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

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES) UNIT 2 TENTH REFUELING OUTAGE (2RF10) STEAM GENERATOR 180 DAY REPORT

REFERENCE:

Dear Sir or Madam:

By means of the Enclosure to this letter, Luminant Generation Company LLC (Luminant Power) submits the steam generator tube in-service inspection 180 Day Report as required by Technical Specification 5.6.9, for the Unit 2 tenth refueling outage (2RF10).

This communication contains no new or revised license commitments.

Should you require any other additional information please contact Mr. Bob Kidwell at (254) 897-5310.

Sincerely,

Luminant Generation Company LLC

Mike Blevins

By: Fred W. Madden

Fred W. Madden
Director, Oversight & Regulatory Affairs

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Enclosure - SG-CDME-08-28, Rev 1 - Steam Generator Condition Monitoring and Operational Assessment for Comanche Peak Unit 2 April 2008 Outage (2RF10)

c - E. E. Collins, Region IV
B. K. Singal, NRR
Resident Inspectors, Comanche Peak

SG-CDME-08-28, Rev 1

Steam Generator Condition Monitoring and Operational Assessment for Comanche Peak Unit 2 April 2008 Outage (2RF10)

September 2008

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Errata

The only change in Revision 1 of this report from Revision 0 is the classification of the document as Westinghouse Non-proprietary. Addition of the Errata section has resulted in the addition of a page and hence the page numbers advance by 1. All other contents remain unchanged.

Executive Summary

The primary side inspection of the Unit 2 steam generators (SG) consisted of bobbin and +Point testing of a 50% sample population for all potential degradation mechanisms (there was no active mechanism prior to 2RF10). Finding of indications at the tube end location in each SG resulted in the expansion of +Point inspection of the hot leg tube end in all SGs to 100%.

Axial and circumferential indications suggestive of flaws at the tube end ID were reported in all SGs. There were nine tubes with axial and four with circumferential indications. All of these 13 tubes were plugged. Due to the complex geometry consisting of the tack roll and the tube end weld, eddy current evaluation cannot clearly resolve whether the flaws are cracks, suggestive of a corrosion mechanism. If they are corrosion induced, this is the first time that corrosion degradation is observed in the Unit 2 SGs.

Structural and leakage performance criteria were satisfied prior to the current shut down. Hence the condition monitoring requirements are satisfied. Further, an operational assessment of the current inspection results shows that the structural and leakage integrity will be satisfied during the next two operating cycles until 2RF12.

1 Introduction

Per NEI 97-06 (Reference 1), a condition monitoring assessment, which evaluates structural and leakage integrity characteristics of the steam generator (SG) at the end of the last operating period, is to be performed following each inspection. This evaluation is "backward looking" and compares the observed SG tube eddy current indication parameters against leakage and structural integrity commensurate with RG 1.121 (Reference 2). Additionally, an operational assessment, or "forward looking" evaluation is used to project the inspection results and trends to the next inspection period. This report documents the condition monitoring and preliminary operational assessment of the inspection results from the Comanche Peak 2RF10 inspection.

1.1 Steam Generator Configuration

The Comanche Peak Unit 2 NSSS has four Westinghouse designed Model D-5 SGs each with 4570 thermally treated Alloy 600 U-tubes. Each U-tube has a nominal diameter of 0.750 inch (OD), a nominal tube wall thickness of 0.043 inch, and a straight length ranging from 303.73 inches (Row 1) to 305.49 inches (Row 49), based on the tube schedule drawing. The tubesheet is 21.23 inches thick with a full depth hydraulic expansion of the tubes in both the hot leg and the cold leg. Approximately 0.75 inch of the tube at both ends was tack expanded prior to tube end welding. On the hot leg side, the U-tubes are supported by seven (7) tube support plates (TSP). A flow distribution baffle (FDB) plate located between the tubesheet and the first support plate helps distribute the secondary side flow over the tubesheet. On the cold leg side there are four (4) TSPs, six (6) preheater baffle plates and the FDB. The flow distribution baffle and the lowest five preheater baffle plates are 0.75 inch thick whereas the TSPs and the top preheater baffle plate are 1.12 inch thick. The FDB and the preheater baffle plates have round drilled holes whereas the TSPs have concave quatrefoil holes. All plates are made of type 405 stainless steel. In the U-bend, the tubes are supported by two (2) sets of chrome-plated Inconel anti-vibration bars (AVB). To reduce tube vibration, 140 tubes in each SG were hydraulically expanded at the B and D preheater baffle plates. This field modification was performed before the initial startup of Unit 2.

1.2 Summary of Operation and Plan

The prior inspection of these SGs was conducted at 2RF08 when the accumulated operating life was 10.2 effective full power years (EFPY). During the 2RF09 outage, neither primary side nor secondary side inspection of the SGs was performed. The cumulative operating experience at the current (2RF10) inspection is 13.04 EFPY.

The next two fuel cycles are planned to be 1.45 (cycle 11) and 1.41 (cycle 12) EFPY. Unit 2 will implement a Stretch Power Uprate of 4.5% of the original power rating during 2RF11 in the Fall of 2009. The uprate will change the current core thermal power from 3458 MWt (101.5% condition) to 3612 MWt. The SG inlet temperature (T_{hot}) of the primary coolant is expected to increase by 1.2°F.

2 Steam Generator Outage Summary

2.1 Primary Side Inspection Plan and Results

2.1.1 Base Scope Inspection

The 2RF10 inspection plan satisfied the requirements of both the Technical Specifications and the EPRI NDE Guidelines Revision 6 (Reference 3). The 2RF10 base scope inspection plan (for all SGs unless specified) included:

1) 55% full length bobbin inspection, including tubes with prior indications (see the next paragraph)
2) 50% Hot Leg TTS +Point from 3" above to 3" below TTS (see the next paragraph)
3) 50% Hot Leg +Point from tube end to 2" above tube end (same tubes as item 2)
4) +Point test of at least 50% of the BLGs and OXPs in Hot Leg tubesheet (subset of tubes from item 2)
5) 50% U-bend mag-biased mid-range +Point of Rows 1 and 2 (select from tubes included in item 1)
6) 50% +Point at expanded preheater baffle plate
7) 100% +Point of ≥ 2 volt dents at H3 TSP
8) 50% +Point of ≥ 5 volt dings and dents in the hot leg
9) Special interest RPC (freespan signals without historical resolution, bobbin I-code indications)
10) 100% tube plug video inspection
11) Top of tubesheet and typical (periphery and T-slot) baffle plate B secondary side video inspection including FOSAR
12) Upper bundle video inspection (through Access Ports 1 and 2 only) in one SG (SG 3).

The initial bobbin inspection program contained all tubes with previously identified indications. Tubes which were identified as possibly having elevated residual stress (Table A-1) were included in the full length bobbin program (item 1 above) and top of tubesheet +Point program (Item 2 above).

2.1.2 Inspection Expansion

Axial and circumferential indications were reported in the tube end inspection program. As a result, the +Point inspection of the tube end (from HTE to HTE+2") was expanded from 50% to 100% of the hot leg tubes in all four SGs. The tubes with the indications were also inspected using a mag-biased +Point probe to characterize and confirm the indication; the pull speed used when testing with this probe is low (0.3 inch/sec) and hence the results provide better resolution of the eddy current signal. Special interest inspection and inspection for wear in tubes adjacent to loose parts were conducted as planned. No other expansion of inspection was necessary.

2.1.3 Inspection Results

A summary of the completed inspection program is shown in Table 2-1. Table 2-2 presents a filtered summary of the tube NDE results, representing data relevant to the condition of the tubes; the data represent total database records, without deleting redundant records. Hence it should be used with caution.

2.2 Tube Repair Summary

A total of 13 tubes were plugged during 2RF10. Table 2-3 summarizes the list of tubes plugged in each SG and the cause of plugging. The number of tubes plugged in each SG is listed in Table 2-4 chronologically.

2.3 Summary of Secondary Side Inspection & Maintenance

The SG secondary side maintenance activities during 2RF10 consisted of sludge lancing, tube bundle video inspection, and foreign object search and retrieval (FOSAR). These services were performed in all four SGs. In addition, upper bundle video inspection was performed in SG3.

A total of 32 pounds of sludge was removed from the four SGs. This quantity is consistent with the prior history of sludge removal from CPNPP Unit 2. The sludge removal history is summarized in Table 2-5.

All possible loose parts (PLP) reported from eddy current inspection were reviewed for FOSAR. Areas of the tube bundle accessible for retrieval include the top of the tubesheet and a large portion of the area over baffle plate B. A FOSAR was conducted for all PLPs located in these areas. The video inspection also resulted in the identification of parts located on the tubesheet and on baffle plate B. The parts judged (based on size and location) to have possibly caused tube wear were identified and eddy current inspection of the potentially affected tubes was conducted. Table 2-6 shows a list of all the parts identified from various inspections and their disposition.

Table 2-1. Summary of Eddy Current Inspections Completed in 2RF10

Inspection	SG1	SG2	SG3	SG4	Total
Hot leg bobbin	2795	2708	2845	2842	11190
Hot leg tubesheet +Point *	3959	4118	3982	3849	15908
Hot leg tube end +Point expansion	2223	2202	2219	2221	8865
Hot leg Row 1 &2 U-bend +Point	114	114	115	114	457
Hot leg straight section +Point DNT/DNG	35	14	27	94	170
Hot leg straight section special interest +Point	6	17	16	13	52
Hot leg above Row 2 U-bend special interest +Point	27	10	2	7	46
Cold leg straight section bobbin	377	366	414	394	1551
Cold leg expanded B & D baffle +Point	140	140	140	140	560
Cold leg straight section +Point DNT/DNG	0	4	0	4	8
Cold leg straight section special interest +Point	6	11	1	6	24
Cold leg above Row 2 U-bend special interest +Point	4	3	2	4	13
All programs	9686	9707	9763	9688	38844

* Tubes with BLG/OXP were tested full depth of the tubesheet which counted as a single test each whereas the remaining tubes in the 50% sample were tested at the top of the tubesheet and the tube end separately and couted as two tests each

Table 2-2. Pivot Table of Inspection Results

Call \ SG	1	2	3	4	Total
PCT	157	49	55	18	279
DNT	231	188	276	528	1223
MBM	69	134	137	153	493
NDF	109	91	92	176	468
PID	1	7	3	2	13
PLP	7	4	5	15	31
PVN	10	9	27	9	55
INF	43	7	19	9	78
INR	306	147	167	193	813
NDD	8656	9123	8782	8531	35092
BLG	1	1			2
DFH	485	283	491	566	1825
DFS	5	19		3	27
DNG	707	344	603	673	2327
DNH	2	3	1	1	7
DNS	4	21	29	34	88
DSH	5	3	6	10	24
DSS	3	4	1		8
NQH	1				1
RBD	52	39	104	29	224
RIC	52	107	34	22	215
RWS	2		3		5
WAR	1	2			3
SAI	2	14	2		18
SCI				4	4
MCI			4		4
MBH	13	32	19	9	73
TBP	1	7	3	2	13
Grand Total	10925	10638	10863	10987	43413

Table 2-3. 2RF10 Tube Plugging Attributes

SG	Row	Col	Volts	Deg	Ind	Chn	Locn	Inch1	Crlen	Crwid	Ceg	Pdia	Ptype	ATTRIBUTE
1	33	54	1.7	44	SAI	6	HTE	0.08	0.17	0.43	66	0.61	ZPSMB	Tube end axial
2	1	21	2.34	41	SAI	6	HTE	0.1	0.17	0.39	59	0.61	ZPSMB	Tube end axial
2	10	31	1.91	27	SAI	6	HTE	0.03	0.17	0.4	61	0.61	ZPSMB	Tube end axial
2	1	32	3.4	33	SAI	6	HTE	0.35	0.23	0.41	63	0.61	ZPSMB	Tube end axial
2	1	44	2.1	35	SAI	6	HTE	0.05	0.23	0.37	56	0.61	ZPSMB	Tube end axial
2	1	45	3.83	40	SAI	6	HTE	0.08	0.2	0.39	59	0.61	ZPSMB	Tube end axial
2	1	74	4.26	37	SAI	6	HTE	0.15	0.2	0.38	58	0.61	ZPSMB	Tube end axial
2	5	93	3.81	31	SAI	6	HTE	0.14	0.2	0.39	59	0.61	ZPSMB	Tube end axial
3	1	47	5.49	37	MCI	P2	HTE	0.11	0.26	1.15	175	0.61	ZPSMB	Tube end circ.
3	1	48	4.98	28	MCI	P2	HTE	0.07	0.18	0.93	141	0.61	ZPSMB	Tube end circ.
3	36	60	3.82	39	SAI	6	HTE	0.08	0.18	0.55	84	0.61	ZPSMB	Tube end axial
4	1	30	1.53	30	SCI	P2	HTE	0.09	0.44	0.64	98	0.61	ZPSMB	Tube end circ.
4	21	69	3.33	25	SCI	P2	HTE	0.11	0.28	0.52	79	0.61	ZPSMB	Tube end circ.

Table 2-4. History of Tube Plugging in CPNPP Unit 2

Outage	Date	EFPY	SG 1	SG 2	SG 3	SG 4	Total	Percent
Pre-service	Pre-serv.	0.000	5	3	3	9	**20**	**0.11%**
2RF01	Nov-94	0.910	0	0	0	0	**0**	**0.00%**
2RF02	Mar-96	2.090	0	0	0	0	**0**	**0.00%**
2RF03	Nov-97	3.489	3	5	0	0	**8**	**0.04%**
2RF04	Apr-99	4.706	1	0	0	4	**5**	**0.03%**
2RF05	Oct-00	6.138	3	0	0	1	**4**	**0.02%**
2RF06	Apr-02	7.520	0	4	7	0	**11**	**0.06%**
2RF07	Oct-03	8.825	3	0	0	1	**4**	**0.02%**
2RF08	Apr-05	10.205	5	2	4	2	**13**	**0.07%**
2RF09	Oct-06	11.639	No SG Inspection				**0**	**0.00%**
2RF10	Apr-08	13.044	1	7	3	2	**13**	**0.07%**
Total			**21**	**21**	**17**	**19**	**78**	**0.43%**
Percent			**0.46%**	**0.46%**	**0.37%**	**0.42%**	**0.43%**	

Table 2-5. History of Sludge Removal from CPNPP Unit 2

Comanche Peak Unit 2 - Pounds of Sludge Removed						
RFO	Date	SG-1	SG-2	SG-3	SG-4	Total
1	Nov-94	2.5	3.0	3.0	3.0	11.5
2	Mar-96	No sludge lancing performed				
3	Nov-97	3.7	4.0	4.5	6.0	18.2
4	Apr-99	3.0	4.0	3.0	3.0	13.0
5	Oct-00	5.5	3.5	5.5	3.5	18.0
6	Apr-02	4.0	6.0	3.0	2.0	15.0
7	Oct-03	No sludge lancing performed				
8	Apr-05	10.0	8.0	7.5	9.0	34.5
9	Oct-06	No sludge lancing performed				
10	Apr-08	8.3	6.8	9.3	7.8	32.0

Table 2-6. Summary of Loose Parts and Eddy Current PLPs from 2RF10

SG1 (Page 1 of 2)

Object Number	SG	Object Description	Location	Elevation (In)	First Found by	Row	Column	Leg	Length	Height	Width (Diameter for wire)	Confirmed by	Object Removed (YES/NO)	Resolution
1-001	1	Metal Object	BP B (C2)	N/A	+Point	48	65	CL	0.5	0.25	0.25	N/A	YES	N/A
1-002	1	Metal Object in the annulus	BP B (C2) Annulus	N/A	Video	25	N/A	CL	0.25	0.25	0.25	N/A	NO	Engineering Disposition
1-003	1	Sludge rock	BP B (C2)	N/A	Video	25	41	CL	0.25	0.25	0.25	N/A	NO	Engineering Disposition
1-004	1	Wire	BP B (C2)	N/A	Video	25	49	CL	0.5	N/A	0.2	N/A	NO	Engineering Disposition
1-005	1	Wire Mesh	BP B (C2)	N/A	Video	25	104	CL	0.375	N/A	0.02	N/A	NO	Engineering Disposition
1-006	1	Metal Object	BP B (C2)	N/A	Video	45	64	CL	0.25	0.375	0.25	N/A	YES	N/A
1-007	1	Metal Object	TTS	N/A	Video	40	95	CL	0.375	0.25	0.25	N/A	YES	N/A
1-008	1	Wire	TTS	N/A	Video	22	6	HL	0.5	N/A	0.02	N/A	YES	N/A
EC 1-01	1	Rough Metal Strip wedged in place. Wedged in between R7C3, R8C2 and R8C3	TTS	0.47	+Point	8	2	HL	3	0.3	0.04	Video / NDE History	NO	Engineering Disposition
EC 1-02	1	Rough Metal Strip wedged in place. Wedged in between R7C3, R8C2 and R8C4 (Same as above)	TTS	0.10	+Point	7	3	HL	3	0.3	0.04	Video / NDE History	NO	Engineering Disposition
EC 1-03	1	Rough Metal Strip wedged in place. Wedged in between R7C3, R8C2 and R8C4 (Same as above)	TTS	0.23	+Point	8	3	HL	3	0.3	0.04	Video / NDE History	NO	Engineering Disposition
EC 1-04	1	Consolidated scale pile	TTS	0.14	+Point	21	38	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition
EC 1-05	1	Consolidated scale pile	TTS	0.07	+Point	22	38	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition
EC 1-06	1	Consolidated scale pile	TTS	0.14	+Point	23	38	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition
EC 1-07	1	Consolidated scale pile	TTS	0.19	+Point	12	39	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition
EC 1-08	1	Nothing was found	TTS	0.07	+Point	24	49	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 1-09	1	Nothing was found	TTS	0.08	+Point	25	50	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 1-10	1	Consolidated scale pile	TTS	0.06	+Point	25	52	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition

Table 2-6. Summary of Loose Parts and Eddy Current PLPs from 2RF10 SG1 (Page 2 of 2)

Object Number	SG	Object Description	Location	Elevation (In)	First Found by	Row	Column	Leg	Length	Height	Width (Diameter for wire)	Confirmed by	Object Removed (YES/NO)	Resolution
EC 1-11	1	Nothing was found	TTS	0.81	+Point	34	55	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 1-12	1	Nothing was found	TTS	1.01	+Point	34	56	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 1-13	1	Metallic Object	BP B (C2)	0.00	+Point	48	65	CL	0.5	0.25	0.25	Video	YES	N/A
EC 1-14	1	Metallic Object - Same as above	BP B (C2)	0.64	+Point	48	66	CL	0.5	0.25	0.25	Video	YES	N/A
EC 1-15	1	Consolidated scale pile	TTS	0.06	+Point	25	68	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition
EC 1-16	1	Consolidated scale pile	TTS	0.07	+Point	26	68	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition
EC 1-17	1	Consolidated scale pile	TTS	0.13	+Point	24	70	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition
EC 1-18	1	Consolidated scale pile	TTS	0.06, 0.08	+Point	25	70	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition
EC 1-19	1	Consolidated scale / Loose material / Tramp Material	TTS	0.08	+Point	24	81	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition
EC 1-20	1	Consolidated scale / Loose material / Tramp Material	TTS	0.04	+Point	25	81	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition

Table 2-6. Summary of Loose Parts and Eddy Current PLPs from 2RF10 SG2 (Page 1 of 3)

Object Number	SG	Object Description	Location	Elevation	First Found by	Row	Column	Leg	Length	Height	Width (Diameter for wire)	Confirmed by	Object Removed (YES/NO)	Resolution
2-001	2	Wire	BP B (C2)	N/A	Video	21	40	CL	1	N/A	0.02	N/A	NO	Engineering Disposition
2-002	2	Metal Object in between C11/12	BP B (C2)	N/A	Video	25	11/12	CL	0.25	0.25	0.25	N/A	NO	Engineering Disposition
2-003	2	Wire	BP B (C2)	N/A	Video	26	16	CL	0.25	N/A	0.015	N/A	NO	Engineering Disposition
2-004	2	Sludge Rock	TTS (Annulus)	N/A	Video	N/A	77	HL	0.25	0.25	0.25	N/A	YES	N/A
2-005	2	Sludge Rock	TTS (Annulus)	N/A	Video	N/A	71	HL	0.125	0.125	0.125	N/A	NO	Engineering Disposition
2-006	2	Metal Object	BP B (C2)	N/A	Video	45	N/A	CL	0.368	0.25	0.25	N/A	YES	N/A
2-007	2	Sludge Rock wedged between the blowdown support and the tube in the T-slot. A retrieval attempt was unsuccessful.	TTS	N/A	Video	35	58	HL	0.368	0.25	0.25	N/A	NO	Engineering Disposition
EC 2-01 (2-008)	2	Sludge Rock	BP B (C2)	.74"	+Point	38	23	CL	0.25	0.25	0.25	Video	NO	Engineering Disposition
EC 2-02	2	Nothing was found	TTS	.12"	+Point	28	40	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 2-03	2	Nothing was found	TTS	.03"	+Point	18	48	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 2-04	2	Consolidated scale / collar	TTS	.00"	+Point	24	50	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition
EC 2-05	2	Consolidated scale / collar	TTS	.08"	+Point	24	53	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition
EC 2-06	2	Nothing was found	TTS	.54"	+Point	38	53	HL	N/A	N/A	N/A	Video	N/A	
EC 2-07	2	Consolidated scale / collar	TTS	.15"	+Point	24	55	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition
EC 2-08	2	Same as EC 2-09*	TTS	1.96"	Bobbin	30	56	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 2-09	2	Blowdown support appears to be touching the tube near the location	TTS	2.30"	+Point	30	56	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 2-10	2	Nothing was found	TTS	.43"	+Point	28	59	HL	N/A	N/A	N/A	Video	N/A	N/A

Table 2-6. Summary of Loose Parts and Eddy Current PLPs from 2RF10 SG2 (Page 2 of 3)

Object Number	SG	Object Description	Location	Elevation	First Found by	Row	Column	Leg	Length	Height	Width (Diameter for wire)	Confirmed by	Object Removed (YES/NO)	Resolution
EC 2-11	2	Nothing was found	TTS	.31"	+Point	35	59	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 2-12	2	Consolidated scale / collar	TTS	.20"	+Point	24	60	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition
EC 2-13	2	Consolidated scale / collar	TTS	.25"	+Point	25	60	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition
EC 2-14	2	Nothing was found	BP B (C2)	2.37"	+Point	46	66	CL	N/A	N/A	N/A	Video	N/A	N/A
EC 2-15	2	Nothing was found	BP B (C2)	2.20"	+Point	46	67	CL	N/A	N/A	N/A	Video	N/A	N/A
EC 2-16	2	N/A	BP B (C2)	.40"	+Point	11	26	CL	N/A	N/A	N/A	N/A	N/A	Location not accessible by video probe
EC 2-17	2	N/A	BP B (C2)	0.42	+Point	12	26	CL	N/A	N/A	N/A	N/A	N/A	Location not accessible by video probe
EC 2-18	2	Tube wear confirmed by +Point. Wire confirmed by Video Inspection. Wire object was retrieved.	BP E (C4)	0.67	+Point	3	114	CL	4.5	N/A	0.125	Video	YES	Retrieved
EC 2-19	2	Tube wear confirmed by +Point. Wire confirmed by Video Inspection. Wire object was retrieved. (Same as above)	BP E (C4)	0.78	+Point	3	114	CL	4.5	N/A	0.125	Video	YES	Retrieved
EC 2-20	2	Tube wear confirmed by +Point. Wire confirmed by Video Inspection. Wire object was retrieved. (Same as above)	BP E (C4)	0.43	+Point	4	114	CL	4.5	N/A	0.125	Video	YES	Retrieved
EC 2-21	2	N/A	BP H (C6)	.48"	+Point	12	23	CL	N/A	N/A	N/A	N/A	N/A	Location not accessible by video probe
EC 2-22	2	N/A	BP H (C6)	0.43	+Point	11	24	CL	N/A	N/A	N/A	N/A	N/A	Location not accessible by video probe
EC 2-23	2	N/A	BP H (C6)	0.4	+Point	13	24	CL	N/A	N/A	N/A	N/A	N/A	Location not accessible by video probe
EC 2-24	2	N/A	BP H (C6)	0.46	+Point	12	25	CL	N/A	N/A	N/A	N/A	N/A	Location not accessible by video probe

Table 2-6. Summary of Loose Parts and Eddy Current PLPs from 2RF10
SG2 (Page 3 of 3)

Object Number	SG	Object Description	Location	Elevation	First Found by	Row	Column	Leg	Length	Height	Width (Diameter for wire)	Confirmed by	Object Removed (YES/NO)	Resolution
EC 2-25	2	N/A	BP H (C6)	0.47	+Point	14	25	CL	N/A	N/A	N/A	N/A	N/A	Location not accessible by video probe
*(2-114)	2	This object was identified as a sludge rock in LTR-CDME-05-163. Nothing was found in 2RF10 video inspection.	BP B (C2)	N/A	2RF08	N/A	N/A	CL	N/A	N/A	N/A	Video	N/A	N/A

*Historical Part Identified in 2RF08 during Video Inspection.

Table 2-6. Summary of Loose Parts and Eddy Current PLPs from 2RF10

SG3

Object Number	SG	Object Description	Location	Elevation	First Found by	Row	Column	Leg	Length	Height	Width (Diameter for wire)	Confirmed by	Object Removed (YES/NO)	Resolution
3-001	3	Wire in the left tube crevice	BP B (C2)	N/A	Video	8	55	CL	0.125	N/A	0.064	N/A	NO	Engineering Disposition
3-002	3	Wire in the right tube crevice	BP B (C2)	N/A	Video	15	55	CL	0.5	N/A	0.064	N/A	NO	Engineering Disposition
3-003	3	Metal Object. This item was a historical object and was dispositioned in 2RF08 as part 2-046.	BP B (C2)	N/A	Video	23	86	CL	0.312	0.312	0.25	N/A	NO	Engineering Disposition
3-004	3	Wire in the right tube crevice	BP B (C2)	N/A	Video	25	81	CL	0.5		0.028	N/A	NO	Engineering Disposition
3-005	3	Wire in the left tube crevice	BP B (C2)	N/A	Video	25	66	CL	0.375		0.064	N/A	NO	Engineering Disposition
3-006	3	Sludge Rock	TTS	N/A	Video	2	1	HL	0.25	0.25	0.25	N/A	YES	N/A
EC 3-01	3	Nothing was found. Piece of scale loosely adherent to the tube.	TTS	.70"	+Point	4	110	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 3-02	3	Nothing was found	TTS	2.78"	+Point	6	114	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 3-03	3	Nothing was found	TTS	2.98"	+Point	6	114	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 3-04	3	Nothing was found	TTS	2.89"	+Point	6	114	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 3-05	3	Nothing was found	TTS	3.10"	+Point	6	114	HL	N/A	N/A	N/A	Video	N/A	N/A
*(3-102)	3	This object was identified as a metal object in 2RF08. Not found in 2RF10.	BP B (C2)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Video	N/A	N/A

*Historical Part Identified in 2RF08 during Video Inspection.

Table 2-6. Summary of Loose Parts and Eddy Current PLPs from 2RF10
SG4 (Page 1 of 2)

Object Number	SG	Object Description	Location	Elevation	First Found by	Row	Column	Leg	Length	Height	Width (Diameter for wire)	Confirmed by	Object Removed (YES/NO)	Resolution
4-001	4	Wire Mesh	BP B (C2)	N/A	Video	10-11	59	CL	0.75	0.125	0.75	N/A	YES	N/A
4-002	4	Wire Mesh	BP B (C2)	N/A	Video	31	18-20	CL	0.5	0.125	0.40	N/A	YES	N/A
*(4-42)	4	Machine Remnant identified in 2RF08. The object was not found during visual inspection in 2RF10.	BP B (C2)	N/A	Video	30-32	22	CL	1.000	N/A	0.35	Video	N/A	Not found in RF10 at this location
*(4-84)	4	Wire Mesh identified in 2RF08. Object may have moved and appears to be object 4-001 which was retrieved during 2RF10.	BP B (C2)	N/A	Video	10	60-61	CL	0.75	0.25	0.01	Video	YES	N/A
EC 4-01	4	Nothing was found.	TTS	0.16	+Point	18	38	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 4-02	4	Nothing was found.	TTS	0.03	+Point	25	53	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 4-03 (4-003)	4	Part identified in between row 34 and 35. Retrieval attempt was unsuccessful.	TTS	0.19	+Point	34	55	HL	0.25	0.125	0.125	Video	NO	Identified in the visual inspection from 2RF08 as part 4-100. Comparison of photos from 2RF08 and 2RF10 confirms it is the same part. Dispositioned in 2RF08.
EC 4-04 (4-003)	4	Part identified in between row 34 and 35. Retrieval attempt was unsuccessful. (Same as above)	TTS	0.07	+Point	35	55	HL	0.25	0.125	0.125	Video	NO	Identified in the visual inspection from 2RF08 as part 4-100. Comparison of photos from 2RF08 and 2RF10 confirms it is the same part. Dispositioned in 2RF08. (Same as above)
EC 4-05	4	Consolidated Scale pile	TTS	0.00	+Point	24	61	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition
EC 4-06	4	Same as above	TTS	0.18	+Point	25	61	HL	N/A	N/A	N/A	Video	NO	Engineering Disposition
EC 4-07	4	Nothing was found.	TTS	0.08	+Point	24	63	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 4-08	4	Nothing was found.	TTS	0.02	+Point	24	64	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 4-09	4	Nothing was found.	TTS	0.14	+Point	18	66	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 4-10	4	Nothing was found.	TTS	0.13	+Point	19	66	HL	N/A	N/A	N/A	Video	N/A	N/A

*Historical Part Identified in 2RF08 during Video Inspection.

Table 2-6. Summary of Loose Parts and Eddy Current PLPs from 2RF10
SG4 (Page 2 of 2)

Object Number	SG	Object Description	Location	Elevation	First Found by	Row	Column	Leg	Length	Height	Width (Diameter for wire)	Confirmed by	Object Removed (YES/NO)	Resolution
EC 4-11	4	Nail	TTS	0.11	+Point	23	79	HL	3	N/A	0.07	Video	NDE History	Nail confirmed by NDE History. No tube wear was ever reported. Engineering Disposition
EC 4-12	4	Nail (Same as above)	TTS	0.27	+Point	22	80	HL	3	N/A	0.07	Video	NDE History	Nail confirmed by NDE History. No tube wear was ever reported. Engineering Disposition (Same as above)
EC 4-13	4	Nail (Same as above)	TTS	0.17	+Point	23	80	HL	3	N/A	0.07	Video	NDE History	Nail confirmed by NDE History. No tube wear was ever reported. Engineering Disposition (Same as above)
EC 4-14	4	Nothing was found.	TTS	0.48	+Point	25	95	HL	N/A	N/A	N/A	Video	N/A	N/A
EC 4-15	4	Nothing was found.	TTS	0.48	+Point	26	95	HL	N/A	N/A	N/A	Video	N/A	N/A

*Historical Part Identified in 2RF08 during Video Inspection.

3 Condition Monitoring

Condition monitoring is the evaluation of the condition of the steam generators to meet the structural, operating leakage and accident condition leakage performance criteria prior to shut down, in light of the inspection results.

3.1 Active Degradation Mechanisms

Prior to 2RF10, there were no active degradation mechanisms in the Comanche Peak Unit 2 SGs. Active degradation mechanisms (as defined by the EPRI PWR SG Examination Guidelines, Rev 6 – Reference 3) are those mechanical or corrosive processes (excluding loose parts wear) with a combination of 10 or more new indications (>20% throughwall depth) and previous indications that display an average growth rate > 25% of the repair limit (of 40%) in an inspection-to-inspection interval in any one SG; one or more new or previous indications which display a growth rate > the repair limit in one inspection-to-inspection interval; or one crack indication (ODSCC or PWSCC).

3.1.1 Axial and Circumferential PWSCC at Hot Leg Tube End

As noted in Section 2.1.1, the base scope inspection included +Point inspection of a 50% sample of the hot leg tube ends in each SG. As a result of the reported indications in the base scope, the tube end +Point inspection was expanded to 100% of the tubes in all SGs.

A number of axial and circumferential indications were reported in the hot leg tube end inspection. Table 2-3 shows a summary of all the tube end indications reported during this outage. The eddy current signals were representative of ID initiated flaws and hence they are assumed to be PWSCC flaws (however, there is no evidence to conclude whether or not they resulted from corrosion). There are a total of 9 axial and 4 circumferential indications. SG1 and SG2 have only axial indications and SG4 has only circumferential indications, whereas SG3 has both. Seven of the 13 affected tubes are in SG2. SG1 is the least affected with only one indication.

All of these indications are at the tube end. The average reported elevation is HTE+0.11 inch. The highest reported elevation is 0.35 inch (R1C32 in SG2) and the lowest reported elevation is 0.03 inch (R10C31 in SG2) above tube end. The reported +Point amplitudes ranged from 1.53 to 5.49 volts, with an average value of 3.27 volts.

Due to the tubesheet restraint, the tube cannot burst at this location. As for leakage, primary to secondary leakage is possible in theory. However, the leak path to the secondary side of the SG consists of the crack opening, approximately 0.5 inch length of tack roll expansion and more than 20 inch length of hydraulic expansion gap between the tube and the tubesheet, all in series. The flow areas along the path are extremely small and hence the hydraulic resistance extremely high. Consequently leak rate from the tube end indications will be negligible. This is substantiated by the fact that no operating leakage was noted during the last cycle, including just prior to shut down. The accident condition leak rate from cracks in the tubesheet is limited to the operating leak rate times 2.5 or less. Since there was no operating leak rate, it follows that there would not be any leakage at accident conditions. Since the burst and leak rates considerations are satisfied, these indications met the structural and leakage performance criteria (condition monitoring) prior to shut down.
Do we need to address tube pull out?

Since the location of the indications is at the tube end, an in situ leak test is not feasible.

3.2 Potential Degradation Mechanisms

Potential degradation mechanisms are those mechanical and corrosive processes that are judged to have the potential to occur based on industry experience and/or laboratory data. Existing degradation not meeting the criteria for "active" degradation are included in this category.

3.2.1 Tube Wear at AVBs

AVB wear has been reported at Comanche Peak Unit 2 SGs in prior inspections. A number of AVB wear indications were reported in each of the SGs during 2RF10. Table 3-1 provides a summary of the AVB wear indications in 2RF10. None of the indications had throughwall depth at or above the repair limit of 40%. Hence no tube was plugged for this mechanism. The maximum reported depth for AVB wear during 2RF10 was 34% throughwall (TW).

As per the pre-outage degradation assessment (Reference 4), the structural limit for AVB wear is 78% TW and the corresponding condition monitoring limit is 60% TW. For primary to secondary leakage, the indicated depth of an OD-initiated flaw has to exceed 75% for any leakage to occur. Since all of the reported AVB indications had throughwall depths below 40%, primary to secondary leakage will not occur either at normal operation or at accident conditions. Thus the structural and leakage performance criteria (condition monitoring) are satisfied for the AVB wear indications.

3.2.2 Tube Wear at Preheater Baffle Plates

Wear at preheater baffle plates has been observed at CPNPP Unit 2 in prior inspections. These have been very few in number and had negligible growth rates. During 2RF10, two baffle plate wear indications have been reported, one each in SGs 1 and 3. The baffle plate wear indications reported during 2RF10 are summarized in Table 3-2. The estimated depths of these indications, 7% and 6%, were far below the repair limit.

As per the pre-outage degradation assessment (Reference 4), the structural limit for baffle plate wear is 69% TW and the corresponding condition monitoring limit is 52% TW, based on bobbin sizing using a wear scar standard. For primary to secondary leakage, the indicated depth of an OD-initiated flaw has to exceed 75% for any leakage to occur. Since all of the reported baffle plate indications had throughwall depths well below 40%, leakage will not occur either at normal operation or at accident conditions. Thus the structural and leakage performance criteria (condition monitoring) are satisfied for the baffle plate wear indications.

3.2.3 Tube Wear Due to Loose Parts

Loose parts wear indications were reported in two adjacent tubes in SG2. The indications were on top of baffle plate E (C4). The affected tubes R3C114 and R4C114 are in the periphery of the SG, column 114 being the last column in the bundle. The depth estimates of the indications were 22% and 23% TW from +Point inspection. As a result of the eddy current inspection, a foreign object search was performed at the given location over baffle plate E and the object was retrieved from the SG. It was 4.5 inches in length and 0.1 inch in diameter and appeared to be a piece of weld rod. It was tightly wedged between tube R3C114 and a baffle plate-to-wrapper wedge. The object was in contact with tube R4C114. Since the part was removed (tube wear at this location will not continue) and the depths of the indications were below 40% TW, the tubes were left in service.

The axial extents of the indications are below 0.25 inch. Hence the structural limit estimated for the AVB wear can be applied for these flaws. As per the degradation assessment (Reference 4), the structural limit for AVB wear (0.45 inch in axial length) is 78% TW and the corresponding condition monitoring limit is 60% TW. Due to the higher NDE uncertainty associated with ETSS 21998.1 (used for sizing the flaws) compared to 96004.3 used for AVB wear sizing, the condition monitoring limit may be closer to 50%. Even so, there is significant margin in the depth of these indications from both the plugging limit and the condition monitoring limit. Hence the structural and leakage performance criteria were satisfied for the loose part wear indications during Cycle 10.

3.2.4 Other Potential Degradation Mechanisms

None of the potential degradation mechanisms listed in the 2RF10 DA other than the three mechanisms described in Section 3.2 were reported during the current outage.

3.3 Secondary Side Integrity

Secondary side sludge lancing, video inspection over the tubesheet and over baffle plate B, and foreign object search and retrieval (FOSAR) at these locations was performed in each SG during 2RF10. In addition, upper bundle inspection was performed in SG3 via access ports 1 and 2.

No anomalous conditions adverse to structural integrity were reported from the video inspection. The FOSAR operation was performed over the tubesheet and over baffle plate B. One object that had led to wear indications in two tubes over baffle plate E (C4) was retrieved. All of the possible loose parts (PLP) reported in the eddy current inspection were subjected to FOSAR. Further, objects identified during the video inspection were retrieved where appropriate. Table 2-6 provides a summary of the results from the FOSAR operation.

3.4 Condition Monitoring Conclusion

During 2RF10, indications suggestive of corrosion related degradation were reported for the first time in the CPNPP Unit 2 SGs. These indications were located at the hot leg tube end. Nine (9) axial and four (4) circumferential indications distributed among the four SGs were reported. All of these indications satisfied the condition monitoring requirements. All of the 13 tubes with the tube end indications were removed from service by plugging.

During this outage, tube plugging was not required for any other mechanism. Since all indications were below the repair threshold, they also met the more stringent condition monitoring criteria.

In summary, each of the four SGs met the condition monitoring requirements during 2RF10.

Table 3-1. Summary of AVB Wear Indications in 2RF10

	SG1	SG2	SG3	SG4	Total
Number of AVB indications	156	47	54	18	275
Maximum depth, %TW	34	32	32	25	34
Number of "new" Indications	8	6	5	0	19
Number of "new" >20% Indications	0	2	0	0	2

Table 3-2. Summary of Baffle Plate Wear Indications

SG	Row	Col	Volts	Deg	Ind	Per	Chn	Locn	Inch1	Pdia	Ptype	Cal
1	49	56	0.39	0	PCT	7	P3	C5	-0.27	0.61	SBACC	109
3	45	55	0.29	0	PCT	6	P3	C2	0.31	0.61	SBACC	67

4 Operational Assessment

Operational assessment is the forward looking evaluation to assess if the steam generators will meet the structural, operating leakage and accident condition leakage performance criteria until the next scheduled inspection.

4.1 Active Degradation Mechanisms

As discussed in Section 3.1, the only active degradation mechanisms reported during the 2RF10 inspection were axial and circumferential PWSCC at the hot leg tube end.

4.1.1 Axial and Circumferential PWSCC at Hot Leg Tube End

Nine axial indications and four circumferential indications located at the hot leg tube end were reported during the current outage. These are summarized in Table 2-3.

Growth data is not available for the tube end indications. For most degradation mechanisms, growth rate of indications is very significant for the operational assessment. However, for the tube end indications, the growth rate is not significant as discussed below.

Due to the tubesheet restraint, the tube cannot burst at this location. As for leakage, as discussed in Section 3.1.1, due to the extremely high hydraulic resistance along the leak path the leak rate from the tube end indications will be negligible. This is substantiated by the fact that no operating leakage was noted during the last cycle, including just prior to shut down. The accident condition leak rate from cracks in the tubesheet is limited to the operating leak rate times 2.5 or less. Since there was no operating leak rate, it follows that there would not be any leakage at accident conditions. Since the burst and leak rate considerations are satisfied, the tube end indications will meet the structural and leakage performance criteria (condition monitoring) during the next two operating cycles.

No inspection of the tube-ends on the cold leg (CL) of the SGs was performed. Consistent with the EPRI PWR Inspection Guidelines (Reference 3) applied during 2RF10, the inspection was expanded to 100% of the tubes on the HL. For temperature sensitive degradation mechanisms such as PWSCC, Reference 3 requires that if a C-3 condition is encountered during an outage, inspection in the cold leg should be performed at the next refueling outage (or the current outage). The current inspection results were C-2 and hence the guidelines would not require an expansion of inspection to the cold leg.

The indications on the HL were interpreted as PWSCC. There is an abundance of evidence from operating SGs, from laboratory work and from theoretical work that relates PWSCC to three principal factors: material condition, stress and temperature. The tubing material is within the specification of Alloy600TT material; thus all of the tubing is from the same material population. At the stage of SG manufacturing when the tube-ends are tack expanded and welded, the HL and CL are not differentiated. In any case, the same processes and procedures are utilized for all tube ends, regardless of position in the bundle. Therefore, the manufacturing stresses are from the same population. During operation, the CL experiences slightly lower loading, but significantly lower temperatures than the HL. Therefore, based on the significant body of knowledge of PWSCC, the cold leg is not expected to exhibit significant cracking until cracking on the HL is extensive. Do we need to address tube pull out?

At 2RF10, over 18,000 tube-ends were inspected in the four SGs. Only 13 tubes were found with tube-end indications, and approximately 70% of those exhibited only axial indications. Thus, only 0.07% of the tubes exhibit any indication and only 0.02% exhibited circumferentially oriented indications.

4.2 Potential Degradation Mechanisms

4.2.1 Tube Wear at AVBs

During 2RF10, no tube plugging was required for AVB wear. The number of AVB indications was a total of 275, compared to 268 reported at 2RF08. Thus the number of indications is reaching a plateau. The maximum reported wear depth during the current outage is 34% TW compared to 37% TW reported at 2RF08. Table 4-1 shows the trends of the number and the maximum reported depth of the AVB indications in each SG.

The growth rate of AVB indications is very low. Figure 4-1 shows the growth rate distribution as a function of the indicated depth at the beginning of the period. It may be noted that the growth rate is independent of the initial wear depth. There are a large number of negative values, which reflect the NDE uncertainty. The average growth of the AVB indications in the last two cycles was 0.18% TW, with a standard deviation of 2.17% TW. Since the combined operating length of cycles 9 and 10 was 2.839 EFPY, the average growth per EFPY was 0.06% with a standard deviation of 0.76%/EFPY. The growth rate at 95% probability and 50% confidence is 1.32%/EFPY. A histogram and a cumulative probability distribution of the growth rates during Cycles 9 and 10 are shown in Figure 4-2. The average and maximum growth rates for the last few cycles are listed in Table 4-2. This table also shows the growth rates at 95% cumulative probability and the 95% probability value at 95% confidence. The latter two values are both equal to 1.41%/EFPY. The combined length of the next two fuel cycles is 2.86 EFPY. Hence using the 95/95 growth rate and the cycle lengths, the projected growth during the next two cycles is 4.03% TW.

The SG specific limiting growth rates in recent cycles are listed in Table 4-3. It lists the maximum growth rate of all AVB indications in each SG and the 95% probability, 50% confidence growth rates in each SG. During the last two cycles the there was less variability in the 95/50 growth rates between the four SGs, compared to prior cycles. The highest 95/50 growth rate was 1.44%/EFPY (in SG2). Using this value and the combined operating durations of the next two cycles (2.86 EFPY) yields a projected growth rate of 4.12% TW.

The Unit 2 is planned to undergo an uprating at the beginning of Cycle 12. Hence the growth rate in cycle 12 may increase by a small amount. An engineering evaluation performed to assess the impact of uprating (Reference 5) indicated that the AVB growth rate could increase by a factor of 1.56. Applying this factor to the projected value in the preceding paragraph and conservatively assuming that it will apply to Cycle 11 as well as Cycle 12, the projected growth rate with uprating is 6.43% TW. This is the projected 95/50 growth rate from 2RF10 to 2RF12 (for two cycles of operation).

Applying this growth rate, a 34% indication (largest indication left in service after 2RF10) will grow to 40% TW at 2RF12. As noted in the degradation assessment, the structural limit for AVB wear is 78% and the condition monitoring limit is 60%. Hence there remains considerable margin from condition monitoring limit. Thus the AVB wear indications will meet the performance criteria during the next two operating cycles.

4.2.2 Tube Wear at Preheater Baffle Plates

During 2RF10, two baffle plate wear indications have been reported, one each in SGs 1 and 3. The baffle plate wear indications reported during 2RF10 are summarized in Table 3-2. The estimated depths of these indications were 7% (SG1 R49C56) and 6% (SG3 R45C55).

The growth rate of the baffle plate indications is very small. The indication in SG1 R49C56 was inspected at 2RF08 with an estimated depth of 5% TW. Hence in the last two cycles, this indication grew by 2% TW. The indication in SG3 R45C55 was also inspected at 2RF08 and had an estimated depth of 7% TW. Hence in the last two cycles, this indication grew by -1% TW. The negative growth reflects the uncertainty in the depth estimate by eddy current. Thus the average growth rate of the two indications in two cycles was 0.5% TW and the maximum growth rate was 2% TW. Since an uprating is planned during the next two cycles, the feed flow will increase by a small amount. The 95 percentile growth rate during the next two cycles is conservatively projected to be twice the maximum growth rate during the last two cycles. This yields a projected 95% growth value of 4% in two cycles.

The largest of the baffle plate indications was 7% in depth. Adding a growth value of 4%, it is projected to be 11% TW at 2RF12. The projected depth is far below the condition monitoring limit of 52% (Reference 4). Hence the structural and leakage integrity will be met for the baffle plate wear mechanism during the next two operating cycles.

4.2.3 Tube Wear Due to Loose Parts

As discussed in Section 3.2.3, a number of loose parts were reported from FOSAR. These parts have accumulated over the ten cycles of plant operation. Those that could be retrieved have been retrieved from the SGs. An engineering assessment of the parts remaining in the SGs was made by experienced engineers. This preliminary assessment concluded that there would be no threat to tube integrity from these parts for at least two fuel cycles of operation. A detailed evaluation was conducted by Westinghouse to confirm this preliminary assessment. The detailed evaluation (Reference 6) showed that it is acceptable to operate the SGs for two fuel cycles with the loose parts left in service since they do not pose a threat to tube integrity.

4.2.4 Possible Loose Parts (PLP)

A number of PLP indications were reported at the top of the tubesheet in the hot leg (HTS) and/or over baffle plates B, D, E and H in the cold leg (C2, C3, C4 and C6) in all steam generators. All PLP locations accessible to FOSAR were video inspected and if any objects were found, the objects were either retrieved or disposed on the basis of an engineering assessment. This section addresses the PLP indications with no coincident tube wear indication in the vicinity, and there is no information regarding an object coincident with the PLP or the confirmation of its presence.

The prior experience at Comanche Peak had indicated that +Point inspection can result in a significant number of false PLP calls. At 2RF08, a large sample of the PLP data was reviewed to quantify the extent of false calls. The sample included the PLPs reported at the top of the tubesheet in all SGs and those over baffle plate B in SG 3. Most of the +Point inspection over baffle plate B in all SGs was performed as a result of the foreign objects observed from FOSAR and hence were in tubes adjacent to the observed objects. In SG 3, this +Point inspection scope was expanded to include tubes adjacent to PLPs (to "box in" PLPs); SG 3 was selected for this reason. Of the 23 PLP indications reported over the tubesheet in all SGs, objects were found adjacent to 12 of the tubes. There were no objects in the vicinity of the remaining 11 tubes with PLPs. Hence 48% of the reported PLPs over the tubesheet were false calls. 45 PLP indications were reported over baffle plate B in SG 3. Of these, 16 were false calls. Thus overall, approximately 40% of the PLP indications reported in the sample population were false calls.

Based on the above data, it is judged at 2RF08 that a large number of PLP indications reported over baffle plates D and H (C3 and C6) are false calls. It is also likely that several of the others, especially over baffle plate H, represent scale that has fallen on to the plate rather than foreign objects. Since these areas are not accessible for video inspection, confirmation of the actual condition has not been possible. If loose parts carried into the SG through feedwater are responsible for any of the PLP calls over these upper baffle plates, the objects are likely to be smaller and lighter than those observed over baffle plate B since those objects would have been transported to the higher elevation after having overcome the normal gravitational settlement over baffle plate B. The lighter and smaller objects tend to be less damaging to tubes. Based on these considerations, it was concluded that most of the PLP indications at these baffle plate locations are benign and would not affect tube integrity. The inspection results from 2RF10 substantiate the above conclusion since no loose parts wear coincident with the 2RF08 PLP locations was reported at C3 or C6.

Over baffle plate H (C6) tubes have been plugged in SG 3 for loose part wear during 2RF08 and 2RF06. Four of these tubes are adjacent tubes in the same column (33). It is likely that the same object is responsible for the wear indications in these tubes. It is also possible that this object may affect other tubes in the vicinity of the plugged tubes in future cycles. However, the wear rate as derived from the plugged tubes is small. Tubes in column 33 adjacent to those previously showing wear indications were inspected during 2RF10 and found to have no wear at baffle plate H (C6). Hence loose parts wear in adjacent tubes appears to have been arrested. Therefore, no leakage is expected during normal operation or at accident conditions. Operational assessment related to loose part wear was discussed in Section 4.2.3. It showed that performance criteria are expected to be met for two operating cycles until 2RF12.

4.3 Secondary Side Integrity

Secondary side sludge lancing, video inspection over the tubesheet and over baffle plate B, and foreign object search and retrieval (FOSAR) at these locations were performed in each SG during 2RF10. In addition, upper bundle inspection was performed in SG3 via access ports 1 and 2.

No anomalous conditions adverse to structural integrity were reported from the video inspection. The FOSAR operation was performed over the tubesheet and over baffle plate B. In addition, a foreign object was retrieved from the top of baffle plate H. All of the possible loose parts (PLP) reported in the eddy current inspection were subjected to FOSAR. Further, objects identified during the video inspection were retrieved where appropriate.

4.4 Operational Assessment Conclusion

The condition of the Comanche Peak 2 SG tubes, as indicated by the Condition Monitoring (Section 3) evaluation and the repair actions during 2RF10, has been subjected to operational assessment with respect to the acceptability of the SGs to provide service with satisfactory structural integrity and leakage integrity until the end of Cycle 12. Planned uprating during the next two cycles have been taken into account in this assessment.

Thirteen tubes were plugged during 2RF10, all due to tube end indications in the hot leg. The condition monitoring evaluation concluded that no challenge with respect to either leakage or tube burst was present. Hence no in situ leak or pressure testing was necessary during 2RF10. It may be noted that all SGs had two continuous cycles of operation without inspection prior to 2RF10. Evaluation of tube wear at baffle plates shows that significant margin from plugging limit will be present during the next two cycles and hence the performance criteria will be met.

Progression of AVB wear indications during 2RF10 was consistent with prior history. Based on a preliminary assessment, significant margin against structural and leakage integrity limits will be present during the next two cycles of operation. An assessment of the potential loose parts wear from parts known to remain in the SGs concluded that the performance criteria will be met during the next two cycles.

In summary, the operational assessment leads to be conclusion that structural and leakage integrity of the SGs will be maintained during the next two fuel cycles, until the end of Cycle 12.

Table 4-1. AVB Indications – Trends of Number and Maximum Depth

Trend of AVB Wear Indications Reported in Recent Inspections								
Inspection	**Number of AVB Indications**				**Maximum depth, %TW**			
	SG 1	SG 2	SG 3	SG 4	SG 1	SG 2	SG 3	SG 4
2RF05	127			15	39			42
2RF06		37	46			34	30	
2RF07	138			14	47			35
2RF08	157	43	50	18	37	34	31	25
2RF09	No SG inspection performed at 2RF09							
2RF10	157	47	54	18	34	32	32	25

Table 4-2. Growth Rate of AVB Wear Indications

Aggregate AVB Wear Growth Rate Summary						
Period	SGs	AVB Indication growth, %TW/EFPY				
Ending	Inspected	Average	Maximum	95% CPDF	95%/95%
2RF04	1, 2, 3, 4	0.93	8.22	4.50	4.48
2RF05	1, 4	0.97	4.93	4.50	6.28
2RF06	2, 3	0.74	2.49	4.19	3.57
2RF07	1, 4	-0.10	7.07	2.42	2.43
2RF08	1, 2, 3, 4	0.92	5.80	3.62	3.71
2RF09	None	NA	NA	NA	NA
2RF10	1, 2, 3, 4	0.06	2.47	1.41	1.41

Table 4-3. Limiting Growth Rates of AVB Wear Indications

AVB Wear Indication Limiting Growth Rate Summary for Each SG								
Period	**Maximum growth, %TW/EFPY**				**95% Conf. growth, %TW/EFPY**			
Ending	SG 1	SG 2	SG 3	SG 4	SG 1	SG 2	SG 3	SG 4
2RF04	8.22	8.22	3.29	6.28	4.04	5.88	3.28	6.02
2RF05	4.88			4.93	3.6			5.47
2RF06		2.23	2.49			2.19	1.43	
2RF07	7.07			1.86	2.26			2.23
2RF08	5.80	2.61	3.72	3.62	4.18	1.92	2.35	2.58
2RF09								
2RF10	2.11	2.47	1.76	1.06	1.37	1.44	1.21	0.99

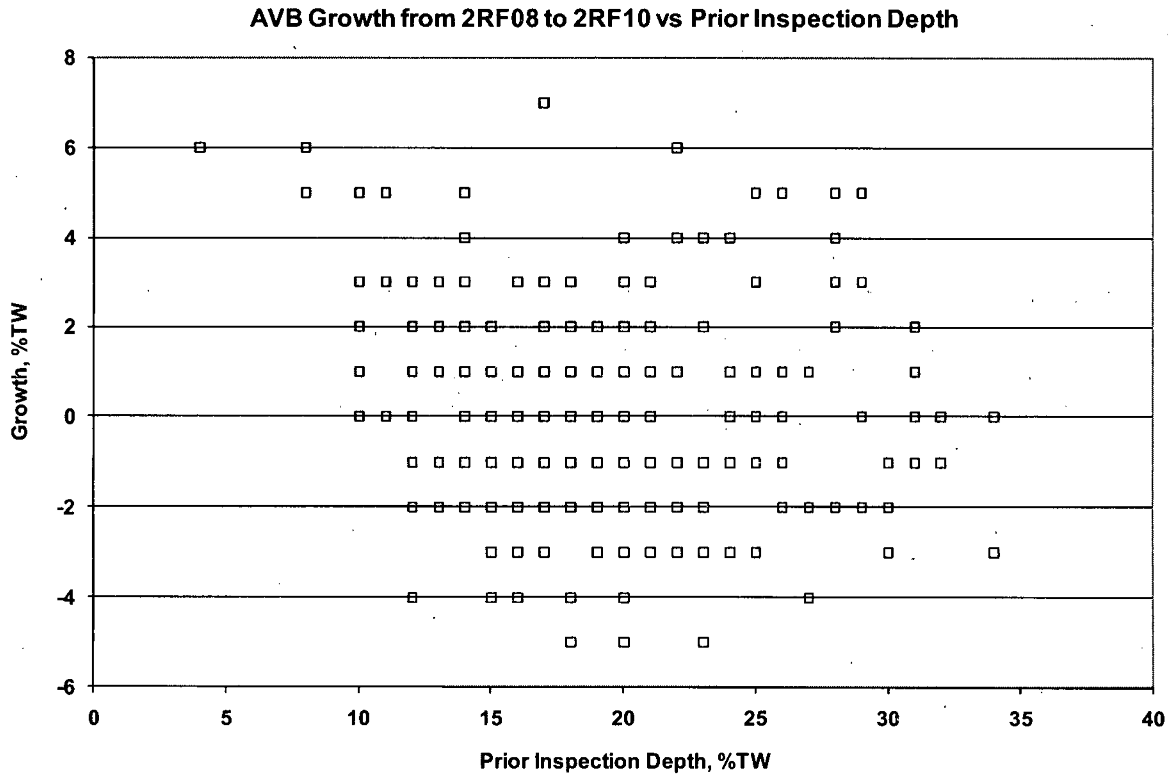

Figure 4-1. Growth rate of AVB wear indications in Cycles 9 and 10

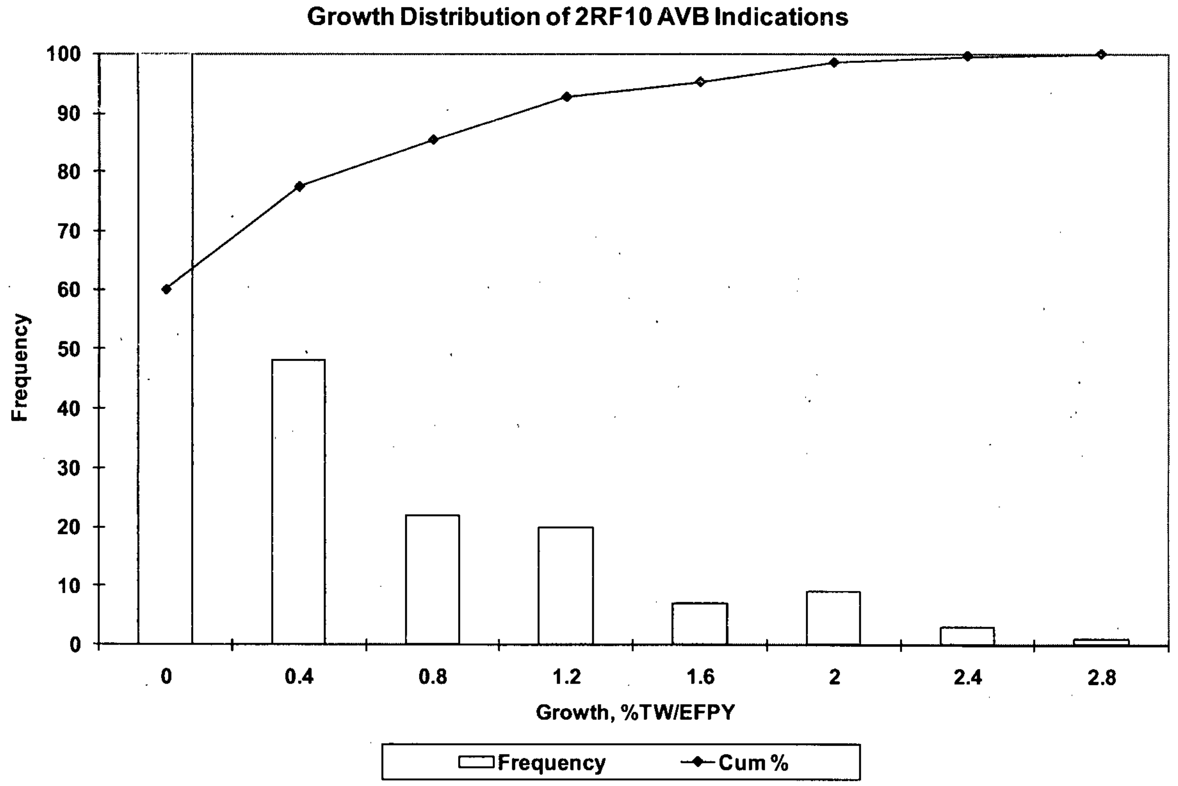

Figure 4-2. Histogram and cumulative probability distribution of AVB wear growth rates during Cycles 9 and 10

5 Classification of Degradation Mechanisms for the Next Inspection

Based on the results of the prior and current inspections through 2RF10 and the industry experience to-date, the degradation mechanisms in CPNPP Unit 2 SGs are classified as follows. The current outage is the last time that these SGs would be inspected under Revision 6 of the NDE Guidelines. The next inspection will require the use of Revision 7 of the Guidelines (Reference 7). The classification of degradation mechanisms in Revision 7 is therefore used in the following. This is a good starting point for the next degradation assessment (DA); however, additional industry guidelines and operating experience during the interim period must be taken into account in the development of the next DA.

5.1 Existing Degradation Mechanisms

The existing degradation mechanisms in the CPNPP Unit 2 SGs as of 2RF10 are:

1) Axial and circumferential (PWSCC) indications at hot leg tube end
2) Tube wear at AVBs
3) Tube wear at preheater baffle plates

5.2 Potential Degradation Mechanisms

The potential degradation mechanisms in the CPNPP Unit 2 SGs as of 2RF10 are:

1) Tube wear due to loose parts
2) Axial ODSCC at tube support plates
3) Axial and circumferential ODSCC at the top of the hot leg tubesheet
4) Axial and circumferential PWSCC at BLG/OXP locations within the hot leg tubesheet.

6 References

1. "Steam Generator Program Guidelines", NEI 97-06 Revision 2, May 2005.
2. "Bases for Plugging Degraded PWR Steam Generator Tubes", Draft Reg. Guide 1.121.
3. "Pressurized Water Reactor Steam Generator Examination Guidelines: Revision 6", EPRI 1003138, October 2002.
4. "Steam Generator Degradation Assessment for Comanche Peak Unit 2 Spring 2008 Outage (2RF10)", WPT-17154, April 9, 2008.
5. "Flow Induced Vibration Tubing Effects on the Comanche Peak Unit 2 Steam Generators on an Uprate to 3628 MWt NSSS Power", Westinghouse Calculation Note CN-SGDA-06-73, Revision 0, February 2007.
6. "2RF10 Steam Generator Secondary Side Inspection", WPT-17162, May 19, 2008.
7. "Steam Generator Management Program: Pressurized Water Reactor Steam Generator Examination Guidelines: Revision 7", EPRI 1013706, October 2007.