Enclosure 2

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(Non-Proprietary)

Comanche Peak Steam Electric Station
1RF10 Outage Condition Monitoring Report
and
Preliminary Cycle 11 Operational Assessment

Westinghouse

Westinghouse Non-Proprietary Class 3

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Comanche Peak Steam Electric Station 1RF10 Outage Condition Monitoring Report and Preliminary Cycle 11 Operational Assessment

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Comanche Peak 1RF10 Condition Monitoring and Preliminary Cycle 11 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 2004, EOC-10 eddy current inspection results. Condition monitoring is "backward looking" and compares the observed EOC-10 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-11. This report documents the condition monitoring of the NDE results from the Comanche Peak 1RF10 Refueling Outage inspection, performed in April, 2004. Additionally, this evaluation provides a preliminary assessment of SG tube integrity at EOC-11 that supports SG operability.

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 1RF10 flaw NDE parameters (i.e., max volts, length, depth) for existing known degradation mechanisms were bounded by the 1RF09 flaw parameters both in number of affected tubes and severity of the indications. The number of affected tubes with circumferential ODSCC was significantly reduced, with the maximum flaw amplitude from +Pt of 0.43 volts, which is below the EPRI In Situ Guideline Revision 2 testing threshold of 0.50 volts. The number of tubes affected with ding ODSCC and freespan ODSCC were slightly reduced, however, the reported flaw parameters were substantially below the levels associated with the observed 1RF09 degradation.

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 noted. A total of 8 tubes were affected with oblique PWSCC at large radius U-bends. This number is low compared to recent inspection results for other plants that have observed this mechanism. It should be noted that the Comanche Peak Unit 1 T-hot of approximately 620^{o}F with 11.7 accumulated EFPY represent the highest PWSCC initiation potential for operating units with mill annealed tubing. The largest +Pt amplitude reported for oblique PWSCC was 2.2 volts. Circumferential PWSCC at the hot leg expansion transition was reported on two tubes; one in SG2, 0.28 volts by +Pt, 56 degrees arc length, the other in SG4, 1.29 volts by +Pt, 106 degrees arc length. The 1.29 volt indication (R11 C91) is a required in situ leakage test. The EPRI Rev 2 In Situ Guideline contains no circumferential PWSCC data in hardroll expansions, thus, the voltage threshold for leakage testing is conservatively low. For the new degradation mechanisms reported at 1RF10, circumferential PWSCC at large radius U-bends and circumferential PWSCC at the top of tubesheet, in situ pressure testing showed no leakage at steam line break (SLB) pressure differential with burst not reported. The 2.2 V oblique PWSCC and the 1.29 V circumferential PWSCC indications were required leakage tests per the EPRI In Situ

Guideline, Rev 2. Although both of these were required leakage tests only, the in situ pressure test was carried through the proof testing stage. No leakage or burst was reported.

Collapsed TIG sleeves were also noted in SGs 2, 3, and 4. 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 passed 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 tubes containing potentially collapsed sleeves were plugged.

Preliminary benchmarking of the observed 1RF10 eddy current parameters indicates that the operational assessment methodologies applied were conservative. Based on these observations, it is judged that structural and leakage integrity will be provided at EOC-11.

The AVB and baffle plate wear mechanisms show low growth rates, and growth trends were consistent with Cycle 9. One baffle plate wear indication required plugging due to measured wear scar depth of 44%TW (SG2); the measured depth at 1RF09 was 38%TW. No AVB wear signals exceeded 40%TW.

During the CPSES 1RF10 steam generator tube inspection, no indications exceeding the structural integrity limits for either axial or circumferential degradation (i.e., burst integrity $\geq$ 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-11 for the degradation mechanisms observed at EOC-10.

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 1RF10. 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 ($\geq$ 20% TW) of thinning, pitting, wear (excluding loose part wear), or impingement and previous indications that display an average growth rate $\geq$ 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 ($\geq$ 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
- Axial PWSCC at the hot leg TTS expansion transition

Degradation Structural Limits

The CPSES 1RF10 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 1RF10 Initial Inspection Plan

The CPSES 1RF10 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 1RF10 initial inspection plan included;

1) 100% full length bobbin examination in Rows 3 and greater in all 4 SGs, 100% bobbin inspection in the hot and cold leg straight sections of Rows 1 and 2
2) 100% Hot Leg top of tubesheet (TTS) +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 10 U-bend mid-range examination in all 4 SGs
5) 20% Row 11 through Row 22 U-bend mid-range examination in all 4 SGs
6) Rotating probe examination of mix 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 bobbin coil indications for flaw confirmation and characterization (special interest).
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% Cold Leg top of tubesheet (TTS) +Pt examination in all 4 SGs
13) 25% +Pt exam of expanded cold leg baffles
14) 100% +Pt inspection of TIG sleeves
15) 100% +Pt inspection of tube in tubesheet at elevation of Alloy 800 sleeve hardroll joint
16) Secondary side FOSAR
17) Tube plug visual inspection

In addition, all deplugged tubes to be returned to service were subject to the same planned requirements listed above for tubes in service at EOC-10.

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 1RF09 outage in September 2002.

3.1 1RF10 Identified Degradation Mechanisms

Indications suggestive of the following degradation mechanisms were detected in the CPSES 1RF10 inspection:

- Axial ODSCC at TSP intersections
- Axial ODSCC at the Hot Leg TTS expansion transition
- Circumferential ODSCC at the Hot Leg TTS expansion transition
- Axial PWSCC at the Hot Leg TTS expansion transition
- Circumferential PWSCC at the Hot Leg TTS expansion transition
- Oblique 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, and >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 1RF10 were nearly identical to 1RF09, both in total number of indications and observed bobbin amplitude. Only 1 indication was reported in a previously active tube had bobbin amplitude greater than 1 volt. This indication, in SG 4, was confirmed by +Pt and plugged.

Table 1 presents a summary of the number of repairable tubes due to degradation in each SG and identifies the mechanism that necessitated the repair. Table 2 presents a summary of tubes repaired for non-degradation mechanisms (i.e., data quality or collapsed sleeves) as well as summary data for tubes permitted to remain in service by application of the voltage based alternate repair criteria per GL 95-05, and F*.

Based on the observation of oblique PWSCC in Row 10 in SGs 1 and 2, the U-bend inspection program was expanded to include 100% of Rows 11 through 21 in all SGs. Indications were observed in Row 13 tubes in SGs 3 (1 tube) and 4 (3 tubes), however, no further expansion of the inspection scope was required as this row was bounded by the critical area redefinition.

The U-bend inspection scope for dents at AVBs was expanded to include all dings within + 1.00" of the AVB. This expansion was necessitated based on observation of a ding ODSCC detected by +Pt at approximately 0.6" from the AVB. A DNI report was not noted for this tube however, close scrutiny of the signal indicates that the signal was present.

A C-3 condition was reported for all SGs due to the detection of >45 indications of degradation at the top of tubesheet location. The 1RF10 base scope inspection program included a 20% sample of the cold leg top of tubesheet expansion transitions, thus the requirement of Section 3.4.1 of the EPRI SG Exam Guideline Revision 6 was satisfied. The cold leg top of tubesheet expansion program was expanded an additional 20% in SG1 based on the observation of a volumetric signal in tube R4 C91. No additional degradation was reported. Upon further review, this indication was judged to be a conservative overcall.

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. SVI calls by RPC not associated with loose parts were traced to the first inservice inspection of the SGs. These indications were conservatively repaired at 1RF10. All loose part wear signals were conservatively repaired.

Additionally, permeability variations were reported based on bobbin or RPC amplitude > 1 volt. Prior to the 1RF10 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 9 tubes; 1 in SG1, 0 in SG2, 5 in SG 3, and 3 in SG4. Additionally, several tubes were conservatively repaired due to dent/ding restrictions that prevented acceptable eddy current data from being collected. One tube in SG1, 1 tube in SG2, and 2 tubes in SG3 were plugged for this reason. Finally, one tube in SG2 was plugged due to a large horizontal noise component that extended for essentially the entire length of tube.

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 1RF10 Tube Repair Statistics Based on Observed Degradation (Values do not reflect sleeve installation in all SGs)

Degradation Mode	HL sludge pile (> 1" above TTS)	HL TTS Exp. Transition	R3 and up U-bend	Hot Leg TSP	Freespan (no ding)	Straight Leg (ding)	U-bend (ding)	Baffle Plate	Cold Leg TTS		Total
SG 1											
Axial ODSCC	0	4	0	0	1	1	1	0	0		7
Axial PWSCC	0	0	0	0	0	0	0	0	0		0
Circ. ODSCC	0	45	0	0	0	0	0	0	0		45
Circ. PWSCC	0	0	1	0	0	0	0	0	0		1
Wear	0	1	0	0	0	0	0	0	0		1
Volumetric	0	1	0	0	2	0	0	0	1		4
Sub Total	0	51	1	0	3	1	1	0	1		57 (1)
SG 2											
Axial ODSCC	0	1	0	0	1	3	3	0	0		8
Axial PWSCC	0	1	0	0	0	0	0	0	0		1
Circ. ODSCC	0	84	0	0	0	0	0	0	0		84
Circ. PWSCC	0	1	2	0	0	0	0	0	0		3
Wear	0	1	0	0	0	0	0	1	0		2
Volumetric	0	0	0	0	0	0	0	1	0		1
Sub Total	0	88	2	0	1	3	3	2	0		99
SG 3											
Axial ODSCC	0	1	0	0	1	0	3	0	0		5
Axial PWSCC	0	0	0	0	0	0	0	0	0		0
Circ. ODSCC	0	83	0	0	0	0	0	0	0		83
Circ. PWSCC	0	0	2	0	0	0	0	0	0		2
Wear	0	1	0	0	0	0	0	0	0		1
Volumetric	0	0	0	0	0	0	0	1	0		1
Sub Total	0	85	2	0	1	0	3	1	0		92
SG 4											
Axial ODSCC	0	1	0	1	1	0	0	0	0		3
Axial PWSCC	0	1	0	0	0	0	0	0	0		1
Circ. ODSCC	0	77	0	0	0	0	0	0	0		77
Circ. PWSCC	0	1	3	0	0	0	0	0	0		4
Wear	0	0	0	0	0	0	0	0	0		0
Volumetric	0	0	0	0	3	0	0	8	0		11
Sub Total	0	80	3	1	4	0	0	8	0		96
Overall Total	0	304	8	1	9	4	7	11	1		344

Notes for Table 1:
(1): Includes one tube plugged with U-bend circ PWSCC and freespan volumetric
(2): Volumetric indications located at cold leg baffles are due to foreign object wear.

Table 2
Summary of Preventively Repaired Tubes, Collapsed Sleeves, and Tube Permitted to Remain in Service by Application of ARCs:
CPSES 1RF10, April 2004
Values Apply to 1RF10 Inspection Only

SG	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	2	32	2	34
2	16	29	1	30
3	34	26	1	27
4	23 (1)	198	2	200
Total	75	285	6	291

(1): Includes one tube preventively plugged due to a 0.98 volt DSI at H5.

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.

- Axial ODSCC in the freespan
- Axial ODSCC in freespan dings
- Axial PWSCC at the hot leg top of tubesheet expansion transition
- Circumferential ODSCC at hot leg top of tubesheet expansion transition
- Axial ODSCC at hot leg top of tubesheet expansion transition
- Axial ODSCC at hot leg TSP intersections

4.1.1 Hot Leg TTS Circumferential Flaw ODSCC Condition Monitoring Evaluation

Structural integrity of circumferential indications at the TTS is defined by EPRI TR-107197, "Depth Based Structural Analysis Methods for SG Circumferential Indications". The controlling parameter with regard to structural integrity of circumferential indications is the percent degraded area, or PDA. The PDA represents the percentage of degraded cross sectional area of the tube. 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 56%. 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 29.9%. An evaluation of burst pressure of a 29.9% PDA circ ODSCC indication was performed using a Monte Carlo simulation that included relational error, NDE error, and material property variation. At the upper 90% probability, 50% confidence, the predicted burst pressure is 6928 psi.

For leak test screening, the first screen is maximum voltage $\geq$ 1.00 volts 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 1RF10 was 0.43 volts, which is bounded by the 1RF09 maximum amplitude of 0.56 volts. 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 recent 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 indications reported at 1RF10 satisfied the NEI 97-06 structural and leakage integrity performance criteria.

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 considered valid for evaluating tube integrity. However, 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 1RF10 was 0.43 volts. Using the lower 90% probability, 50% confidence line relating +Pt amplitude to burst pressure, the estimated burst pressure of this indication is 7400 psi. Using the lower 90% probability, 50% confidence line relating +Pt amplitude to PDA, the estimated PDA of this indication is [ ]^{a,c}. At the lower 90% probability, 50% confidence, the calculated burst pressure for a PDA of [ ]^{a,c} including material property variance and burst relation uncertainty is 5451psi. The quick screening NDE adjusted PDA for this indication is only 37% due to the limited arc length of 167° and maximum depth of 40%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 1RF08, 1RF09, and 1RF10 outages. This plot shows that the 1RF10 amplitude distribution is bounded by the 1RF09 amplitude distribution. For the 1RF10 outage, a total of 289 tubes were reported with circumferential ODSCC at the hot leg top of tubesheet expansion transition. The breakdown of affected tubes per SG is; 45 in SG1, 84 in SG2, 83 in SG3, and 77 in SG4. This is a significant reduction from the number of 667 reported at the 1RF09 inspection. Figure 3 presents a cumulative probability distribution plot comparing calculated PDAs for the 1RF10 and 1RF09 outages.

4.1.2 Hot Leg TTS Axial Flaw 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 $\geq$ 0.43" and the maximum depth screening value is $\geq$ 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 $\geq$ 3.07 volts for ID indications, $\geq$1.0 volts for OD indications; the second screen is max depth $\geq$ 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 $\geq$ 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 1RF10 inspection, 7 tubes (8 indications) were reported with axial ODSCC indications at the tubesheet. The largest +Pt amplitude was 0.38 volts. The longest reported axial ODSCC flaw length was 0.28", which is well less than the 100%TW critical flaw length of 0.43", reduced for length measurement uncertainty. Therefore, structural integrity of these indications is provided. Maximum reported depth of these indications was well below the in situ screening limit, and therefore, leakage integrity is also established. The +Pt depth profiles for those indications profiled suggest very shallow depths. As a conservative measure, the maximum depth versus +Pt amplitude correlation identified in Reference 2 was used to evaluate the flaw depths. The upper 90% probability, 50% confidence relation was used. The depth from amplitude for the largest amplitude flaw ([ ]^{a,c}) is significantly deeper than the depth estimate from phase (21%TW). As the depth estimate from phase is considered unreliable for this amplitude, the maximum depth from amplitude will be used to assess structural integrity. No profile was performed for this flaw. The average depth will be estimated based on a relation of maximum depth to average depth for pulled tubes with axial degradation. This relation indicates that the maximum to average depth ratio is 1.25. The flaw length estimate will be increased by 0.06", or roughly allowing for one additional scan line of flawed length above and below the indicated length. Thus, the modeled flaw has an average depth of [ ]^{a,c} and total length of 0.24". At the lower 90% probability, 50% confidence, the predicted burst pressure is 6744 psi.

Therefore, as the maximum flaw length was less than the 100%TW critical flaw length, and the maximum axial ODSCC depth is significantly less than depth associated with breakthrough during a postulated steam line break of 95%TW, the NEI 97-06 performance criteria are satisfied.

Additionally, the axial ODSCC indications at the tubesheet were reviewed by the Westinghouse Corporate Level III designate, and it was judged that 3 of the 7 tubes with reported indications are false calls, suggesting that the total number of affected tubes is likely 4, not 7. Of the remaining 4, three were located at the expansion transition, with a maximum length of 0.18". The final indication was noted at 18" below the top of tubesheet in a WEXTEX expanded tube. The validity of this indication must also be challenged based on the fact that 18" of tube expansion exist above the location of the signal. It is highly unlikely that corrosive product could be located at this location, however, the response of the +Pt coil, the inspection of record, has to be used. This signal also exhibits characteristics not typical of other axial ODSCC indications. For example, the circumferential affected length is approximately 80° arc. Typical circumferential affected arc lengths for axial ODSCC indications verified by tube pull are approximately 40° arc based on NDE. It is judged that this signal is most likely an artifact of tube installation. These tubes were conservatively repaired by plugging or sleeving.

4.1.3 Freespan Axial ODSCC Condition Monitoring Evaluation

The bobbin analysis program conducted at 1RF10 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 4 tubes reported with freespan axial ODSCC. The confirmation rate of DFI signals was extremely low. Table 3 presents a summary of the total number of DFI, NQI, and SAI calls reported in each SG. In SG1, a total of 91 DFI or NQI reports on 71 tubes were reported with only 1 tube confirmed to contain freespan ODSCC. The number of DFI reports was substantially higher in the other SGs, with only one confirmed tube with freespan ODSCC in each SG. The flaw characteristics for these indications was similar to those reported at the 1RF09 outage in that multiple initiation sites were noted over substantial tube axial lengths. All of these indications were aligned along a common azimuth. Evaluation of the 1RF09 pulled tube (0.20 volts +Pt maximum) showed that the amplitude based correlation of +Pt amplitude to maximum depth was within 2%TW of the actual maximum depth of the burst flaw ([ ]^{a,c}). The +Pt phase depth estimates produced uncharacteristically large depths at the tails of the indication. At the largest +Pt amplitudes the phase depth reports were shown to be conservative. A correlation of the 300 kHz bobbin amplitude to maximum depth was developed in Reference 2. Using this relation, the estimated maximum depth of this indication is [ ]^{a,c} at the upper 90% probability, 50% confidence. The +Pt amplitude of this indication was small; the largest amplitude signal was 0.21 volts. It should be noted that a 0.80 volt by +Pt, 2.94" long freespan axial ODSCC indication was reported at 1RF09 that was in situ pressure tested with no leakage at SLB conditions and no burst at proof test pressure.

Table 3						
	DFI Calls		NQI Calls		+PT Confirmed Calls	
SG	Indications	Tubes	Indications	Tubes	Indications	Tubes
1	88	68	3	3	1	1
2	191	153	0	0	1	1
3	168	135	0	0	2	1
4	132	94	3	3	6	1

At 1RF10 R7 C12 in SG3 was conservatively selected for pressure testing as the phase based depths showed near 100%TW depths for significant lengths and this indication had the largest +Pt amplitude of the 1RF10 freespan axial ODSCC indications. It should be noted that the maximum amplitude of this indication, 0.20 volts by +Pt, is well below the EPRI In Situ Guideline Rev 2 screening limit value of 0.50 volts by +Pt. Using the correlation of +Pt amplitude to maximum depth, the maximum depth of this indication is estimated to be [ ]^{a,c} at the upper 90% probability, 50% confidence. Using the correlation of the 300 kHz bobbin amplitude to maximum depth results in maximum depths of [ ]^{a,c} at the upper 90% probability, 50% confidence. Two separate flaw locations were noted for this tube, 0.65" and 0.53" in length based on profiling. The indications were in close proximity with a non-degraded separation distance of approximately 0.6" between the two flaws. This tube was in situ pressure tested with no leakage at 2841 psi, and no burst reported at 4266 psi. Burst capability of R7 C12 was estimated using the upper 90% probability, 50% confidence +Pt amplitude profile. The actual material properties of this tube, reduced for operating temperature effects were also used. The simulation then only included burst relational error. The total flaw length was also increased by 0.06". The predicted burst capability at 90% probability, 50% confidence is 5128 psi, well above the 3 times normal operating pressure differential of 3855 psi. The bobbin based depths were also used to estimate burst pressure. For this case, the maximum bobbin amplitude based depth of [ ]^{a,c} was applied to the entire flaw length of 1.79". It should be noted that the +Pt depth profile indicates a return to null between the two separate signals. The total length encompassing both flaws was conservatively used. At 90% probability, 50% confidence, the predicted burst capability is 5717 psi for the total assumed flawed length. Figure 4 presents the as-reported phase and amplitude based depth profile with +Pt voltage. Figure 4 also includes the bobbin based integrity profile using the maximum depth from bobbin analysis applied to the total flaw length. As seen from Figure 4, the phase based depth profile is inconsistent with the amplitude based profile as well as reported voltage.

The phase based depth profile for this indication produced uncharacteristic (i.e., near 100%TW phase based depth for signal responses <0.10 volt by +Pt) depths due to a horizontal noise component present in the tube. This horizontal noise component affected the phase response such that the indicated depths approached 100%TW for substantial lengths. The phase based depth reports are not meaningful in light of the in situ pressure test results and indicated +Pt amplitude.

Table 4 presents a summary of the freespan axial ODSCC NDE parameters.

Table 4							
			+Pt		300 kHz Bobbin		Bobbin Signal Observable in 2002 Data
SG	Tube	Elevation	Volts	Length	Volts	Phase	
1	R7 C63	C10 +13.44"	0.16	0.27"	0.24	67°	Yes
2	R12 C78	H3 +7.03"	0.12	0.57"	0.19	98°	Yes
		H3 +7.79"	0.07	2.05"			
		H3 +10.93"	0.05		0.15	87°	Yes
		H3 +13.27"	0.06	0.12"	0.14	97°	Yes
		H3 +17.54"	0.06	0.12"			
		H3 +19.47"	0.05	0.12"			
		H3 +25.68"	0.04	0.12"			
3	R7 C12	H5 +8.71"	0.20	0.53"	0.08	22°	
		H5 +9.9"	0.18	0.65"	0.13	112°	Yes
4	R15 C82	C7 +16.2"	0.11	0.55"	0.13	86°	Yes
		C7 +17.6"	0.06	0.48"	0.08	101°	

The only other freespan axial ODSCC with substantial lengths was reported in SG2, R12 C78. The maximum +Pt amplitude for this flaw was 0.12 volts, while the corresponding bobbin amplitude in 300 kHz was 0.19 volts. The total affected length exceeded several inches, however, the flaw reports over this length were sporadic (i.e., a phase response that produced measurable depths). The +Pt amplitude over the remainder of the flaw varied from 0.04 to 0.07 volts. The corresponding bobbin amplitudes in 300 kHz ranged from 0.08 to 0.15 volts. The phase based depths for this indication are considered unreliable. As with R7 C12, a horizontal noise component is affecting the phase response, producing uncharacteristic depths for the amplitudes reported. The depth profile for R12 C78 includes 0.03 volt reports with depths ranging from 0%TW to 100%TW. The integrity evaluation of this flaw was performed by applying the bobbin based maximum depth of 56%TW at the upper 90% probability, 50% confidence, to the entire assumed length of the flaw, 2.77". This assumed flaw length included the lower two indications combined as one even though a return to null for approximately 0.3" is noted between the two indications. This is considered conservative since no allowance is included for average depth effects. Using the actual material properties for tube R12 C78, SG2, reduced for operating temperature effects, the predicted burst pressure at the lower 90% probability, 50% confidence is 5285 psi. Based on the limited number of reportable depth hits within the 2" long flaw section, assuming that the flaw maintains a modest depth of 56%TW over the entire length is judged conservative.

Since the phase reports are considered unreliable, the burst capability of this flaw was also evaluated using the upper 90% probability, 50% confidence relation of +Pt amplitude to flaw maximum depth. This profile was then input to a Monte Carlo simulation that included burst relational error only. As the input flaw depths were already adjusted to the upper 90% probability, 50% confidence, and material properties for this tube are known, simulation of NDE errors and material property variance were not considered. The predicted burst pressure at the lower 90% probability, 50% confidence is 6581 psi. Figure 5 presents the profile of R12 C78 including the same information as in Figure 4 for R7 C12.

4.1.4 TSP Axial ODSCC Condition Monitoring Evaluation

Only 1 indication exceeding 1.0 volt was reported by bobbin (R37 C81 at H5 in SG 4). This indication was confirmed by +Pt (0.55 volts, 94° phase angle) and repaired by plugging. 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 5. This data reflects DSI totals for tubes in service at EOC-10.

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 -0.004 volts, or essential zero average voltage growth. The largest single absolute voltage growth was 0.40 volts for Cycle 10, or 0.32 volts per EFPY.

Mix residual signals with bobbin voltage >1.5 volts were RPC inspected. No mix 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 1RF10 TSP ODSCC bobbin amplitudes are essentially equal to the 1RF09 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 5 (EPRI NP-7480-L, "Steam Generator Tubing Outside Diameter Stress Corrosion at Tube Support Plates Database for Alternate Repair Limits) relation of burst pressure to bobbin amplitude, the lower 95% confidence burst pressure of a 1.06 volt indication is >5000 psi.

Table 5
1RF10 TSP ODSCC Degradation Summary

	SG 1	SG 2	SG 3	SG 4
Number Ind.	32	29	26	186
Number ≥ 1 volt	0	0	0	1
Average 1RF10 Voltage	0.25 volts	0.37 volts	0.43 volts	0.41 volts
Max 1RF10 Voltage	0.55	0.80	0.85	1.09
Average Absolute Voltage Growth Cycle 10 (per EFPY)	-0.01 volts	-0.02 volts	0.00 volts	0.00 volts
Average % Voltage Growth Cycle 10 (per EFPY)	-0.05%	-0.03%	0.00%	0.00%

DSI signals < 1V by bobbin were returned to service in deplugged and sleeved tubes. The totals are 1 in SG2 and 13 in SG4. The largest DSI signal returned to service in a deplugged tube was 0.74 volts.

4.1.5 Hot Leg TTS Axial PWSCC Condition Monitoring Evaluation

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

During the 1RF10 inspection, 2 axial PWSCC indications were reported at the expansion transition, one in SG2 (R31 C17), one in SG4 (R31 C72). The most significant of these was the indication reported in SG4. The maximum +Pt amplitude was 1.32 volt by +Pt with a length from profiling of 0.17". The maximum reported depth of 90%TW occurred at the tail, with associated amplitude of 0.41 volts. At the maximum amplitude response, the depth from phase was reported as 59%TW. The most reliable depth from phase of 59%TW is similar to the amplitude based depth of [ ]^{a,c}. As the flaw length with NDE uncertainty considered is approximately 0.30", structural integrity is established as the total flaw length of 0.30" is within the 100%TW critical flaw length of 0.43" reduced for uncertainty. Therefore, structural and leakage integrity commensurate with the performance criteria of NEI 97-06 is verified. The integrity evaluation of R31 C72 was performed using a total flaw length of 0.30" with an average depth of 50%. The average depth determined by the depth profile was approximately 30%. Using the actual tube material properties adjusted for operating temperature, the lower 90% probability, 50% confidence burst pressure is 6308 psi.

The second indication (R31 C17) had a +Pt amplitude of 1.04 volts with a length from profiling of 0.14". The maximum reported depth of 70%TW is similar to the amplitude based depth of [ ]^{a,c}. This indication was located at 5.04" below the top of tubesheet and was left in service by application of the F* alternate repair criterion.

During the 1RF09 inspection, two axial PWSCC indications with amplitudes of 1.44 volts and 0.75 volts and lengths of 0.16" each were reported, while at the 1RF08 inspection, one axial PWSCC indication with a flaw amplitude of 0.63 volts and length of 0.13" was reported. Therefore, the observed axial PWSCC indication responses for the past 3 outages do not show an increase in the flaw severity, suggesting no change in the associated growth or initiation functions.

4.1.6 Axial ODSCC at Freespan Dings Condition Monitoring Evaluation

Axial ODSCC at freespan dings was detected in the final three outages prior to replacement at freespan dings in two units with Model E2 SGs. As the CPSES Unit 1 SGs and the Model E2 SG share similar secondary side structure designs, the potential exists that similar indications could be reported in a Model D4 SG. Ding ODSCC was first reported at Comanche Peak Unit 1 at the 1RF08 inspection with one reported confirmed DNI signal. At 1RF09, 16 tubes were reported with ding ODSCC. At 1RF10, 11 tubes were reported with ding ODSCC indications. At the 1RF09 inspection, the history review criteria looking for change in bobbin signals was performed by comparing the current outage inspection data against the first ISI data for that tube. Thus, the number of DNI signals at 1RF09 was substantially increased from 1RF08 as confirmed DNIs often do not exhibit significant change from one inspection to the next.

Two of the 1RF10 ding ODSCC indications were reported at cold leg U-bend tangent points. It is believed that the dings on these tubes were initiated by overinsertion of the tube during tube installation, resulting in contact between the tube intrados and TSP. This was confirmed as the +Pt examination trace indicates that the indication was located at the intrados by using the AVB position and orientation. All ding signals >5V at tangents were subsequently examined with +Pt; no additional indications were reported. Two other 1RF10 ding ODSCC indications were found in >5V freespan dings not associated with tangents. As the bobbin ding ODSCC technique is qualified for dings ≤5V, no bobbin call is expected for these locations, however, one of these did produce a reportable call from the bobbin coil. The ding amplitude was 5.8 volts. These locations were inspected by +Pt as part of the >5V ding program, which included 100% of all freespan dings >5V. One ding ODSCC report was not reported from the bobbin coil due to its proximity to an AVB. The ding was reported, however, the flaw signal could not reliably be identified. All ding signals within 1" on either side of the AVB were subsequently examined with the +Pt coil. One ding ODSCC signal was reported at a dent at an AVB. The base inspection scope included all dents at AVBs, regardless of the dent voltage. The remaining 5 ding ODSCC indications were reported by bobbin as DNI or DFI signals in <5V dings.

The most significant of the ding flaws (R27 C51) was in situ pressure tested. No leakage or burst occurred in a full tube test mode at 4266 psi. Comparison of the pre and post in situ +Pt examination data for the 1RF09 ding flaws indicates that the +Pt amplitude was essentially unchanged, as well as the +Pt phase angle response (Reference 2). The dings flaws reported at 1RF10 all had ID phase angles or OD phase angles suggesting significant depth. This phenomenon has been evidenced both at other plants and in the laboratory program. 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 1RF10 ding axial ODSCC indicates that the maximum reported ding ODSCC length was 0.77". Structural and leakage integrity of this indication were verified by in situ test. The remaining indications had axial length reports ranging from 0.14" to 0.35". The integrity evaluation of R27 C51 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. It should be noted that that the total length of 0.77" includes all potential length with some measure of +Pt lissajous distortion. Using the actual tube material properties adjusted for temperature and average depth of 60%TW applied to the total flaw length, the predicted burst pressure at the lower 90% probability, 50% confidence is 5671 psi.

In summary, structural and leakage performance criteria are satisfied at EOC-10 conditions for axial ODSCC at freespan dings.

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.

- 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
- Oblique PWSCC in Row 3 and higher U-bends
- Axial PWSCC in Row 3 and higher U-bends
- Freespan Volumetric degradation
- Axial and Circ PWSCC within expanded tubesheet

4.2.1 Freespan Volumetric Degradation

Five 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 2002 bobbin data showed a similar signal to the 1RF10 bobbin data. Three of the five were reviewed back to the 1996 inspection with essentially no change in the bobbin signal. 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 resultant 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 largest axial length report for the freespan volumetrics was coincident with the largest maximum depth of 21%TW. Past evaluations have shown the +Pt coil universally overestimates the axial and circumferential involvement of volumetric indications. The true axial length is estimated to be no greater than 0.20".

Therefore, the structural and leakage performance criteria of NEI 97-06 are satisfied.

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 1RF10. No degradation was observed.

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, Non-expanded Preheater Baffles, and Due to Loose Parts/Foreign Objects

Tube wear due to foreign object interaction was reported in all SGs. The tubes with wear indications were located at the top of tubesheet and in upper bundle regions. One tube each in SGs 1, 2, and 3 were judged to contain volumetric signals due to foreign object interaction at the top of tubesheet. Seven tubes (total) were reported in SGs 2, 3, and 4 with volumetric indications atop cold leg baffles due to foreign object interaction. 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 35%TW, 0.32" axial length, and was noted atop C9. The longest indication was reported at 0.35". The tubes with foreign object wear at the top of tubesheet were bounded in severity by the indications located atop C9.

The wear mechanisms observed by bobbin coil generally had small bobbin amplitudes, i.e., less than 1.0 volt in the primary mix channel. As a comparison, the volumetric wall loss associated with the 40% depth, 0.187" diameter flat bottom hole of the ASME standard is approximately 3 volts. Based on flaw geometry characterization with RPC and relation to laboratory wear scars, the axial extents of the wear indications were about 0.21" max, with a maximum circumferential involvement of about 50 degrees. The uniform thinning burst model of NUREG-0718 can be used to estimate the burst pressure. At up to 83% TW degradation for a 0.26" axial involvement, the predicted 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 53%TW. At the approximated maximum depth of 53%, a 0.21" axial length uniform thinning flaw with LTL material properties has a predicted burst pressure of 7667 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 1RF09 repairable indication was reported at 40%TW. Only one repairable baffle wear signal was reported at 1RF10. The reported depth was 44%TW with a growth of 6%TW per cycle, 4.72% per EFPY. If the sizing uncertainty for wear per ETSS 96004.3 is applied, the NDE adjusted depth of this indication is 58%TW, which is below the structural limit of 68%TW for an assumed ¾" wear axial length. Evaluation of the +Pt data for a sample of baffle wear signals indicates that the axial lengths are less than ¾" in length. If 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 5108 psi.

The overall baffle wear growth for all SGs is 0.43%TW per EFPY average, 3.68%TW per EFPY at the upper 90% probability, 50% confidence. The singular largest baffle wear growth was 8%TW per cycle, 6.3% per EFPY. 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 34%TW. This location was also the largest AVB wear depth at 1RF09 at 33%TW. The largest reported AVB wear growth reported was 2% TW. As only 7 AVB wear indications were reported with corresponding depth values in 1RF09, a statistical growth evaluation can not be performed. Instead, a bounding growth of 10% will be used in the operational assessment.

Two tubes were judged to contain volumetric signals due to foreign object wear at the hot leg top of tubesheet. No loose parts were associated with these signals, however, a review of the 1RF09 +Pt data indicates no change in the signal response. The extent of these signals were bounded by other locations with regard to the integrity evaluation.

In summary, structural and leakage performance criteria are satisfied at EOC-10 conditions for preheater baffle wear and AVB wear.

4.2.5 Oblique PWSCC at Row 3 and Higher U-bends

A total of 8 tubes were reported, 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" +Pt amplitude is then 1.84 volts. Using a correlation of +Pt amplitude to maximum depth for pulled tubes and laboratory doped steam samples, the estimated maximum depth from amplitude for 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}.

The distribution of +Pt voltages indicates that 95th percentile value occurs within the 1 to 1.25 volts bin. Thus, the tube containing the 2.2 volt indication that was in situ pressure tested had substantially larger amplitude than the remainder of the tubes with indications.

As with the previously reported indications at other units with this mechanism, the affected arc lengths are short, approximately 30 to 50° 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°.

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 response for the 0.560" +Pt coil.

Table 6 Summary of Oblique PWSCC at Row 3 and Higher U-bends				
SG	Tube	Elevation of Max Amplitude	Number of Indications	Max +Pt Amplitude
1	R10 C105	H11 +8.34"	11	2.2
2	R4 C37	H11 +18.73"	3	0.97
2	R10 C10	H11 +14.94"	1	0.19
3	R5 C52	H11 +22.46"	10	1.12
3	R13 C15	H11 +7.19"	2	0.41
4	R13 C71	AV1 +10.72"	1	0.20
4	R13 C90	AV1 +3.9"	1	0.38
4	R13 C95	H11 +14.21"	1	0.66

4.2.6 Axial PWSCC at Row 3 and higher U-bends

No tubes were reported with axial PWSCC at Row 3 and higher U-bends.

4.2.7 Axial and Circumferential PWSCC within the expanded tubesheet

As noted in Section 4.1.5, one axial PWSCC indication was reported at approximately 5" below he top of tubesheet and permitted to remain in service by application of the F* alternate repair criterion.

Two tubes were reported with circumferential PWSCC at the hot leg TTS expansion transition. The limiting indication was reported in SG4 with a 1.27 volt +Pt amplitude. The measured arc length was 106°, with a near 100%TW depth from phase report over the entire reportable length. This indication was in situ pressure tested with no leakage at SLB conditions and no burst at the structural performance criterion limit pressure differential. As no leakage was reported from the test, the reported depth from phase is likely not accurate. Geometry changes associated with the expansion transition and the influence of the carbon steel upon signal phase response can affect the phase rotation. Based on a correlation of +Pt amplitude to indication maximum depth, the depth of this indication is estimated at approximately 60%TW. The reported arc length is well below the 100%TW flaw critical arc length for circumferential PWSCC mechanisms of 203°, with NDE uncertainty. The second indication was substantially smaller than the limiting indication. The +Pt amplitude was 0.28 volts, with an indicated arc length of 23° arc. Thus, the circumferential PWSCC observed at 1RF10 satisfied the structural and leakage integrity performance criteria.

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 1RF10 are;

- Axial PWSCC at expanded cold leg baffles
- Axial PWSCC at freespan dings
- SCC degradation of TIG sleeves
- SCC degradation of the parent tube in TIG sleeve installations

A 20% +Pt sample of expanded cold leg baffles has been performed for several outages. No degradation of expanded baffles has been reported. A +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. No degradation of either the TIG sleeve or parent tube was reported.

4.4 Summary of Limiting Indications

Table 7 presents a summary of the limiting indications for the 1RF10 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 7 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 1RF10, any potential for SLB leakage at end of Cycle 10 conditions is judged to be negligible based on in situ pressure test results for the limiting indications and assessment of flaw maximum depth using the most appropriate depth evaluation technique.

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 1RF10 was 0.43. No leakage was reported for the 1RF06, 1RF07, 1RF08, or 1RF09 in situ testing campaigns.

The largest axial ODSCC flaw at the TTS had a +Pt amplitude of 0.38 volts, with a maximum depth of 21% TW as estimated from phase analysis, [ ]^{a,c} based on a correlation of +Pt amplitude to maximum depth at the upper 90% probability, 50% confidence. At such low amplitude, this flaw would not have contributed to leakage at SLB conditions. These depths are well below the depth level assumed to represent a potential for leakage at SLB conditions of 95%TW.

The largest axial PWSCC flaw at the TTS had a +Pt amplitude of 1.32 volts, but included contribution from two closely spaced axial flaws based on evaluation of the 80 mil high frequency coil. The maximum depth from the +Pt phase depth analysis is 59%TW for the largest amplitude signal. The depth from the +Pt amplitude correlation is [ ]^{a,c}, thus good agreement is shown between both depth evaluation methods for the axial PWSCC. These depths are well below the depth level assumed to represent a potential for leakage at SLB conditions of 95%TW. 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 TTS had a +Pt amplitude of 1.29 volts. This indication was in situ pressure tested with no leakage at SLB conditions and no burst at the proof pressure. 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 largest amplitude oblique PWSCC indication in a large radius U-bend was pressure tested in a full tube mode to 4266 psi with no leakage or burst reported. The change in signal amplitude in the post in situ exam was minimal. The amplitude based depth estimate of [ ]^{a,c} at the upper 90% probability, 50% confidence represents a more reasonable assessment of maximum depth than the phase based analysis, which indicates a maximum depth of 95%TW.

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

<u>In Situ Testing Summary:</u>

The in situ testing performed for the 1RF10 outage supports the conclusion that postulated SLB condition primary to secondary leakage will remain below 1 gpm for all SGs.

4.6 1RF10 Condition Monitoring Conclusion

Based on the CPSES 1RF10 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 1RF09 inspection.

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

5.0 DEGRADATION MECHANISM CLASSIFICATION FOR 1RF11

Based on the 1RF10 inspection results, the following mechanisms are considered active for the 1RF11 inspection per the ERPI Rev.6 ISI Guidelines:

- Circumferential ODSCC at hot leg TTS expansion transitions
- Axial ODSCC at hot leg TTS expansion transitions
- Axial PWSCC at hot leg TTS expansion transitions
- Circumferential PWSCC at hot leg TTS expansion transitions
- Axial ODSCC at hot leg TSP intersections
- Axial ODSCC at freespan dings

- Axial ODSCC in straight leg freespan section in the absence of dings
- Oblique PWSCC at Row 3 and higher U-bends

As depth sizing methods are not considered qualified for continued operation justification, all crack like indications are considered active mechanisms.

Based on the 1RF10 inspection results, the following mechanisms are considered non-active per the ERPI Rev.6 ISI Guidelines:

- Tube wear at nonexpanded preheater baffles
- Tube wear at AVB intersections
- Tube wear due to foreign objects/loose parts
- Freespan volumetric degradation

Based on accepted depth sizing techniques for preheater baffle wear and AVB wear, the reported growth statistics do not classify these mechanisms as active. The largest reported baffle or AVB wear growth for Cycle 10 was 8%TW per cycle, 6.3% per EFPY, however overall baffle wear growth statistics are consistent with Cycle 9. The foreign objects/loose parts wear observed could not be considered to be within the qualification scope of the available bobbin analysis techniques. Supplemental evaluations performed using rotating probes and sizing methodology of ETSS 21998.1 indicate a maximum depth of 53%TW. All foreign object/loose part wear indications had precursor signals in the 1RF09 history review. Freespan volumetric degradation assumed to be laps, were traced through history to the 1996 inspection with no apparent change in the signal response.

6.0 CYCLE 11 PRELIMINARY OPERATIONAL ASSESSMENT

Circumferential ODSCC at Hardroll Expansion Transition

Figure 2 shows that the cumulative probability distribution function for +Pt amplitude for 1RF10 is bounded by the 1RF09 distribution. As all 1RF09 and 1RF10 indications satisfied both structural and leakage integrity criteria, a similar result would be anticipated for EOC-11. Assuming the probability of detection for both the 1RF09 and 1RF10 outages were consistent, Figure 2 suggests that the growth and initiation function for Cycle 10 is reduced compared to Cycle 9. As no changes in the chemistry regime or operating temperature are anticipated for Cycle 11, the EOC-11 +Pt amplitude distribution is expected to be similar to that observed for 1RF10.

Axial ODSCC at Hardroll Expansion Transition

A total of 4 tubes are judged to contain signals indicative of axial ODSCC at the expanded tubesheet. The longest of these was 0.18" based on the +Pt depth profile. Maximum +Pt amplitudes for axial ODSCC at the expansion transition have remained essentially constant for the past two inspections. As no changes to the chemistry regime or operating temperature are anticipated for Cycle 11, the EOC-11 axial ODSCC indications are expected to be consistent with those reported at 1RF10. the number of affected tubes is equal for both 1RF09 and 1RF10, again suggesting that the growth and initiation functions remain constant.

Axial PWSCC at Hardroll Expansion Transition

Only two tubes were affected at both 1RF10 and 1RF09. 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.

Circumferential PWSCC at Hardroll Expansion Transition

Two tubes were reported with circumferential PWSCC at the hardroll expansion transition. The largest of these had a 1.29 volt +Pt response with a total affected arc of 106°. Review of the 1RF09 +Pt data for this tube indicates a 0.14 volt, 53° arc precursor signal. It is judged unlikely that the PWSCC growth and initiation function would increase to the point where indications below the detection threshold would grow to 100%TW conditions over arc lengths sufficient to challenge structural or leakage integrity.

Oblique PWSCC at Row 3 and higher U-bends

As no large scale inspection of the Row 3 to Row 10 U-bends had been performed in previous examinations, the observation of 8 tubes with oblique PWSCC at U-bends represents an inspection transient. 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 1RF11 is expected to be bounded by the 1RF10 results as 1RF10 was the first large scale inspection of this region.

Freespan Axial ODSCC

At both the 1RF09 and 1RF10 inspections, all freespan confirmed indications with >0.10 +Pt amplitude response were reported by bobbin. The associated depth with 0.10 +Pt volts is approximately [ ]^{a,c}. Thus, the bobbin coil detection capabilities remain high. Additionally, review of the 1RF09 bobbin data for the 1RF10 confirmed indications indicates that at least one 1RF10 signal had a corresponding signal response in the 1RF09 bobbin data for each tube, indicating the growth condition has not changed from Cycle 9 to Cycle 10.

TSP ODSCC

The bobbin amplitude distribution for 1RF10 is essentially equal to the 1RF09 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 tubes affected with ding ODSCC was reduced for 1RF10 compared to 1RF09, however the change in history review protocol at 1RF09 likely identified some number of ding ODSCC signals that had been present for some time. All of the ding ODSCC signals reported by bobbin had precursor signals in the 1RF09 data, and some had precursors present in the 1RF08 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.

AVB and Baffle Wear

AVB and baffle wear growth rates remain low. The single largest baffle wear growth for Cycle 10 was 8%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 2%TW for Cycle 10.

Conclusion

The preliminary evaluation of mechanism growth rates indicates that there is no apparent change in growth rates for Cycles 10 and 9. As eddy current detection conditions remain consistent, there is no basis to conclude that the observed indication severities at 1RF11 will vary significantly from that observed at 1RF10.

7.0 POTENTIAL NEW DEGRADATION MECHANISM ASSESSMENT

In all SGs, oblique PWSCC at Row 3 and higher U-bends was reported. This represents a new degradation mechanism for Comanche Peak Unit 1. This mechanism was identified as a relevant mechanism in the 1RF10 degradation assessment based on the observation of this mechanism at several plants since Spring 2003. As with the other plant experiences, the indications were short in circumferential extent and therefore do not represent a structural integrity challenge. The limiting indication was in situ pressure tested in a full tube mode with no leakage reported at 4266 psi.

Circumferential PWSCC was reported for the first time at the hardroll expansion transitions. This mechanism was fairly prevalent at other units with hardroll expanded tubes. The application of shot peening prior to operation was likely a contributor to the extended incubation period for this mechanism.

Partially collapsed TIG sleeves were observed in SGs 2, 3, and 4. Again, this mechanism is not new to the industry. Both laser welded sleeves and TIG welded sleeves have been affected in the industry. Past evaluation has indicated that the welds remain leaktight in the event of a sleeve collapse. The hardroll joint is sufficiently robust that the pressures applied within the tube to sleeve crevice will not affect the integrity of the 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 mechanisms observed at Comanche Peak Unit 1 during the 1RF10 outage have been previously reported in the industry, and none represent a structural or leakage integrity challenge.

8.0 COMANCHE PEAK 1 IN SITU PRESSURE TESTING HISTORY

Table 8 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 changed over at least 4 inspections.

9.0 REFERENCES

1. SG-SGDA-04-3 Rev 1, "Comanche Peak Steam Electric Station Unit 1 Steam Generator Degradation Assessment 1RF10 Refueling Outage", April 2004 (Westinghouse Proprietary)

2. SG-SGDA-02-43, "Comanche Peak Steam Electric Station 1RF09 Condition Monitoring Report and Preliminary Cycle 10 Operational Assessment", October 2002 (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 (WPT-16550), "Evaluation of Collapsed TIG Welded Sleeves at Comanche Peak Unit 1," April 2004

Table 7 Summary of Limiting Indications at 1RF10 at Lower 90% Probability, 50% Confidence Evaluation						
Mechanism	Tube	Max Length	Max Depth	Avg. Depth	Calculated Burst Pressure	SLB Leakage gpm
Circ ODSCC at hot leg TTS	SG3 R2 C94	N/A	N/A	[ ]a,c (1)	5451 psi	0
Axial ODSCC at TTS	SG3 R30 C80	0.18"	[ ]a,c (2)	[ ]a,c	6744 psi	0
Freespan Axial ODSCC	SG3 R7 C12	1.79"	[ ]a,c (3)	[ ]a,c	5128 psi	0
Axial ODSCC in Dings	SG1 R27 C51	0.77"	<75% (4)	<60%	5671 psi	0
Axial PWSCC at TTS	SG4 R31 C72	0.17"	62%	50%	6308 psi	0
Axial ODSCC at TSP	SG4 R37 C81	N/A	N/A	N/A	>5000 psi (5)	0.002 (6)
Baffle Wear	SG2 R48 C40	<0.75"	44%	<44%	>5108 psi	0
AVB Wear	SG3 R43 C59	0.288"	34%	<34%	>7230 psi	0

1): PDA is conservatively based on maximum +Pt flaw amplitude. This methodology results in the lowest predicted burst pressure.
2): Maximum depth is based on +Pt flaw amplitude. That assessment of depth results in the most conservative depth estimate.
3): Based on +Pt amplitude to maximum depth correlation.
4): Based on comparative +Pt response for laboratory samples suggesting <70%TW. Max depth of 75%TW used for integrity evaluation.
5): For the lower 95% confidence interval correlation from Addendum 5 to the TSP ODSCC database
6): Calculated value

Table 8 Comanche Peak Unit 1 In Situ Pressure Testing History										
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°	~95%	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"	1.79"	~50%	0.20	2841	4266	No	No
R11 C91	4	Circ PWSCC	HTS	106°	~95%	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

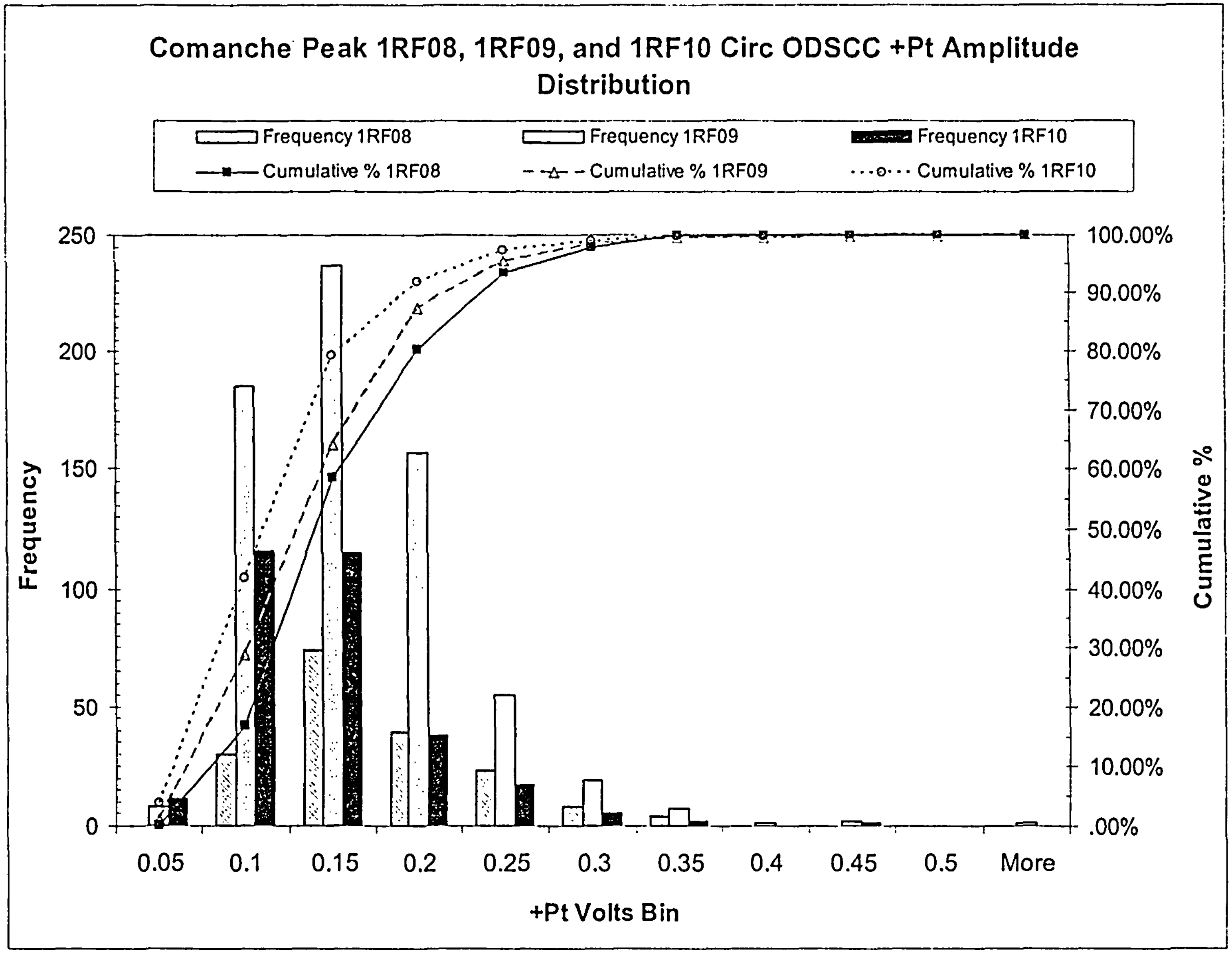
Comanche Peak 1RF08, 1RF09, and 1RF10 Circ ODSCC +Pt Amplitude Distribution
Frequency 1RF08
Frequency 1RF09
Frequency 1RF10
Cumulative % 1RF08
Cumulative % 1RF09
Cumulative % 1RF10
Frequency
250
200
150
100
50
0
Cumulative %
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
.00%
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
More
+Pt Volts Bin

Figure 3

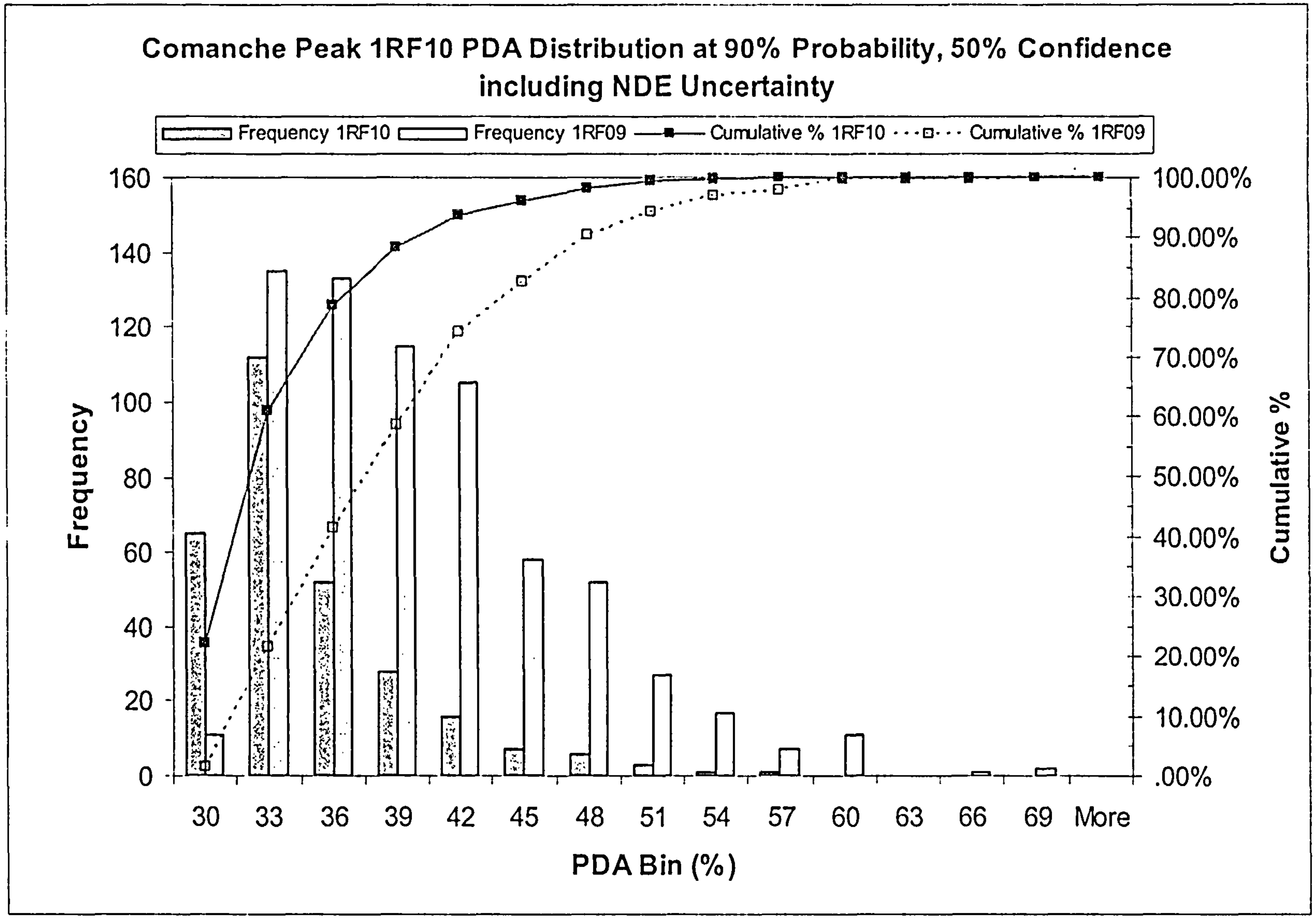
Comanche Peak 1RF10 PDA Distribution at 90% Probability, 50% Confidence including NDE Uncertainty
Frequency 1RF10
Frequency 1RF09
Cumulative % 1RF10
Cumulative % 1RF09
Frequency
160
140
120
100
80
60
40
20
0
Cumulative %
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
.00%
30
33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

Figure 4

a,c

Figure 5

a,c

Enclosure 3

CAW-04-1882
APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE, PROPRIETARY INFORMATION NOTICE, AND COPYRIGHT NOTICE

Westinghouse

Westinghouse Electric Company
Nuclear Services
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Document Control Desk
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Our ref: CAW-04-1882

August 20, 2004

APPLICATION FOR WITHHOLDING PROPRIETARY
INFORMATION FROM PUBLIC DISCLOSURE

Subject: Westinghouse Report "Comanche Peak Steam Electric Station 1RF10 Outage Condition Monitoring Report and Preliminary Cycle 11 Operational Assessment" SG-SGDA-04-21 Revision 1.

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit CAW-04-1882 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-04-1882, and should be addressed to J. A. Gresham, Manager, Regulatory Compliance and Plant Licensing, Westinghouse Electric Company LLC, P.O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

Very truly yours,

J. A. Gresham, Manager
Regulatory Compliance and Plant Licensing

Enclosures

cc: W. Macon
E. Peyton

bcc: 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-04-1882

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared J. A. Gresham, 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:

J. A. Gresham, Manager
Regulatory Compliance and Plant Licensing

Sworn to and subscribed
before me this 20th day
of August, 2004

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 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 the Attachment to WPT-16584, "SG-SGDA-04-21 Revision 1; Comanche Peak Steam Electric Station 1RF10 Outage Condition Monitoring Report and Preliminary Cycle 11 Operational Assessment" (Proprietary) dated April, 2004, being transmitted by the 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 use by TXU Power is expected to be applicable for use in support of other licensee submittals.

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).