Enclosure 2

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Comanche Peak Steam Electric Station
1RF11 Outage Condition Monitoring Report
and
Preliminary Cycle 12 Operational Assessment

Westinghouse Non-Proprietary Class 3

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Comanche Peak 1RF11 Condition Monitoring and Preliminary Cycle 12 Operational Assessment

1.0 INTRODUCTION

Per NEI 97-06, a condition monitoring assessment which evaluates structural and leakage integrity characteristics of SG eddy current indications 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 2005, EOC-11 eddy current inspection results. Condition monitoring is "backward looking" and compares the observed EOC-11 steam generator tube eddy current indication parameters against structural and leakage integrity commensurate with the NEI 97-06 performance criteria. Additionally, an operational assessment, or "forward looking" evaluation is used to project the inspection results and trends to the next inspection to determine primarily if tube structural or leakage integrity will be challenged at EOC-12. This report documents the condition monitoring of the NDE results from the Comanche Peak 1RF11 Refueling Outage inspection, performed in October 2005. Additionally, this evaluation provides a preliminary assessment of SG tube integrity at EOC-12 that supports SG operability. Note that no steam generator inspections are planned for the 1RF12 outage as the original steam generators are scheduled for replacement at that time.

The Comanche Peak Unit 1 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

The 1RF11 flaw parameters for existing known degradation mechanisms are consistent with the 1RF10 and 1RF09 flaw parameters in severity of the indications based on NDE data. At 1RF10 the number of affected tubes with circumferential ODSCC was significantly reduced, and this trend continued with the number of tubes affected with circumferential ODSCC at 1RF11 being less than 1RF10. The 1RF11 maximum circumferential ODSCC flaw amplitude from +Pt of 0.27 volts is well below the EPRI In Situ Guideline Revision 2 testing threshold of 0.50 volts. The number of tubes affected with ding ODSCC was slightly reduced while the number of tubes with freespan ODSCC was slightly increased. In general, the signal amplitudes for all mechanisms were consistent with, or bounded by the 1RF10 results suggesting that there were no significant differences in the secondary side ODSCC aggressiveness that will suggest any result difference from past results for the Cycle 12 operational assessment.

Two new degradation mechanisms, oblique PWSCC at large (Row 3 and higher) U-bends, and circumferential PWSCC at the hot leg hardroll expansion transition were reported for the 1RF10 outage. Oblique PWSCC was again reported at 1RF11, however, circumferential PWSCC at the expansion transition was not reported in full depth roll expanded tubes. A total of 8 tubes were affected with oblique PWSCC at large radius U-bends at 1RF10 while 4 were reported at 1RF11. These numbers are judged low compared to recent inspection results for plants that have observed this mechanism. It should be noted that the Comanche Peak Unit 1 T-hot of approximately 620°F with 13.12 accumulated EFPY represent the highest PWSCC initiation potential for operating units

with mill annealed tubing. The largest +Pt amplitude reported for oblique PWSCC at 1RF10 was 2.2 volts, while the largest +Pt amplitude reported for oblique PWSCC at 1RF11 was 0.64 volt.

Two tubes were reported with circumferential PWSCC at the tack roll to WEXTEX expansion transition in WEXTEX expanded tubes at 1RF11. The maximum reported +Pt amplitude was 1.53 volts with a circumferential involvement of 103°.

Collapsed TIG sleeves were also noted in SGs 2, 3, and 4 at 1RF10. No TIG sleeves are installed in SG1. The total number of TIG sleeves that would not pass a 0.500" +Pt probe was 38. An additional 22 sleeves were observed to contain a signature on the +Pt trace that suggested a possible ovalization condition, even though the 0.500" +Pt passes from end to end. These possible ovalized sleeves in SG3 (6), along with a set of control sleeves that did not contain this trace were gauged using a 0.540" bobbin probe. It was found that all control sleeves would pass the 0.540" bobbin probe while all potentially ovalized sleeves would not pass a 0.540" bobbin probe. Thus it was concluded that the remaining 16 potentially collapsed sleeves would also not permit passage of the 0.540" bobbin probe. All 60 potentially collapsed sleeves were plugged. At 1RF11, 7 additional TIG sleeves were found to be collapsed. A total of 547 Alloy 800 sleeves were installed at 1RF10; none were found to be collapsed at 1RF11.

Preliminary benchmarking of the observed 1RF11 eddy current parameters indicates that the operational assessment methodologies applied were conservative. Based on these observations, it is concluded that structural and leakage integrity will be maintained at EOC-12.

The AVB and baffle plate wear mechanisms did not show excessive growth, and growth trends were consistent with Cycle 10. One baffle plate wear indication required plugging due to measured wear scar depth of 45%TW (SG2); the measured depth at 1RF10 was 39%TW. No AVB wear signals exceeded 40%TW.

During the CPSES 1RF11 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. Based on the changes made to the bobbin reporting criteria and the observed signal characteristics for the top of tubesheet ODSCC mechanisms, which will be discussed in detail later, it is expected that all operational assessment structural and leakage integrity requirements will be satisfied at EOC-12 for the degradation mechanisms observed at EOC-11.

3.0 PRE-OUTAGE EVALUATION OF SG DEGRADATION STATUS

Pre-Outage Degradation Assessment

A pre-outage degradation assessment pursuant to EPRI TR-107621 R1 and EPRI 1003138 was performed for CPSES 1RF11. This degradation assessment (Reference 1) 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 1003138, "PWR Steam Generator Examination Guidelines: Revision 6", an active degradation mechanism is:

1. A combination of ten or more new indications (≥ 20% TW) of thinning, pitting, wear (excluding loose part wear), or impingement and previous indications that display an average growth rate ≥ 25% of the repair limit in one inspection-to-inspection interval in any one SG or,

2. One or more new or previously identified indications (≥ 20%TW) which display a growth rate equal to the repair limit in one inspection-to-inspection interval, or

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

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 1003138) in the CPSES Unit 1 SGs.

- Axial ODSCC at TSP intersections
- Circumferential and Axial ODSCC at the hot leg TTS expansion transition
- Axial ODSCC at Freespan dings
- Axial ODSCC in the freespan not associated with dings
- Circumferential and Axial PWSCC at the hot leg TTS expansion transition
- Oblique PWSCC at Row 3 and higher U-bends

Degradation Structural Limits

The CPSES 1RF11 pre-outage degradation assessment (Reference 1) identified length and depth based structural limits for freespan axial and circumferentially oriented degradation. Lower bound length and depth based structural limits were developed for volumetric degradation modes (i.e., AVB wear, TSP wear) based on previously published industry data and correlations. The degradation assessment provides the structural limits and NDE uncertainties to support the condition monitoring and operational assessments of this report.

CPSES 1RF11 Initial Inspection Plan

The CPSES 1RF11 inspection plan exceeded both the Technical Specification minimum requirements as well as the recommendations of EPRI 1003138, PWR Steam Generator Examination Guidelines: Revision 6. The 1RF11 initial inspection plan included;

1) 100% full length bobbin examination in Rows 5 and greater in all 4 SGs, 100% bobbin inspection in the hot and cold leg straight sections of Rows 1 thru 4 ***
2) 100% Hot Leg top of tubesheet (TTS) +Pt examination in all 4 SGs
    - from +3 to –3" for hardroll expanded tubes
    - from +3 to hot leg tube end for WEXTEX expanded tubes
3) 100% Row 1 and 2 U-bend mid-range +Pt examination in all 4 SGs
4) 100% Row 3 through Row 16 U-bend mid-range examination in all 4 SGs

5) 100% +Pt examination of DSI signals >1V (per GL 95-05)
6) 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.
7) Rotating probe examination of freespan bobbin coil indications for flaw confirmation and characterization.
8) 100% +Pt inspection of all dented TSP intersections at the H3 TSP ≥ 2 volts
9) 100% +Pt inspection of >5V dings (both legs, including U-bend)
10) 100% +Pt inspection of all dents at AVBs, regardless of voltage
11) 20% +Pt freespan paired ding inspection between the top 2 TSPs
12) 20% +Pt examination of non-expanded tube baffle wear in all 4 SGs
13) 25% +Pt exam of expanded cold leg baffles
14) 100% +Pt full length inspection of Alloy 800 sleeves including parent tube 3 inches above and below the sleeve
15) 20% +Pt full length inspection of TIG sleeves including parent tube 3 inches above and below the sleeve
16) +Pt examination of TIG sleeves +/- 3 inches from top of sleeve in TIG sleeves not +Pt examined full length
17) 100% +Pt examination of AVB wear sites
18) Secondary side FOSAR at top of tubesheet and atop cold leg baffle B (C2 plate)
19) Tube plug visual inspection

***: For tubes in Rows 1 thru 4 with installed TIG sleeves the 0.540 inch wide groove bobbin probe was used for inspection of the parent tube above the sleeve to the hot leg U-bend tangent. For tubes in Rows 1 thru 4 with installed Alloy 800 sleeves the 0.520 inch wide groove bobbin probe was used for inspection of the parent tube above the sleeve to the hot leg U-bend tangent.

The inspection plan was developed to specifically address the areas of active degradation as well as areas expected to be affected based on recent industry experience as well as experience from the CPSES 1RF10 outage in April 2004.

3.1 1RF11 Identified Degradation Mechanisms

Indications suggestive of the following degradation mechanisms were detected in the CPSES 1RF11 inspection:

- Axial ODSCC at TSP intersections
- Circumferential ODSCC at the Hot Leg TTS expansion transition
- Axial PWSCC at the Hot Leg TTS expansion transition
- Circumferential PWSCC at the Hot Leg tack roll to WEXTEX expansion transition
- Oblique PWSCC at large radius (Row 3 and higher) U-bends
- Axial PWSCC at large radius (Row 3 and higher) U-bends
- Axial ODSCC in the freespan not associated with dings
- Axial ODSCC at freespan dings <5V
- Freespan Volumetric indications (not associated with operational degradation)
- AVB wear
- Wear at non-expanded preheater baffle intersections
- Wear due to loose parts or foreign objects

The 90-day report for axial ODSCC at TSP intersections will be documented in a separate ARC report, as part of analyses required per NRC Generic Letter 95-05. Tube support plate ODSCC indications for 1RF11 were nearly identical to 1RF10, both in total number of indications and observed bobbin amplitude. Only 1 indication had bobbin amplitude greater than 1 volt. This indication, in SG 2, was confirmed by +Pt and plugged.

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 all 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.

Based on the observation of axial PWSCC in a Row 13 tube in SG4, the U-bend inspection program was expanded to include 100% of Rows 17 through 25 in SG4. Oblique PWSCC Indications were observed in Row 5 tubes in SGs 1 and 2, and a Row 3 tube in SG3, however, no further expansion of the inspection scope was required as these rows are bounded by the critical area redefinition.

At 1RF10 the U-bend inspection scope for dents at AVBs was expanded to include all dings within +/- 0.75 inch of the AVB. This expansion was necessitated based on observation of ODSCC at a ding detected by +Pt at approximately 0.6" from the AVB. A DNI report was not noted for this tube however close scrutiny of the bobbin data indicates that a DNI signal was present. At 1RF11 the base scope included all dings within +/- 1 inch of AVBs. Only one ding ODSCC signal in the U-bend region was reported at 1RF11; this signal was reported as DNI from bobbin and was located 1.54 inch from the AVB.

A C-3 condition was reported for SG4 due to the detection of >45 indications of degradation at the top of tubesheet location.

Disposition Techniques for Identified Degradation Mechanisms

Depth measurement of AVB wear indications and non-expanded preheater baffle plate wear using the bobbin coil is acceptable per EPRI Appendix H standards, 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 or equal to 1 volt by bobbin were RPC inspected for flaw confirmation, even though only those DSIs >1 volt are required to be +Pt inspected per GL 95-05. Indications (regardless of bobbin voltage) identified in exclusion zones related to tube collapse potential near TSP wedges were RPC inspected, and if confirmed, are repaired regardless of voltage. No bobbin indications at TSP intersections were reported in exclusion zones. All mix residual signals were inspected with +Pt; none were confirmed.

All crack-like indications in the expansion transition down to the F* distance were repaired upon detection since depth sizing techniques are not acceptable for continued operation justification. All hot leg top of tubesheet circumferential indications were located within the expansion transition region.

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 RPC inspected. No ODSCC was detected. Through 1RF09, all previously reported baffle wear had been inspected with +Pt.

Indications previously called volumetric, have in the past been reviewed, and determined to be attributed to deposits, MBMs, dings and bulges, or tube material property changes which sometimes occur after power operation. At 1RF11 all SVI calls by RPC not able to be dispositioned by F* were repaired by plugging. A bobbin history review was performed for each of these indications to show that the signal had not changed since the 1RF10 inspection. SVI calls can include volumetric tube degradation associated with a non-corrosion related mechanism such as laps or gouges, and loose part wear signals.

Additionally, permeability variations were reported based on bobbin or RPC amplitude > 1 volt. Prior to the 1RF11 inspection, it was defined that permeability variations coincident with regions of the tube where active degradation mechanisms were present should be repaired if it was judged that the permeability could interfere with adequate flaw detection. This resulted in the conservative repair of 4 tubes; 0 in SG1, 1 in SG2, 1 in SG 3, and 2 in SG4. Additionally, several tubes were conservatively repaired due to dent/ding restrictions that prevented acceptable eddy current data from being collected. Zero tubes in SG1, 0 tubes in SG2, 1 tube in SG3 and 2 tubes in SG4 were plugged for this reason. The tube in SG3 preventively repaired contained a >5V ding in the U-bend above H11 that could not be inspected due to sleeve installation in the hot leg at 1RF10. The two tubes in SG4 preventively plugged had intermittent data collection through the U-bend due to dents at lower elevations that interfered with the probe translation.

Any tube scheduled for a particular test (such as full length bobbin), that could not be tested due to a restriction in the tube or due to poor data quality, was conservatively repaired.

In addition to the mechanisms identified, the mechanisms that were *not* identified are also noteworthy. These include:

- SCC at dented TSP intersections
- Small radius (Row 1 and 2) U-bend PWSCC

"Dents" at Comanche Peak Unit 1 are believed to be related to manufacture, and not to corrosion of the carbon steel TSPs. Comanche Peak Unit 1 has not operated with secondary side chemistry regimes conducive to traditional denting morphologies. The lack of small radius U-bend PWSCC is related to the in situ heat treatment of the Row1 and 2 U-bends prior to operation. For similar plants that have performed U-bend heat treatment prior to operation, no degradation in the U-bends has been reported.

Table 1
Summary of 1RF11 Tube Repair Statistics

Degradation Mode	HL sludge pile (>1" above TTS)	HL TTS Exp. Transition and Expanded Tube	R1 and 2 U-bend	Hot Leg TSP	Freespan (no ding)	Freespan (ding)	>Row 2 U-bend	Baffle Plate	Cold Leg TTS		Total
SG 1											
Axial ODSCC	0	0	0	0	4	3	0	0	0		7
Axial PWSCC	0	0	0	0	0	0	0	0	0		0
Circ. ODSCC	0	5	0	0	0	0	0	0	0		5
Circ PWSCC	0	1	0	0	0	0	1	0	0		2
Wear	0	0	0	0	0	0	0	0	0		0
Volumetric	0	0	0	1	1	0	0	1 (1)	0		3
Sub Total	0	6	0	1	5	3	1	1	0		17
SG 2											
Axial ODSCC	0	0	0	1	2	2	0	0	0		5
Axial PWSCC	0	0	0	0	0	0	0	0	0		0
Circ. ODSCC	0	9	0	0	0	0	0	0	0		9
Circ. PWSCC	0	1	0	0	0	0	2	0	0		3
Wear	0	0	0	0	0	0	0	0	0		0
Volumetric	0	0	0	0	2	0	0	0	0		2
Sub Total	0	10	0	1	4	2	2	0	0		23 (2)
SG 3											
Axial ODSCC	0	0	0	0	0	0	0	0	0		0
Axial PWSCC	0	0	0	0	0	0	0	0	0		0
Circ. ODSCC	0	24	0	0	0	0	0	0	0		24
Circ PWSCC	0	0	0	0	0	0	1	0	0		1
Wear	0	0	0	0	0	0	0	0	0		0
Volumetric	0	2	0	1 (1)	0	0	0	0	0		3
Sub Total	0	26	0	1	0	0	1	0	0		33 (3)
SG 4											
Axial ODSCC	0	0	0	1 (5)	2	0	0	0	0		3
Axial PWSCC	0	1	0	0	0	0	1	0	0		2
Circ. ODSCC	0	57	0	0	0	0	0	0	0		57
Wear	0	0	0	0	0	0	0	1	0		1
Volumetric	0	2	0	0	0	0	0	0	0		2
Sub Total	0	60	0	1	2	0	1	1	0		70 (4)
Overall Total	0	102	0	4	11	5	5	2	0		143

Notes for Table 1:
(1): Volumetric indications located at TPSs and cold leg baffles are due to foreign object wear.
(2): Includes 3 collapsed TIG sleeves and one PVN signal preventively plugged.
(3): Includes 3 collapsed TIG sleeves, one >5V ding not inspected due to a sleeve in the hot leg, and one PVN signal preventively plugged.
(4): Includes 1 collapsed TIG sleeve, two restricted tubes in U-bend, and two PVN signals in U-bend preventively plugged.
(5): Indication reported by RPC only

Table 2
Summary of Repaired Indications and Indications Justified for Continued Operation by Application of ARCs: CPSES 1RF11, October 2005
Values Apply to 1RF11 Inspection Only

SG	Tubes Repaired by Plugging	Tubes Plugged for Crack-like Defects	Tubes Repaired for Volumetric Signals Including Wear	Tubes Preventively Plugged including Collapsed Sleeves	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 ARCs
1	17	14	3	0	32	1	33
2	23	17	2	4	30	0	30
3	33	25	3	5	33	2	35
4	70	62	3	5	220	1	221
Total (1)	143	118	11	14	315	4	319

(1) Totals for tubes returned to service does not include indications permitted to remain in service that were subsequently plugged due to repairable indications at other elevations.

4.0 CONDITION MONITORING EVALUATION

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

The degradation assessment concluded that the following mechanisms met the criteria to be classified as active mechanisms for the 1RF11 inspection.

- Circumferential ODSCC at hot leg top of tubesheet expansion transition
- Axial ODSCC at hot leg top of tubesheet expansion transition
- Axial ODSCC in the freespan
- Axial ODSCC at hot leg TSP intersections
- Axial PWSCC at the hot leg top of tubesheet expansion transition
- Axial ODSCC in freespan dings
- Oblique PWSCC at Row 3 and greater U-bends
- Circumferential PWSCC at the hot leg top of tubesheet expansion transition

4.1.1 TTS Circumferential ODSCC Condition Monitoring Evaluation

Structural integrity of circumferential indications at the TTS is defined by EPRI TR-107197, "Depth Based Structural Integrity of Circumferential Indications". The controlling parameter with regard to structural integrity of circumferential indications is the percent degraded area, or PDA. The PDA represents the percentage of degraded cross sectional area of the tube.

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 100%TW critical crack angle value of 294° (82% PDA) for CPSES Unit 1 at 3ΔP conditions using mean material property values.

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-1007904, "Steam Generator In Situ Pressure Test Guidelines Revision 2". Indications are first screened against the maximum +Pt coil amplitude threshold value of 0.50 volts. Indications with a +Pt amplitude exceeding 0.50 volts are screened against the PDA screening limit. The PDA screening limit is developed by reducing the 82% PDA for material properties at the lower tolerance limit (LTL) values and NDE uncertainty at the 95% probability level. The resultant PDA used for in situ screening purposes is 59.5%. The as-reported PDA values from NDE are then compared against this value. As all circumferential ODSCC indications had +Pt amplitude < 0.50 volts, in situ pressure testing was not required, and screening against the PDA screen limit was not required. For completeness, all circumferential ODSCC indications had PDA values developed using the methodology as described in Reference 3. The 1RF09 condition monitoring report (Reference 2) provides PDA data developed using both the quick screening method and profiling. When plotted, this data shows a correlation with slope of essentially 1.0 with a small y-intercept, indicating that both methods will produce a similar result. Thus, it is concluded that profiling is not required in order to support structural integrity of top of tubesheet circumferential ODSCC indications. All PDAs were found to be less than the screening value, with the maximum as-reported PDA of 33.96%. Using the quick screening method the NDE adjusted

PDA at 90% probability, 50% confidence is [ ]^{a,c}. An evaluation of burst pressure of a [ ]^{a,c} PDA circ ODSCC indication was performed using a Monte Carlo simulation that included relational error, NDE error, and material property variation. At the upper 95% probability, 50% confidence, the predicted burst pressure is 6493 psi.

For leak test screening, the first screen is maximum voltage ≥ 1.00 volt for PWSCC, 1.25 volts for ODSCC. As no ODSCC indications exceeded the 1st screen, leak testing was not required. The largest circumferential ODSCC amplitude reported for 1RF11 was 0.27 volts, which is bounded by the 1RF10 maximum amplitude of 0.43 volt and the 1RF09 maximum amplitude of 0.56 volt. The 0.56 volt indication at 1RF09 was in situ pressure tested with no leakage or burst. The conservatism of the screening limits is verified by test data developed by Argonne National Laboratories (Reference 7). In this program, sections of tube and tubesheet were removed from a retired SG using ¾" OD by 0.043" wall thickness tubes, hardrolled through the tubesheet thickness. Maximum +Pt amplitudes ranged from 0.76 to 2.36 volts. No leakage was reported at SLB conditions, with the minimum observed leakage occurring at a pressure greater than 5000 psi, which exceeds the temperature adjusted 3 times normal operating pressure differential for Comanche Peak Unit 1.

Therefore, the circumferential ODSCC reported at 1RF11 satisfied the NEI 97-06 performance criteria for structural integrity and leakage.

Maximum +Pt flaw amplitude is a reasonable qualitative assessment tool for determining the relative structural integrity characteristics of circumferential ODSCC indications. Figure 1 presents a summary of the maximum +Pt amplitude vs burst pressure and PDA for the hardroll ODSCC pulled tube database. The correlations developed satisfy the requirements of Reference 4, and therefore are valid for evaluating tube integrity. In this evaluation, the amplitude correlations are provided as a defense in depth in support of the PDA determination and in situ testing performed at 1RF10, as well as past inspections. The largest circumferential flaw amplitude reported at 1RF11 was 0.27 volt. Using the lower 90% probability, 50% confidence line relating +Pt amplitude to burst pressure, the estimated burst pressure of this indication is approximately 8000 psi. Using the lower 90% probability, 50% confidence line relating +Pt amplitude to PDA, the estimated PDA of this indication is approximately 59%. At the lower 95% probability, 50% confidence, this PDA results in a burst pressure of 5793 psi. The quick screening NDE adjusted PDA for this indication is only 37.7% due to the limited arc length of 150° and maximum depth of 48%TW. It should be noted that the morphology of the circumferential ODSCC mechanism at Comanche Peak Unit 1 has been established by tube pulls. This morphology has shown numerous (up to 70) non-degraded ligaments exist within the entire flaw network. The flaws are shown to exist within a relatively consistent elevation band. The tubes pulled for characterization of the circumferential ODSCC mechanism at Comanche Peak unit 1 were burst tested with the expansion transition in an unrestrained mode, that is, no tubesheet simulant was applied to the expansion transition region during burst testing. Burst pressures were >10,000 psi, consistent with the non-degraded tube burst pressure, and the burst occurred in the freespan region, several inches away from the expansion transition. Based on measured PDAs, these indications would have been expected to burst at approximately 7000 to 8000 psi. The numerous non-degraded ligaments clearly added to the burst capability of these indications.

Figure 2 presents a cumulative probability distribution plot of circ ODSCC +Pt amplitudes for the 1RF09, 1RF10, and 1RF11 outages. This plot shows that the 1RF11 amplitude distribution is bounded by the 1RF10 and 1RF09 amplitude distribution. For the 1RF11 outage, a total of 95 tubes

were reported with circumferential ODSCC at the hot leg top of tubesheet expansion transition. The breakdown of affected tubes per SG is; 5 in SG1, 9 in SG2, 24 in SG3, and 57 in SG4. This is a significant reduction from the number of 667 reported at the 1RF09 inspection and 289 reported at the 1RF10 inspection. Figure 3 presents a cumulative probability distribution plot of circ ODSCC PDAs for the 1RF09, 1RF10, and 1RF11 outages. This figure shows that the PDA distributions for 1RF10 and 1RF11 are essentially equal which suggests that the applied initiation and growth functions are essentially equal for both operating cycles.

4.1.2 Expansion Transition Axial ODSCC Condition Monitoring Evaluation

Structural integrity of axial flaws is established based on reported NDE length and depth. The program used to perform this calculation uses a model consistent with the EPRI Flaw Handbook, and uses a Monte Carlo simulation methodology to account for NDE errors, material property variation when specific tube material properties are not known, and burst equation relational uncertainty.

With regard to freespan axial indications, the in situ screening procedure for burst is as follows. Maximum +Pt voltage is compared against the initial screening value of 0.50 volts. Indications exceeding this value are screened for crack length and maximum depth. The length screening value is ≥ 0.43" and the maximum depth screening value is ≥ 70%. These values are reduced for eddy current uncertainty. 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 draft RG 1.121 recommendations. The freespan screening flaw length of 0.43" provides for burst integrity at draft RG 1.121 recommendations for single flaw morphology of 100% TW depth, using LTL material properties. For flaws with 100%TW lengths greater than about 0.1", the +Pt coil is expected to overestimate the true flaw length. The unadjusted 100%TW flaw length that provides for burst capability at 3ΔP is 0.48", however, this value was conservatively reduced using length measurement uncertainty data for part throughwall flaws.

For transition region indication leakage screening, the first screens used in the EPRI In Situ Guideline Rev 2 are maximum +Point field evaluation voltage ≥ 3.07 volts (2.50 volts for WEXTEX expansions) for ID indications, ≥1.0 volts for OD indications; the second screen is max depth ≥ 70%. Freespan OD indications were screened using a +Pt voltage limit of 0.50 volt. If the first screen is not exceeded, leakage testing is not required. If the first and second screens are 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 all relevant indications are adequately evaluated.

At the CPSES 1RF11 inspection, no tubes were reported with axial ODSCC indications at the top of tubesheet. One tube in SG1 was reported with an axial ODSCC indication at 2.5 inches below the TTS. The validity of such an indication must be questioned as this location is a full depth roll expanded tube with no reported anomalies in the roll or evidence of missing rolls or skip rolls. As this elevation is below the F* distance this tube is permitted to remain in service.

4.1.3 Freespan ODSCC Condition Monitoring Evaluation

The bobbin analysis program conducted at 1RF11 was an outcome of the lessons learned from the 1RF09 inspection. The most notable aspect is that no lower voltage threshold for reporting of potential axial ODSCC in the freespan was used. As a result, a significant number of bobbin DFI reports were encountered. A supplemental +Pt exam was performed for each of these signals, resulting in a total of only 7 tubes reported with freespan axial ODSCC; 4 in SG1, 2 in SG2, none in SG3, and 2 in SG4.

One notable difference observed on R32 C99 in SG1 was that the number of individual axial cracks in the spans with confirmed DFI reports (C7 to C8 and C8 to C9) was larger than observed at previous outages. During the PID run of this tube, +Pt data was collected through the C10 elevation. A continuous crack nearly 33 inches long was reported. This location had no corresponding bobbin reports from the production analysis. Burst pressure estimation of this section of tube indicates that the minimum burst pressure for the tube was located within this span. Based on the observations from R32 C99 it was concluded that a supplemental review of the 2005 bobbin data be performed using the automated data screening (ADS) software function of ANSER to ensure that all similar signals had been reported. The screening criteria used a [

]^{a,c}. ADS was applied to the 1RF11 bobbin data of R32 C99; a total of 34 bobbin DFI signals were reported with multiple signals in the C5, C6, C7, C8, and C9 spans as well as for the H1, H3, and H7 spans. Additionally, the ADS screening reported DFIs for each of the other tubes with freespan axial ODSCC indications except one. The one tube not reported by ADS had a maximum signal amplitude of <0.15 volt in the 300 kHz channel; the corresponding +Pt amplitude was <0.10 volt, suggesting a shallow depth. The intent of the supplemental ADS screening was to provide a high level of confidence that indications of modest depth and significant length (like R32 C99) were not missed by the production analysis. The supplemental ADS screening identified a total of 167 additional DFI reports, all of which were inspected with the +Pt coil. Of these, only one was confirmed as axial ODSCC by +Pt. This tube, R35 C37 in SG1, had a maximum +Pt amplitude of only 0.08 volt and a maximum continuous length of 1.28 inch.

Thus, based on the results of the ADS screening there is a high level of confidence that all flaws with a signal amplitude of > 0.15 volt in 300 kHz have been identified by bobbin, validated, and subsequently interrogated with +Pt. As an example, Table 3 presents a summary of the ADS reports for R32 C99 using the 1RF11, 1RF10, and 1RF09 bobbin data. As seen from this data, the ADS screening criteria would have resulted in the generation of DFI reports for R32 C99 as early as 1RF09. Additionally, manual review of the 1RF08 data for some segments of R32 C99 indicates that flaw signals are present. Thus it can be concluded that the freespan axial ODSCC observed at 1RF11 is similar to past occurrences in that the mechanism appears to be slow growing.

Table 3 ADS Results for R32 C99 SG1				
Elevation	1RF11 ADS Call	1RF10 ADS Call	1RF09 ADS Call	1RF11 +Pt Confirm?
H1 +14.18	X	X		Yes
H1 +17.82	X	X	X	Yes
H3 +13.60	X			Yes
H3 +14.48	X			Yes
H7 +8.82	X			Yes
H7 +35.95	X	X		No
H10 +29.49			X	No
C10 +8.17	X		X	Yes
C9 +30.47	X	X	X	Yes
C9 +11.32	X	X	X	Yes
C9 +8.36	X			Yes
C9 +1.74	X			Yes
C8 +32.60	X			Yes
C8 +24.02	X	X		Yes
C8 +10.07	X	X		Yes
C8 +7.21	X	X		Yes
C8 +2.22	X	X		Yes
C8 -1.99	X	X		Yes
C7 +39.71	X			Yes
C7 +38.50	X	X	X	Yes
C7 +33.36	X			Yes
C7+27.62	X			Yes
C7 +18.09	X	X		Yes
C7 +12.81	X			Yes
C7 +3.59	X	X		Yes
C7 +2.54	X	X	X	Yes
C6 +10.71	X	X		Yes
C6 +5.48	X	X		Yes
C6 +3.20	X	X	X	Yes
C6 +1.25	X	X		Yes
C5 +14.26	X			Yes
C5 +13.22	X			Yes
C5 +12.83	X	X		Yes
C5 +9.54	X	X		Yes
C5 +8.93	X	X		Yes

The segment of R32 C99 with the limiting burst pressure was the section between C9 and C10. This segment contained the longest continuous flaw segments and largest +Pt amplitude responses. The flaw depth was determined by profiling. The length versus depth profile was developed both for the phase based depths and amplitude based depths from the +Pt coil. The phase based profile yielded uncharacteristically large depths for the observed signal amplitude. The pulled tube results from 1RF09 showed that the mean regression of +Pt amplitude to depth accurately predicted the true flaw depth. Figure 4 presents a comparison of the phase based and amplitude based profile for the C9 location. Both profiles were evaluated for burst capability using a Monte Carlo simulation that included material property variance and burst relational uncertainty. The simulation was performed at 95% probability, 95% confidence, more conservative than required by the EPRI Tube Integrity Guideline. Table 4 summarizes the simulation results for all freespan ODSCC indications that involved significant flaw lengths. Figures 5 and 6 present the length versus depth profiles for the C7 segment of R32 C99. These plots show the amplitude based profile bounds the phase based profile even though the +Pt amplitudes in the C7 and C9 segments were essentially equal but phase based depths varied dramatically.

Based on the phase based profile analysis results and burst pressure prediction, R32 C99 was selected for in situ pressure testing even though analysis of the amplitude based profile developed from the mean amplitude regression showed a burst pressure of 5300 psi. Since R24 C22 had larger +Pt amplitudes compared to R32 C99, R24 C22 was also conservatively selected for in situ pressure testing. Both tubes were tested in a full tube mode. The 3 times normal operating pressure differential in situ test pressure for Comanche Peak using the actual primary to secondary pressure differential just before shutdown is 4266 psi. A 3 times normal operating pressure differential test condition of 4350 psi was selected using the minimum burst pressure based on the calculated burst pressure of 3946 psi for the upper 95th percentile amplitude based sizing of R32 C99. The proof test pressure of 4350 psi was developed by applying a 1.08 temperature adjustment factor and adding 100 psi for gauge measurement uncertainty. The in situ pressure test of R32 C99 included a 300 psi overpressure condition (peak proof test pressure of 4650 psi) to further strengthen the sizing methodology as described below. Post in situ +Pt examination showed little flaw change in either amplitude or width due to the test. As no leakage or burst was reported, and the post in situ pressure test +Pt exam showed little flaw amplitude change even after the 300 psi overpressure condition, it can be concluded that the most accurate method of sizing freespan axial ODSCC continues to be the mean regression of +Pt amplitude to depth. Had this flaw contained significant depths as predicted using phase based analysis, the tube would have burst. Had the flaw contained significant depths as predicted by the upper 95th percentile amplitude based sizing analysis, the flaw would have experienced plastic yielding with imminent burst. As such, the post test flaw amplitudes would have shown significant change in both amplitude and width; neither was observed.

R24 C22 contained significantly higher +Pt flaw amplitudes than R32 C99, and thus deeper flaw depths. The in situ pressure test of R24 C22 did not include an overpressure condition thus the peak in situ proof test pressure was 4350 psi. Consistent with R32 C99, the post in situ RPC data shows essentially no change in flaw amplitude or width. Figure 7 presents a plot of +Pt amplitude for the pre and post ISPT condition and shows little variance in +Pt amplitude between the two cases thus the same judgment can be applied to R24 C22, that plastic deformation of the flaw did not occur, and that the most accurate sizing method remains the mean +Pt amplitude to depth correlation. As R32 C99 and R24 C22 passed the in situ pressure test with no leakage or burst, the performance criteria

were satisfied. Additionally, the depth assessment using the mean regression of +Pt amplitude to depth, which has been shown by the pulled tube analysis to be the most representative method of sizing, includes burst pressures evaluated at 95% probability, 95% confidence that exceed the three times normal operating pressure differential of 4266 psi. Therefore, condition monitoring is satisfied. For all other freespan ODSCC signals the flaw lengths and depths were bounded by R32 C99.

This mechanism has been shown to be confined to the straight leg section. R32 C99 was tested from hot leg top of tubesheet to cold leg top of tubesheet using a +Pt probe. Axial ODSCC was not detected in the U-bend region. All other tubes with freespan ODSCC except R35 C37 in SG1 and R30 C65 in SG2 were inspected through the U-bends with a +Pt probe as part of the oblique PWSCC inspection program. All tubes with freespan ODSCC except R32 C99 were inspected with a +Pt probe from the hot leg top of tubesheet to H11 and from the cold leg top of tubesheet to C11. No other tubes contained extended length indications such as that found on R32 C99.

Table 5 presents a summary of the freespan axial ODSCC NDE parameters. Due to the large number of indications on R32 C99 extending over multiple tube spans, only the largest +Pt amplitude signal for the indicated span is included.

Table 4 Freespan ODSCC Burst Pressure Evaluation Comparison at 95% Probability, 95% Confidence						
SG	Tube	Location	As Reported Phase Analysis	As Reported Amplitude Analysis	Upper 95th Percentile Amplitude Analysis	ISPT Peak Pressure
1	R32 C99	C9 +28"	2718 psi	5327 psi	3946 psi	4650 psi
1	R32 C99	C7 +20"	7788 psi	6113 psi	4965 psi	4650 psi
2	R30 C65	H3 +34"	4561 psi	6177 psi	5049 psi	Not Tested
4	R24 C22	C8 +28"	5798 psi	5515 psi	4191 psi	4350 psi

Table 5							
			+Pt		300 kHz Bobbin		Bobbin Signal Observable in 2004 Data?
SG	Tube	Elevation	Volts	Length	Volts	Phase	
1	R6 C50	C10 +4.44	0.11	0.20	0.19	82	Yes
1	R15 C25	C7 +8.8	0.07	0.23	0.11	118	Yes
1	R32 C99	C5 +12.64	0.19	4.23	0.17	78	Yes
		C6 +5.42	0.24	20.2	0.23	78	Yes
		C7 +39.71	0.22	0.81	0.17	115	Yes
		C8 +7.24	0.15	0.42	0.19	129	Yes
		C9 +18.93	0.24	17.0	0.11	80	Yes
1	R35 C37	C8 +21.6	0.08	0.37	0.07	79	Yes
2	R11 C91	H10 +9.9	0.10	0.55	0.18	129	Yes
2	R30 C65	H3 +33.1	0.24	1.05	0.38	77	Yes
4	R9 C39	C8 +41.4	0.18	0.18	0.24	103	Yes
4	R24 C22	C8 +27.7	0.42	3.3	0.29	73	Yes

4.1.4 TSP ODSCC Condition Monitoring Evaluation

One DSI signal exceeded the 1.0 volt repair limit; the DSI amplitude was 1.26 volt located at the H5 TSP. A 0.87 volt DSI is observed for this location using the 1RF10 data, however, no DSI report was made at this location at 1RF10. The H3 location of the same tube also contained a 0.88 volt DSI at 1RF11 with a 0.80 volt DSI shown in the 1RF10 data base. A noticeable amount of horizontal probe motion was observed in the 1RF11 data for this tube, thus the DSI amplitude measurement could involve a modest error. The +Pt amplitude of 0.18 volt suggests a depth of 47%TW. The voltage based structural limit for TSP ODSCC indications is 4.69 volts for a SLB ΔP of 2560 psi (with safety factor applied). The largest bobbin DSI voltages and total DSI reports for each SG are provided below in Table 6.

This data shows that SG 4 appears to be the most susceptible SG with regard to ODSCC initiation. For all SGs, the average absolute voltage growth is 0.04 volt for Cycle 11, or essential zero average voltage growth. The largest single absolute voltage growth was 0.62 volt for Cycle 11, or 0.44 volt per EFPY. The average percentage voltage growth for SG2 is larger than has been observed for past cycles, however, the average DSI amplitudes are so low that small changes can have a large percentage change.

Mixed residual signals with bobbin voltage > 1.5 volts were RPC inspected. No mixed residuals >1.5 volts were confirmed to contain axial ODSCC.

A complete evaluation per the GL 95-05 requirements will be provided in the ARC 90-day report. The 1RF11 TSP ODSCC bobbin amplitudes are essentially equal to the 1RF10 values. Past GL 95-05 analyses have indicated that the projected leak rate at end of next cycle conditions will be approximately 0.001 gpm, and conditional burst probability of several orders of magnitude less than the GL 95-05 burst limit. Using the Addendum 6 relation of burst pressure to bobbin amplitude, the lower 95% confidence burst pressure of a 1.06 volt indication is >5000 psi.

Table 6
1RF11 TSP ODSCC Degradation Summary

	SG 1	SG 2	SG 3	SG 4
Number Ind.	32	32	35	259
Number ≥ 1 volt	0	1	0	0
Average 1RF11 Voltage	0.23	0.46	0.41	0.45
Max 1RF11 Voltage	0.45	1.26	0.94	0.92
Average Absolute Voltage Growth Cycle 11 (per EFPY)	-0.01	0.05	-0.02	0.03
Average % Voltage Growth Cycle 11 (per EFPY)	-5.6%	19.6%	-7.7%	5%

One additional tube in SG4 was plugged due to detection of a small amplitude axial ODSCC signal at the H11 plate (R1 C100). No bobbin DSI signal was reported for this tube. An Alloy 800 tubesheet sleeve was installed at 1RF10 on the hot leg of this tube. Review of the 1RF11 bobbin data shows

that the probe snapped at the beginning of the pull, distorting the bobbin response at this elevation and rendering the 520 wide groove bobbin analysis somewhat ineffective. Due to the 100% base scope +Pt examination of Row 1 through 16 U-bends, all tubes with sleeves in which the hot leg straight sections were inspected with either the 540 or 520 wide groove probes were inspected at H11 with a +Pt coil. Thus, this issue is not transferable to all tubes with sleeves in which the hot leg straight sections were inspected with the wide groove probes. The issue with probe snap occurs at the initiation of the pull; good data was collected for all other TSP elevations above sleeves. Note that for sleeves installed in Rows 5 and higher that the 610 diameter bobbin coil was used for inspection above the sleeve. In these cases the bobbin data was collected from the cold leg side.

4.1.5 Axial PWSCC at Hot Leg Top of Tubesheet Expansion Transition

Structural integrity of axial flaws is established based on reported NDE length and depth.

During the 1RF11 inspection, 1 tube was plugged due to a reported axial PWSCC indication within the F* distance. The maximum flaw amplitude was only 0.66 volt, while the flaw length was reported at 0.17 inch. Review of the 600 kHz +Pt data suggests that this signal is comprised of 3 closely spaced axial PWSCC indications located within the expansion transition.

When the flaw length error defined by ETSS 20511.1 is applied to the 0.17 inch flaw length the NDE adjusted length is less than the 100%TW critical flaw length of 0.43 inch, thus the structural performance criteria is satisfied. The maximum +Pt amplitude of 0.66 volt suggests shallow depth. The phase angle of the signal is 33°, suggesting a near 100%TW depth. However, the influence of the carbon steel tubesheet material can act to rotate weak PWSCC signals into the OD flaw plane, which is what is observed here. While the phase based depth suggests near 100%TW depth, the signal amplitude is well below the in situ leak testing threshold of 3.07 volts for axial PWSCC at hardroll expansion transitions. It should be noted that a review of the 1RF10 +Pt data for this location indicates a reduced amplitude of 0.32 volt and phase angle of 37°, further supporting the conclusion that the phase based depth is unreliable. Note that with increased flaw amplitude the signal phase has shifted slightly towards the ID plane.

During the 1RF10 inspection, two axial PWSCC indications were reported with amplitudes of 1.32 volts and 0.41 volt with a maximum reported flaw length of 0.17 inch. The small number of PWSCC indications at the top of tubesheet location reported for recent outages is attributed application of shot peening prior to operation.

4.1.6 ODSCC at Freespan Dings

<u>Axially Oriented Indications:</u>

Ding ODSCC was first reported at Comanche Peak Unit 1 at the 1RF08 inspection with one confirmed DNI signal. The total number of tubes with ding ODSCC at each of the subsequent outages was 16 at 1RF09, 10 at 1RF10, and 5 at 1RF11. At the 1RF09 inspection, the history review criteria looking for change in bobbin signals were performed using the first ISI of the tube. Thus, the number of DNI signals was substantially increased as confirmed DNIs often do not exhibit significant change from one inspection to the next.

The dings flaws reported at 1RF11 all had ID phase angles or OD phase angles suggesting significant depth. This phenomenon has been observed both at other plants and in the laboratory program that developed the bobbin detection technique (Reference 10). The influence of the ding on the +Pt response overpowers the flaw response for short, shallow axial ODSCC. For these cases, the laboratory flaws generally had maximum depths <70%TW, and flaw lengths <0.12". The +Pt lissajous responses for these flaws are consistent with the laboratory ding specimens. Length evaluation of the 1RF11 ding axial ODSCC indicates that the maximum reported ding ODSCC length was 0.34 inch (R27 C23 in SG1). The remaining indications had axial length reports ranging from 0.14 inch to 0.24 inch. Performance evaluation of axial length sizing for ding ODSCC indications indicates that the [

]^{a,c}. The integrity evaluation of R27 C23 used a conservative maximum depth estimate of 75%TW, with an average depth of 60%TW based on the relation of maximum to average depth of 1.25 for pulled tubes with axial ODSCC. Burst capability was evaluated using a Monte Carlo simulation that included tube material properties and relational error. The simulation was evaluated at the lower 95% probability, 50% confidence level, or slightly conservative compared to the recommendations of the EPRI Tube Integrity Assessment Guideline. The estimated burst pressure for this length and depth combination is 5301 psi, well above the performance criterion of 3855 psi.

The extensive data base developed in the laboratory development program shows that as the ding amplitude is reduced below the qualified detection range of ≤ 5 volts, the bobbin phase response migrates to deeper OD depths due to the reduced influence of the ding signal. The +Pt phase response also migrates from the ID plane to the OD plane as the ding amplitude is reduced. As the bobbin phase angles were >109 degrees, +Pt phase angles remained well within the ID plane, and ding amplitudes are small, it is judged that all reported ding ODSCC signals identified at 1RF11 were shallow and bounded in maximum depth by 70%TW.

In summary, structural and leakage performance criteria are satisfied at EOC-11 conditions for axial ODSCC at freespan dings.

With regard 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 +Pt inspected. No degradation was observed.

4.1.7 Oblique PWSCC at Row 3 and Higher U-bends

This mechanism was first observed at the 1RF10 outage; no large scale inspection of the Row 3 and higher U-bends was performed prior to the 1RF10 inspection. A total of 8 tubes were affected at 1RF10, with the most significant containing a 2.22V indication. This tube was in situ pressure tested in a full tube mode. No leakage or burst was reported at a test pressure of 4266 psi. The maximum depth of this indication was reported at 95%TW based on the reported phase angle of the signal. The reported amplitude of 2.22 V using the 0.560" +Pt probe was adjusted to a 0.610" probe basis by comparing the amplitude responses of the two probes for the axial and circumferential EDM notches of the calibration standard. The average 0.610 to 0.560" amplitude ratio was 0.83 for all notches. The equivalent 0.610" volts are then 1.84. Using a correlation of +Pt amplitude to maximum depth

for pulled tubes and laboratory doped steam samples, the estimated maximum depth of this indication is [ ]^{a,c}. This result is more consistent with the in situ result than is the phase based result. It should be noted that nearly all of the U-bend indications exhibit phase based maximum depth reports that approach the 90%TW minimum through wall range even though the flaw amplitudes range from about 0.3 volts to 1.09 volts. The amplitude based depth reports for this range of amplitudes is [ ]^{a,c}.

At 1RF11, a total of 4 tubes were affected by this mechanism, with the maximum reported +Pt amplitude of 0.64 volt and the maximum reported arc length of 70° (different tubes). The reduced number of indications and reduced +Pt amplitude compared to 1RF10 suggests that the indications reported at 1RF10 had been present for several cycles before their detection.

As with the previously reported indications at other units with this mechanism, the affected arc lengths are short, approximately 30 to 70° arc. As such, these indications do not represent a structural integrity challenge as the indicated arc lengths are significantly less than the 100%TW circumferential critical flaw arc length of 294°. In Table 8 the calculated burst pressure assumes the limiting flaw to be 100%TW over the maximum reported arc length.

As the limiting indication was shown not to represent a leakage potential at well beyond the SLB pressure differential, and no burst occurred during the in situ pressure test, the NEI 97-06 structural and leakage performance criteria are satisfied.

Table 6 presents a summary of the affected tubes and maximum +Pt amplitude. The 0.560" +Pt was used for inspection of these tubes. Amplitude responses for the 0.560" +Pt and 0.610" +Pt were compared to determine if the voltage as reported from the 0.560" +Pt is consistent with the 0.610" +Pt. This comparison indicated that the 0.560" produced larger amplitudes for each of the part throughwall EDM notches of the calibration standard. The average ratio was 0.83. This value was used to adjust the 0.560" voltage responses for estimating depth as a function of +Pt amplitude. The values in Table 7 represent the as-reported 0.560" +Pt amplitudes.

Table 7
Summary of Oblique PWSCC at Row 3 and Higher U-bends

SG	Tube	Elevation of Max Amplitude	Number of Indications	Max +Pt Amplitude
1	R5 C10	H11 +21.9"	3	0.64
2	R5 C20	H11 +18.8"	2	0.30
2	R5 C23	H11 +17.3"	2	0.40
3	R3 C15	H11 +15.7"	1	0.64

4.1.8 Circumferential PWSCC at Hot Leg Top of Tubesheet Expansion Transition

No circumferential PWSCC at the hot leg top of tubesheet expansion transitions were reported for the 1RF11 outage.

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 for the 1RF11 inspection.

- Circumferential ODSCC in freespan dings
- Axial PWSCC in small radius U-bends
- AVB wear
- Tube wear at non-expanded preheater baffles
- Tube wear due to foreign objects/loose parts
- Axial PWSCC in Row 3 and higher U-bends
- Freespan Volumetric degradation
- Axial or circumferential PWSCC of parent tube behind sleeve hardroll joints

4.2.1 Freespan Volumetric Indications

Three freespan indications were reported by bobbin as DFI signals and confirmed by +Pt as volumetric in nature. These indications occurred in the freespan area away from structures, with no evidence of foreign objects in either this tube or surrounding tubes. For all of these indications, the 2004 bobbin data showed a similar signal to the 1RF11 bobbin data. One of these was reviewed back to the 2002 inspection with essentially no change in the bobbin signal. At the 1RF10 outage freespan volumetric indications were reviewed back to the 1996 inspection with no change. Thus it can be concluded that these indications are not representative of an on-going degradation mechanism. The cause of these signals may be attributed to laps or gouges resulting from the tube installation process or manufacturing process. These indications were preventively repaired by plugging. The maximum depth of these indications based on depth sizing using the EPRI volumetric standard and ETSS 21998.1 was 21%TW; the NDE adjusted depth is bounded by 40%TW. The largest axial length report for the freespan volumetrics was coincident with the largest maximum depth of 21%TW. [

]a,c

Therefore, the structural and leakage performance criteria of NEI 97-06 are satisfied as the best estimate flaw geometry parameters are bounded by the degradation structural limit for AVB wear.

4.2.2 Circumferential ODSCC at Freespan Dings

At the 1999 inspection of a Model E2 SG, OD circumferential indications were reported in the freespan region several inches below the top cold leg TSP. The indications were reported coincident with a circumferentially oriented ding, known as a ding pair. The ding pair is believed to be resultant from out of plane rotation of the tube while engaged with the top TSP during tube insertion. The geometry of this type of ding has been studied by Westinghouse and found to be significantly different from the dings that have historically resulted in axial ODSCC. Based on this similar plant experience, 20% of the hot and cold leg paired dings between the top two TSPs were inspected with +Pt at 1RF11, a practice that has been in place since the 1RF08 inspection. No degradation was

observed for the 1RF11 outage or any other preceding inspection.

4.2.3 Small Radius U-bend PWSCC

No small radius (Row 1 or Row 2) 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 SG1 and SG3. These occurrences are all associated with small foreign objects that were wedged between the tube and TSP. In all cases, the wear mechanism could be tracked to the previous inspection. These indications were sized using the EPRI volumetric standard and guidance provided in ETSS 21998.1. The deepest indication was reported at 27%TW, 0.24". The axially longest indication was reported at 0.31".

The wear mechanisms observed by bobbin coil generally had small bobbin amplitudes, i.e., well less than 1.0 volt in the primary mix channel or 300 kHz differential channel for freespan indications. As a comparison, the volumetric wall loss associated with the 40% depth, 0.187" diameter flat bottom hole of the ASME standard gives a signal of approximately 3 volts. Based on flaw geometry characterization with RPC and relation to laboratory wear scars, the axial extents of the wear indications were about 0.16" max, with a maximum circumferential involvement of about 50 degrees. The uniform thinning burst model of NUREG/CR-0718 can be used to estimate the burst pressure. At up to 83% TW degradation for a 0.26" axial involvement, burst pressure using LTL material properties exceeds the Comanche Peak 1 3ΔP value of 3855 psi. At 85% TW, the bobbin amplitude would be expected to be substantially larger than 3 volts. Using the ETSS 21998.1 depth measurement uncertainties at 90% probability, 50% confidence, maximum depth is estimated to be bounded by 42%TW. At the approximated maximum depth of 42%, a 0.16" axial length uniform thinning flaw with LTL material properties has a predicted burst pressure of 7319 psi.

Tube wear at non-expanded baffles is a low growth mechanism. The largest reported depth at 1RF08 was 43% TW with a growth of 6%TW. The largest reported depth at 1RF09 was 41% TW, with a growth of 6%TW. One additional repairable indication was reported at 40%TW. The largest reported depth at 1RF10 was 44%TW with a growth of 6%TW. The largest reported depth at 1RF11 was 45%TW with a growth of 6%TW for Cycle 11. If the sizing uncertainty for wear per ETSS 96004.3 is applied, the NDE adjusted depth of this indication is 59%TW, which is below the structural limit of 68%TW for an assumed ¾" wear axial length (Reference 1). Evaluation of the +Pt data for a sample of baffle wear signals indicates that the axial lengths are significantly less than ¾" in length. If it is assumed that the baffle wear extends for 0.75", and applying the ETSS 96004.3 uncertainty, the predicted burst capability using lower tolerance material properties and the NUREG/CR-0718 uniform thinning equation is 5000 psi.

Growth was evaluated individually for all SGs; the values were all similar thus it was concluded that the baffle wear growth for all SGs can be combined. The 95th percentile baffle wear growth was found to be 2.1%TW per EFPY. For a Cycle 12 length of 500 EFPD or 1.37 EFPY, the growth allowance applied for Cycle 12 is 3%TW. The deepest baffle wear scar returned to service was 38%TW in SG2. Thus, with NDE depth measurement applied, the maximum EOC-12 baffle wear depth is estimated to be 56%TW, which is well below the structural limit, thus the structural and leakage performance criteria are satisfied.

Wear growth statistics for the C2 and C3 plates were essentially equal to the overall value, suggesting that there is not a preferential growth by plate location.

The largest reported AVB wear indication was 32%TW. This location was also the largest AVB wear depth at 1RF10 at 34%TW, and also the largest AVB wear depth at 1RF09 of 33%TW. The historical data for this indication suggests that the AVB wear growth has essentially arrested, and depths at EOC-12 are not expected to be significantly different from those reported at 1RF11. The largest reported AVB wear growth reported for Cycle 11 was 4% TW. As only 8 AVB wear indications were reported at 1RF11 with 7 containing corresponding depth values in 1RF10, a statistical growth evaluation can not be performed. Instead, a bounding growth of 10% will be used in the operational assessment.

No tubes were judged to contain volumetric signals due to foreign object wear at the hot leg top of tubesheet attributable to foreign object wear. A total of four volumetric signals were reported at the hot leg top of tubesheet region. Of the 4 volumetric signals reported at this location, three were in the full depth roll expanded portion of tube with the location of the indications below the expansion transition. A review of the 1RF10 +Pt data shows the indications were present, with no change compared to 1RF11. One indication in SG3 was reported to contain a volumetric indication within the expansion transition. A review of the 1RF10 +Pt data shows a modest change however the 1RF11 signal parameters of 0.19 volt, axial extent of 0.26 inch, and circumferential extent of 73 degrees arc. This signal could represent a small foreign object wear signal, or possibly a mixed mode ODSCC flaw; no PLP signal was associated with this location and no PLP reports are present for surrounding tubes. Regardless of the true orientation, the signal parameters are bounded by the structural limit flaw models for either axial cracking, circumferential cracking, or uniform thinning.

In summary, structural and leakage performance criteria are satisfied at EOC-11 conditions for preheater baffle wear, AVB wear, and foreign object wear.

4.2.5 Axial PWSCC at Row 3 and higher U-bends

One tube in Row 13 in SG4 was reported to contain an axial PWSCC indication. The maximum +Pt amplitude was 0.38 volt, with a length of 0.37 inch. Estimated depth from phase analysis is 35%TW. .A length error of 0.12 inch per ETSS 20511.1 is applied to the reported length of 0.37 inch to develop a length for evaluation of 0.49 inch. Maximum depth error per ETSS 20511.1 at 90% probability, 50% confidence is 8%TW, thus the flaw parameters used for evaluation are 0.49 inch and 43%TW. Using a Monte Carlo simulation of burst pressure that includes material property variance and burst relational error, the burst pressure evaluated at 95% probability, 50% confidence is 6263 psi.

4.2.6 Axial or Circumferential PWSCC of Parent Tube behind Sleeve Hardroll Joints

At the 1RF10 inspection, 100% of all 1RF09 installed TIG sleeves were inspected full length with the +Pt coil; no indications were detected. At 1RF11, 20% of the 1RF09 installed TIG sleeves were inspected full length with the +Pt coil; no indications were detected. At 1RF11, 100% of all 1RF10 installed Alloy 800 sleeves were inspected with the +Pt coil; no indications were detected. Additionally, the 1RF10 Alloy 800 sleeve installation included an inspection of the parent tube in the

sleeve to tube hardroll joint region using the +Pt coil prior to installation of the sleeve. No degradation of the parent tube was detected.

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

The final degradation classification addressed in the degradation assessment is 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 degradation modes classified as potential for CPSES 1RF11 are;

- Axial PWSCC at expanded cold leg baffles
- Axial PWSCC at freespan dings
- SCC degradation of TIG and Alloy 800 sleeves
- Axial ODSCC at cold leg baffle and AVB wear sites

A 25% +Pt sample of expanded cold leg baffles has been performed for several outages. No degradation of tubes at expanded baffles has been reported. A 20% +Pt sample of >2V dings between the hot leg top of tubesheet and H3 has been performed for several outages. No PWSCC degradation has been reported. All TIG sleeves and parent tubes in the pressure boundary region were inspected with +Pt at 1RF10; the test extent was from 3 inches above the sleeve to 3 inches below the sleeve. No degradation of either the TIG sleeve or parent tube was reported. A 20% +Pt sample of TIG sleeves installed at 1RF09 was performed; the test extent was from 3 inches above the sleeve to 3 inches below the sleeve. All remaining TIG sleeves were inspected from 3 inches below to 3 inches above the sleeve top to complete the inspection of the parent tube for axial ODSCC in the hop off region above the sleeve that may not be inspectable with the bobbin probe due to the probe design. No parent tube or sleeve indications were reported. At 1RF11 all Alloy 800 sleeves installed at 1RF10 were inspected full length, from 3 inches above to 3 inches below the sleeve using a +Pt coil. No degradation of the parent tube or the Alloy 800 sleeves was reported. At 1RF11 a 20% +Pt sample of non-expanded cold leg baffles was performed to determine if SCC signals were present but overshadowed to the bobbin coil by the amplitude of the wear scar. The signals selected for this sample included the largest depth wear calls in each SG as if SCC were to develop it would likely develop first at indications with the deepest wear scar depths and associated highest stresses due to the thinned material. No SCC indications were detected. Also, as only 8 AVB wear scars were reported at 1RF11, and the base scope inspection included a large number of +Pt tests in the U-bend region addressing >5V dings, a decision was made to inspect all AVB wear sites with the +Pt coil to validate the position that ODSCC coincident with AVB wear sites was not present in the Comanche Peak Unit 1 SGs. No SCC degradation was reported coincident with AVB wear sites.

4.4 Summary of Limiting Indications

Table 8 presents a summary of the limiting indications for the 1RF11 inspection. All indications had predicted burst capabilities of greater than the $3\Delta P_{NormOp}$ value of 3855 psi using either material properties consistent with the EPRI tube integrity guideline or actual tube material properties reduced for operating temperature effect. Table 8 also provides the burst pressure assessment per Table 8-1 of the EPRI tube integrity guideline, using NDE sizing uncertainty, material properties, and relation

error at the lower 90% probability, 50% confidence level. The values listed for max length, max depth, and average depth are the as-reported NDE values.

4.5 SLB Leakage Discussion

For all degradation mechanisms observed at 1RF11, any potential for SLB leakage at end of Cycle 11 conditions is judged to be negligible.

The circumferential ODSCC indications at the TTS are of sufficiently low magnitude that no leakage contribution is expected. Past in situ testing of larger amplitude signals confirmed that no leakage was observed. Based on the available industry database, SLB leakage is not expected for maximum +Pt amplitudes of about 1.25 volt. The +Pt amplitudes of the previous in situ leak tested circumferential flaws ranged from 0.18 to 0.56 volts. The largest +Pt amplitude observed for all SGs at 1RF11 was 0.27 volt. No leakage was reported at any of the 1RF06, 1RF07, 1RF08, or 1RF09 in situ testing campaigns for tests of tubes with circumferential ODSCC indications.

The single axial PWSCC flaw at the TTS had a +Pt amplitude of 0.66 volt, but included contribution from 3 closely spaced axial flaws based on evaluation of the 80 mil high frequency coil. The maximum depth from the +Pt phase depth analysis is near 100%TW for the largest amplitude signal. The depth from the +Pt amplitude correlation for PWSCC is <40%TW (Reference 2). Previous discussion has shown the phase based sizing to be unreliable based on the lack of phase change with modest amplitude change from 1RF10 to 1RF11. The indicated amplitude is well below the in situ leakage test threshold of 3.07 volts. Maximum +Pt amplitudes for axial PWSCC indications at the TTS in 7/8" hardroll expanded tubes of up to 6 volts did not leak during in situ test.

The largest circumferential PWSCC flaw at the tack roll to WEXTEX expansion transition had a +Pt amplitude of 1.53 volts. Using the PWSCC –Pt amplitude vs depth correlation, the estimated maximum depth of this indication is [ ]a,c at the upper 90% probability, 50% confidence. The phase angle response is 13° or 33%TW.

The largest amplitude oblique PWSCC indication in a large radius U-bend was 0.64 volt, and well below the flaw amplitude that was in situ pressure tested at 1RF10 in a full tube mode of 2.22 volt.

Volumetric degradation depths were well below potential breakthrough depths, and also do not represent a leakage potential at SLB conditions.

4.6 In Situ Testing Summary

The in situ testing performed for the 1RF11 outage supports the conclusion that postulated SLB condition primary to secondary leakage will remain below 1 gpm for all SGs.

4.7 1RF11 Condition Monitoring Conclusion

Based on the CPSES 1RF11 inspection results, all tubes satisfied the NEI 97-06 structural and leakage performance criteria. The relative severity levels of the observed degradation for existing degradation mechanisms was judged consistent with or bounded by the levels associated with the 1RF10 inspection.

In situ pressure testing of showed no potential for the structural integrity or leakage performance criteria of NEI 97-06 to be challenged.

5.0 CYCLE 12 PRELIMINARY OPERATIONAL ASSESSMENT

Circumferential ODSCC at Hardroll Expansion Transition

Figure 2 shows that the cumulative probability distribution function for +Pt amplitude for 1RF11 is bounded by the 1RF10 distribution. As all 1RF11 and 1RF10 indications satisfied both structural and leakage integrity criteria, a similar result would be anticipated for EOC-12 based on the trending shown on Figures 2 and 3. Assuming the probability of detection for both the 1RF11 and 1RF10 outages were consistent, Figure 2 suggests that the growth and initiation function for Cycle 11 is reduced compared to Cycle 10. As no changes in the chemistry regime or operating temperature are anticipated for Cycle 12, the EOC-12 +Pt amplitude distribution is expected to be similar to that observed for 1RF11.

Axial PWSCC at Hardroll Expansion Transition

Only one tube was affected at 1RF11; two tubes were affected at 1RF10. The application of shotpeening prior to operation has apparently reduced the potential for initiation of this mechanism. The consistency between the results for both inspections suggests that no change in growth or initiation trends are occurring with increased operating time. The peak flaw amplitude reported for 1RF11 was well below the 1RF10 peak flaw amplitude.

Oblique PWSCC at Row 3 and higher U-bends

The observation of 4 tubes with oblique PWSCC at U-bends represents a reduction in the number of indications and is consistent with other plants that have performed more than one inspection for this mechanism. Operating history from another unit indicates that this unit had operated with a 100%TW indication due to this mechanism for approximately 4 years prior to the detection of the indication by secondary side pressure test. Stress fields in U-bends at the flank are believed to have limited arc involvement extent. This is shown by the fact that all indications observed at Comanche Peak as well as other units all have limited circumferential extent, bounded by about 60° arc response to the +Pt coil. The observed number of indications and severity at 1RF12 is expected to be bounded by the 1RF11 results as 1RF11 was the second large scale inspection of this region.

Freespan Axial ODSCC

Severity of this mechanism is expected to be bounded by the results from 1RF11 based on the supplemental ADS screening performed. The ADS screening results show that DFI reports would have been produced at 1RF09 for R32 C99, thus, it can be assumed that similar indications would have been reported at 1RF11. At 0.15 volt in the 300 kHz bobbin, the depth associated with this amplitude is approximately [ ]^{a,c}. The +Pt and bobbin amplitudes for approximately 50 1RF11 confirmed indications were compiled. A plot of 300 kHz bobbin amplitude versus +Pt amplitude indicates that the mean predicted +Pt amplitude is 0.14 volt, while the upper 90% probability, 50% confidence +Pt amplitude is 0.21 volt. For a +Pt amplitude of 0.21 volt, the predicted maximum depth is [ ]^{a,c}. Evaluation of growth based on the 300 kHz bobbin amplitude response indicates that the 95th percentile growth is [ ]^{a,c} per cycle. Thus, at EOC-12, a freespan ODSCC depth of [ ]^{a,c} could be realized. When the 1.25 maximum to average

depth ratio is applied, this indication could contain average depth of approximately [ ]^{a,c}. For an assumed flaw length of 3 inches, a [ ]^{a,c} average depth flaw would retain a burst capability of approximately 5300 psi at the 95% probability, 50% confidence level.

TSP ODSCC

The bobbin amplitude distribution for 1RF11 is essentially equal to the 1RF10 bobbin amplitude distribution. Thus, growth conditions can be assumed to have not changed over this period. The low growth function associated with the TSP ODSCC mechanism at Comanche Peak does not support a potential for a growth exceeding 3 volts, which would then postulate an indication with an amplitude approaching the voltage based structural limit. For each of the last three inspections, only one tube has been required to be plugged due to a bobbin amplitude exceeding 1 volt.

Ding ODSCC

The number of tubes affected with ding ODSCC was reduced for 1RF11 compared to 1RF10. All of the ding ODSCC signals reported by bobbin had precursor signals in the 1RF10 data, and some had precursors present in the 1RF09 data, supporting the previous supposition that ding ODSCC is generally not a mechanism with significant growth rates. In the case of the 0.77" long indication in situ pressure tested at 1RF10, the signal was present at 1RF08, although the 130 kHz phase response was less than the reportable value. Thus, the indication depth likely was shallow.

AVB and Baffle Wear

AVB and baffle wear growth rates remain low. The single largest baffle wear growth for Cycle 11 was 6%TW. The average baffle wear growth was approximately 1%TW, and baffle wear growth rates have not changed for the past several outages. The total number of affected tubes with AVB wear is small, less than 10. The largest growth was 4%TW for Cycle 11.

Conclusion

The preliminary evaluation of mechanism growth rates indicates that there is no apparent change in growth rates for Cycles 11 and 10. As eddy current detection conditions remain consistent, there is no basis to conclude that the observed indication severities at 1RF12 will vary significantly from that observed at 1RF11.

6.0 Potential New Degradation Mechanism Assessment

The only new degradation mechanism reported at 1RF11 was axial PWSCC in large radius U-bends. The signal parameters were small, and the Row location (Row 13) suggests that this signal could be a false call as no axial indications were reported in Rows with much higher ovality and total strain conditions. The slow growth observed for the oblique PWSCC indications suggests that if real, such indications would also not represent a high growth condition. Previous industry occurrences of axial PWSCC in Row 3 and higher U-bends have been limited to Rows 4 and 5.

Partially collapsed TIG sleeves were again observed in SGs 2, 3, and 4. Again, this mechanism is not new to the industry, or to Comanche Peak Unit 1. This mechanism is addressed here only to capture

the results of the +Pt inspection of the sleeve lower hardroll for collapsed TIG sleeves at 1RF11 which shows that no detectable degradation was observed in the 1RF11 collapsed TIG sleeves, either in the parent tube or sleeve at the lower hardroll joint. Reference 8 provides an assessment of potential TIG sleeve collapse for Comanche Peak and concludes that the weld and hardroll joints will retain integrity in the event of a collapse.

In conclusion, the new mechanism observed at Comanche Peak Unit 1 during the 1RF11 outage has been previously reported in the industry, and does not represent a structural or leakage integrity challenge.

7.0 Comanche Peak 1 In Situ Pressure Testing History

Table 9 presents a summary of the in situ testing history at Comanche Peak Unit 1. The flaw parameters for the tested circumferential ODSCC indications are consistent for each inspection, suggesting that the upper bound flaw severity has not increased over at least 4 inspections.

8.0 References

1. SG-SGDA-05-32, Rev 1, "Comanche Peak Steam Electric Station Unit 1 Steam Generator Degradation Assessment 1RF11 Refueling Outage", October 2005 (Westinghouse Proprietary)

2. SG-SGDA-04-21, Rev 1, "Comanche Peak Steam Electric Station 1RF10 Condition Monitoring Report and Preliminary Cycle 11 Operational Assessment", April 2004 (Westinghouse Proprietary)

3. CN-SGDA-02-93, "Circumferential ODSCC Sizing Uncertainties", April 2002 (Westinghouse Proprietary)

4. EPRI TR-107621R1, "Steam Generator Integrity Assessment Guidelines", March 2000

5. EPRI 1003138, "PWR Steam Generator Examination Guidelines Revision 6", October 2002

6. EPRI 1007904, "Steam Generator In Situ Pressure Test Guidelines Revision 2", August 2003

7. Argonne National Laboratory, February 2003 Monthly Report for Job Code Y6588, "Tube Integrity Program"

8. LTR-SGDA-04-137, "Evaluation of Collapsed TIG Welded Sleeves at Comanche Peak Unit 1," April 2004

9. SG-SGDA-04-21, Rev 1, "Comanche Peak Steam Electric Station 1RF10 Condition Monitoring Report and Preliminary Operational Assessment," April 2004

10. SG-99-03-005, "Appendix H Certification of Bobbin Coil Detection Performance in Freespan Dings", March 1999

Table 8
Summary of Limiting Indications at 1RF11 at Lower 95% Probability, 50% Confidence Evaluation

Mechanism	Tube	Max Length	Max Depth	Avg. Depth	Calculated Burst Pressure	SLB Leakage gpm
Circ ODSCC at hot leg TTS	R36 C79	296°	70%	34%	6493	0.00
Oblique PWSCC in U-bends	Combined Flaws	70°	<60% (1)	N/A	6642	0.00
Freespan Axial ODSCC	R32 C99	~36"	53% (2)	From profiling	5300	0.00
Axial ODSCC in Dings	R27 C23	0.34"	75% (3)	60%	5301	0.00
Axial PWSCC at TTS	R2 C99	0.21"	<40%TW (1)	N/A	4871	0.00
Axial ODSCC at TSP	R26 C65	N/A	N/A	N/A	5300	0.06 gpm (4)
Baffle Wear	R48 C39	0.75" (5)	45%	N/A	4706	0.00
AVB Wear	R47 C67	0.35"	38%	N/A	6671	0.00

1): Assumed maximum depth for burst pressure analysis is 100%TW
2): Maximum depth is based on +Pt flaw amplitude.
3): Assumed bounding value based on +Pt lissajous response.
4): For the lower 95% tolerance bound from Addendum 6 to the TSP ODSCC database
5): Assumed to be equal to baffle thickness, uniform thinning model applied

Table 9 Comanche Peak Unit 1 In Situ Pressure Testing History										
CPSES 1RF11 In Situ Testing Summary										
Tube	SG	Degradation Mode	Location	Flaw Length	Max Depth (NDE)	+Pt Volts	Leak Test Pressure	Proof Test Pressure	Leakage	Burst
R332 C99	1	Axial ODSCC	C9 to C10	~36"	53%	0.26	2841	4650	No	No
R24 C22	4	Axial ODSCC	C8 to C9	~4"	60%	0.42	2841	4350	No	No
CPSES 1RF10 In Situ Testing Summary										
Tube	SG	Degradation Mode	Location	Flaw Length	Max Depth (NDE)	+Pt Volts	Leak Test Pressure	Proof Test Pressure	Leakage	Burst
R10 C105	1	Oblique PWSCC	H11 +8.6"	45°	~72%	2.2	4266	4266	No	No
R27 C51	1	Axial ODSCC	C10 +36.6"	0.77"	~70%	1.11	4266	4266	No	No
R7 C12	3	Axial ODSCC	H5 +8.6"		~50%	0.20	2841	4266	No	No
R11 C91	4	Circ PWSCC	HTS	106°	~61%	1.29	2925	4480	No	No
CPSES 1RF09 In Situ Testing Summary										
Tube	SG	Degradation Mode	Location	Flaw Length	Max Depth (NDE)	+Pt Volts	Leak Test Pressure	Proof Test Pressure	Leakage	Burst
R41 C55	1	Axial ODSCC	H10 +38"	0.10"	~70%	0.93	4070	4070	No	No
R41 C75	1	Axial ODSCC	C10 +38"	0.23"	~70%	0.48	4070	4070	No	No
R42 C59	1	Axial ODSCC	AV3 +1.6"	0.27"	~70%	0.52	4070	4070	No	No
R45 C24	1	Axial ODSCC	AV3 +1.7"	0.20"	~70%	0.43	4070	4070	No	No
R5 C70	2	Circ ODSCC	HTS -0.29"	360°	61%	0.18	2970	4375	No	No
R7 C73	2	Circ ODSCC	HTS -0.29"	330°	76%	0.32	2970	4375	No	No
R11 C42	2	Axial ODSCC	H5 +10.63"	1.63"	64%	0.21	2841	N/A	No	N/A
R41 C71	2	Axial ODSCC	AV3 +26"	0.91"	100%	6.5	2150	N/A	Yes	N/A
R44 C83	2	Axial ODSCC	AV2 +27"	0.25"	~70%	0.45	4070	4070	No	No
R7 C17	3	Axial ODSCC	H5 +11.73"	1.14"	68%	0.26	4070	4070	No	No
R4 C51	3	Axial ODSCC	H9 +9"	0.89"	71%	0.24	2841	4070	No	No
R2 C77	3	Circ ODSCC	HTS -0.31"	270°	60%	0.38	2970	4375	No	No

R38 C77	3	Circ ODSCC	HTS –0.25"	270°	76%	0.42	2970	4375	No	No
R7 C90	3	Axial ODSCC	H3 +29.2"	2.81"	60%	0.26	2841	4070	No	No
R23 C90	3	Circ ODSCC	HTS –0.29"	120°	76%	0.44	2970	4375	No	No
R36 C93	3	Circ ODSCC	HTS –0.14"	210°	82%	0.22	2970	4375	No	No
R7 C112	3	Axial ODSCC	H8 +8.56"	2.88"	62%	0.81	2841	4070	No	No
R32 C65	4	Circ ODSCC	HTS –0.46"	330°	76%	0.56	2970	4375	No	No
R4 C77	4	Circ ODSCC	HTS –0.25"	330°	48%	0.26	2970	4375	No	No
CPSES 1RF08 In Situ Testing Summary										
Tube	SG	Degradation Mode	Location	Flaw Length	Max Depth (NDE)	+Pt Volts	Leak Test Pressure	Proof Test Pressure	Leakage	Burst
R18 C84	4	Circ ODSCC	HTS –0.28"	270°	91%	0.19	2955	4395	No	No
R2 C72	4	Circ ODSCC	HTS –0.02"	270°	42%	0.31	2955	4395	No	No
CPSES 1RF07 In Situ Testing Summary										
Tube	SG	Degradation Mode	Location	Flaw Length	Max Depth (NDE)	+Pt Volts	Leak Test Pressure	Proof Test Pressure	Leakage	Burst
R22 C89	4	Circ ODSCC	HTS –0.23"	339°	69%	0.23	2925	4385	No	No
R32 C77	4	Circ ODSCC	HTS –0.14"	292°	63%	0.32	2925	4385	No	No
R38 C78	4	Circ ODSCC	HTS +0.11"	265°	71%	0.17	2925	4385	No	No
CPSES 1RF06 In Situ Testing Summary (limiting indications)										
Tube	SG	Degradation Mode	Location	Flaw Length	Max Depth	+Pt Volts	Leak Test Pressure	Proof Test Pressure	Leakage	Burst
R1 C69	2	Circ ODSCC	HTS +0.12"	296°	61%	0.43	2925	4315	No	No
R1 C73	2	Circ ODSCC	HTS –0.17"	326°	67%	0.47	2925	4315	No	No
R1 C95	2	Circ ODSCC	HTS –0.32"	337°	64%	0.44	2925	4315	No	No
R3 C96	2	Circ ODSCC	HTS –0.25"	350°	71%	0.38	2925	4315	No	No
R3 C103	2	Circ ODSCC	HTS –0.14"	360°	71%	0.43	2925	4315	No	No

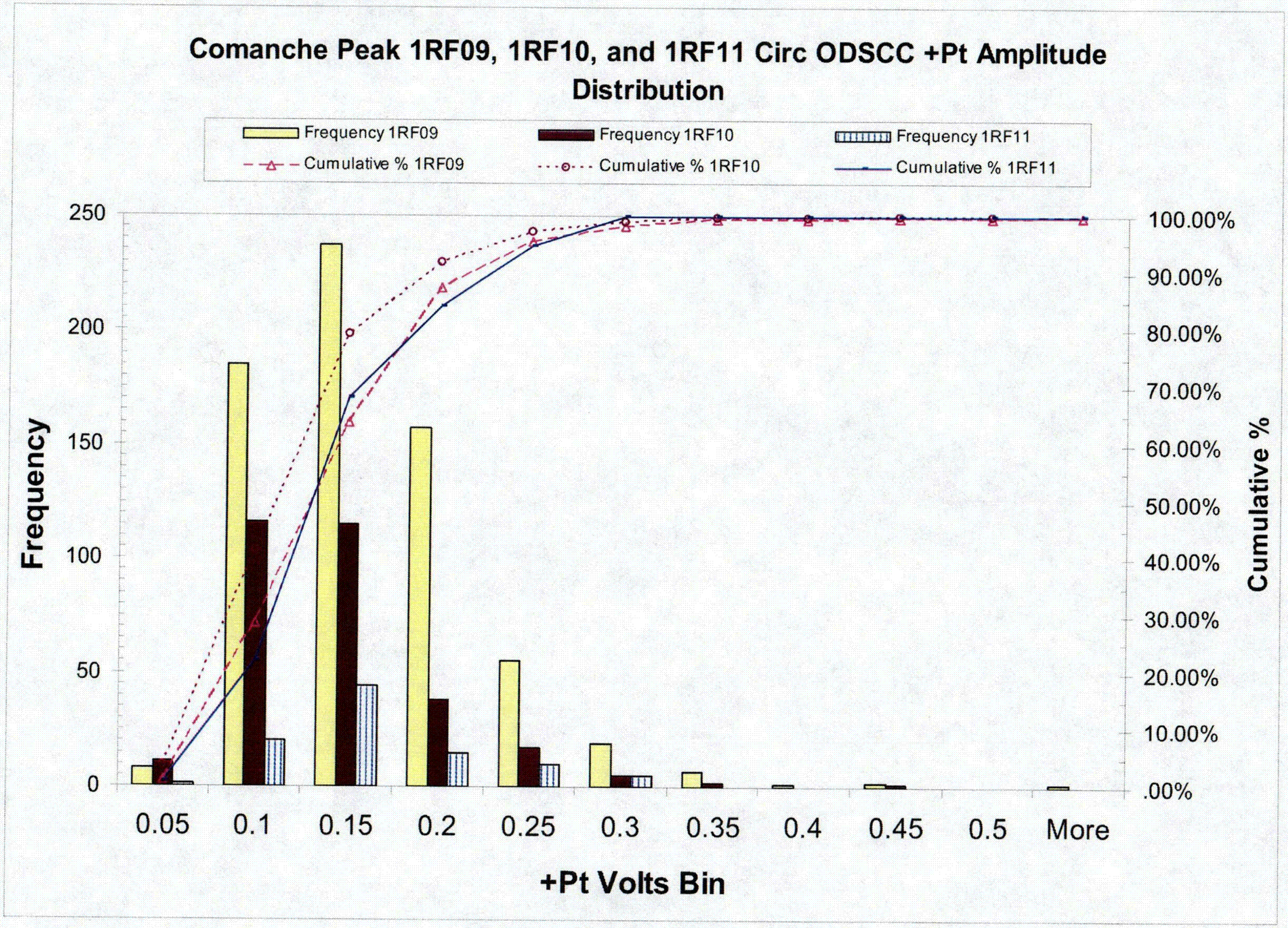
Notes:

1. R41 C71 leaked at a maximum rate of 0.03 gpm at pressure differential of 1439 psi (normal operating temperature adjusted). Leak test was stopped at 2150 psi due to leakage exceeding pump capacity of 2.6 gpm. Burst could not be established. Predicted burst pressure is approximately 2727 psi.
2. All axial ODSCC tests were conducted using full tube setup, thus leak and proof test pressures are equal. R11 C42 was leak tested only to 2841 psi. This tube was pulled for destructive exam. Laboratory burst pressure was 8177 psi.
3. All maximum depths based on phase analysis for most reliable depth points.

Figure 1

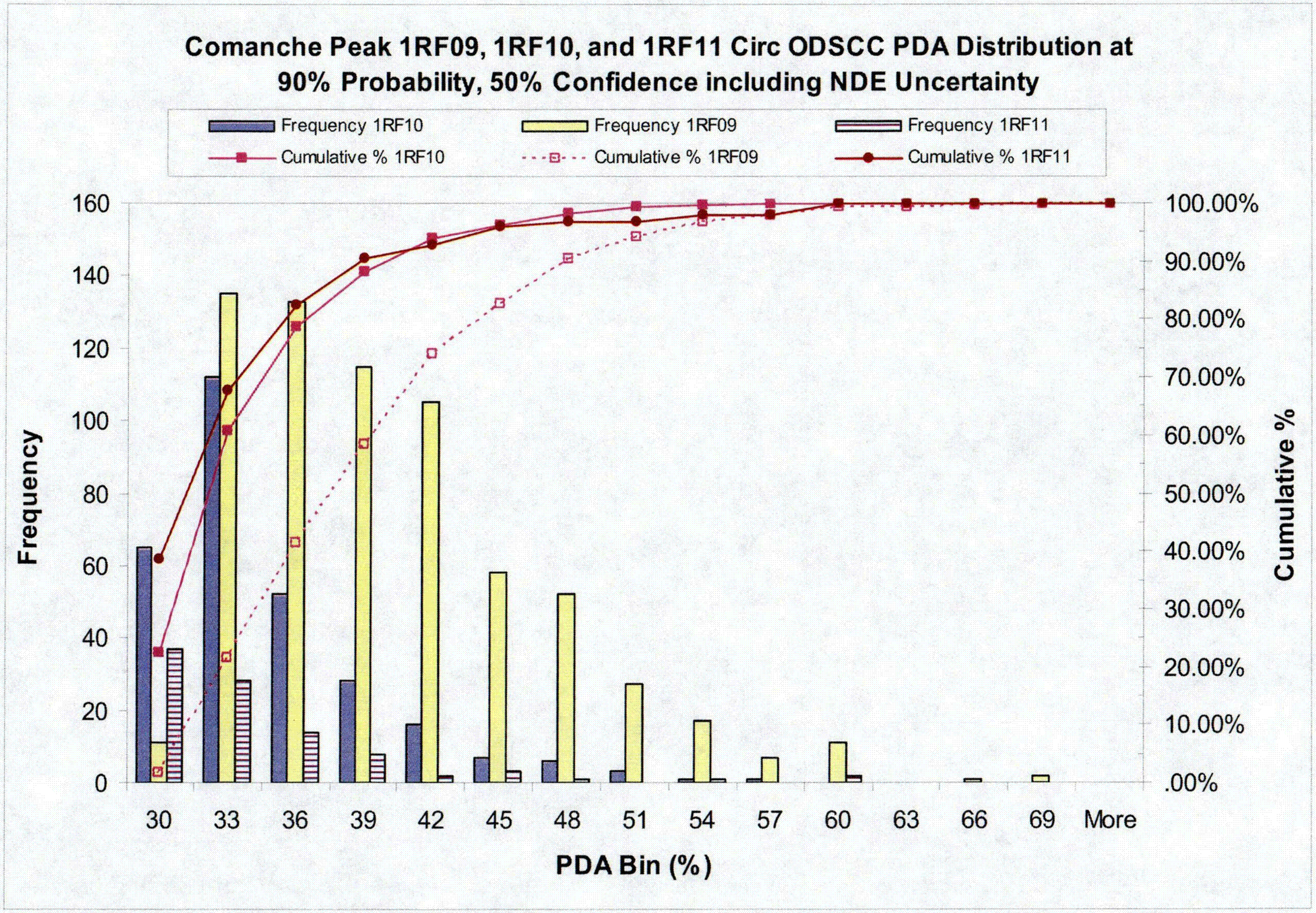
a,c

Figure 2


Comanche Peak 1RF09, 1RF10, and 1RF11 Circ ODSCC +Pt Amplitude Distribution
Frequency 1RF09
Frequency 1RF10
Frequency 1RF11
Cumulative % 1RF09
Cumulative % 1RF10
Cumulative % 1RF11
Frequency
0
50
100
150
200
250
Cumulative %
.00%
10.00%
20.00%
30.00%
40.00%
50.00%
60.00%
70.00%
80.00%
90.00%
100.00%
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
More
+Pt Volts Bin

C01

Figure 3


Comanche Peak 1RF09, 1RF10, and 1RF11 Circ ODSCC PDA Distribution at 90% Probability, 50% Confidence including NDE Uncertainty
Frequency 1RF10
Frequency 1RF09
Frequency 1RF11
Cumulative % 1RF10
Cumulative % 1RF09
Cumulative % 1RF11
Frequency
Cumulative %
PDA Bin (%)
0
20
40
60
80
100
120
140
160
.00%
10.00%
20.00%
30.00%
40.00%
50.00%
60.00%
70.00%
80.00%
90.00%
100.00%
30
33
36
39
42
45
48
51
54
57
60
63
66
69
More

COZ

Figure 4

a,c

Figure 5

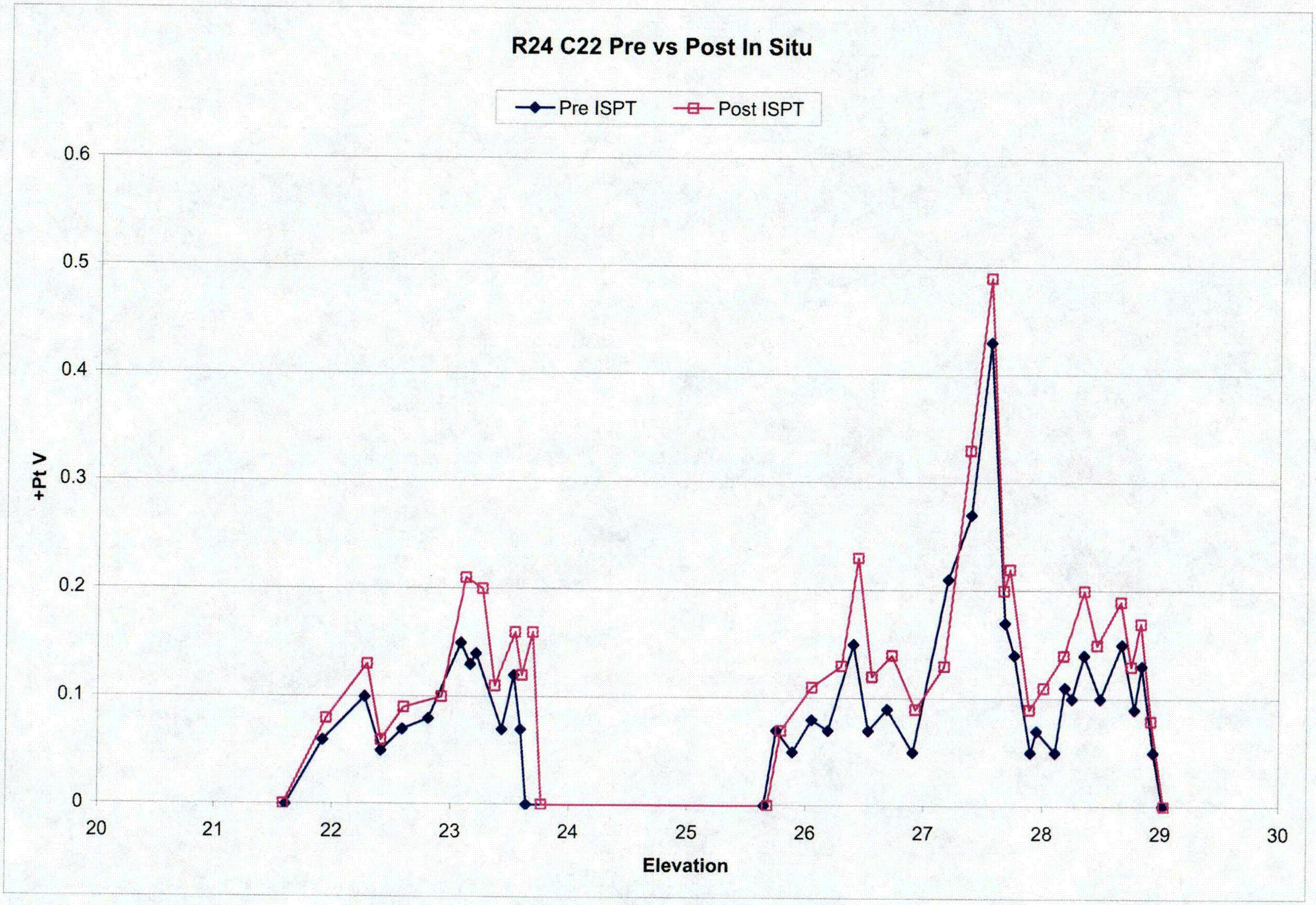
a,c

Figure 6

a,c

[ ]

Figure 7


R24 C22 Pre vs Post In Situ
Pre ISPT
Post ISPT
0.6
0.5
0.4
0.3
0.2
0.1
0
+Pt V
20
21
22
23
24
25
26
27
28
29
30
Elevation

C03

Enclosure 3

CAW-06-2096
"APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE"

PROPRIETARY INFORMATION NOTICE AND COPYRIGHT NOTICE

Westinghouse

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Document Control Desk
Washington, DC 20555-0001

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Our ref: CAW-06-2096

February 7, 2006

APPLICATION FOR WITHHOLDING PROPRIETARY
INFORMATION FROM PUBLIC DISCLOSURE

Subject: SG-SGDA-05-45-P, "Comanche Peak Steam Electric Station 1RF11 Outage Condition Monitoring Report and Preliminary Cycle 12 Operational Assessment," dated October 2005 (Proprietary)

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit CAW-06-2096 signed by the owner of the proprietary information, Westinghouse Electric Company LLC. The affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.390 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying affidavit by TXU Power.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference this letter, CAW-06-2096, and should be addressed to B. F. Maurer, Acting Manager, Regulatory Compliance and Plant Licensing, Westinghouse Electric Company LLC, P.O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

Very truly yours,

B. F. Maurer, Acting Manager
Regulatory Compliance and Plant Licensing

Enclosures

cc: B. Benney
L. Feizollahi

bcc: B. F. Maurer (ECE 4-7A) 1L
R. Bastien, 1L (Nivelles, Belgium)
C. Brinkman, 1L (Westinghouse Electric Co., 12300 Twinbrook Parkway, Suite 330, Rockville, MD 20852)
RCPL Administrative Aide (ECE 4-7A) 1L, 1A (letter and affidavit only)

CAW-06-2096

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared B. F. Maurer, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse), and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

B F Maurer

B. F. Maurer, Acting Manager
Regulatory Compliance and Plant Licensing

Sworn to and subscribed
before me this 10th day
of February, 2006

Sharon L Fiori
Notary Public

Notarial Seal
Sharon L. Fiori, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires January 29, 2007
Member, Pennsylvania Association Of Notaries

(1) I am Acting Manager, Regulatory Compliance and Plant Licensing, in Nuclear Services, Westinghouse Electric Company LLC (Westinghouse), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse "Application for Withholding" accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in SG-SGDA-05-45-P, "Comanche Peak Steam Electric Station 1RF11 Outage Condition Monitoring Report and Preliminary Cycle 12 Operational Assessment," dated October 2005 (Proprietary), being transmitted by TXU Power letter and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse for the Comanche Peak Steam Electric Station Unit 1 is expected to be applicable for other licensee submittals in response to certain NRC requirements for justification of plant operation with the condition of the steam generators as determined from the inspection during the outage.

This information is part of that which will enable Westinghouse to:

(a) Provide information in support of steam generator licensing submittals.

(b) Provide plant specific calculations.

(c) Provide licensing documentation support for customer submittals.

Further this information has substantial commercial value as follows:

(a) Westinghouse plans to sell the use of similar information to its customers for purposes of meeting NRC requirements for licensing documentation associated with steam generator submittals.

(b) Westinghouse can sell support and defense of the technology to its customers in the licensing process.

(c) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar calculations, evaluations, analyses and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

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