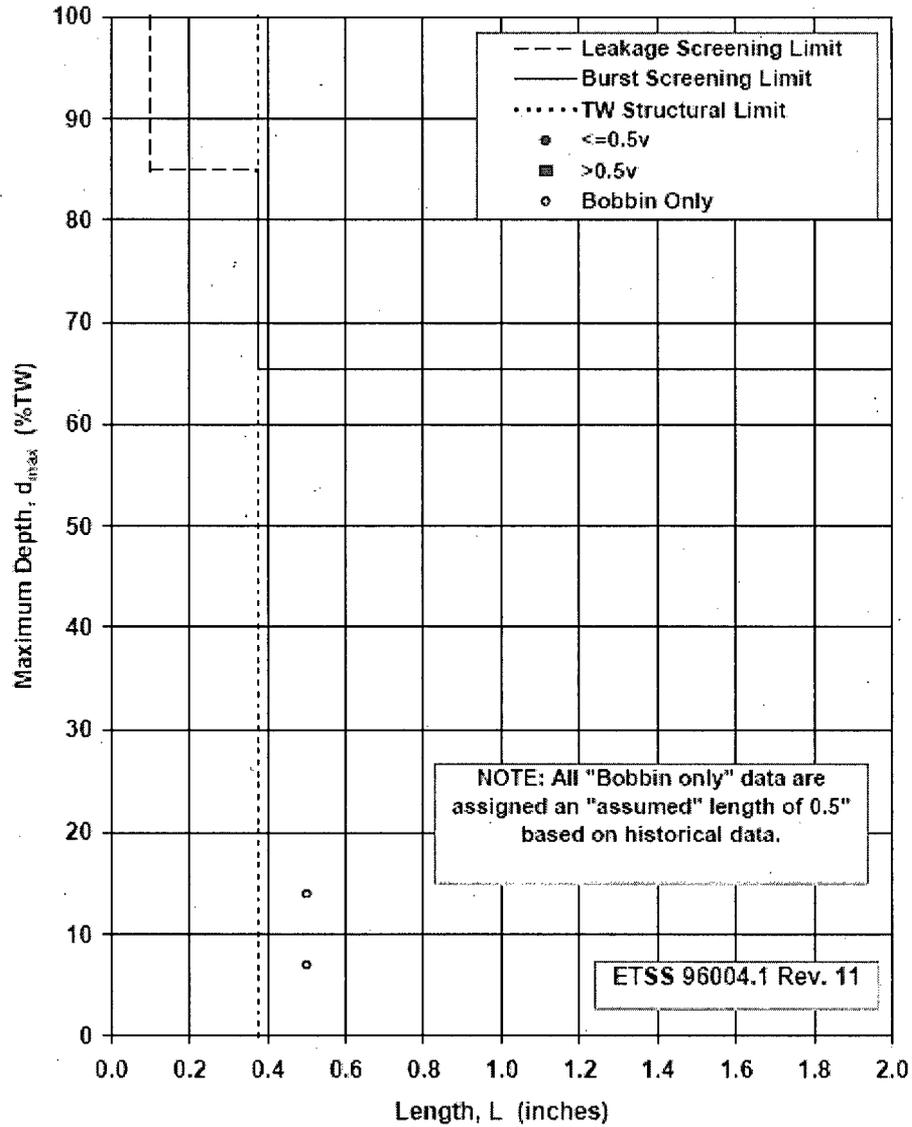


Figure 3 — Condition Monitoring Results for Horizontal Lattice Grid Wear
PSL-1 S/G A - October 2008 (SL1-22).

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PSL-1 S/G B Horizontal Lattice Grid Wear Screening Limits
October 2008

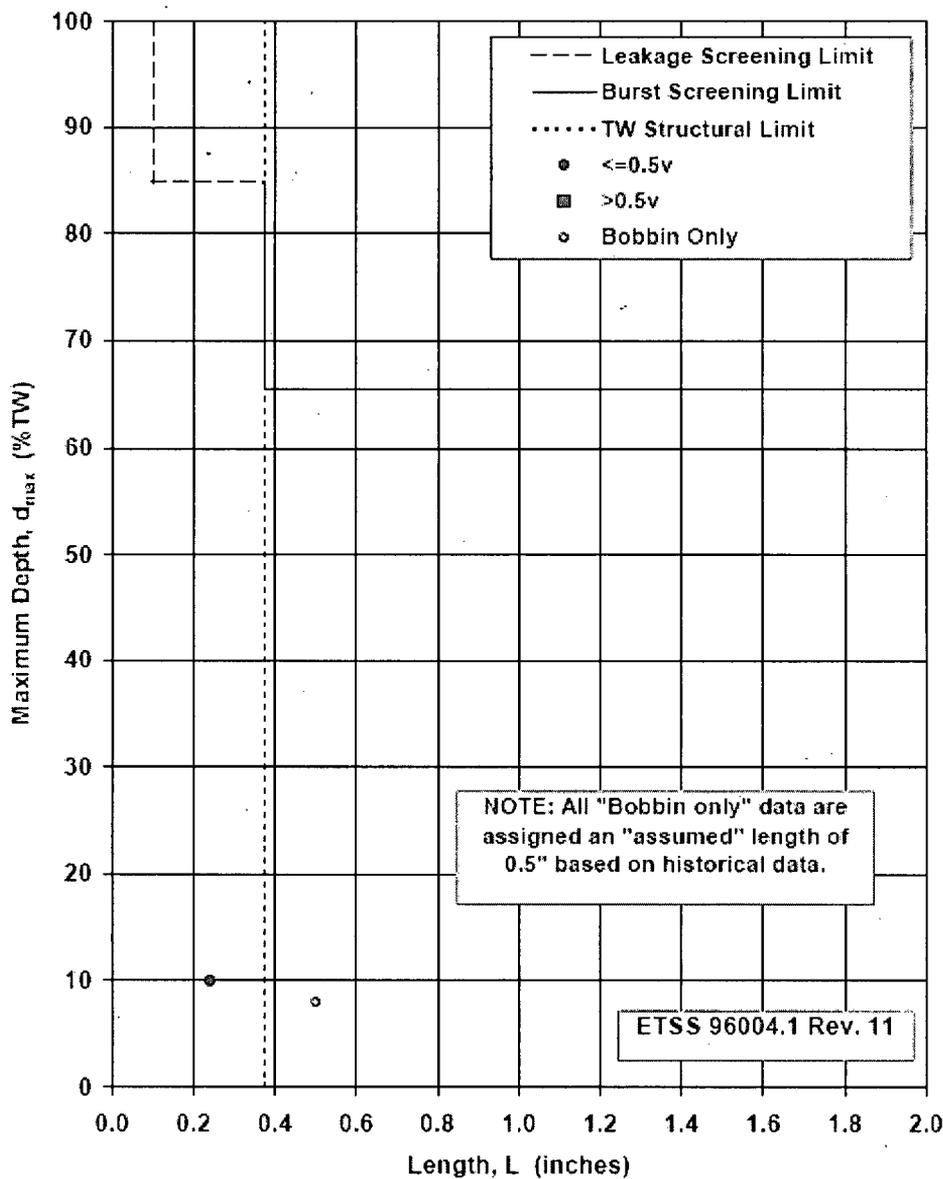


Figure 4 — Condition Monitoring Results for Horizontal Lattice Bar Wear
PSL-1 S/G B - October 2008 (SL1-22).

**St. Lucie Unit 1
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h. The effective plugging percentage for all plugging in each steam generator

No tube repair methods (i.e. sleeving) are approved for St. Lucie Unit 1 that would have an affect on the effective plugging percentages. Therefore, the applicable effective plugging percentage is synonymous with the % Plugged in item f. above.

ADDITIONAL INFORMATION

The following information is included to assist the staff in their review of the information provided in this report.

Abbreviations

CSI - Component Support and Inspections
SG - Steam Generator
ISI - In-service Inspection
ECT - Eddy Current Testing
NEI – Nuclear Energy Institute
EPRI – Electric Power Research Institute

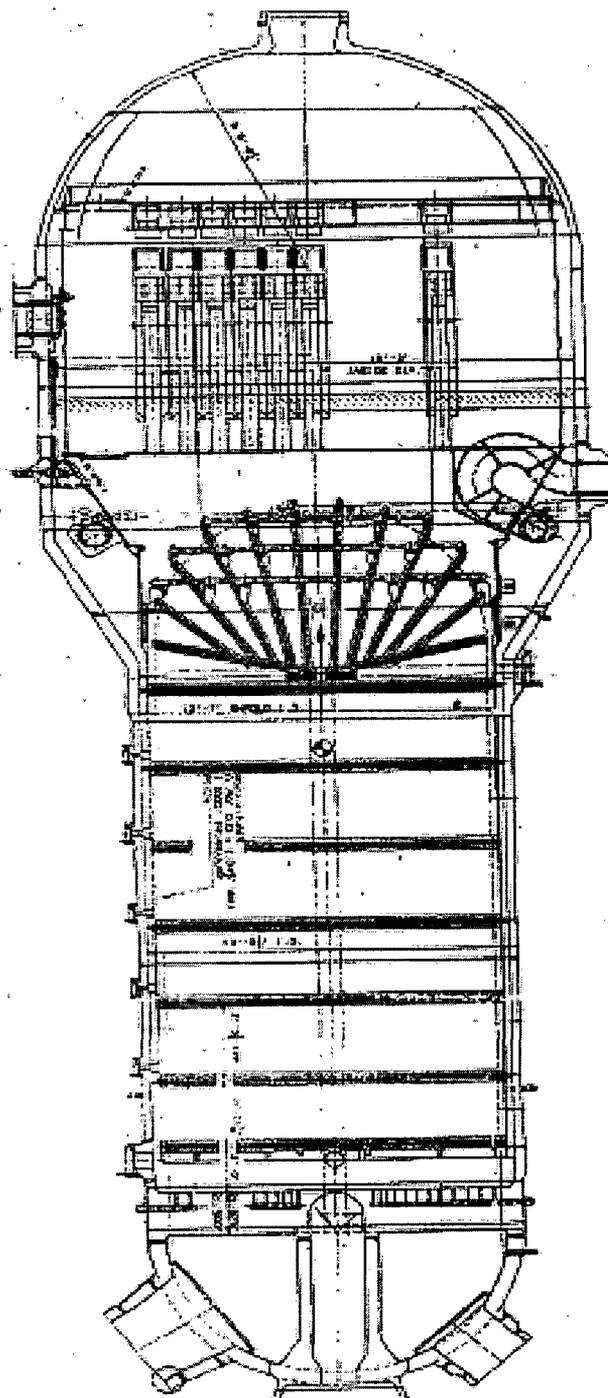
Acronyms

H/L -	Hot Leg
C/L -	Cold Leg
VOL -	Volumetric Indication
SVI -	Single Volumetric Indication
PIT -	Pit Indication
PLP -	Possible Loose Part
WAR -	Mechanical Wear
TWD -	Through Wall Depth
TSH -	Tubesheet Hot Leg
TEH -	Tube End Hot Leg
TSC -	Tubesheet Cold Leg
TEC -	Tube End Cold

The last three pages of this document show a side view of the installed St. Lucie Unit 1 RSGs, a detailed view of the fan bar arrangement, and a table showing the distances between the support structures in the SGs.

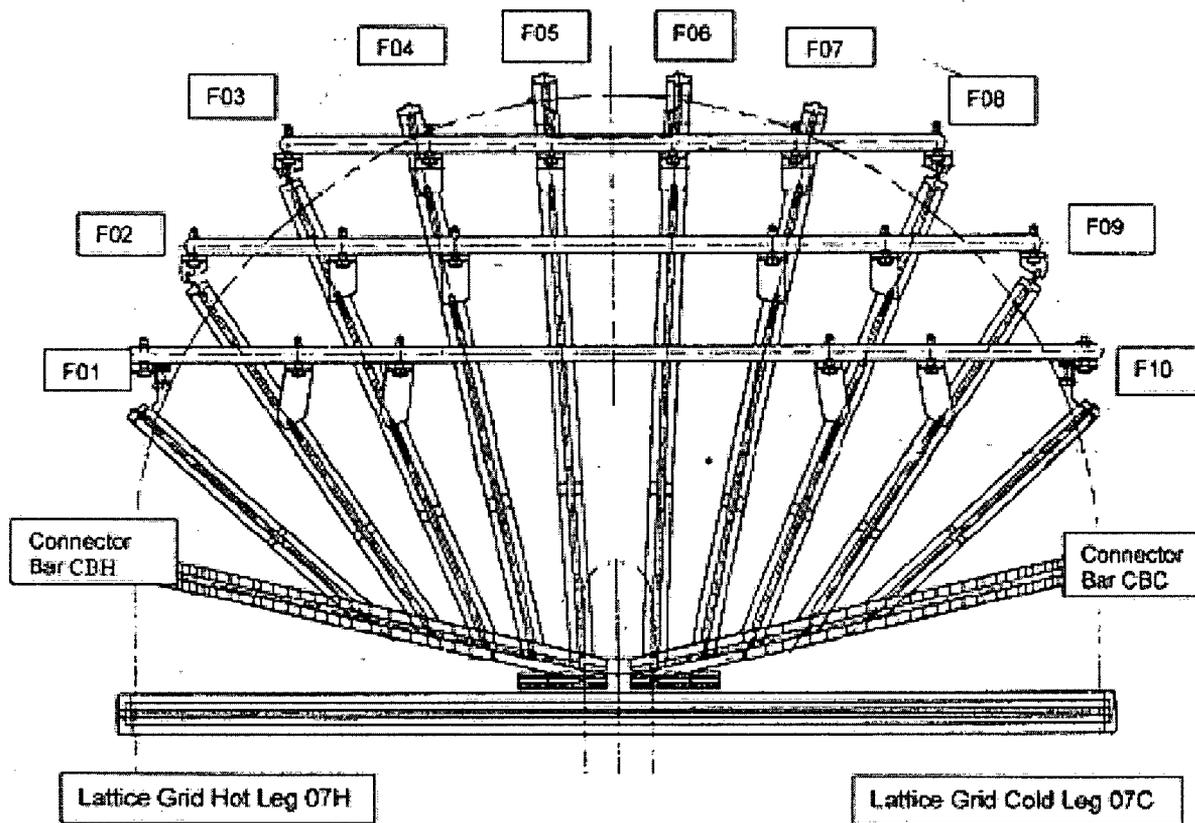
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ST. LUCIE UNIT 1
B&W ADVANCED SERIES PWR
REPLACEMENT STEAM GENERATOR (RSG)



St. Lucie Unit 1
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Detailed Fan Bar View



St. Lucie Unit 1
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PSL-1 STEAM GENERATOR
ELEVATIONS AND STRUCTURE ACRONYMS

<u>CODE</u>	<u>DEFINITION</u>		<u>INCREMENTAL</u> <u>DISTANCE</u>	<u>CUMULATIVE</u> <u>DISTANCE</u>
TEH	Hot Leg Tube End		0.0"	0.0"
TSH	Hot Leg Tube Sheet		21.88" (Nominal)	21.88"
01H	#1 Lattice Grid Hot Leg	TSH - 01H	24.0"	45.88"
02H	#2 Lattice Grid Hot Leg	01H - 02H	35.125"	81.0"
03H	#3 Lattice Grid Hot Leg	02H - 03H	41.625"	122.6"
04H	#4 Lattice Grid Hot Leg	03H - 04H	41.625"	164.25"
05H	#5 Lattice Grid Hot Leg	04H - 05H	41.625"	205.88"
06H	#6 Lattice Grid Hot Leg	05H - 06H	41.625"	247.51"
07H	#7 Lattice Grid Hot Leg	06H - 07H	41.625"	289.13"
CBH	Connector Bar Hot Leg	Variable		
F01	#1 Fan Bar	Variable		
F02	#2 Fan Bar	Variable		
F03	#3 Fan Bar	Variable		
F04	#4 Fan Bar	Variable		
F05	#5 Fan Bar	Variable		
F06	#6 Fan Bar	Variable		
F07	#7 Fan Bar	Variable		
F08	#8 Fan Bar	Variable		
F09	#9 Fan Bar	Variable		
F10	#10 Fan Bar	Variable		
CBC	Connector Bar Cold Leg	Variable		

*DISTANCE MEASUREMENTS ARE CENTER TO CENTER