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SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES) Unit 1
DOCKET NO. 50-445
UNIT 1 SEVENTH REFUELING OUTAGE
CONDITION MONITORING REPORT
SPECIAL REPORT 445/00-001-00

Attached is the 12 Month Special Report (SR) 1-SR-00-001-00 for Comanche Peak Steam Electric Station (CPSES) Unit 1. This report meets the requirements of Special Report as specified in CPSES Technical Specification 5.6.10.b., and NEI 97-06.

Should you require additional information please contact Obaid Bhatty at (254) 897-5839.

D029

Additionally, this communication does not contain any new commitments pertaining to CPSES license.

Sincerely,

C. L. Terry

By: D R Woodlan

D. R. Woodlan
Docket Licensing Manager

OAB/oab
Attachment

cc: E. W. Merschoff, Region IV
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TXU ELECTRIC
COMANCHE PEAK STEAM ELECTRIC STATION - UNIT 1
SPECIAL REPORT NO. 1-SR-00-001-00
UNIT 1, SEVENTH REFUELING OUTAGE
STEAM GENERATOR TUBE INSPECTION RESULTS
TECHNICAL SPECIFICATIONS 5.6.10.b

1.0 INTRODUCTION

The subject report is being submitted pursuant to the requirements of Comanche Peak Steam Electric Station (Comanche Peak and or CPSES) Technical Specification (TS) 5.6.10.b. Additionally, this report was prepared under the auspices of Nuclear Energy Institute's document NEI 97-06, "Steam Generator Program Guidelines."

NEI 97-06 requires that a condition monitoring assessment, which evaluates structural integrity characteristics of steam generator (SG) eddy current inspections, is to be performed following each inspection. This evaluation provides an assessment of the Comanche Peak Unit 1 steam generator tube structural and leakage integrity based on the 1999 end of cycle (EOC)-7 eddy current inspection results. Condition monitoring is "backward looking" and compares the observed EOC-7 steam generator tube eddy current indication parameters against structural and leakage integrity commensurate with draft Regulatory Guide (RG) 1.121. This report documents the final condition monitoring assessment of the NDE results from the Comanche Peak seventh refueling outage (1RF07) inspection, performed in October 1999.

The Comanche Peak Unit 1 steam generators (SGs) are Westinghouse Model D4 SGs with mill annealed Alloy 600 tubing, full depth mechanical (hardroll) expanded tube to tubesheet joints, and carbon steel tube support plates with drilled tube holes and drilled flow holes. A small number of tubes in each SG are expanded in the tubesheet using the WEXTEX explosive expansion process.

2.0 OVERALL CONCLUSIONS

During the CPSES 1RF07 steam generator tube inspection, no indications exceeding the structural integrity limits for either axial or circumferential degradation (i.e., burst integrity > 3 times normal operating primary to secondary pressure differential across SG tubes) were detected; therefore, no tubes were identified to contain eddy current indications that could potentially challenge the Reg. Guide 1.121 tube integrity recommendations. Based on the

observed indications at 1RF07, the CPSES Unit 1 SGs are expected to meet all structural and leakage integrity requirements at the eighth refueling outage (1RF08).

3.0 PRE-OUTAGE EVALUATION OF SG DEGRADATION STATUS

CPSES 1RF07 Inspection Plan

The CPSES 1RF07 inspection plan exceeded both the Technical Specification minimum requirements as well as the recommendations of EPRI TR-107569-V1R5, "PWR Steam Generator Examination Guidelines: Revision 5, Volume 1: Requirements." The 1RF07 initial inspection plan included:

1) 100% full length bobbin examination in Rows 3 and greater in all 4 SGs, 100% bobbin inspection in the hot and cold leg straight sections of Rows 1 and 2
2) 100% hot leg top of tubesheet (TTS) Plus Point examination in all 4 SGs
3) 100% Row 1 and 2 U-bend Plus Point (+Pt) examination in all 4 SGs
4) Rotating probe examination of mixed residuals (> 1.5 volts as measured by bobbin) and hot leg dented intersections > 5 volts (as measured by bobbin) according to the requirements of GL 95-05.
5) Rotating probe examination of freespan bobbin coil indications for flaw confirmation and characterization.
6) 20% Plus Point inspection of hot leg and cold leg straight length freespan dings > 5 volts, plus 20% Plus Point inspection of freespan dings > 5 volts between 11H and ant-vibration bar (AVB) 1 and AVB 4 and 11C.
7) 100% Tube plug visual inspection.

The inspection plan was developed to specifically address the areas of active degradation as well as areas expected to be affected based on industry experience as well as experience from the CPSES 1RF06 outage in April 1998.

Based on a reported C-3 condition in SG 4 due to the detection of 48 circumferentially oriented outside diameter stress corrosion cracking (ODSCC) indications, the top of tubesheet Plus Point inspection program was expanded to include 20% of the cold leg top of tube sheet (TTS) expansion transitions in SG 4. No degradation was reported in this expansion program.

Pre-Outage Degradation Assessment

A pre-outage degradation assessment pursuant to EPRI Publication GC-107621, "Steam Generator Integrity Assessment Guidelines," Rev. A2 (Draft) was performed for CPSES 1RF07. This degradation assessment identified the degradation modes which could occur at CPSES Unit 1 and evaluated the adequacy of the eddy current techniques applied for detection and sizing of these mechanisms.

Per EPRI TR-107569-V1R5, "PWR Steam Generator Examination Guidelines: Revision 5 Volume 1: Requirements", an active degradation mechanism is:

1. A combination of ten or more new indications of degradation (> 20% through wall (TW)) and previous indications of degradation which display an average growth rate > 25% of the repair limit per cycle in any one SG or,

2. One or more new or previously identified indications of degradation, including cracks, which display a growth rate equal to the repair limit in one cycle of operation.

Based upon the likelihood of indications, the degradation assessment classified degradation mechanisms as active, relevant, or potential, with correspondingly decreasing likelihood of initiation and potential impact upon SG tube integrity. The degradation assessment concluded that the following degradation mechanisms were active (as defined by EPRI TR-107569-V1R5) in the CPSES Unit 1 SGs:

- Axial ODSCC at tube support plate (TSP) intersections
- Circumferential and Axial ODSCC at the hot leg TTS expansion transition

3.1 1RF07 Identified Degradation Mechanisms

Indications suggestive of the following degradation mechanisms were detected in the CPSES 1RF07 inspection:

1. Axial ODSCC at TSP intersections
2. Axial ODSCC at the Hot Leg TTS expansion transition
3. Circumferential ODSCC at the Hot Leg TTS expansion transition
4. Freespan Volumetric indications
5. Anti-vibration bar (AVB) wear
6. Wear at non-expanded preheater baffle intersections
7. Wear due to loose parts or foreign objects

The 90-day report for axial ODSCC at TSP intersections was documented in a separate alternate repair criteria (ARC) report, as part of analyses required per NRC Generic Letter 95-05[1].

Identified axial ODSCC and circumferential ODSCC indications at the TTS were, not sufficient in magnitude to warrant in situ testing, however, some testing at this location was performed. In general, the voltage magnitudes and arc lengths of identified circumferential degradation at the TTS were consistent with or below previously observed limiting indication levels that were in situ tested at 1RF06, as well as below our predetermined screening criteria.

Table 1 presents a summary of the number of repaired tubes in each SG and identifies the mechanism that necessitated the repair. A summary of the repaired tubes, including tubes plugged for degradation, tubes preventively plugged, and tubes permitted to remain in service by application of the voltage based alternate repair criteria per GL 95-05, and F*, is provided in Table 2.

Disposition Techniques for Identified Degradation Mechanisms

Depth measurement of AVB wear indications and non-expanded preheater baffle plate wear was performed and these indications were sized against the 40% depth repair criteria. ODSCC indications at the TSP intersections were sized based on voltage using the bobbin coil according to guidance contained in GL 95-05. Indications greater than 1 volt by bobbin were inspected utilizing Plus Point method for flaw confirmation. Indications identified in exclusion zones related to tube collapse potential near TSP wedges were Plus Point inspected, and if confirmed, were repaired regardless of voltage. No bobbin indications at TSP intersections were reported in exclusion zones. Mixed residual indications >1.5 volts by bobbin were Plus Point inspected. All crack-like indications in the expansion transition down to the F* distance were plugged upon detection since depth sizing techniques are not qualified.

To reduce the potential for an axially oriented ODSCC indication to be obscured by baffle wear, all newly reported occurrences of preheater baffle wear by bobbin were Plus Point inspected. No ODSCC was detected.

Indications previously called volumetric, have in the past been reviewed, and determined to be attributed to deposits, manufacturing buff marks (MBMs), dings and bulges, or tube material property changes which sometimes occur after power operation. Single volumetric indication (SVI) calls by Plus Point that did not have a corresponding bobbin MBM signal in the baseline, were conservatively plugged during 1RF07. The tubesheet SVI calls were shown to be present in the 1RF06 Plus Point data, and were conservatively plugged during 1RF07. The two freespan volumetric indications in SG 4 were tracked through the bobbin history with no apparent growth

[1] TXU Electric letter to the NRC logged TXX-00036, dated February 4, 2000.

in amplitude or apparent phase shift. These indications were conservatively plugged during 1RF07 based on the inability to conclusively determine the nature of the degradation which produced the Plus Point response.

3.2 Tube Plugging

The total number of tubes plugged by outage is shown in Table 3.

3.3 Indication Listing

The tubes containing percent thru-wall and/or other repairable indications are listed in Table 4.

Table 1:
Summary of CPSES 1RFO7 Plugging Repair Statistics: Number of Tubes Repaired for Observed Degradation Only

Degradation Mode	HL TTS Exp. Transition down to F*	CL TTS Exp. Transition down to F*	Hot Leg TSP	Freespan	U-bend	Baffle Wear		Total
SG 1								
Axial ODSCC	0	0	0	0	0	0		0
Axial PWSCC	0	0	0	0	0	0		0
Circ. ODSCC	0	0	0	0	0	0		0
Wear	0	0	0	4	0	0		4
Volumetric	1	0	0	0	1	0		2
Sub Total	1	0	0	4	1	0		6
SG 2								
Axial ODSCC	1	0	0	0	0	0		1
Axial PWSCC	0	0	0	0	0	0		0
Circ. ODSCC	19	0	0	0	0	0		19
Wear	0	0	0	0	0	0		0
Volumetric	0	0	0	0	0	0		0
Sub Total	20	0	0	0	0	0		20

Table 1:
Summary of CPSES 1RFO7 Plugging Repair Statistics: Number of Tubes Repaired for Observed Degradation Only

Degradation Mode	HL TTS Exp. Transition down to F*	CL TTS Exp. Transition down to F*	Hot Leg TSP	Freespan	U-bend	Baffle Wear		Total
SG 3								
Axial ODSCC	1	0	0	0	0	0		1
Axial PWSCC	0	0	0	0	0	0		0
Circ. ODSCC	29	0	0	0	0	0		29
Wear	0	0	0	2	0	0		2
Volumetric	0	0	0	0	0	0		0
Sub Total	30	0	0	2	0	0		32
SG 4								
Axial ODSCC	0	0	1	0	0	0		1
Axial PWSCC	0	0	0	0	0	0		0
Circ. ODSCC	48	0	0	0	0	0		48
Wear	0	0	0	3	0	0		3
Volumetric	1	0	0	2	0	0		3
Sub Total	49	0	1	5	0	0		55

Table 2
Summary of Repaired Indications and Indications Justified for Continued Operation by Application of Alternative Repair Criteria (ARC):
CPSES 1RF07, October 1999
Values Apply to 1RF07 Inspection Only

SG	Tubes Repaired by Plugging	Tubes Repaired for Crack-like Defects	Tubes Repaired for Volumetric Signals	Tubes Preventively Plugged	Tubes Permitted to Remain in Service by TSP ARC	Tubes Permitted to Remain in Service by F*	Total Tubes Permitted to Remain in Service by ARC
1	8	0	2	6 (1)	11 (11 indications)	0	11
2	20	20	0	0	18 (19 indications)(4)	0	18
3	35	30	0	5 (2)	9 (9 indications)	0	9
4	57	49	3	5 (3)	62 (65 indications)(5)	0	62
Total	120	99	5	16	100 (104 indications)	0	100

(1) Includes 2 tubes repaired due to restrictions and 4 tubes repaired due to nonquantifiable loose parts wear

(2) Includes 2 tubes repaired due to restrictions, 2 tubes repaired due to nonquantifiable loose parts wear, 1 tube preventively repaired due to a loose part signal with wear at the two adjacent tube locations

(3) Includes 1 tube repaired due to a restriction, 3 tubes repaired due to nonquantifiable loose parts wear, 1 non-repairable tube pulled for GL 95-05

(4) One tube was pulled for metallurgical examination that could have remained inservice via the ARC

(5) Multiple indications occurred in some tubes

Table 3
Tube Plugging by Outage

Cycle	SG 1	SG 2	SG 3	SG 4	Total	% plugged
Preservice	14	4	5	11	34	0.186%
U1RF01	-2	-1	0	0	-3	-0.016%
U1RF02	0	0	0	0	0	0.000%
U1RF03	0	0	0	0	0	0.000%
U1RF04	0	1	1	0	2	0.011%
U1RF05	0	11	2	6	19	0.104%
U1RF06	0	67	8	27	102	0.557%
U1RF07	8	20	35	57	120	0.655%
Total tubes	20	102	51	101	274	1.496%
Total % per SG	0.44%	2.23%	1.11%	2.21%		

Table 4 Indication list					
ROW	**COL**	**IND**	**PER**	**LOC**	**INCH**
Steam Generator 1					
34	13	PCT	18	AV2	-.24
12	21	PCT	10	C6	.42
13	21	PCT	8	C6	.47
11	22	PCT	4	C6	.42
12	22	PCT	7	C6	.39
45	24	PCT	19	AV4	-.12
45	29	PCT	15	AV1	.10
48	42	PCT	4	C3	.36
49	36	SVI	Y[2]	AV4	1.17
49	52	PCT	2	C7	-.29
45	71	PCT	7	C3	.29
47	73	PCT	4	C3	-.29
48	73	PCT	6	C7	-.44
48	73	PCT	21	C3	-.10
48	73	PCT	23	C2	-.26
48	74	PCT	7	C7	-.39
47	75	PCT	9	C3	-.18
48	75	PCT	7	C5	.31
48	75	PCT	25	C3	.18
48	75	PCT	10	C2	.37
48	76	PCT	19	C3	.31
48	77	PCT	9	C3	.13

[2] Y= There is no qualified sizing method for volumetric indications not associated with wear at structures. These type of indications are plugged on detection at CPSES.

Table 4 Indication list					
ROW	**COL**	**IND**	**PER**	**LOC**	**INCH**
48	79	PCT	6	C5	.00
48	79	PCT	5	C3	-.18
3	57	SVI	Y	HTS	-.50
12	21	WAR/PLP	10	C6	.41
13	21	WAR/PLP	8	C6	.32
11	22	WAR/PLP	4	C6	.39
12	22	WAR/PLP	7	C6	.18
Steam Generator 2					
1	23	SCI	X[3]	HTS	-.19
48	38	PCT	10	C7	.00
48	38	PCT	10	C2	-.09
49	38	PCT	4	C7	-.25
47	39	PCT	3	C7	-.33
48	39	PCT	4	C9	.24
48	39	PCT	5	C8	.36
48	39	PCT	7	C7	.12
48	39	PCT	2	C5	.21
48	39	PCT	10	C3	.00
47	40	PCT	2	C7	.21
47	40	PCT	9	C2	.35
48	40	PCT	2	C8	.29
48	40	PCT	9	C7	.00

[3] X = There is no CPSES qualified sizing method for ODSCC at the top of the tube sheet expansion transitions. These types of indications are plugged on detection.

Table 4 Indication list

ROW	COL	IND	PER	LOC	INCH
48	40	PCT	12	C5	.00
48	40	PCT	34	C3	.23
48	40	PCT	3	C2	.40
46	45	PCT	9	C7	-.32
47	45	PCT	12	C3	.37
49	45	PCT	4	C7	-.17
49	46	PCT	12	C7	-.29
49	47	PCT	4	C7	.00
45	48	PCT	8	C2	.20
47	48	PCT	12	C3	.17
47	48	PCT	5	C2	.20
47	49	PCT	8	C5	-.06
47	49	PCT	14	C3	-.12
47	49	PCT	6	C2	-.17
26	53	SCI	X	HTS	.00
37	53	SCI	X	HTS	-.15
44	53	PCT	3	C2	-.27
40	55	SCI	X	HTS	-.14
5	56	SCI	X	HTS	-.22
45	60	PCT	6	C3	.00
42	62	PCT	4	C2	-.06
24	64	SCI	X	HTS	-.06
3	65	SCI	X	HTS	-.38
37	65	SCI	X	HTS	-.10

Table 4 Indication list					
ROW	**COL**	**IND**	**PER**	**LOC**	**INCH**
47	65	PCT	17	C3	.30
27	67	SCI	X	HTS	-.09
36	67	SCI	X	HTS	-.09
46	67	PCT	12	C3	.18
47	67	PCT	31	C3	.27
47	67	PCT	7	C2	.44
47	68	PCT	5	C3	.29
4	69	SCI	X	HTS	-.30
5	69	SCI	X	HTS	-.27
46	70	PCT	3	C3	.23
25	73	SCI	X	HTS	-.05
47	73	PCT	8	C3	.41
15	74	SCI	X	HTS	-.07
36	79	SCI	X	HTS	-.20
25	82	SCI	X	HTS	-.03
4	85	SCI	X	HTS	.07
1	96	SCI	X	HTS	-.29
1	97	SCI	X	HTS	-.25
20	77	SAI	X	HTS	-.04

Table 4 Indication list					
ROW	**COL**	**IND**	**PER**	**LOC**	**INCH**
Steam Generator 3					
1	18	SCI	X	HTS	.05
9	22	SCI	X	HTS	-.26
2	23	SCI	X	HTS	-.15
3	25	MCI	X	HTS	-.02
1	31	SCI	X	HTS	-.14
7	31	MCI	X	HTS	-.23
6	32	SCI	X	HTS	.03
1	34	MCI	X	HTS	-.40
2	34	SCI	X	HTS	-.06
3	34	SCI	X	HTS	-.19
48	34	PCT	9	C7	-.50
2	35	SCI	X	HTS	-.09
2	37	SCI	X	HTS	-.11
3	37	SCI	X	HTS	-.26
47	37	PCT	4	C5	.39
2	39	SCI	X	HTS	-.20
24	39	SCI	X	HTS	-.11
2	40	SCI	X	HTS	-.14
4	40	SCI	X	HTS	-.09
46	41	PCT	12	C2	-.06
48	41	PCT	16	C2	.24
1	42	SAI	X	HTS	-.32
48	42	PCT	14	C3	-.39

Table 4 Indication list

ROW	COL	IND	PER	LOC	INCH
48	42	PCT	8	C2	.03
1	43	SCI	X	HTS	-.41
49	43	PCT	5	C7	-.30
2	44	SCI	X	HTS	-.17
23	45	SCI	X	HTS	-.27
43	48	PCT	4	C2	-.29
24	49	SCI	X	HTS	-.23
47	49	PCT	37	C3	.09
47	49	PCT	11	C2	-.06
47	50	PCT	36	C3	-.09
24	51	SCI	X	HTS	-.22
11	52	SCI	X	HTS	-.20
45	54	PCT	23	C3	-.30
27	56	PCT	6	C3	.17
20	59	PCT	7	C3	-.36
21	59	PCT	7	C3	.27
36	59	PCT	13	C3	-.35
41	59	PCT	27	AV3	.00
43	59	PCT	29	AV2	.00
43	59	PCT	35	AV3	.00
45	62	PCT	8	C3	-.36
32	65	SCI	X	HTS	-.21
45	70	PCT	7	C3	-.32
48	75	PCT	9	C5	-.45

Table 4 Indication list					
ROW	**COL**	**IND**	**PER**	**LOC**	**INCH**
2	78	SCI	X	HTS	-.24
39	78	SCI	X	HTS	.15
48	79	PCT	5	C5	-.30
48	79	PCT	7	C2	-.09
48	81	PCT	6	C7	-.30
28	88	SCI	X	HTS	-.22
24	90	SCI	X	HTS	-.25
1	91	SCI	X	HTS	-.13
Steam Generator 4					
2	10	SCI	X	HTS	-.17
44	23	PCT	5	C2	-.26
45	24	PCT	9	C2	-.26
45	24	PCT	12	C2	.40
45	24	PCT	7	C5	.14
45	24	PCT	21	C3	-.23
45	24	PCT	7	C2	-.14
45	24	PCT	9	C2	.40
12	26	PCT	9	C6	-.51
46	26	PCT	5	C3	-.29
48	32	PCT	8	C5	-.20
48	32	PCT	6	C3	-.26
49	32	PCT	10	AV1	.00
47	34	PCT	6	C3	-.28
47	34	PCT	1	C2	-.26

Table 4 Indication list					
ROW	**COL**	**IND**	**PER**	**LOC**	**INCH**
48	34	PCT	11	C3	-.23
48	34	PCT	7	C2	-.34
47	36	PCT	4	C5	-.23
47	36	PCT	4	C3	-.23
48	36	PCT	6	C2	-.17
48	39	PCT	16	C3	-.34
48	42	PCT	8	C5	-.26
2	43	SCI	X	HTS	.03
47	43	PCT	6	C5	-.31
45	44	PCT	7	C3	-.20
45	44	PCT	5	C2	-.20
45	48	PCT	17	C3	-.17
47	48	PCT	6	C7	-.43
47	48	PCT	12	C5	-.03
47	48	PCT	5	C7	-.31
47	48	PCT	9	C5	.00
47	48	PCT	20	C3	.00
2	52	SCI	X	HTS	.00
45	53	PCT	20	C3	-.67
1	54	SCI	X	HTS	-.16
21	55	PCT	5	C3	-.11
25	55	PCT	3	C2	-.26
29	55	PCT	6	C2	-.20
45	55	PCT	12	C3	-.42

Table 4 Indication list					
ROW	COL	IND	PER	LOC	INCH
4	56	SCI	X	HTS	-.45
25	56	PCT	7	C2	-.26
29	56	PCT	14	C3	-.34
35	56	PCT	4	C2	-.17
25	59	PCT	2	C3	.06
30	59	PCT	7	C3	-.17
31	59	PCT	12	C3	-.31
33	59	PCT	13	C3	-.34
33	59	PCT	5	C2	-.14
21	60	PCT	7	C3	-.42
32	60	PCT	6	C3	-.20
33	60	PCT	9	C3	-.28
49	60	PCT	15	AV4	-.27
19	62	SCI	X	HTS	-.05
46	62	PCT	7	C3	-.20
3	63	SCI	X	HTS	-.17
46	63	PCT	9	C3	.28
21	64	SCI	X	HTS	-.11
45	64	PCT	19	C3	-.25
2	66	SCI	X	HTS	-.28
46	66	PCT	6	C3	-.23
5	67	SCI	X	HTS	-.09
21	67	SCI	X	HTS	-.09
31	67	SCI	X	HTS	-.14

Table 4 Indication list					
ROW	COL	IND	PER	LOC	INCH
1	69	SCI	X	HTS	-.33
4	69	SCI	X	HTS	-.23
6	69	SCI	X	HTS	-.24
48	73	PCT	15	C3	-.08
48	73	PCT	5	C2	-.31
2	74	SCI	X	HTS	-.42
5	74	MCI	X	HTS	-.05
48	74	PCT	19	C3	-.11
48	74	PCT	6	C2	-.31
48	74	PCT	30	C5	-.29
48	74	PCT	16	C3	-.06
48	74	PCT	5	C2	-.40
48	75	PCT	17	C3	-.28
48	75	PCT	10	C2	-.26
48	75	PCT	34	C5	-.23
48	75	PCT	16	C3	.31
48	75	PCT	11	C2	.00
1	76	SCI	X	HTS	-.05
20	77	SCI	X	HTS	-.16
32	77	SCI	X	HTS	-.14
34	77	SCI	X	HTS	-.15
40	77	SCI	X	HTS	-.25
20	78	SCI	X	HTS	-.05
38	78	MCI	X	HTS	.11

Table 4 Indication list

ROW	COL	IND	PER	LOC	INCH
2	79	SCI	X	HTS	-.30
4	79	SCI	X	HTS	-.24
33	79	MCI	X	HTS	-.29
4	80	SCI	X	HTS	-.30
34	80	SCI	X	HTS	-.15
37	80	SCI	X	HTS	-.13
9	82	SCI	X	HTS	-.14
18	82	MCI	X	HTS	-.18
25	81	SAI	X	H5	.00
25	82	SCI	X	HTS	-.21
32	83	SCI	X	HTS	-.16
3	84	SCI	X	HTS	-.17
7	84	SCI	X	HTS	-.14
14	87	PCT	7	C6	.37
15	87	PCT	6	C6	.37
16	87	PCT	9	C6	.31
2	88	SCI	X	HTS	-.18
6	88	SCI	X	HTS	-.14
13	89	PCT	5	C6	.26
22	89	SCI	X	HTS	-.14
33	89	SCI	X	HTS	-.11
13	91	SCI	X	HTS	-.20
20	91	SCI	X	HTS	-.32
21	92	SCI	X	HTS	-.17

Table 4 Indication list

ROW	COL	IND	PER	LOC	INCH
18	94	SCI	X	HTS	-.26
27	95	SCI	X	HTS	-.08
29	95	SCI	X	HTS	-.15
3	96	SCI	X	HTS	-.03
18	103	SCI	X	HTS	-.17
6	58	SVI	Y	C10	7.24

Legend for Indications:

PLP - Possible Loose Part

SCI - Single Circumferentially Oriented Indication

SAI - Single Axial Indication

MCI - "Multiple Circumferentially

WAR - Wear Indication

4.0 CONDITION MONITORING EVALUATION

4.1 Condition Monitoring Evaluation of Active Degradation Mechanisms as Classified by the Pre-Outage Degradation Mechanism

4.1.1 TTS Circumferential Flaw ODSCC Condition Monitoring Evaluation

Structural integrity of circumferential indications at the TTS is defined by EPRI TR-107197, "Depth Based Structural Analysis Methods for SG Circumferential Indications." The controlling parameter with regard to structural integrity of circumferential indications is the percent degraded area (PDA). The PDA represents the percentage of degraded cross sectional area of the flaw, integrated over 360° arc length of tube.

Screening of indications for selection as in situ test candidates is performed at CPSES Unit 1 using a methodology which is consistent with EPRI Report TR-107620-R1, "Steam Generator In Situ Pressure Test Guidelines." The burst correlation for circumferential indications is documented in EPRI TR-107197, "Depth Based Structural Analysis Methods for SG Circumferential Indications." The burst curve was used to develop the critical crack angle value of 277° for CPSES Unit 1 at $3\Delta P$ conditions.

For in situ testing purposes, screening limits are applied to identify the most relevant subset of indications for testing. For proof test screening of circumferential indications, the first screen is crack angle $\geq$ 187°, and the second screen is average voltage (in Eddynet multiscan mode), or voltage integral, $\geq$ 0.35 volts. Indications exceeding both screens are depth profiled to determine percent degraded area (PDA). Indications with PDA $\geq$ 29% determined by Plus Point depth profile analysis are proof tested. PDA sizing uncertainties are taken from EPRI TR-107197. For leak test screening, the first screen is maximum voltage in multiscan mode $\geq$ 1.25 volts for PWSCC, 1.00 volts for ODSCC, while the second screen is max depth $\geq$ 80% for PWSCC, 75% for ODSCC. Indications exceeding both screens are depth profiled to determine the arc length at depth $\geq$ the second screen depth limit value. Indications with arc length $\geq$ 20° at the second screen depth limit are leak tested. If no indications exceed the 1st screens, the indications with the largest reported angles and largest voltages are evaluated against the second screens to ensure that indications are adequately evaluated. For circumferential indications, those which exceeded two of the three screening values were conservatively tested due to the small reported Plus Point voltages.

The limiting circumferential arc length for a single, 100% TW flaw, which would be expected to provide structural integrity at the draft RG 1.121 recommendations for CPSES Unit 1 conditions was identified in the degradation assessment as 277°, throughwall over this length, resulting in a

percent degraded area of 77%. The in situ testing screening limit of 187° represents the limiting crack angle of 277° reduced for measurement uncertainty.

A total of 96 circumferential indications were identified. Based on phase angle analysis, all were judged to be representative of ODSCC. Of these 96 indications, 95 were observed in hardroll expanded tubes, and 1 was observed in WEXTEX expanded tube.

At 1RF06, ten circumferential ODSCC indications at the hot leg TTS were in situ pressure tested. The eddy current parameters for these indications were comparable to or slightly more limiting than the 1RF07 circumferential flaw parameters. The arc lengths of the indications in situ tested at 1RF07 were 339°, 292°, and 260°, maximum depths were 69% to 74% based on the shallowest phase angle response for the entire signal, and PDAs ranged from 50% to 40% based on Plus Point depth profile. In general, the voltage integral value is roughly ½ to 1/3 of the peak flaw voltage. As the maximum flaw amplitude of the in situ tested tubes was 0.32 volts, the voltage integral values are estimated to be bounded by about 0.16. Comparison of the Plus Point signal responses for 1RF06 and 1RF07 suggests that the 1RF06 flaws were more well developed than the 1RF07 flaws. The 1RF06 Plus Point terrain plots suggest that few ligaments may exist between individual circumferential flaw initiation sites. The 1RF07 Plus Point terrain plots suggest a less well developed flaw with possibly more ligaments between individual circumferential flaw initiation sites.

Taking the results of the circumferential depth profile by Plus Point, the calculated burst pressure of the limiting expansion transition indication, R22 C89 in SG 4, is approximately 6000 psi, using LTL material properties at 650° F. The expected limiting indication at R22 C89 SG 4 was in situ pressure tested and did not burst at a pressure loading of 4385 psi, nor did it leak at a pressure loading of 2925 psi. Consequently, this indication satisfies condition monitoring requirements and other circumferential indications would be expected to have larger margins against the performance criteria. Refer to Table 7 for tubes tested during 1RF07.

4.1.2 Expansion Transition Axial Flaw ODSCC Condition Monitoring Evaluation

Structural integrity of axial flaws is established based on reported NDE length and depth. With regard to freespan axial indications, the in situ screening procedure for burst is as follows. The first two screens are crack length ≥ 0.48" and maximum depth ≥ 70%. Indications which exceed both screens are depth profiled. The average depth over the crack length is determined from the depth profile. Average depth vs. length is compared against a table of limiting crack length and average depth relationships provided in the degradation assessment which provide for structural integrity at RG 1.121 recommendations. The freespan screening flaw length of 0.48" provides for burst integrity at RG 1.121 recommendations for a single flaw morphology of 100% TW depth, using LTL material properties. For transition region indication leakage screening, the

first screen is maximum Plus Point voltage ≥ 2.50 volts for ID indications, 1.5 volts for OD indications, and the second screen is max depth ≥ 70%. Freespan OD indications were screened using a Plus Point voltage limit of 1.0 volt. If the second screen is exceeded the indication is depth profiled to determine length at max depth. Indications with ≥ 0.1" length at the second screen max depth limit are leak tested. Axial indications located below the TTS do not represent a potential for burst. If the 1st leak test screen is not exceeded for all indications, the largest voltage indications are evaluated against the second screen to ensure that indications are adequately evaluated.

At the CPSES 1RF07 inspection, the longest reported indication at the TTS was in R20 C77 SG 1, at 0.25" long. Based on the comparison of the 1RF07 axial indication NDE values against the in situ screening parameters, it is concluded that no axial indications identified at 1RF07 challenged structural integrity, and none would have been expected to leak at SLB conditions. Only 2 axial ODSCC indications were reported at 1RF07.

4.1.3 TSP ODSCC Condition Monitoring Evaluation

Only 1 indication exceeding 1.0 volt was reported by bobbin, and this indication was confirmed by Plus Point. This tube (R25 C81 at H5, in SG 4) was pulled for destructive examination purposes and compliance with GL 95-05. The second tube pulled for GL 95-05 compliance was R31 C81, with bobbin DSI amplitudes of 0.57 volts at H3 and 0.74 volts at H5. The largest bobbin DSI voltages for each SG are provided below in Table 5:

Table 5
TSP ODSCC Degradation Summary

	SG 1	**SG 2**	**SG 3**	**SG 4**	**All SGs**
Number Ind.	11	19	9	65	104
Number ≥ 1 volt	0	0	0	1	1
Max 1RF07 Voltage	0.62	0.96	0.76	1.17	1.17
Average Voltage Growth	-0.019 volts	-0.002 volts	0.101 volts	-0.006 volts	0.003 volts
% Voltage Growth (Cycle 7)	-5.1%	-0.3%	29.5%	-1.1%	0.6%
% Voltage Growth (per EFPY)	-3.6%	-0.2%	21.1%	-0.8%	0.4%

The voltage based structural limit for TSP ODSCC indications is 4.79 volts for a SLB DP of 2560 psi.

Mixed residual indications with a bobbin voltage > 1.5 volts were Plus Point inspected. No degradation was detected with the Plus Point probe.

4.2 Condition Monitoring Evaluation of Degradation Modes Classified as Relevant in the Degradation Assessment

The degradation assessment concluded that the following mechanisms did not meet the criteria to be classified as active mechanisms, and therefore were categorized as relevant mechanisms:

Axial and circumferential ODSCC in the freespan and at freespan dings
AVB wear
Tube wear at non-expanded preheater baffles
Tube wear due to foreign objects/loose parts

Condition monitoring of relevant mechanisms indicates that no indications were present at 1RF07 which represented a challenge to structural integrity or leakage integrity.

4.2.1 Freespan ODSCC Condition Monitoring

No axial or circumferential ODSCC indications were reported in the freespan. In SG 1, a possible indication was reported in the U-bend region by bobbin. Plus Point examination suggested a volumetric flaw. The bobbin history of this indication showed no growth in amplitude or phase shift over several cycles. This indication most likely is attributed to an MBM. This indication was conservatively plugged. In SG 4, two possible indications were reported by bobbin above the C10 TSP. Plus Point examination suggested pit-like indications. The 115 mil pancake coil data indicated that these indications were coincident with a vertical line of freespan dings, and most likely are attributed to a small gouge on the tube OD. Both indications were conservatively plugged, even though the bobbin history suggested no growth in amplitude or phase shift over several cycles. This elevation is not expected to support a pitting mechanism due to the reduced sludge or OD scale at this elevation. Furthermore, pitting degradation is strongly correlated to high concentrations of copper species in sludge piles. CPSES removed copper from the secondary feedtrain prior to commercial operations.

4.2.2 ODSCC at Freespan Dings

<u>Axially Oriented Indications:</u>

Bobbin indications in the freespan were Plus Point inspected if the low frequency differential bobbin phase angle response was less than 155° at ding locations. This calling criteria was

specifically developed to identify axial ODSCC at freespan dings. A total of 8 bobbin indications at dents (DNI) were reported. However, none were confirmed by Plus Point exam.

With respect to PWSCC, a 20% sample of all hot leg dings from the hot leg top of tubesheet to H3, the first TSP above the flow distribution baffle, and all dents at H3 > 2 volts were Plus Point inspected. No degradation was observed.

Circumferentially Oriented Indications:

Based on industry experience, 20% of the hot and cold leg paired dings between the top two TSPs were inspected with Plus Point at 1RF07. No degradation was observed.

4.2.3 Small Radius U-bend PWSCC

No small radius U-bend PWSCC indications were reported.

4.2.4 Tube Wear at AVBs, Preheater Baffles, and Due to Loose Parts/Foreign Objects

Tube wear due to foreign object interaction was reported in SGs 1, 3, and 4. The tubes with wear indications were reported within the preheater and typically clustered in groups. In nearly all cases, the wear mechanism could be tracked in previous inspections. As the wear morphology could not be judged to be consistent with an available sizing standard, these indications were repaired. The wear mechanisms observed generally had small bobbin amplitudes, i.e., less than 1 volt in the primary mix channel. As a comparison, the volumetric wall loss associated with the 40% depth, 0.187" diameter flat bottom hole of the ASME standard is approximately 3 volts. Based on flaw geometry characterization with Plus Point, the axial extents of the wear indications were about 0.11" max, with a maximum circumferential involvement of about 150 degrees.

Tube wear at non-expanded baffles represents a very low growth mechanism. The largest reported depth at 1RF07 was 37% TW. The growth associated with this indication was 7% TW. The average and 95%confidence growth rates for all wear indications combined is 1.24% and 6%, respectively, while the largest reported growth was only 9% TW.

The maximum AVB wear depth reported was 35% TW in SG 3. The growth associated with this indication was 4% TW. The largest reported AVB or non-expanded baffle wear growth reported was 9% TW.

Using the uniform thinning burst equation of NUREG-0718, TSP wear of up to about 69% TW would be expected to provide structural integrity at the Comanche Peak 1 3DP value of 3810 psi.

4.3 Condition Monitoring Evaluation of Degradation Modes Classified as Potential in the Degradation Assessment

The final degradation classification addressed in the degradation assessment are potential degradation modes. Potential degradation modes are modes not seen in CPSES Unit 1, but represent a potential to occur based on experience at other plants or in laboratory testing.

The only degradation mode classified as potential for CPSES 1RF07 is cold leg TTS SCC. Due to the reported C-3 condition in SG 4, a 20% cold leg TTS Plus Point inspection program was implemented. No degradation was reported in this program.

4.4 Summary of Limiting Indications

Table 6 presents a summary of the limiting indications for the 1RF07 inspection.

Table 6: Summary of Limiting Indications at 1RF07

Mechanism	Max Length	Max Depth	Avg. Depth	Calculated Burst Pressure
Circ ODSCC at hot leg TTS	339°	69%	51%	6038 psi *
Circ ODSCC at hot leg TTS	339°	48%	31%	7000 psi *
Axial ODSCC at TTS	0.25"	85%	85% (assumed)	6225 psi
Axial ODSCC at TSP	0.23	1.12 volts	N/A	> 8000 psi
Baffle Wear	0.75"	37%	N/A	7069 psi
AVB Wear	0.04"	34%	34%	7973 psi

*: Successfully proof tested at a test pressure of 4385 psig. No leakage reported at 2925 psig.

4.5 Steam line Break (SLB) Leakage Discussion

For all degradation mechanisms observed at 1RF07, any potential for SLB leakage at end of Cycle 8 conditions is judged to be negligible. The circumferential ODSCC indications at the TTS are of sufficiently low magnitude that no leakage contribution is expected. Based on the available industry database, SLB leakage is not expected for maximum Plus Point amplitudes of about 1 volt. The Plus Point amplitudes of the in situ leak tested circumferential flaws was 0.17.

0.23, and 0.32. The largest Plus Point amplitude observed for all SGs was 0.39. At 1RF06, three flaws with Plus Point amplitudes of 0.47 volts were in situ tested with no leakage. No leakage was reported at a maximum pressure of 2925 psi in either the 1RF06 or 1RF07 in situ testing campaigns.

In Situ Testing Summary:

The in situ testing performed during 1RF07, supports the conclusion that postulated SLB condition primary to secondary leakage will remain below 1 gpm for all SGs.

Using the available database of hardroll pulled tubes with circumferential ODSCC at TTS expansions, maximum Plus Point amplitudes of 1.33 volts for ¾" OD tubes and 2.18 volts for 7/8" tubes showed no leakage during in situ test or during destructive examination at simulated SLB conditions. The maximum reported Plus Point amplitude for circumferential ODSCC at the TTS was 0.39 volts for 1RF07. Maximum Plus Point amplitude can also be used for assessment of general structural integrity characteristics. The two pulled tube indications had burst pressures of 4670 psi and 7980 psi, respectively, when normalized to LTL material property values at 650° F.

Table 7 list the limiting indications at 1RF07 and 1RF06 with their corresponding in situ results.

Table 7 CPSES 1RF07 In Situ Testing Summary								
Tube	**S G**	**Degradation Mode**	**Location**	**Flaw Length**	**Max Depth**	**Plus Point Volts**	**Leakage**	**Burst**
R22 C89	4	Circ ODSCC	HTS –0.23"	339°	69%	0.23	No	No
R32 C77	4	Circ ODSCC	HTS –0.14"	292°	63%	0.32	No	No
R38 C78	4	Circ ODSCC	HTS +0.11"	265°	71%	0.17	No	No
CPSES 1RF06 In Situ Testing Summary (limiting indications)								
Tube	**S G**	**Degradation Mode**	**Location**	**Flaw Length**	**Max Depth**	**Plus Point Volts**	**Leakage**	**Burst**
R1 C69	2	Circ ODSCC	HTS +0.12"	296°	61%	0.43	No	No
R1 C73	2	Circ ODSCC	HTS –0.17"	326°	67%	0.47	No	No
R1 C95	2	Circ ODSCC	HTS –0.32"	337°	64%	0.44	No	No
R3 C96	2	Circ ODSCC	HTS –0.25"	350°	71%	0.38	No	No
R3 C103	2	Circ ODSCC	HTS –0.14"	360°	71%	0.43	No	No

4.6 1RF07 Condition Monitoring Conclusion

Based on the CPSES 1RF07 inspection results, no tubes contained indications which represented a challenge to structural or leakage integrity and all condition monitoring requirements are satisfied. The relative severity levels of the observed degradation was judged consistent with or bounded by the levels associated with the 1RF06 inspection. Based on the apparent non-increasing expansion transition ODSCC growth and initiation rates, it is unlikely that a substantial increase in either number of indications or growth rates would be encountered during Cycle 8. The Cycle 8 operating period is approximately equal to the Cycle 7 period, with no expected change in operating conditions.