Pacific Gas and
Electric Company

James R. Becker
Vice President-Diablo Canyon
Operations and Station Director

Diablo Canyon Power Plant
P.O. Box 56
Avila Beach, CA 93424

805.545.3462
Fax: 805.545.4234

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PG&E Letter DCL-04-112

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

Docket No. 50-275, OL-DPR-80
Diablo Canyon Unit 1
Special Report 04-02 - Results of Steam Generator Inspections for Diablo Canyon Power Plant Unit 1 Twelfth Refueling Outage

Dear Commissioners and Staff:

In accordance with Technical Specifications (TS) 5.6.10.e and 5.6.10.f, Enclosure 1 provides the 90-day reporting of results of Unit 1 steam generator (SG) W star alternate repair criteria (ARC) tubesheet inspections and calculated steam line break leakage from application of all ARC criteria.

In accordance with TS 5.6.10.h, Enclosure 2 provides the 120-day reporting of results of Unit 1 SG primary water stress corrosion cracking ARC inspections at dented tube support plate (TSP) intersections.

In accordance with PG&E's commitment to NEI 97-06, Revision 1, Enclosure 3 provides the 120-day SG condition monitoring and operational assessment report. The condition monitoring report is required when greater than one percent of inspected SG tubes are classified as defective (refer to licensee event report 1-2004-001-00, submitted via DCL-04-056 dated May 10, 2004). The operational assessment report is provided for information. Enclosure 3 focuses on non-ARC degradation mechanisms.

In accordance with PG&E's commitment to Generic Letter 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking (ODSCC)," Enclosure 4 provides the 90-day reporting of results of Unit 1 SG voltage-based ARC inspections for TSP ODSCC, prepared by Framatone-ANP for PG&E. In support of continued implementation of voltage-based ARC for Unit 1, Enclosure 5 contains the 90-day reporting of destructive examination analysis of TSP ODSCC tube samples pulled during 1R12, prepared by Framatone-ANP for PG&E.

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If you have any questions or require additional information, please contact Thomas Baldwin at (805) 545-6060.

Sincerely,

James R. Becker
Vice President – Diablo Canyon Operations and Station Director

ddm1/469
Enclosures
cc: David L. Proulx
Diablo Distribution
cc/enc: Bruce S. Mallett
Girija S. Shukla
State of California, Pressure Vessel Unit

ENCLOSURE 1
SPECIAL REPORT 04-02

W* ALTERNATE REPAIR CRITERIA 90 DAY REPORT

DIABLO CANYON POWER PLANT UNIT 1 TWELFTH REFUELING OUTAGE

NRC Reporting Requirements

Diablo Canyon Power Plant (DCPP) Technical Specification (TS) 5.6.10.e requires that the results of the inspection of Wstar (W*) tubes be reported to the Commission pursuant to 10 CFR 50.4 within 90 days following return to service of the steam generators (SGs). The report shall include:

1. Identification of W* tubes. Per TS 5.5.9.d.1.k, a W* tube is a tube left in service with degradation within or below the W* length.

2. W* inspection distance measured with respect to the Bottom of the WEXTEX Transition (BWT) or the top of tubesheet, whichever is lower.

3. Elevation and length of axial indications within the flexible W* distance and the angle of inclination of clearly skewed axial cracks (if applicable).

4. The total steam line break leakage for the limiting SG per WCAP-14797 Revision 1 ("Generic W* Tube Plugging Criteria for 51 Series Steam Generator Tubesheet Region WEXTEX Expansions").

DCPP TS 5.6.10.f requires that the aggregate calculated steam line break leakage from application of all alternate repair criteria (ARC) be reported to the Commission pursuant to 10 CFR 50.4 within 90 days following return to service of the SGs.

W* Inspections and Results

This report implements the DCPP TS reporting criteria. W* ARC was implemented for the fourth time in DCPP Unit 1 during the Unit 1 twelfth refueling outage (1R12) SG inspections and repairs completed in April 2004.

One hundred percent of the SG tubes were inspected by bobbin from tube end to tube end. One hundred percent of the hot leg top of tubesheet (TTS) WEXTEX region was inspected by Plus Point in each SG. Cold leg TTS Plus Point inspections were not required.

Table 1 provides a comprehensive list of axial primary water stress corrosion cracking (PWSCC) indications detected in the hot leg WEXTEX region during 1R12 Plus Point inspections. The following TS-required reporting information is extracted from Table 1:

1. *Identification of W* tubes.* Table 1 column labeled "W* Tube" identifies 15 tubes (containing 16 single axial PWSCC indications (SAI) in the W* length and 1 single volumetric indication (SVI) located below the W* length) that are categorized as W* tubes and left in service under W* ARC. No tubes were plugged because of failure to meet W* ARC.

   Regarding the SG 1-3 R2C14 SVI located at approximately 8 inches below the hot leg TTS, below the W* length, this is a repeat indication detected in both 1R11 and 1R12 and is ID initiated, but was erroneously reported in the 1R11 90 day report as OD initiated (refer to Table 3 of Enclosure 3 of PG&E letter DCL-02-098 dated August 22, 2002). Based on the SVI Plus Point phase angle in 1R11 and 1R12, the indication is ID initiated. The cause of the ID signal is believed to be a dent based on detection of a 193-degree phase angle indication in the 1R11 and 1R12 bobbin data. The dent signal was also traceable to the 1R6 bobbin data. The Plus Point voltage in 1R11 and 1R12 is small (0. 59 volts in 1R11 and 0.44 volts in 1R12), and indicates no growth. In conclusion, the SVI ID signal is a conservative call, and is more likely a non-degradation dent signal.

   Not included in Table 1 are four circumferential indications located at the top of tubesheet that were plugged because the crack type and location is excluded from application of W* ARC, and these indications are assessed in Enclosure 3. Also not included in Table 1 are tubes with PWSCC in the plug expansion zone (PEZ), described below.

   PWSCC in Plug Expansion Zone (PEZ) in Deplugged Tubes (New Degradation Mechanism). During 1R12 visual examinations of the tubesheet during the planned secondary side pressure test of SG 1-4 in 1R12, small boron deposits were noted inside the hot leg tube end on SG 1-4 R39C58. The tube was subsequently Plus Point inspected the entire length of the hot leg tubesheet region to determine if throughwall degradation was in the tube. Several axial PWSCC indications were detected near the tube end, within the shop hard roll region. The shop hard roll is located about 2.5 inches above the tube end. The mechanical plugs are expanded into the tube within the shop hard roll region, and this region is termed as the plug expansion zone (PEZ). R39C58 had been plugged with a roll plug in 1R8, and the roll plug was removed in 1R9 and the tube returned to service under alternate repair criteria.

   It has been confirmed that PWSCC was not active at the time of deplugging based on proactive Plus Point inspection of full length hot leg tubesheets of deplugged tubes in 1R9, which showed no detectable degradation (NDD). Tubes deplugged subsequent to 1R9 did not receive a Plus Point full-length tubesheet inspection, as this inspection was not required.

Upon identification of this issue, 100 percent of the susceptible PEZ locations in all Unit 1 SGs (165 total, 112 with roll plugs removed and 53 with rib plugs removed) were Plus Point inspected to gain knowledge of this damage mechanism and to assist in cause determination. The Plus Point inspection extent was specified as tube end hot to 4 inches above tube end hot. Inspection of this region is not required based on W* ARC requirements, because PEZ locations are well below the W* lengths. Degradation detected in the PEZ locations is acceptable to remain in service under W* ARC. Table 3 provides a matrix of the 165 tubes (SG, type of plug removed, and outage removed) and shows that 136 were confirmed to have PWSCC based on 1R12 inspections.

For each tube with PWSCC, Table 4 provides the type of plug that was removed (Westinghouse rib plug or Framatome-ANP roll plug), the outage in which deplugging occurred (R11, R10, or R9), the number of PWSCC indications detected (the majority of indications were multiple axial indications), and maximum voltage. All of the plugs were removed using the Framatome-ANP tungsten inert gas (TIG) relaxation process. There were 3 tubes that had single circumferential indications (SCI) in the PEZ region. All of the indications were located in the plug expansion zones, within the shop hard roll region, based on review of Plus Point C-scans. The BWT locations are also provided for all locations and indicate that these tubes are fully expanded over the length of the tubesheet. Four cold leg PEZ locations in SG 1-3 were also inspected and no degradation was noted. The Table 4 tubes are defined as W* tubes in accordance with W* ARC.

The cause of the PEZ PWSCC could be due to high residual stresses caused by the roll and rib plug expansion processes, or sensitization of the tube material from the TIG process, because the cracking was limited to the location of the expanded location of the plugs. When the plug is removed, the residual stresses in this area remain high, and in combination with high RCS temperature (about 604°F), PWSCC developed in as little as 1 cycle.

Because of W* ARC, PEZ PWSCC does not require the tube to be plugged and no accident induced steam line break (SLB) is postulated for PEZ PWSCC. The indications are located within the original shop hard roll, such that leakage is precluded during all plant conditions.

Because of the identification of this new degradation mechanism, the 1R12 degradation assessment was revised and INPO operating experience OE 18236 was issued by PG&E to disseminate this information to the industry.

2. *W* inspection distance measured with respect to BWT or TTS, whichever is lower.* For the one hundred percent Plus Point hot leg TTS exam, the inspection extent relative to the TTS was specified as +2/-8.5 inches. Assuming no degradation in the W* length, 8.5 inches below the TTS constitutes the W* inspection distance. This distance bounds W* lengths for hot leg Zone A and Zone B (5.2 inch and 7.0 inch,

respectively, relative to BWT) and cold leg Zone A and Zone B (5.5 inch and 7.5 inch, respectively, relative to BWT), and includes margin for a nominal distance from BWT to TTS plus nondestructive examination (NDE) uncertainty in measuring W* length. If degradation is detected in the W* region, the inspection extent must bound the calculated flexible W* length. The "W* Inspect Dist" column in Table 1 lists the W* inspection distances measured with respect to BWT for tubes in which axial PWSCC was detected (in all cases, BWT was lower than the TTS). The W* inspection distance must be greater than or equal to the flexible W* length.

3. *Elevation and length of axial indications within the flexible W* distance.* See "LCT", "UCT" and "Crack Length" columns in Table 1 for elevation of the upper crack tip, elevation of the lower crack tip, and crack length of the axial indications. The elevations of the UCT and LCT are relative to the TTS.

   Angle of inclination of clearly skewed axial cracks (if applicable). None of the axial indications were skewed, so this reporting requirement is not applicable.

4. *The total steam line break leakage for the limiting SG per WCAP-14797.* Steam line break (SLB) leakage attributed to each W* indication at end of the cycle (EOC) 12 (condition monitoring) and projected EOC 13 (operational assessment) are listed in "CM Leak Rate" and "OA Leak Rate" columns in Table 1. The W* leakage model conservatively assumes all W* indications are throughwall cracks. The total leak rates for each SG are also provided in Table 1.

Table 5 and Table 6 reports the following SLB leak rates for condition monitoring and operational assessment, pursuant to TS 5.6.10.e.4 and 5.6.10.f. For W* ARC leak rates, the SLB differential pressure is conservatively assumed to be 2560 psi. For PWSCC ARC and voltage-based ARC leak rates, the SLB differential pressure is assumed to be 2405 psi.

1. Total W* ARC SLB leakage for each SG at EOC 12 (condition monitoring). The maximum leak rate is 0.037 gpm (at room temperature) in SG 1-2.

2. Total W* ARC SLB leakage for each SG at EOC 13 (operational assessment). The maximum leak rate is 0.042 gpm (at room temperature) in SG 1-2.

3. The aggregate calculated EOC 12 (condition monitoring) SLB leakage from application of voltage-based ARC, PWSCC ARC, W* ARC, and non-ARC degradation. The maximum leak rate is 0.99 gpm (at room temperature) in SG 1-1.

4. The aggregate calculated EOC 13 (operational assessment) SLB leakage from application of voltage-based ARC, PWSCC ARC, W* ARC, and non-ARC degradation. The maximum leak rate is 4.35 gpm (at room temperature) in SG 1-1.

Table 7 reports the projected EOC 12 leak rates from the prior cycle operational assessment for comparison with the as-found leak rates listed in Table 5, and the projected leak rates are very close to the as found leak rates. The leak rates in 3 SGs were slightly under predicted, the largest being 0.005 gpm in SG 1-1 and 0.004 gpm in SG 1-3. These are insignificant relative to the available margins. The slight SG 1-1 under prediction is attributed to a repeat indication in R3C2 (only 0.61 volts Plus Point, not expected to leak at SLB conditions), which had a growth rate that was larger than anticipated in the prior cycle OA (0.118 inch/EFPY as found versus 0.081 inch/EFPY used in prior cycle OA). The slight SG 1-3 under prediction is attributed to a new indication in R10C20, which is only 0.44 volts and not expected to leak at SLB conditions. Leakage is predicted for all indications in the W* length based on the ARC methods conservative assumption of throughwall indications, which ignores the low voltages for most of the indications.

Axial PWSCC Growth Rates

Of the 16 axial PWSCC indications in the hot leg WEXTEX region that were detected in 1R12 listed in Table 1, 2 were new indications and 14 were repeat W* indications that had been left in service in the prior inspection. All repeat indications were detected in 1R12. Based on a 1R11 lookup review of the 2 new indications, 1 was detectable and 1 was not inspected because it was located below the 1R11 inspection extent. As a result, 15 additional growth rate data points were available for evaluation, and their average growth rate was 0.028 inch per EFPY at Thot of 604 degrees F.

After addition of the Unit 1 Cycle 12 data points, the updated W* growth rate distribution now consists of 189 data points from DCPP Units 1 and 2. The updated growth rate at 95 percent cumulative probability is 0.119 inch per EFPY at 604 degrees F, identical to the pre-1R12 growth rate (includes data through 2R11), and this value is used in the operational assessment for DCPP Unit 1 Cycle 13. The 0.119 inch/EFPY growth rate replaces the less conservative 0.081 inch/EFPY rate used in the prior Unit 1 Cycle 12 OA, which was the 95 percent value for all DCPP data through 1R11. Because there are less than 200 data points in the growth rate distribution, all data is included, except for data that are normally excluded if greater than or equal to 25% of the crack length is above BWT.

The actual length of Unit 1 Cycle 12 was 1.61 EFPY and the projected length of Unit 1 Cycle 13 is 1.36 EFPY, and the growth rates reflect these cycle lengths.

In Situ Leak Testing

In Situ Test Screening Methodology

In support of W* leak rate model validation, PG&E letter DCL-01-095 dated September 13, 2001, defined a four step sequential screening process for determining the need for in situ leak testing of axial PWSCC indications in the WEXTEX region.

The screening criteria are described below. No in situ testing was conducted in 1R12, based on the following assessment of the 16 axial PWSCC indications detected in 1R12. The logic is also tabulated in Table 2.

- Step 1: Prior leak tested W* indications with maximum Plus Point voltages greater than or equal to 1.25 times the prior leak test voltage are carried to Step 2. W* indications with no prior leak test are also carried to step 2.

  PG&E evaluation: No W* indications had been leak tested in prior outages, so all 16 indications were carried to step 2.

- Step 2: Indications with maximum Plus Point voltages exceeding the critical voltage (V_{crit}) are leak tested independent of other parameters. V_{crit} equals 4.0 volts for nondeplugged indications and 6.0 volts for deplugged indications. Indications with maximum Plus Point voltages less than V_{crit} are carried to Step 3.

  PG&E evaluation: The maximum voltage of the 13 nondeplugged axial PWSCC indications was 2.26 volts, less than the 4.0 volt threshold value. The maximum voltage of the 3 deplugged axial PWSCC indications was 2.09 volts, less than the 6.0-volt threshold value. Therefore, since no indications exceeded V_{crit}, all indications were carried to step 3.

- Step 3: Indications with maximum Plus Point voltages exceeding V_{thr} are carried to the Step 4 depth evaluation. A minimum of the five largest voltage indications are carried to the depth evaluation if less than five indications exceed the voltage threshold. V_{thr} equals 2.5 volts for nondeplugged indications and 4.0 volts for deplugged indications.

  PG&E evaluation: The maximum voltage of the 13 nondeplugged axial PWSCC indications was 2.26 volts, less than the 2.5 volt threshold value. The maximum voltage of the 3 deplugged axial PWSCC indications was 2.09 volts, less than the 4.0-volt threshold value. Therefore, since no indications exceeded V_{thr}, the five largest voltage indications are required to be carried to step 4.

- Step 4 (depth evaluation): Indications with maximum depths exceeding the maximum depth leakage threshold ($MD_{L\text{-}thr}$) over lengths greater than the deep crack length threshold ($L_{L\text{-}min}$) are leak tested. $MD_{L\text{-}thr}$ equals 80% and $L_{L\text{-}min}$ equals 0.1 inch.

  PG&E evaluation: All axial PWSCC indications in the WEXTEX region were depth profiled using the same techniques as axial PWSCC at dented TSP intersections. For each indication, the flaw length exceeding 80% maximum depth is listed in Table 2. Only two flaws had maximum depths exceeding 80%, but the portion of the flaw lengths that exceeded 80% were less than the 0.1-inch threshold. Therefore,

since there were no indications with maximum depth greater than $MD_{L\text{-}thr}$ over lengths greater than $L_{L\text{-}min}$, no indications required in situ leak testing.

In situ testing was not performed on any of the PWSCC indications in the PEZ listed in Table 4, because the indications were located in the shop hard roll and where the in situ testing tool head would seat/seal, so the test would not have been capable of pressurizing the indication. In addition, because the shop hard roll would prevent leakage under any plant conditions, in situ test results would not provide meaningful data for validation of the W* leakage model.

Tube Integrity Performance Monitoring

Condition Monitoring Performance Criteria to Limit Free Span Cracking: The upper crack tip (UCT) of W indications returned to service under W* ARC in the prior inspection shall remain below the TTS at EOC 12 by at least the NDE uncertainty on locating the crack tip relative to the TTS.*

The "UCT adj" column in Table 1 provides the EOC 12 elevation of the upper crack tip relative to the top of tubesheet, accounting for NDE uncertainty in locating the crack relative to the top of tubesheet. In all cases, the EOC 12 crack tip for indications returned to service in the prior inspection is below the top of tubesheet, as indicated by "Yes" in the column "UCT below TTS?" Therefore, the performance criterion was satisfied for condition monitoring at EOC 12.

Accident-Induced Leakage Performance Criteria: W leak rates under postulated SLB conditions, when combined with SLB leak rates from application of GL 95-05 voltage-based ARC and PWSCC ARC, and SLB leak rates from non-ARC degradation mechanisms, shall not exceed 10.5 gpm (at room temperature) in the faulted SG for condition monitoring and operational assessment.*

The 10.5 gpm limit was approved by the NRC as requested in PG&E license amendment request (LAR) 01-05. The aggregate calculated SLB leakage at EOC 12 is 0.99 gpm for the limiting SG (SG 1-1) as shown in Table 5. The projected aggregate calculated SLB leakage at EOC 13 is 4.35 gpm for the limiting SG (SG 1-1) as shown in Table 6. In both assessments, SLB leakage is less than the allowable limit. Therefore, the performance criterion has been satisfied for condition monitoring at EOC 12 and operational assessment at EOC 13.

Table 1
1R12 Indications in Hot Leg WEXTEX Tubesheet Region (Excluding Circumferential Indications and PWSCC at Tube End)

SG	Row	Col	Ind	Volts	MD	Crack No	Cal	LCT	UCT	Crack Length	UCT adj	UCT below TTS?	W* Zone	W* Length	BWT	Dist UCT to BWT	UCT Below W* ?	UCT Below BWT?	EOC (N+1) UCT to TTS	EOC (N+1) UCT Below TTS?	W* Tube?	Inspect Extent	W* Inspect Dist	Flex W* Length	CM Leak Rate	Dist EOC (N+1) UCT to BWT	OA Leak Rate	Prev W*Tube?	Tube Plugged?
11	3	2	SAI	0.61	49	1	21	-1.31	-0.93	0.38	-0.71	Yes	A	5.32	-0.09	0.56	No	Yes	-0.55	Yes	Yes	-8.93	8.75	5.72	0.026	0.40	0.030	Yes	
	15	10	SAI	0.72	43	1	21	-8.60	-8.37	0.23	-8.15	Yes	A	5.32	-0.26	7.83	Yes	Yes	-7.99	Yes	Yes	-9.45	9.10	5.32	0.000	7.67	0.000	Yes	
	15	10	SAI	1.02	61	2	21	-7.98	-7.57	0.41	-7.35	Yes	A	5.32	-0.26	7.03	Yes	Yes	-7.19	Yes	Yes	-9.45	9.10		0.000	6.87	0.000	Yes	
	20	44	SAI	0.58	36	1	54	-8.27	-8.19	0.08	-7.97	Yes	B2	7.12	-1.85	6.06	No	Yes	-7.81	Yes	Yes	-9.68	7.74	7.22	0.001	5.90	0.001	Yes	
	Total Leak Rate																								0.026		0.031		
12	1	87	SAI	2.26	63	1	59	-9.67	-9.34	0.33	-9.12	Yes	A	5.32	-0.28	8.78	Yes	Yes	-8.96	Yes	Yes	-11.35	10.98	5.32	0.000	8.62	0.000		
	7	33	SAI	1.23	96	1	31	-2.04	-1.67	0.37	-1.45	Yes	B2	7.12	-0.35	1.04	No	Yes	-1.29	Yes	Yes	-9.20	8.76	7.51	0.018	0.88	0.020	Yes	
	20	37	SAI	2.09	96	1	31	-1.53	-1.36	0.17	-1.14	Yes	B3	7.12	-0.13	0.95	No	Yes	-0.98	Yes	Yes	-10.32	10.10	7.31	0.019	0.79	0.021	Yes	
	Total Leak Rate																								0.037		0.042		
13	2	14	SVI	0.44	NA	1	31	-8.40	-8.16	0.24	-7.94	Yes	A	5.32	-0.20	7.68	Yes	Yes	-7.78	Yes	Yes	-9.57	9.28	5.32	NA	NA	NA	Yes	
	10	20	SAI	0.44	20	1	61	-2.17	-2.02	0.15	-1.8	Yes	B4	7.12	-0.11	1.63	No	Yes	-1.64	Yes	Yes	-11.34	11.14	7.29	0.007	1.47	0.008		
	30	45	SAI	0.32	20	1	30	-1.97	-1.84	0.13	-1.62	Yes	B4	7.12	-0.19	1.37	No	Yes	-1.46	Yes	Yes	-9.64	9.36	7.27	0.009	1.21	0.011	Yes	
	31	36	SAI	0.44	20	1	30	-2.63	-2.48	0.15	-2.26	Yes	A	5.32	-0.21	1.99	No	Yes	-2.10	Yes	Yes	-9.75	9.45	5.49	0.004	1.83	0.005	Yes	
	33	37	SAI	0.46	20	1	30	-5.62	-5.47	0.15	-5.25	Yes	A	5.32	-0.40	4.79	No	Yes	-5.09	Yes	Yes	-9.84	9.35	5.49	0.000	4.63	0.001	Yes	
	39	46	SAI	0.63	20	1	30	-2.54	-2.29	0.25	-2.07	Yes	A	5.32	-0.25	1.76	No	Yes	-1.91	Yes	Yes	-10.4	10.06	5.59	0.005	1.60	0.006	Yes	
	Total Leak Rate																								0.026		0.030		
14	23	7	SAI	0.41	24	1	30	-8.17	-7.99	0.18	-7.77	Yes	A	5.32	-0.19	7.52	Yes	Yes	-7.61	Yes	Yes	-10.85	10.57	5.32	0.000	7.36	0.000	Yes	
	28	57	SAI	0.26	20	1	30	-2.91	-2.77	0.14	-2.55	Yes	B4	7.12	-0.33	2.16	No	Yes	-2.39	Yes	Yes	-9.74	9.32	7.42	0.005	2.00	0.006	Yes	
	28	57	SAI	0.39	20	2	30	-7.11	-6.99	0.12	-6.77	Yes	B4	7.12	-0.33	6.38	No	Yes	-6.61	Yes	Yes	-9.74	9.32		0.000	6.22	0.000	Yes	
	39	58	SAI	0.35	20	1	76	-6.43	-6.35	0.08	-6.13	Yes	A	5.32	-0.04	6.03	Yes	Yes	-5.97	Yes	Yes	-21.4	21.27	5.32	0.000	5.87	0.000	Yes	
	Total Leak Rate																								0.005		0.006		

Table 2
1R12 In Situ Test Screening of W* Indications

SG	Row	Col	Ind	Volts	MD	Crack No	LCT	UCT	Deplugged?	Prior Insitu Voltage	Vcrit	Vthr	Step 1	Step 2	Step 3	Rank	Top 5 Voltage Rank	L>80%TW MD	Step 4	Insitu Req'd?
11	3	2	SAI	0.61	49	1	-1.31	-0.93			4	2.5	Go to Step 2	Go to Step 3	Rank	6		0		No
	15	10	SAI	0.72	43	1	-8.60	-8.37			4	2.5	Go to Step 2	Go to Step 3	Rank	5	Go to Step 4	0	Stop	No
	15	10	SAI	1.02	61	2	-7.98	-7.57			4	2.5	Go to Step 2	Go to Step 3	Rank	4	Go to Step 4	0	Stop	No
	20	44	SAI	0.58	36	1	-8.27	-8.19			4	2.5	Go to Step 2	Go to Step 3	Rank	8		0		No
12	1	87	SAI	2.26	63	1	-9.67	-9.34			4	2.5	Go to Step 2	Go to Step 3	Rank	1	Go to Step 4	0	Stop	No
	7	33	SAI	1.23	96	1	-2.04	-1.67	Yes		6	4	Go to Step 2	Go to Step 3	Rank	3	Go to Step 4	0.05	Stop	No
	20	37	SAI	2.09	96	1	-1.53	-1.36	Yes		6	4	Go to Step 2	Go to Step 3	Rank	2	Go to Step 4	0.05	Stop	No
13	10	20	SAI	0.44	20	1	-2.17	-2.02			4	2.5	Go to Step 2	Go to Step 3	Rank	11		0		No
	30	45	SAI	0.32	20	1	-1.97	-1.84			4	2.5	Go to Step 2	Go to Step 3	Rank	15		0		No
	31	36	SAI	0.44	20	1	-2.63	-2.48			4	2.5	Go to Step 2	Go to Step 3	Rank	10		0		No
	33	37	SAI	0.46	20	1	-5.62	-5.47			4	2.5	Go to Step 2	Go to Step 3	Rank	9		0		No
	39	46	SAI	0.63	20	1	-2.54	-2.29			4	2.5	Go to Step 2	Go to Step 3	Rank	7		0		No
14	23	7	SAI	0.41	24	1	-8.17	-7.99			4	2.5	Go to Step 2	Go to Step 3	Rank	12		0		No
	28	57	SAI	0.26	20	1	-2.91	-2.77			4	2.5	Go to Step 2	Go to Step 3	Rank	16		0		No
	28	57	SAI	0.39	20	2	-7.11	-6.99			4	2.5	Go to Step 2	Go to Step 3	Rank	13		0		No
	39	58	SAI	0.35	20	1	-6.43	-6.35	Yes		6	4	Go to Step 2	Go to Step 3	Rank	14		0		No

Column – Tables 1 and 2	Legend and Notes for Tables 1 and 2
SG	Steam generator
Row	Tube Row
Col	Tube Column
PP Volts	Peak voltage from Plus Point coil
MD	Maximum depth (% throughwall) from Plus Point coil. The depth is the adjusted depth using the same techniques as PWSCC ARC depth sizing.
Crack No	Crack number
Cal	Plus Point calibration group number
LCT	Elevation (inch) of lower crack tip (LCT), relative to the top of tubesheet (TTS).
UCT	Elevation (inch) of upper crack tip (UCT), relative to the TTS.
Crack length	Length of crack (inch)
UCT adj	Adjusted elevation (inch) of the UCT relative to TTS, including $\Delta NDE_{CT\text{-}TTS}$ (Plus Point NDE uncertainty on locating the crack tip relative to the TTS).
UCT below TTS?	If the adjusted elevation of the UCT (including NDE uncertainty) is located below TTS, then the tube is a W* candidate.
W* Zone	W* tubesheet zone based on crack location.
W* Length	W* length is 7.12 inch for hot leg Zone B and 5.32 inch for hot leg Zone A, and includes ΔNDE_W (NDE uncertainty in measuring the W* depth).
BWT	Elevation of the bottom of the WEXTEX transition (BWT), inch, measured by bobbin relative to the TTS.
UCT to BWT	Distance (inch) from the UCT to BWT, minus $\Delta NDE_{CT\text{-}BWT}$ (Plus Point NDE uncertainty on locating the crack tip relative to the BWT).
UCT below W*?	If the UCT is located below the W* length, then the tube is a W* tube. Any type of degradation below the W* length is acceptable.
UCT below BWT?	If the UCT is located below BWT, then the tube is a W* candidate.
EOC (n+1) UCT to TTS	Elevation (inch) of UCT relative to TTS at the end of the next operating cycle, based on growing the UCT at 0.119 inch/EFPY.
EOC (n+1) UCT below TTS?	If the UCT is below TTS at the end of the next cycle, a free span indication is precluded and the tube is a W* candidate.
W* Tube?	If the UCT is below BWT and the EOC (n+1) UCT is projected to be below TTS at the end of the next cycle, then the tube is a W* tube.
Inspect Extent	Elevation of Plus Point inspection relative to TTS (inch).
W* Inspect Dist	W* inspection distance (inch). This is the Plus Point inspection extent relative to BWT. The W* inspection distance below BWT is equal to the Plus Point inspection extent below TTS, plus measured distance from BWT to TTS, plus bobbin NDE uncertainty in locating BWT relative to TTS. The W* inspection distance must be greater than or equal to the flexible W* length.
Flex W* Length	Flexible W* length relative to BWT (inch), equal to W* Length + $\sum Cl_i$ (total axial crack length) + $N_{CL}*\Delta NDE_{CL}$ (number of indications times Plus Point NDE uncertainty with measuring length of axial cracks) + $N_{CL}*\Delta CG$ (number of indications times crack growth, 0.119 inch/EFPY)
CM Leak Rate	Condition monitoring SLB leak rate, gpm at room temperature, based on distance of UCT to BWT, using Figure 6.4-3 of WCAP-14797 Rev 1. No accident leakage is assigned to indications with UCT below W* length.
EOC (n+1) UCT to BWT	Distance (inch) of the UCT relative to BWT at end of the next cycle, minus $\Delta NDE_{CT\text{-}BWT}$ (Plus Point NDE uncertainty on locating the crack tip relative to the BWT), based on growing the UCT at 0.119 inch/EFPY. This entry is not applicable to indications that are plugged.
OA Leak Rate	Operational assessment leak rate, gpm at room temperature, at end of next cycle based on distance of EOC (n+1) UCT to BWT, using Figure 6.4-3 of WCAP-14797 Rev 1. No accident leakage is assigned to an indication with UCT below W* length.
Previous W* Tube?	If the indication was left in service in the prior cycle, it is classified as a repeat. Otherwise, the indication is new.
Tube Plugged?	If tube was plugged during the current outage, then "yes" is indicated.
MD	Maximum depth, percent through-wall, using TSP axial PWSCC depth sizing technique.
Deplugged?	Tube was deplugged in a prior outage.
Prior In situ Voltage	If prior in situ testing was performed, the Plus Point voltage of the indication in the outage that in situ leak testing was performed.
Vcrit	Critical voltage for determining need for in situ testing
Vthr	Threshold voltage for determining need for in situ testing
Steps 1 through 4	Logical steps used for screening indications for in situ testing
Voltage rank	Plus Point voltage ranking of indications as required by in situ screening Step 3
Top 5 Voltage Rank	Five largest Plus Point voltages are identified for further screening
L >80% TW MD	The length of the indication that exceeds 80% maximum depth, based on Plus Point line by line sizing.
In situ Req'd?	Identifies indications that require in situ leak testing based on the four step screening logic

Table 3
Deplugged Tube Population and Plus Point Results

Unit 1 Tubes Deplugged and Inservice in U1C12						
SG	Roll			Rib		Total
	R11	R10	R9	R11	R10	
11		5	15		7	27
12	51	20	10	46		127
13			4			4
14			7			7
Total	51	25	36	46	7	165

Tubes with Plus Point PWSCC Indications in Plug Expansion Zone (PEZ)						
SG	Roll			Rib		Total
	R11	R10	R9	R11	R10	
11		3	8		7	18
12	48	20	9	31		108
13			4			4
14			6			6
Total	48	23	27	31	7	136

Table 4 - Tubes with PWSCC indications in the Plug Expansion Zone (PEZ)								
SG	Row	Col	Plug Removal Outage	Type Plug Removed	1R12 Tube End indication	# Ind	Indication Max Volts	BWT, inch relative to TSH
11	4	61	1R9	Roll	MAI	12	3.89	-0.06
11	5	59	1R9	Roll	MAI	9	2.96	-0.15
11	5	64	1R9	Roll	MAI	17	3.23	-0.63
11	11	58	1R9	Roll	MAI	16	4.47	-0.07
11	14	13	1R10	Rib	MAI	8	0.83	-0.32
11	15	76	1R10	Roll	SAI	1	2.53	-0.04
11	16	68	1R9	Roll	MAI	20	4.28	-0.11
11	16	70	1R10	Rib	MAI	8	2.87	0.08
11	17	76	1R9	Roll	MAI	13	4.78	-0.02
11	20	28	1R10	Rib	MAI	11	0.76	-1.01
11	20	29	1R10	Roll	MAI	14	2.11	-0.21
11	20	65	1R10	Rib	MAI	6	1.15	-0.12
11	25	40	1R9	Roll	SAI	1	0.58	-0.3
11	25	57	1R10	Roll	MAI	9	3.87	-0.22
11	28	41	1R9	Roll	SAI	1	1.82	-0.21
11	29	37	1R10	Rib	MAI	9	1.96	-0.23
11	30	67	1R10	Rib	MAI	16	1.82	-0.18
11	37	32	1R10	Rib	MAI	2	0.99	-0.25
12	1	44	1R11	Roll	MAI	9	2.96	-0.15
12	2	28	1R11	Roll	SAI	14	4.12	-0.2
12	2	79	1R10	Roll	MAI	7	3.03	-0.13
12	2	90	1R11	Roll	MAI	14	1.71	-0.23
12	4	54	1R11	Roll	MAI	9	2.98	-0.13
12	4	84	1R10	Roll	MAI	10	4.05	-0.33
12	5	39	1R11	Roll	MAI	10	3.75	-0.26
12	5	49	1R11	Roll	MAI	7	2.86	-0.28
12	5	65	1R10	Roll	MAI	4	3.19	-0.17
12	5	66	1R10	Roll	MAI	8	3.33	-0.22
12	5	78	1R11	Roll	MAI	9	1.9	-0.24
12	5	93	1R10	Roll	MAI	11	2.91	-0.17
12	7	17	1R9	Roll	MAI	9	3.68	-0.26
12	7	33	1R11	Rib	MAI	10	1.99	-0.35
12	7	53	1R11	Roll	MAI	10	2.52	-0.24
12	7	68	1R10	Roll	MAI	13	3.11	-0.34
12	8	66	1R10	Roll	MAI	10	3.88	-0.19
12	9	27	1R11	Roll	MAI	8	2.63	-0.23
12	9	30	1R11	Rib	MAI	12	2.06	-0.28
12	9	38	1R11	Rib	MAI	12	1.77	-0.34
12	9	45	1R11	Rib	MAI	7	2	-0.21
12	9	53	1R11	Roll	MAI	9	2.97	-0.19

Table 4 - Tubes with PWSCC indications in the Plug Expansion Zone (PEZ)								
SG	Row	Col	Plug Removal Outage	Type Plug Removed	1R12 Tube End indication	# Ind	Indication Max Volts	BWT, inch relative to TSH
12	9	82	1R11	Roll	MAI	3	3.02	-0.18
12	10	49	1R11	Roll	MAI	9	2.68	-0.28
12	10	62	1R11	Roll	MAI	11	4.52	-0.34
12	10	67	1R10	Roll	MAI	7	5.36	-0.3
12	10	85	1R10	Roll	MAI	8	2.41	-0.17
12	11	20	1R11	Rib	MAI	8	1.9	-0.17
12	11	71	1R11	Roll	MAI	4	2.23	-0.24
12	12	77	1R11	Rib	MAI	2	1.77	-0.17
12	13	34	1R11	Roll	MAI	8	3.5	-0.28
12	13	44	1R11	Rib	MAI	6	1.82	-0.3
12	13	60	1R11	Roll	MAI	12	3.43	-0.43
12	13	83	1R11	Roll	MAI	8	1.11	-0.28
12	14	68	1R10	Roll	MAI	14	3.15	-0.24
12	14	70	1R10	Roll	MAI	8	2.43	-0.33
12	14	74	1R11	Roll	MAI	10	1.98	-0.19
12	16	82	1R11	Roll	MAI	8	2.57	-0.32
12	16	85	1R11	Roll	MAI	6	2.13	-0.37
12	16	87	1R11	Rib	SAI	1	0.65	-0.3
12	16	88	1R11	Rib	MAI	3	0.84	-0.34
12	17	9	1R11	Roll	MAI	7	2.28	-0.21
12	17	59	1R11	Roll	MAI	8	2.76	-0.29
12	17	66	1R11	Roll	MAI	13	3.09	-0.28
12	17	67	1R11	Roll	MAI	13	2.92	-0.28
12	17	88	1R11	Rib	MAI	6	1.78	-0.35
12	18	64	1R11	Roll	MAI	13	2.73	-0.25
12	19	34	1R11	Roll	MAI	10	3.62	-0.3
12	20	37	1R11	Rib	MAI	8	2.17	-0.13
12	20	40	1R11	Rib	MAI	5	1.05	-0.21
12	20	43	1R9	Roll	MAI	14	6.14	-0.28
12	20	77	1R11	Roll	MAI	7	2.83	-0.26
12	21	38	1R11	Rib	MAI	5	1.18	-0.19
12	21	46	1R11	Roll	MAI	12	3.59	-0.24
12	21	57	1R11	Roll	MAI	12	3.1	-0.32
12	21	60	1R10	Roll	MAI	11	4.29	-0.32
12	21	62	1R9	Roll	MAI	12	4.84	-0.41
12	21	65	1R11	Rib	MAI	6	1.33	-0.34
12	22	22	1R9	Roll	MAI	7	3.77	-0.19
12	22	42	1R11	Roll	MAI	15	10.2	-0.24
12	22	54	1R11	Rib	MAI	2	1.4	-0.19
12	23	17	1R11	Rib	MAI	11	1.2	-0.27
12	25	25	1R9	Roll	MAI	9	3.5	-0.27

Table 4 - Tubes with PWSCC Indications in the Plug Expansion Zone (PEZ)								
SG	Row	Col	Plug Removal Outage	Type Plug Removed	1R12 Tube End indication	# Ind	Indication Max Volts	BWT, inch relative to TSH
12	25	50	1R11	Rib	SAI	1	1.49	-0.41
12	25	57	1R9	Roll	MAI	8	5.17	-0.24
12	25	87	1R11	Roll	MAI	7	1.43	-0.32
12	26	22	1R11	Roll	MAI	9	2.89	-0.29
12	26	73	1R11	Rib	MAI	4	1.12	-0.38
12	27	29	1R9	Roll	MAI	12	4.05	-0.33
12	27	63	1R11	Rib	MAI	2	1.45	-0.45
12	27	64	1R10	Roll	MAI	16	2.39	-0.29
12	27	65	1R11	Rib	MAI	4	1.11	-0.40
					SCI	1	0.48	
12	27	69	1R11	Roll	MAI	8	3.45	-0.26
12	28	24	1R9	Roll	MAI	10	5.84	-0.29
12	28	47	1R11	Roll	MAI	10	1.53	-0.3
12	29	24	1R11	Roll	MAI	8	3.08	-0.24
12	29	38	1R11	Rib	MAI	2	1.19	-0.15
12	29	66	1R11	Rib	MAI	9	1.79	-0.32
12	30	30	1R11	Rib	MAI	3	0.93	-0.23
12	30	35	1R9	Roll	MAI	4	5.87	-0.27
12	30	56	1R11	Rib	MAI	4	1.32	-0.51
					SCI	1	0.66	
12	30	62	1R10	Roll	MAI	8	1.6	-0.26
12	31	37	1R10	Roll	MAI	15	2.95	-0.21
12	31	47	1R11	Rib	MAI	6	0.91	-0.21
12	31	66	1R11	Roll	MAI	9	3.81	-0.3
12	31	68	1R11	Roll	MAI	13	2.56	-0.53
12	32	30	1R11	Roll	MAI	13	1.94	-0.29
12	32	37	1R10	Roll	MAI	9	2.28	-0.26
12	32	44	1R11	Roll	MAI	7	3.66	-0.23
12	32	47	1R11	Roll	MAI	10	1.58	-0.21
12	33	57	1R11	Roll	MAI	9	3.84	-0.26
12	33	72	1R11	Roll	MAI	8	2.9	-0.32
12	34	36	1R10	Roll	MAI	10	2.74	-0.25
12	34	47	1R11	Roll	MAI	9	1.69	-0.26
12	34	49	1R11	Rib	MAI	8	1.15	-0.3
12	34	53	1R11	Rib	MAI	6	1.02	-0.29
12	34	57	1R11	Rib	MAI	2	1.36	-0.34
12	34	59	1R11	Roll	MAI	2	1.08	-0.23
12	34	65	1R10	Roll	MAI	3	1.03	-0.21
12	35	49	1R11	Rib	MAI	7	1.62	-0.25
12	35	56	1R10	Roll	MAI	6	1.92	-0.38
12	36	53	1R11	Roll	MAI	9	3.71	-0.41

Table 4 - Tubes with PWSCC indications in the Plug Expansion Zone (PEZ)								
SG	Row	Col	Plug Removal Outage	Type Plug Removed	1R12 Tube End indication	# Ind	Indication Max Volts	BWT, inch relative to TSH
12	37	53	1R11	Rib	SCI	1	0.41	-0.36
					MAI	4	1.54	
12	37	69	1R11	Roll	MAI	6	1.44	-0.36
12	37	70	1R11	Rib	MAI	3	1.82	-0.26
12	37	73	1R10	Roll	MAI	9	1.59	-0.3
12	37	74	1R11	Roll	MAI	4	1.87	-0.35
12	43	49	1R11	Roll	MAI	10	2.85	-0.26
13	9	56	1R9	Roll	MAI	10	3.64	-0.38
13	9	61	1R9	Roll	MAI	3	2	-0.3
13	9	66	1R9	Roll	MAI	9	3.56	-0.33
13	9	70	1R9	Roll	MAI	10	3.01	-0.33
14	4	6	1R9	Roll	MAI	2	1.16	-0.2
14	16	66	1R9	Roll	MAI	11	3.77	-0.32
14	20	63	1R9	Roll	MAI	7	2.45	-0.21
14	35	36	1R9	Roll	MAI	8	1.92	-0.27
14	39	48	1R9	Roll	MAI	10	3.89	-0.22
14	39	58	1R9	Roll	MAI	7	4.25	-0.04

Note: All plugs were removed by Framatome-ANP TIG relaxation process.

Table 5
DCPP Unit 1 Condition Monitoring Steam Line Break Leak Rates for Alternate Repair Criteria

EOC 12 Condition Monitoring Leak Rate (gpm at room temperature)	SG 1-1	SG 1-2	SG 1-3	SG 1-4
W* ARC	0.026	0.037	0.026	0.005
Voltage-Based ARC (Note 1)	0.96	0.31	0.16	0.15
PWSCC ARC (Note 3)	0	0.063	0	0
Non-ARC degradation (Note 2)	0	0	0 (note 2)	0 (note 2)
Aggregate ARC	0.99	0.41	0.19	0.16

Note 1: Voltage-based ARC leak rates are described in Enclosure 4.
Note 2: Non-ARC degradation leak rate of 0 gpm based on results of in situ leak tests of tubes with circumferential PWSCC in U-bend region (Enclosure 3).
Note 3: PWSCC ARC leak rates are described in Enclosure 2.

Table 6
DCPP Unit 1 Operational Assessment Steam Line Break Leak Rates for Alternate Repair Criteria

EOC 13 Operational Assessment Leak Rate (gpm at room temperature)	SG 1-1	SG 1-2	SG 1-3	SG 1-4
W* ARC	0.031	0.042	0.030	0.006
Voltage-Based ARC (note 1)	4.32	1.33	0.89	0.51
PWSCC ARC	0	0	0	0
Non-ARC degradation	0	0	0	0
Aggregate ARC	4.35	1.37	0.92	0.52

Note 1: Leak rates calculated using POD of 0.6 for voltage-based ARC (Enclosure 4).

Table 7
DCPP Unit 1 Prior Cycle W* ARC Leak Rate Predictions

Predicted EOC 12 Leak Rate (from prior cycle OA) (gpm at room temperature)	SG 1-1	SG 1-2	SG 1-3	SG 1-4
W* ARC	0.021	0.035	0.022	0.005

ENCLOSURE 2
SPECIAL REPORT 04-02

TSP PWSCC ALTERNATE REPAIR CRITERIA 120 DAY REPORT

DIABLO CANYON POWER PLANT UNIT 1 TWELFTH REFUELING OUTAGE

NRC Reporting Requirements

PWSCC alternate repair criteria (ARC) for axial PWSCC at dented tube support plates (TSP) was implemented for the second time in DCPP Unit 1 during 1R12. 1R12 SG inspections and repairs were completed in April 2004.

For implementation of ARC for axial PWSCC at dented TSPs, DCPP TS 5.6.10.h requires that the results of the condition monitoring and operational assessments be reported to the NRC within 120 days following completion of the inspection. This report implements the DCPP TS reporting criteria.

To satisfy the TS, this report includes the following:

- Tabulations of indications found in the inspection, tubes repaired, and tubes left in service under the ARC.
- Growth rate distributions for indications found in the inspection and growth rate distributions used to establish the tube repair limits.
- Plus Point confirmation rates for bobbin detected indications when bobbin is relied upon for detection of axial PWSCC in less than or equal to 2 volt dents.
- For condition monitoring, an evaluation of any indications that satisfy burst margin requirements based on the Westinghouse burst pressure model, but do not satisfy burst margin requirements based on the combined Argonne National Laboratory (ANL) ligament tearing and EPRI throughwall (ANL/TW) burst pressure model.
- Performance evaluation of the operational assessment methodology for prediction of flaw distributions as a function of flaw size.
- Evaluation results of number and size of previously reported versus new PWSCC indications found in the inspection, and the potential need to account for new indications in the operational assessment burst evaluation.
- Identification of mixed mode (axial PWSCC and circumferential) indications found in the inspection and an evaluation of the mixed mode indications for potential impact on the axial indication burst pressures or leakage. In addition, as committed in DCL-02-045, performance of a trending analysis to assess the potential for increasing mixed mode affects over time.
- Any corrective actions found necessary in the event that condition monitoring requirements are not met.

One tube (two intersections) was pulled in 1R12 to satisfy voltage-based ARC requirements for axial ODSCC at TSPs. As committed in PG&E letter DCL-02-045 and as noted in the NRC safety evaluation in NRC letter to PG&E dated May 1, 2002, Attachment 1 of this enclosure provides an evaluation of ligament tearing following the SLB leak test in the laboratory. The results show that the ligament tearing model provides very conservative results.

Background: Dented TSP Plus Point Inspection Scope

The dented TSP inspection criteria and expansion plan criteria described below are based on PG&E letter to the NRC dated April 16, 2001, and WCAP-15573, Revision 1, "Depth-Based SG Tube Repair Criteria for Axial PWSCC at Dented TSP Intersections – Alternate Burst Pressure Calculation." The 1R12 Plus Point dent inspection scope was based on greater than 2 volt dents called in the prior outage, plus previously unidentified greater than 2 volt dents called in 1R12.

Plus Point inspection criteria for axial PWSCC left in service

Plus Point inspections shall be conducted on 100 percent of axial PWSCC indications at dented TSP intersections that were left in service in Unit 1 Cycle 12. 215 axial PWSCC indications had been left in service in Cycle 12 under PWSCC ARC.

Plus Point inspection criteria for >2 and <5 volt dents and for ≥ 5 volt dents

On a SG-specific basis, Plus Point inspections shall be conducted on 100 percent of ≥ 5 volt dented intersections up to and including the highest hot leg TSP elevation where PWSCC (at any size dent), circumferential indications (at any size dent), or axial ODSCC Not Detected by Bobbin (AONDB) (at ≥ 5 volt dent) have been previously detected in that SG in the prior two outages, or current outage (expansion required), plus 20 percent of ≥ 5 volt dents at each hot leg TSP elevation. In each SG where 100 percent hot leg TSP Plus Point inspections are not required, Plus Point inspections shall be conducted on 20 percent of ≥ 5 volt dents at each hot leg TSP. For any 20 percent sample, a minimum of 50 ≥ 5 volt dents shall be inspected. If the population of ≥ 5 volt dents at that TSP elevation is less than 50, then 100 percent of the ≥ 5 volt dents at that TSP shall be inspected.

On a SG-specific basis, Plus Point inspections shall be conducted on 100 percent of > 2 and < 5 volt dented intersections up to and including the highest hot leg TSP elevation where PWSCC (at any size dent), circumferential indications (at any size dent), or ≥ 2 inferred volt AONDB (at > 2 and < 5 volt dent) have been previously detected in that SG in the prior two outages, or current outage (expansion required), plus 20 percent of > 2 and < 5 volt dent at the next higher TSP elevation. If a SG is free from PWSCC (at any size dent), circumferential indications (at any size dent) and ≥ 2 inferred volt AONDB (at > 2 and < 5 volt dent), then Plus Point inspections shall be conducted on 20 percent of > 2 and < 5 volt dents at 1H. For any 20 percent sample, a

minimum of 50 > 2 and < 5 volt dents shall be inspected. If the population of > 2 and < 5 volt dents at that TSP elevation is less than 50, then 100 percent of the > 2 and < 5 volt dents at that TSP shall be inspected.

The highest TSP where PWSCC or circumferential indications have been found in the prior two outages is 4H for SG 1-1, 6H for SG 1-2, and 6H for SG 1-4. In SG 1-3, no PWSCC or circumferential indications have been detected. Because all inferred bobbin voltages for AONDB indications have been less than 2 volts, AONDB indications do not factor into the inspection scope. Based on this information, the following Plus Point dent inspection criteria was implemented to meet the requirements specified above.

≥ 5 volt dents:

- SG 1-1: 100% at 1H to 4H, 20% at 5H to 7H
- SG 1-2: 100% at 1H to 6H, 20% at 7H
- SG 1-3: 20% at 1H to 7H
- SG 1-4: 100% at 1H to 6H, 20% at 7H

> 2 and < 5 volt dents:

- SG 1-1: 100% at 1H to 4H, 20% at 5H
- SG 1-2: 100% at 1H to 6H, 20% at 7H
- SG 1-3: 20% at 1H
- SG 1-4: 100% at 1H to 6H, 20% at 7H

Table 1 provides the dent distributions that implement these criteria, and was included in the initial scope for 1R12 Plus Point inspections of greater than 2 volt dents.

Expanded Plus Point inspection scope was necessary as a result of the initial scope inspection results. Axial PWSCC was detected at three TSP 7C locations in SG 1-2 as part of the rows 3 to 10 Plus Point U-bend inspection program. These TSPs had never been inspected with a rotating coil in any prior outage. The deepest maximum depth of the three indications was sized at 56%, and the indications did not challenge structural or leakage integrity. As a result, the Plus Point inspection scope in SG 1-2 was expanded during 1R12 to include 100% of >2 volt dents at 7H and 7C, and 20% at 6C. No additional PWSCC indications were detected in this expanded scope. No PWSCC was detected in the other 3 SGs outside the critical area, so no other Plus Point expansion scope was necessary in the >2 volt dent population.

Plus Point inspection criteria for detection of circumferential indications at dents

On a SG-specific basis, if a circumferential indication or ≥ 2 inferred volt AONDB is detected in a dent of "x" volts in the prior two outages, or current outage (expansion required), then Plus Point inspections shall be conducted on 100 percent of dents greater than "x - 0.3" volts up to the affected TSP, plus 20 percent of dents greater than

"x – 0.3" volts at the next higher TSP. "X" is defined as the lowest dent voltage where a circumferential crack or ≥ 2 inferred volt AONDB was detected in that SG. For any 20 percent sample, a minimum of 50 "x – 0.3" volt dents shall be inspected. If the population of "x – 0.3" volt dents at that TSP elevation is less than 50, then 100 percent of the "x – 0.3" volt dents at that TSP shall be inspected.

Prior to 1R12, the smallest dent in which a Unit 1 circumferential crack has been detected in the prior two outages was 2.45 volts in SG 1-2. Thus, "x" = 2.45 volts, and "x – 0.3" = 2.15 volts. Since 2.15 volts is greater than 2 volts, the 2 volt dent cutoff for 1R12 Plus Point inspection was sufficient for the initial inspection scope. In 1R12, ten circumferential indications at dented TSPs were detected, as listed in Enclosure 3. All associated dent voltages were large (greater than 4 volts), except for one small circumferential ODSCC indication (0.63 volts Plus Point) detected in SG 1-1 R29C46 at 1H, for which the dent voltage was 0.51 volts. As a result, an expansion of Plus Point scope was required in SG 1-1 to include 100% of dents >0.21 volts (that is, 0.51 - 0.3 = 0.21) at 1H and 20% of dents >0.21 volts at 2H. No additional circumferential indications were detected in this expanded scope.

Plus Point inspection of bobbin distorted indications at less than or equal to 2 volt dents

One hundred percent of the tubes were inspected by bobbin coil, and the bobbin coil was relied upon for detection of axial PWSCC in ≤ 2 volt dents. If the bobbin coil detected a distorted ID support signal (DIS) at a dented TSP intersection, then Plus Point inspection was performed.

<u>Tabulations of indications found in the inspection, tubes repaired, and tubes left in service under the ARC.</u>

Two hundred twenty nine axial PWSCC indications at dented TSP intersections were detected in 1R12. Table 5 provides a tabulation of indications, including the following information:

- SG, row, column, TSP, crack number, calibration group number
- Identifies the indication as repeat or new.
- For indications that were plugged in 1R12, the reason for plugging
- Unadjusted and adjusted NDE measurements (length, maximum depth, and average depth), voltage, and adjusted NDE crack location relative to the TSP centerline.
- Burst pressures (free span and total length). For the EOC 13 operational assessment, the pressures are calculated using the ANL/TW burst model. For the EOC 12 condition monitoring assessment, the pressures are calculated using the

Westinghouse burst model. A burst pressure of 6100 psi represents a predicted burst pressure ≥ 6100 psi since all pressures predicted to exceed 6100 psi are grouped at 6100 psi to reduce computer storage requirements in the analysis.

- SLB leak rates (free span and total length) using the ANL ligament tearing model, for EOC 13 operational assessment and EOC 12 condition monitoring.

The PWSCC ARC allows axial PWSCC indications to remain in service at dented TSP intersections if the following PWSCC ARC conditions are satisfied for each indication:

- OA free span burst pressure (based on the ANL/TW model) exceeds $3\Delta P_{NO}$. The $3\Delta P_{NO}$ burst pressure is equal to 4419 psi.

- OA total length burst pressure (based on the ANL/TW model) exceeds $1.4\Delta P_{SLB}$. The $1.4\Delta P_{SLB}$ burst pressure is equal to 3367 psi, based on a ΔP_{SLB} of 2405 psi (pressurizer PORV setpoint plus uncertainty).

- OA free span leak rate, when combined with free span leak rates from other degradation mechanisms, is less than 1 gpm (0.72 gpm at room temperature) in a faulted SG.

- OA total length leak rate, when combined with leak rates from other degradation mechanisms, is less than 10.5 gpm (room temperature) in a faulted SG.

- The indication is less than 40% through-wall outside the TSP crevice.

In addition to the above PWSCC ARC conditions, axial PWSCC indications must satisfy the following exclusion criteria in order to remain in service:

- The indication is not located at a TSP intersection located in the wedge region or 7H/7C high bending stress region.

- The indication is not located at a TSP intersection that contains cracked or missing TSP ligaments.

- The indication is not located at a TSP intersection that contains another degradation mechanism.

- The indication is not located in a tube that contains another repairable indication.

Two hundred fifteen axial PWSCC indications at dented TSPs had been left in service following 1R11 under PWSCC ARC, 100 of which had been deplugged in 1R11 and returned to service. (Note: Based on results of the 1R12 sizing, re-reviews of the 1R11 data for several of the repeat indications was performed, resulting in some multiple

indications being changed to single indications, such that the actual number of repeat indications was 212, not 215.) Following 1R12 Plus Point inspection, sizing, and application of PWSCC ARC requirements, 12 of the repeat axial PWSCC indications were plugged: 6 due to ID/OD indications at the same TSP, 1 due to >40% axial PWSCC indication outside the TSP, 1 due to axial PWSCC exceeding the OA burst pressure limit at EOC 13, 1 due to a mix mode indication, 1 preventively plugged due to permeability variation at another tube location, and 2 preventively plugged due to axial PWSCC low OA burst pressure at EOC 13.

In 1R12, 17 new axial PWSCC indications at dented TSPs were detected, sized by Plus Point, and applied to PWSCC ARC requirements. All of these were allowed to remain in service under PWSCC ARC.

The indications that were located outside the TSP region were reviewed to determine the need for in situ pressure testing in accordance with the criteria in WCAP-15573 Revision 1. Namely, if condition monitoring for axial PWSCC at dented TSPs predicts free span leakage or free span burst pressures less than $3\Delta P_{NO}$, then in situ pressure testing is required. These conditions were not predicted by condition monitoring, and therefore no in situ pressure testing of axial PWSCC at dents was required nor performed.

Two hundred seventeen axial PWSCC indications at dented TSPs were returned to service in 1R12: Two hundred repeat indications and 17 new indications.

Growth rate distributions

Preliminary OA growth rate distribution.

The growth rate distribution used for the preliminary operational assessment (OA) was based on prior outage growth data. The methodology for establishing the preliminary OA growth rate was established in WCAP-15573, Revision 1 as further explained in PG&E letters DCL-02-023 and DCL-02-045. The methodology is summarized below:

- If there are at least 200 points in each of the last two cycles on the unit being inspected, the most conservative growth distribution from the last two cycles shall be used.

- If there are at least 200 points over the last two cycles on the unit being inspected, the growth distribution to be used is the more conservative of the combined data or either of the two cycles.

- If there are less than 200 points over the last two cycles on the unit being inspected, the growth distribution to be used shall contain data from both units over the last two (or three if necessary) cycles of each unit until 200 data points are obtained. The data from each cycle is compared for consistency in growth magnitude. If a given

cycle has lower growth rates than other cycles, it is not included in the growth distribution.

For 1R12, the second bullet applies. The number of growth rate data points in 1R10 and 1R11 are 83 and 119, respectively, such that there are 202 points over the last two cycles. Because there are a total of at least 200 points over the last two cycles on Unit 1, the growth distribution used for the preliminary operational assessment in 1R12 was the more conservative of 1R10 data, 1R11 data, or 1R10 plus 1R11 combined data. An evaluation was performed in Enclosure 2 to DCL-02-098 (1R11 PWSCC ARC 120 day report) and concluded that the following growth data should be used for the 1R12 preliminary OA: 1R10 length data, 1R11 average depth data, and 1R11 maximum depth data.

Cycle 12 growth rate distribution and final growth rate distribution used to establish tube repair limits.

In accordance with WCAP-15573, Revision 1, Unit 1 cycle 12 growth rates that could impact the upper tail of the preliminary OA growth distribution were monitored and evaluated during 1R12. The methodology requires that if new growth data cause the growth distribution above 90 percent probability to be more conservative, the new data should be added to the growth distribution for the final OA.

Two hundred fifteen additional growth rate data points from Cycle 12 were established, 211 from repeat indications and 4 from new indications. The Cycle 12 growth rates were compared to the 90 percentile growth rates values used in the preliminary OA. Several Cycle 12 growth rates exceeded these values, and the WCAP methodology required that these Cycle 12 data points be added to the growth distribution for the final OA. To bound the WCAP methodology, PG&E chose to develop a conservative growth distribution based on the lower bound of the cumulative probability growth distributions from the combined Cycle 12 data set and the preliminary OA data set. This lower bound growth distribution was separately developed for growth in length, maximum depth, and average depth, and then used for the 1R12 final OA calculations to determine the need for tube repair.

Table 2 provides the growth rate cumulative distribution function (CDF) per EFPY at 604 degrees F for the preliminary cycle 13 OA distribution, Cycle 12 distribution, and final cycle 13 OA distribution. Table 3 provides the 90 and 95 percentile growth values for these distributions, in addition to the prior Unit 1 cycles and the cycle 12 OA distribution for comparison.

<u>Plus Point confirmation rates for bobbin detected indications when bobbin is relied upon for detection of axial PWSCC in less than or equal to 2 volt dents.</u>

In 1R12, the bobbin coil was relied upon for detection of axial PWSCC in less than or equal to 2 volt dents. As identified in Table 4, there were 55 DIS indications detected

by bobbin at TSP intersections with non-repeat PWSCC indications. Tracking of Plus Point confirmation rates for repeat PWSCC indications tubes is not required because these known flaws are inspected by Plus Point regardless of the bobbin call.

All DIS indications were inspected by Plus Point. Only 6 of the DIS indications were confirmed as PWSCC by Plus Point, for a Plus Point confirmation rate of 10.9 percent, or an 89.1 percent bobbin overcall rate. The high bobbin overcall rate is equivalent to the approximately 90% overcall rate generated during the bobbin coil performance test documented in WCAP-15573, Revision 1. The high bobbin overcall rate establishes a very high probability of detecting significant axial PWSCC indications in less than or equal to 2 volt dents.

For condition monitoring, an evaluation of any indications that satisfy burst margin requirements based on the Westinghouse burst pressure model, but do not satisfy burst margin requirements based on the combined ANL ligament tearing and throughwall burst pressure model.

This item is not applicable, because all indications satisfied condition monitoring burst margin requirements for both the Westinghouse burst model and the ANL/TW model. The total length condition monitoring burst requirement for EOC 12 was 3367 psi at 1.4 ΔP_{SLB}, based on ΔP_{SLB} of 2405 psi (pressurizer PORV setpoint plus uncertainty). The free span length condition monitoring burst requirement for EOC 12 was 4419 psi, based on 3 times the normal operating pressure differential. The lowest total length burst pressure was associated with SG 1-2 R34C49 2H (3834 psi using Westinghouse model and 3561 psi using the ANL/TW model, per Table 6).

Performance evaluation of the operational assessment methodology for prediction of flaw distributions as a function of flaw size.

PG&E evaluated the performance of the PWSCC ARC OA methodology for prediction of flaw distributions as a function of flaw size. WCAP-15573 Revision 1 provides guidance for determining when corrective actions are needed when a single indication OA prediction significantly underestimates the burst pressure or leak rate when compared to the CM results. When comparing single indication projected leak and burst data with that obtained for the same indication from the inspection results, additional evaluations are to be performed and included in the 120 day report if: 1) the CM single indication burst pressure is <5600 psi and more than 500 psi less than the projection obtained using the same burst model; or 2) the CM single indication leak rate is more than 0.2 gpm larger than the projected SLB leak rate.

Analysis of SLB Leak Rates

Regarding CM single indication total length SLB leak rates, an EOC 12 leak rate of 0.063 gpm is calculated for SG 1-2 due to a 100% throughwall axial PWSCC indication in R34C49 2H. Other than R34C49, no other CM single indication leakage was

calculated in any SG, either from total length or free span. From the prior cycle OA, no CM single indication leakage was calculated in any SG, either from total length or free span. Therefore, the R34C49 CM total length leakage at EOC 12 was not predicted, but since the leak rate was negligible and less than the 0.2 gpm threshold value for significance, corrective actions are not required.

Analysis of Burst Pressures

The free span burst for all indications exceeded the default value of 6100 psi for both the prior cycle OA and the CM. Therefore, no performance evaluation is required for free span burst pressures.

A detailed total length burst pressure benchmarking analysis (CM versus prior cycle OA projections) was performed for the repeat indications that had been left in service in Unit 1 Cycle 12 under PWSCC ARC. As required by the PWSCC ARC, the OA burst pressures are 95/95 values, and the CM burst pressures are 95/50 values. Table 6 provides the results of the benchmarking. For both the Westinghouse model and the ANL/TW model, the total length burst pressures listed in the "prior cycle OA projection" columns were compared against the burst pressures in the "CM" columns, and the differences in CM versus OA burst pressures are listed. Since the CM of record uses the Westinghouse model and the OA of record uses the ANL/TW model, a comparison of the Westinghouse CM versus ANL/TW OA burst pressures was also performed in Table 6. Figure 1 plots the results of this latter comparison as a means to evaluate the performance of the PWSCC ARC OA methodology for prediction of flaw distributions as a function of flaw size. The Figure 1 comparison shows that the majority of the CM as found burst pressures were greater (more conservative) than the prior cycle OA burst pressures, thus verifying the effectiveness of the ARC methods.

The EOC 12 projections used very conservative growth rate distributions that were established prior to 1R11, using bounding data from Unit 1 and Unit 2 cycles 8, 9, and 10, as described in Enclosure 2 to PG&E letter DCL-02-098 (1R11 120 day report for PWSCC ARC). The 95% growth rates from this data set were 0.081 inch, 14.57% maximum depth, and 12.35% average depth (see Table 3). Prior cycle data from both plants was used because there was less than 200 data points over Unit 1 cycles 9 and 10, per the growth criteria listed in the third bullet described earlier. No data from Unit 1 Cycle 11 was included because it was determined to be less conservative then this data set. Use of this growth distribution resulted in conservative predictions for burst pressure in all but four cases, when comparing burst pressures from the Westinghouse model for CM and the ANL/TW model for OA. From Figure 1 and Table 6, four indications had Westinghouse CM burst pressures less than the prior cycle ANL/TW OA burst pressures, with the maximum "under prediction" of 319 psi for SG 1-2 R34C49 2H.

For CM single indications with burst pressures less than 5600 psi, the data was evaluated to determine if the CM burst pressure was more than 500 psi less than the OA projection obtained using the same burst model. There was one indication that met

this criteria: SG 1-2 R34C49 2H. From Table 6, the burst pressures were "under predicted" by 548 psi and 592 psi using the Westinghouse and ANL/TW models, respectively.

Section 7.12 of WCAP-15573 Revision 1, states: "Growth rates were evaluated as a potential causative factor for the discrepancy between the projections and measurements. If the under prediction is not attributable to underestimates of growth in the projections, additional evaluations shall be performed to identify the causative factor and the evaluation shall be included in the 120 day report. If the under prediction is attributable to underestimates of growth in the projections, the 120 day report should provide a corrected growth distribution to better predict the next EOC conditions."

PG&E reviewed the R34C49 under prediction to determine if it was attributable to underestimates of growth in the projections. To determine if there were causal relationships between under predictions and growth rates, the following factors were evaluated and flagged in Table 6: the growth rate was in a deplugged tube; the growth rate was in an indication that was less than 1 volt in 1R11 and exceeded 1 volt in 1R12; the growth rate was in the upper 95% tail of the growth rate distribution used to project the burst pressure. In addition, the overall Cycle 12 growth trends were reviewed against prior cycles. These factors are discussed and evaluated below.

Review of Cycle 12 and prior cycle growth trends. Table 6 provides the Cycle 12 growth rates for all of the indications, and Table 3 provides the 90 and 95 percentile growth rate values for Cycle 12. It was noted that the 95% Cycle 12 growth rates for length, maximum depth, and average depth are higher than Unit 1 Cycle 10 and 11, with a slight increasing trend by cycle. The growth data set has also increased each cycle, from 83, 119, and 215. The large data set increase in cycle 12 is due to the large number of PWSCC indications deplugged and returned to service in 1R11. The Cycle 12 95% growth rates are within expectations and bounded by the 95% growth rates originally derived in WCAP-15573 Revision 1. It was also noted that the Cycle 12 95% growth rates are less than the growth rates used in the prior cycle OA for EOC 12 projections, leading to a conclusion that potential under predictions would not generally be attributable to underestimates of growth in the projections.

Review of difference in sizing techniques. Several maximum depth and average depth growth rates were in the upper 95% tail of the growth distribution used in the prior cycle OA, including R34C49 2H. Although not applicable to R34C49, it was determined that the majority of these instances were due to an indication increasing from less than 1 volt in 1R11 to greater than 1 volt in 1R12. In accordance with PWSCC ARC methods, the maximum depth for an indication less than 1 volt is determined by the depth from phase angle analysis at maximum volts (likely most reliable depth for low voltage indications) with a minimum of 20%, and the maximum depth for an indication greater than 1 volt is determined by direct phase angle analysis even though the location of maximum depth may not be at the location of maximum volts. This difference in sizing techniques for low voltage indications can lead to increased growth estimates. There

were 20 data points in this category, and the majority of these points were in the upper tail of the Cycle 12 growth distribution. For sensitivity, these MD and AD points were removed from the Cycle 12 growth distribution, and reduced the 90% growth values to approximately the same values as the Cycle 11 growth rates (see Table 3). This demonstrates that the Cycle 12 growth rates were not increasing at unexpected rates. For conservatism, all of these data points were included in the growth distribution for the Cycle 13 OA. No methods changes are recommended because all growth rates are conservatively included in the OA.

Review of deplugged tube growth. R34C49 was deplugged in 1R11 and returned to service in Cycle 12. The 90% growth values for tubes deplugged in 1R11 and returned to service in cycle 12 were calculated and are listed in Table 3. The 90% values are less than the 90% values with all Cycle 12 data, so deplugged tubes are not growing at a rate higher than the non-deplugged tubes, and methods changes are not needed for deplugged tubes.

Review of high growth in upper tail. From Table 6, it was noted that the maximum and average depth growth rates for R34C49 were in the 95% upper tail of the growth distribution used in the prior cycle OA. For R34C49, the 1R11 maximum depth was 75% with a maximum voltage of 3.81 volts, and the 1R12 maximum depth was 100% with a maximum voltage of 4.20 volts. The 1R11 and 1R12 flaw profiles for R34C49 were evaluated and no significant flaw changes were apparent, other than an increase in depth. The burst pressure projection for R34C49 is primarily influenced by growth in average depth. From Table 6, the average depth growth rate was 13.7% per EFPY, which corresponds to a cumulative probability of about 97% for the growth distribution used in the EOC 12 projections. Since the calculated burst pressures are evaluated at 95% probability, the large average depth growth rate for R34C49 would not have been fully reflected in the predicted burst pressure. Thus, it is concluded that the under predicted burst pressure for R34C49 is a statistical consequence of applying 95% probability for the burst pressure projections.

To confirm that R34C49 under prediction has no affect on the total SG probability of burst, a benchmark was conducted by calculating the total SG 1-2 POB using Monte Carlo analysis for both the projected EOC 12 (prior cycle OA) and for the as found EOC 12 conditions (CM).

Total SG 1-2 POB

	POD	POB
Projected EOC 12 (95/95)	0.6	2.3E-04
Projected EOC 12 (95/95)	1.0	8.5E-05
As Found EOC 12 (95/50)	0.6	2.3E-05
As Found EOC 12 (95/50)	1.0	1.3E-05

These results show that POB projections were conservative when applying either a POD of 1.0 or 0.6. The conservative benchmarking using a POD of 1.0 (8.5E-05

projected versus 1.3E-05 as found) validates the ARC methods assumption that new indications do not need to be accounted for in the ARC analysis.

Based on the above evaluations, it is concluded that the R34C49 under prediction is not attributable to underestimates of growth in the projections. Additional evaluations were performed to identify the causative factor. It is concluded that the under predicted burst pressure for R34C49 is a statistical consequence of applying 95% probability for the burst pressure projections. Therefore, the operational assessment methodology is determined to be adequately conservative. As a preventive measure, two indications with the lowest projected EOC 13 OA burst pressures (other than SG 1-2 R34C49 2H) were preventively plugged: SG 1-2 R34C57 2H, crack 1 and crack 2 with OA burst pressures of 3940 psi and 4003 psi, respectively.

Evaluation results of number and size of previously reported versus new PWSCC indications found in the inspection, and the potential need to account for new indications in the operational assessment burst evaluation.

As discussed above, 17 new axial PWSCC indications at dented TSPs were detected, sized by Plus Point, and applied to PWSCC ARC requirements. All of these were allowed to remain in service under PWSCC ARC. With one exception, the CM and OA burst pressures were in excess of 6100 psi using either the Westinghouse model or the ANL/TW model. The Westinghouse CM and ANL/TW OA burst pressures for SG 1-2 R7C31 7C were 5703 and 4866 psi, respectively. Therefore, because the number of new flaws is relatively small and all new indications have OA burst pressures well in excess of burst margin requirements, there is no need to account for new indications in the OA burst evaluation.

Identification of mixed mode (axial PWSCC and circumferential) indications found in the inspection and an evaluation of the mixed mode indications for potential impact on the axial indication burst pressures or leakage. In addition, performance of a trending analysis to assess the potential for increasing mixed mode affects (e.g., circumferential crack depths, burst pressure reductions, increased leakage rates) over time.

For PWSCC ARC, a mixed mode indication is defined as an axial PWSCC indication and a circumferential indication (either PWSCC or ODSCC) occurring at the same dented TSP intersection. One mixed mode indication (axial PWSCC and circumferential PWSCC) was detected during 1R12 and was plugged. The location was SG 1-2 R36C53 3H. The tube had been unplugged in 1R11, and axial PWSCC was left in service at this location under PWSCC ARC. The circumferential PWSCC indication was not detected in 1R11 but was detectable based on a lookup of 1R11 data. The dent was measured as 4.02 volts.

For SG 1-2 R36C53 3H, the 1R12 null distance of 56 degrees (0.43 inch) was measured between the axial and circumferential indications using the 0.080 pancake coil technique at 600 Khz. The 0.43 inch null distance exceeds the 0.25 inch

separation distance requirement, and therefore the flaw is not interacting. Even if the flaw was interacting, the NDE average depth of the circumferential flaw is 51 percent, including 95 percent uncertainty for mixed mode affects, which is less than the 75 percent average depth threshold value for mixed mode affects. In addition, neither the axial nor circumferential indications are 100 percent throughwall at any point. The circumferential indication is 64 percent maximum depth, including 95 percent NDE uncertainty. The measured maximum depth of the axial indication is 30 percent (adjusted NDE), and has no predicted SLB leakage at 95/50 confidence for condition monitoring (CM). The CM burst pressure of the axial indication is in excess of 6100 psi. Based on this mixed mode assessment, there is no potential impact on the axial PWSCC indication burst pressure or leakage.

There are several conditions that require evaluation to determine the need for corrective actions. These are discussed below.

- If an interacting mixed mode indication is found to have led to a reduction in the axial indication burst pressure by more than 10 percent and to less than 4000 psi, or to have caused an indication to not satisfy burst margin requirements, the burst margin requirements for implementation in the OA at the next and subsequent outages must be increased by the percentage reduction in the burst pressure found for the mixed mode indication. As discussed above, because this condition did not occur, there are no corrective actions needed to adjust burst margin requirements for future operational assessments.

- If an interacting mixed mode indication is found, and the axial indication condition monitoring predicts SLB leakage at 95/50, and the circumferential indication has > 50 percent average depth including NDE uncertainty, then the CM leak rate for the axial indication must be increased by a leakage factor. In addition, the OA SLB leak rate for each SG must be increased by a leakage factor. As discussed above, because this condition did not occur, there are no corrective actions needed to adjust SLB leak rates for CM or OA.

- If a previously Plus Point inspected TSP intersection is found to have a circumferential indication with average depth > 80 percent after accounting for NDE uncertainty, then the OA SLB leak rate for each SG must be increased by a leakage factor. 9 of the 10 TSP circumferential indications detected in 1R12 were previously Plus Point inspected in 1R11. Of these 9, the deepest 1R12 circumferential indication was 55 percent average depth, including NDE uncertainty, less than the 80 percent average depth threshold. Therefore, no corrective actions are needed to adjust the OA SLB leak rates.

In response to NRC request for additional information, PG&E letter DCL-02-045 dated April 18, 2002, committed to perform a trending analysis in the 120 day report to assess the potential for increasing mixed mode affects (e.g., circumferential crack depths, burst pressure reductions, increased leakage rates) over time. Since no burst pressure

reductions or leakage rate multipliers have been required, there is no data to trend for these parameters. Trending of circumferential depths and number of circumferential indications is provided in Figures 2, 3, and 4. Figure 2 provides all DCPP Units 1 and 2 TSP PWSCC and ODSCC circumferential indication measured "adjusted" average depths versus year detected. The adjustments do not include NDE uncertainty. The average depths show a fairly flat trend line. Figure 3 data is a subset of Figure 2, showing the mixed mode circumferential indication average depths versus year detected. Only two mixed mode circumferential indications have been detected at the same TSP with an axial PWSCC indication that had been returned to service (1R11 SG 1-2 R11C81 and 1R12 SG 1-2 R36C53). The Figure 3 average depths show a decreasing trend line. Figure 4 provides the cumulative distribution of the number of DCPP Units 1 and 2 TSP PWSCC and ODSCC circumferential indications detected over time. The trend does not indicate a large increase in the numbers of circumferential indications in recent inspections.

This trending assessment does not indicate a need to modify any mixed mode evaluation criteria such as applying the criteria that could lead to an increase in the burst margin requirements.

Any corrective actions found necessary in the event that condition monitoring requirements are not met.

This item is not applicable, because all indications satisfied condition monitoring burst margin requirements and leakage margin requirements.

All CM burst pressures, evaluated at 95 percent probability and 50 percent confidence (95/50), exceeded the 3367 psi total length SLB burst margin requirement and the 4419 psi free span burst margin requirement, using both the Westinghouse model and the ANL/TW model.

CM single indication SLB leak rates were evaluated at 95 percent probability and 50 percent confidence (95/50), using the ANL ligament tearing model. No free span leakage was calculated, and only one indication had total length leakage. SG 1-2 R34C49 2H had a total length leak rate of 0.063 gpm. The contribution of this leak rate to leakage from other ARC (W* ARC and voltage-based ARC) results in total ARC leak rate in SG 1-2 much less than the 10.5 gpm ARC leak rate limit.

Table 1
1R12 Initial Scope for Plus Point Inspection of > 2 Volt Dents

2 - 5 Volt Dents

TSP	SG 1-1	SG 1-2	SG 1-3	SG 1-4	TOTAL
1H	15	166	50	357	588
2H	56	149	0	150	355
3H	17	98	0	202	317
4H	7	107	0	133	247
5H	7	63	0	82	152
6H	0	17	0	221	238
7H	0	50	0	50	100
TOTAL	102	650	50	1195	1997

≥ 5 Volt Dents

TSP	SG 1-1	SG 1-2	SG 1-3	SG 1-4	TOTAL
1H	1	90	17	356	464
2H	20	62	5	52	139
3H	5	58	9	62	134
4H	2	75	4	88	169
5H	4	18	36	38	96
6H	1	1	16	240	258
7H	50	29	50	71	200
TOTAL	83	333	137	907	1460

Initial scope criteria:

- SG 11: 100% of >2 and <5 volt dents from 1H to 4H, 20% at 5H
  100% of ≥5 volt dents from 1H to 4H, 20% from 5H to 7H
- SG 12: 100% of >2 and <5 volt dents from 1H to 6H, 20% at 7H
  100% of ≥5 volt dents from 1H to 6H, 20% at 7H
- SG 13: 20% of >2 and <5 volt dents at 1H
  20% of ≥5 volt dents from 1H to 7H
- SG 14: 100% of >2 and <5 volt dents from 1H to 6H, 20% at 7H
  100% of ≥5 volt dents from 1H to 6H, 20% at 7H
- All 20% samples shall contain a minimum of 50 dents. If the population of dents at the TSP elevation is less than 50, then inspect 100% of the dents at the TSP.

Note: Scope was expanded beyond above table in accordance with the following criteria:

- SG 11: 100% of >0.21 volt dents at 1H, 20% of >0.21 volt dents at 2H
- SG 12: 100% of >2 and <5 volt dents at 6H, 7H, 7C, 20% at 6C
  100% of ≥5 volt dents at 6H, 7H, 7C, 20% at 6C
- All 20% samples shall contain a minimum of 50 dents. If the population of dents at the TSP elevation is less than 50, then inspect 100% of the dents at the TSP.

Table 2
Axial PWSCC Cumulative Probability Distribution (CPD) Growth Rates per EFPY at 604F for Length, Maximum Depth, and Average Depth

	Prelim Cycle 13 OA CPD	Cycle 12 CPD	Lower Bound CPD (used for Final Cycle 13 OA)
Length Bin (inch)			
0	0.289	0.363	0.289
0.01	0.337	0.474	0.337
0.02	0.470	0.684	0.470
0.03	0.590	0.763	0.590
0.04	0.687	0.847	0.687
0.05	0.771	0.912	0.771
0.06	0.819	0.944	0.819
0.07	0.892	0.967	0.892
0.08	0.928	0.972	0.928
0.09	0.976	0.991	0.976
0.1	0.976	1.000	0.976
0.11	0.976	1.000	0.976
0.12	0.988	1.000	0.988
0.13	0.988	1.000	0.988
0.14	1.000	1.000	1.000
MD Bin (% TW fraction)			
0	0.504	0.293	0.293
0.01	0.580	0.330	0.330
0.02	0.655	0.423	0.423
0.03	0.739	0.498	0.498
0.04	0.773	0.586	0.586
0.05	0.815	0.716	0.716
0.06	0.849	0.749	0.749
0.07	0.891	0.800	0.800
0.08	0.908	0.833	0.833
0.09	0.941	0.874	0.874
0.1	0.975	0.921	0.921
0.11	0.983	0.930	0.930
0.12	0.983	0.963	0.963
0.13	0.992	0.967	0.967
0.14	1.000	0.972	0.972
0.15		0.981	0.981
0.16		0.991	0.991
0.17		0.991	0.991
0.18		0.991	0.991
0.19		0.991	0.991
0.20		1.000	1.000
AD Bin (% TW fraction)			
0	0.387	0.247	0.247
0.01	0.521	0.363	0.363
0.02	0.664	0.474	0.474
0.03	0.714	0.553	0.553
0.04	0.765	0.660	0.660
0.05	0.840	0.767	0.767
0.06	0.882	0.851	0.851
0.07	0.916	0.907	0.907
0.08	0.950	0.935	0.935
0.09	0.950	0.944	0.944
0.1	0.966	0.963	0.963
0.11	0.975	0.967	0.967
0.12	0.983	0.977	0.977
0.13	0.983	0.986	0.983
0.14	1.000	1.000	1.000

Table 3
Growth Rates per EFPY at 604F

Cycle	Length (inch)		MD %		AD %	
	90%	95%	90%	95%	90%	95%
Unit 1 Cycle 10	0.074	0.083	5.51	6.89	4.74	6.38
Unit 1 Cycle 11	0.037	0.050	7.80	9.22	6.29	8.03
Unit 1 Cycle 12 OA (used to establish 1R11 tube repair limits), Note 2	0.069	0.081	12.07	14.57	9.23	12.35
Unit 1 Cycle 12	0.050	0.060	9.69	11.37	6.88	9.14
Unit 1 Cycle 12, deplugged only	0.052	0.058	8.45	11.18	5.50	8.26
Unit 1 Cycle 12 with exclusion of certain depth data, Note 1	0.050	0.060	8.07	9.94	5.93	7.50
Preliminary Unit 1 Cycle 13 OA, Note 3	0.074	0.083	7.80	9.22	6.29	8.03
Final Unit 1 Cycle 13 OA (used to establish 1R12 tube repair limits)	0.074	0.083	9.69	11.37	6.88	9.14

Note 1: Depth data points excluded if 1R11 maximum volts is less than 1 volt and 1R12 maximum volts is greater than 1 volt.
Note 2: Consists of bounding data from Unit 1 cycles 8, 9, and 10, and Unit 2 cycles 8, 9, and 10, as defined in Table 2 of DCL-02-098.
Note 3: Consists of data from Unit 1 Cycle 10 (length) and Unit 1 Cycle 11 (max depth and average depth).

Table 4
DIS Confirmation Rates

	SG 1-1	SG 1-2	SG 1-3	SG 1-4	Total
Number of bobbin DIS (excludes repeat PWSCC indications)	18	27	6	4	55
Number of new PWSCC indications confirmed by Plus Point	5	1	0	0	6
Plus Point confirmation rate	28%	4%	0%	0%	10.9%
Bobbin DIS overcall rate	72%	96%	100%	100%	89.1%

Table 5 - 1R12 PWSCC ARC Summary of Analysis Results

									Unadjusted NDE			Adjusted NDE						EOC 12 CM (WEC Burst Model)				EOC 13 OA (ANL/TW Burst Model)			
Insp Year	SG	Row	Col	TSP	Crack No.	Cal	1R12 category	Reason for 1R12 plugging	Length (in.)	Max. Depth (%)	Avg. Depth (%)	Length (in.)	Max. Depth (%)	Avg. Depth (%)	Volts	From	To	FS Burst Press psi	FS Leakage gpm	Total Length Burst Press. psi	Total Length Leakage gpm	FS Burst Press psi	FS Leakage gpm	Total Length Burst Press. psi	Total Length Leakage gpm
2004	1	3	28	02H	1	21	Repeat		0.14	43.0	30.6	0.14	43.0	30.6	0.58	-0.18	-0.04	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	4	41	01H	1	21	Repeat		0.13	31.0	20.9	0.06	20.0	11.8	0.43	-0.04	0.02	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	14	28	02H	1	21	Repeat		0.13	37.0	28.3	0.13	31.0	23.7	0.42	0.13	0.26	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	15	16	02H	1	21	Repeat		0.24	26.0	15.6	0.10	20.0	11.0	0.38	-0.07	0.03	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	15	76	02H	1	21	Repeat		0.12	67.0	40.8	0.08	34.0	19.0	0.46	-0.11	-0.03	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	17	16	02H	1	71	New		0.24	61.0	32.8	0.18	37.0	26.3	0.97	-0.19	-0.01	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	19	15	03H	1	21	Repeat		0.29	46.0	31.5	0.26	46.0	30.5	1.15	-0.09	0.17	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	20	28	02H	1	21	Repeat		0.22	43.0	26.6	0.19	28.0	19.1	0.89	-0.23	-0.04	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	20	29	02H	1	21	Repeat		0.24	58.0	39.2	0.17	40.0	29.6	0.74	0.09	0.26	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	20	33	01H	1	21	Repeat		0.11	34.0	16.2	0.09	20.0	14.4	0.28	-0.18	-0.09	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	21	13	03H	1	71	New		0.21	31.0	17.9	0.19	26.0	14.1	0.99	-0.13	0.06	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	21	51	02H	1	69	New		0.09	20.0	14.2	0.09	20.0	14.2	0.40	-0.14	-0.05	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	21	54	01H	1	81	New		0.22	74.0	51.5	0.10	41.0	28.2	0.66	-0.08	0.02	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	22	23	02H	1	21	Repeat		0.16	40.0	26.6	0.16	34.0	22.6	0.90	-0.26	-0.10	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	22	23	02H	2	21	Repeat		0.17	46.0	30.5	0.10	31.0	19.4	0.68	0.09	0.19	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	22	23	02H	3	21	New		0.16	43.0	30.3	0.14	23.0	15.2	0.57	0.26	0.40	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	23	14	03H	1	21	Repeat		0.15	58.0	32.7	0.13	40.0	24.7	0.56	-0.11	0.02	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	24	67	02H	1	21	Repeat		0.25	52.0	36.2	0.18	37.0	27.3	0.80	-0.08	0.10	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	25	57	03H	1	21	Repeat		0.38	55.0	34.6	0.24	34.0	23.8	0.69	-0.10	0.14	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	26	25	01H	1	21	Repeat	IDOD	0.38	49.0	33.3	0.28	49.0	33.2	1.31	0.02	0.30	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	27	75	02H	1	21	Repeat		0.21	70.0	41.8	0.12	34.0	21.3	0.90	0.31	0.43	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	28	27	01H	1	21	Repeat	IDOD	0.34	52.0	33.1	0.34	52.0	33.1	1.22	-0.34	0.00	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	29	37	02H	1	21	Repeat		0.24	40.0	26.2	0.20	34.0	23.9	0.72	-0.07	0.13	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	30	21	02H	1	21	Repeat		0.24	58.0	37.0	0.15	28.0	17.0	0.60	-0.10	0.05	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	30	59	02H	1	69	New		0.19	49.0	32.5	0.13	31.0	24.3	0.57	-0.13	0.00	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	30	67	02H	1	21	Repeat		0.33	40.0	29.8	0.31	40.0	28.7	1.06	-0.15	0.16	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	34	24	03H	1	21	Repeat		0.18	49.0	23.1	0.15	37.0	18.1	0.54	-0.06	0.09	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	34	24	03H	2	21	Repeat		0.14	31.0	17.6	0.09	26.0	13.3	0.44	0.14	0.23	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	35	59	03H	1	21	Repeat		0.27	43.0	26.1	0.27	43.0	26.1	1.10	-0.16	0.11	6100	0.000	6100	0.000	6100	0.000	6100	0.000

Table 5 - 1R12 PWSCC ARC Summary of Analysis Results

									Unadjusted NDE			Adjusted NDE						EOC 12 CM (WEC Burst Model)				EOC 13 OA (ANL/TW Burst Model)			
Insp Year	SG	Row	Col	TSP	Crack No.	Cal	1R12 category	Reason for 1R12 plugging	Length (in.)	Max. Depth (%)	Avg. Depth (%)	Length (in.)	Max. Depth (%)	Avg. Depth (%)	Volts	From	To	FS Burst Press psi	FS Leakage gpm	Total Length Burst Press. psi	Total Length Leakage gpm	FS Burst Press psi	FS Leakage gpm	Total Length Burst Press. psi	Total Length Leakage gpm
2004	1	38	41	04H	1	21	Repeat		0.23	37.0	17.4	0.23	31.0	14.6	0.99	-0.29	-0.06	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	1	39	57	02H	1	21	Repeat		0.14	34.0	21.9	0.09	20.0	13.0	0.52	-0.18	-0.09	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	2	10	03H	1	31	Repeat		0.42	62.0	32.2	0.37	42.0	29.4	1.21	-0.20	0.17	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	2	28	03H	1	31	Repeat		0.26	62.0	42.6	0.22	42.0	28.2	0.76	-0.21	0.01	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	2	76	02H	1	29	Repeat		0.17	48.0	18.5	0.15	20.0	13.2	0.49	-0.17	-0.02	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	2	78	01H	1	29	Repeat		0.12	51.0	22.5	0.06	20.0	10.0	0.53	0.08	0.14	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	2	79	03H	1	29	Repeat		0.48	63.0	19.4	0.39	20.0	12.0	0.71	-0.15	0.24	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	2	90	04H	1	30	Repeat		0.12	45.0	30.5	0.12	45.0	30.5	1.11	-0.38	-0.26	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	2	90	04H	2	30	Repeat		0.37	55.0	30.8	0.25	55.0	30.9	1.67	-0.22	0.03	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	2	92	05H	1	30	Repeat		0.06	39.0	24.0	0.06	33.0	20.3	0.22	-0.42	-0.36	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	2	92	05H	2	30	Repeat		0.08	45.0	20.0	0.08	20.0	8.9	0.46	-0.07	0.01	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	2	92	05H	3	30	Repeat		0.21	16.0	8.8	0.13	20.0	15.0	0.54	0.13	0.26	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	2	93	04H	1	30	Repeat		0.11	27.0	15.7	0.11	27.0	15.7	0.43	0.12	0.23	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	3	46	7C	1	71	New		0.24	65.0	30.2	0.24	31.0	19.1	0.89	-0.08	0.16	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	4	54	02H	1	29	Repeat		0.26	36.0	22.4	0.24	27.5	15.9	0.81	-0.08	0.16	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	4	57	01H	1	29	Repeat		0.16	60.0	22.0	0.06	20.0	12.3	0.42	0.05	0.11	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	4	58	01H	1	29	New		0.13	90.0	43.8	0.08	28.0	17.9	0.78	-0.26	-0.18	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	4	58	01H	2	29	Repeat		0.71	69.0	32.2	0.63	45.0	30.1	1.11	-0.30	0.33	6100	0.000	6100	0.000	6100	0.000	5544	0.000
2004	2	4	58	01H	3	29	Repeat		0.56	76.0	47.5	0.41	54.0	46.0	2.84	-0.05	0.36	6100	0.000	5712	0.000	6100	0.000	4897	0.000
2004	2	4	84	01H	1	30	Repeat		0.17	73.0	36.7	0.15	33.0	21.5	0.51	0.00	0.15	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	5	39	02H	1	31	Repeat	IDOD	0.24	66.0	37.8	0.19	36.0	28.5	1.00	-0.18	0.01	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	5	65	01H	1	29	Repeat		0.43	36.0	21.4	0.29	36.0	24.2	0.66	-0.24	0.05	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	5	66	02H	1	29	Repeat		0.16	45.0	31.7	0.14	33.0	23.4	0.77	-0.15	-0.01	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	5	77	05H	1	29	Repeat		0.21	54.0	33.1	0.21	45.0	27.6	0.92	-0.28	-0.07	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	5	78	01H	1	29	Repeat		0.49	54.0	29.0	0.34	54.0	30.9	1.16	0.07	0.41	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	5	93	01H	1	30	Repeat		0.29	33.0	16.9	0.29	27.0	13.9	0.80	-0.21	0.08	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	6	55	7C	1	63	New		0.31	53.0	35.3	0.23	35.0	26.4	0.74	-0.16	0.07	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	6	74	03H	1	29	Repeat		0.09	28.0	14.9	0.07	20.0	11.1	0.33	-0.48	-0.41	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	6	74	03H	2	29	New		0.26	33.0	22.0	0.21	20.0	12.8	0.67	-0.15	0.06	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	7	31	01H	1	31	Repeat		0.31	66.0	35.9	0.29	33.0	25.7	0.84	0.01	0.30	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	7	31	7C	1	65	New		0.56	79.0	45.3	0.49	56.0	42.6	2.07	-0.30	0.19	6100	0.000	5703	0.000	6100	0.000	4866	0.000

Table 5 - 1R12 PWSCC ARC Summary of Analysis Results

									Unadjusted NDE			Adjusted NDE						EOC 12 CM (WEC Burst Model)				EOC 13 OA (ANL/TW Burst Model)			
Insp Year	SG	Row	Col	TSP	Crack No.	Cal	1R12 category	Reason for 1R12 plugging	Length (in.)	Max. Depth (%)	Avg. Depth (%)	Length (in.)	Max. Depth (%)	Avg. Depth (%)	Volts	From	To	FS Burst Press psi	FS Leakage gpm	Total Length Burst Press. psi	Total Length Leakage gpm	FS Burst Press psi	FS Leakage gpm	Total Length Burst Press. psi	Total Length Leakage gpm
2004	2	7	53	03H	1	29	Repeat		0.20	66.0	28.7	0.17	30.0	17.2	0.70	-0.02	0.15	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	7	68	03H	1	29	Repeat		0.17	83.0	39.6	0.13	33.0	23.4	0.98	0.15	0.28	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	8	4	05H	1	93	New		0.30	57.0	35.5	0.25	42.0	32.1	1.06	-0.27	-0.02	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	8	15	02H	1	31	Repeat		0.37	45.0	35.5	0.29	45.0	34.2	1.05	-0.13	0.16	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	8	48	01H	1	90	New		0.14	34.0	23.6	0.14	26.0	18.0	0.56	-0.22	-0.08	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	8	55	01H	1	29	Repeat		0.26	69.0	41.5	0.20	48.0	35.1	1.34	-0.11	0.09	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	8	57	01H	1	29	Repeat		0.50	79.0	49.0	0.44	60.0	45.3	2.17	-0.30	0.14	6100	0.000	5734	0.000	6100	0.000	4905	0.000
2004	2	8	61	02H	1	29	Repeat		0.22	51.0	37.8	0.22	51.0	37.8	1.14	-0.32	-0.10	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	8	61	02H	2	29	Repeat		0.14	42.0	32.0	0.14	36.0	27.5	0.55	-0.10	0.04	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	8	61	02H	3	29	Repeat		0.27	60.0	28.9	0.20	36.0	18.9	0.76	0.04	0.24	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	8	66	02H	1	29	Repeat		0.15	66.0	39.4	0.13	39.0	30.6	0.48	-0.31	-0.18	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	8	93	01H	1	30	Repeat		0.15	59.0	38.9	0.13	33.0	20.0	0.89	-0.19	-0.06	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	9	27	03H	1	31	Repeat		0.13	39.0	24.5	0.11	24.0	15.9	0.30	-0.14	-0.03	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	9	30	01H	1	31	Repeat		0.52	84.0	56.2	0.37	59.0	49.3	2.30	-0.18	0.19	6100	0.000	5628	0.000	6100	0.000	4843	0.000
2004	2	9	38	02H	1	31	Repeat		0.50	59.0	45.3	0.41	59.0	44.0	2.62	-0.24	0.17	6100	0.000	5891	0.000	6100	0.000	5070	0.000
2004	2	9	45	01H	1	31	Repeat		0.19	45.0	28.5	0.19	45.0	28.5	1.23	0.05	0.24	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	9	53	01H	1	29	Repeat		0.40	45.0	30.8	0.28	39.0	30.3	1.26	-0.09	0.19	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	9	56	01H	1	29	Repeat		0.22	60.0	35.8	0.19	52.5	33.5	1.03	-0.35	-0.16	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	9	82	03H	1	30	Repeat		0.23	45.0	29.7	0.23	45.0	29.7	1.39	0.06	0.29	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	10	49	03H	1	31	Repeat		0.31	36.0	20.8	0.20	24.0	13.7	0.61	0.01	0.21	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	10	62	01H	1	29	Repeat		0.41	54.0	37.7	0.33	51.0	36.5	1.11	-0.11	0.22	6100	0.000	6100	0.000	6100	0.000	5764	0.000
2004	2	10	67	01H	1	29	Repeat		0.32	45.0	26.1	0.30	22.0	14.0	0.82	-0.28	0.02	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	10	68	01H	1	29	Repeat		0.34	73.0	43.5	0.20	45.0	34.4	1.46	-0.22	-0.02	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	10	69	02H	1	29	Repeat		0.09	14.0	10.9	0.09	20.0	15.6	0.48	-0.25	-0.16	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	10	80	01H	1	30	Repeat		0.23	52.0	24.4	0.17	30.0	19.9	0.62	-0.31	-0.14	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	10	85	04H	1	30	Repeat		0.13	55.0	32.7	0.08	36.0	24.2	0.53	0.18	0.26	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	11	20	02H	1	31	Repeat		0.35	62.0	44.1	0.24	55.0	40.3	1.61	-0.09	0.15	6100	0.000	6100	0.000	6100	0.000	5860	0.000
2004	2	11	45	01H	1	31	Repeat		0.41	52.0	18.9	0.41	52.0	18.9	1.01	-0.12	0.29	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	11	66	03H	1	29	Repeat		0.22	33.0	23.5	0.20	25.0	16.4	0.96	-0.19	0.01	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	11	71	01H	1	29	Repeat		0.38	48.0	38.8	0.31	48.0	37.9	1.45	-0.30	0.01	6100	0.000	6100	0.000	6100	0.000	5785	0.000
2004	2	11	71	01H	2	29	Repeat		0.11	60.0	35.4	0.09	28.0	15.5	0.54	0.03	0.12	6100	0.000	6100	0.000	6100	0.000	6100	0.000

Table 5 - 1R12 PWSCC ARC Summary of Analysis Results

									Unadjusted NDE			Adjusted NDE						EOC 12 CM (WEC Burst Model)				EOC 13 OA (ANL/TW Burst Model)			
Insp Year	SG	Row	Col	TSP	Crack No.	Cal	1R12 category	Reason for 1R12 plugging	Length (in.)	Max. Depth (%)	Avg. Depth (%)	Length (in.)	Max. Depth (%)	Avg. Depth (%)	Volts	From	To	FS Burst Press psi	FS Leakage gpm	Total Length Burst Press. psi	Total Length Leakage gpm	FS Burst Press psi	FS Leakage gpm	Total Length Burst Press. psi	Total Length Leakage gpm
2004	2	11	71	01H	3	29	Repeat		0.13	42.0	18.9	0.11	20.0	13.3	0.43	-0.16	-0.05	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	11	71	01H	4	29	Repeat		0.23	28.0	16.1	0.20	25.0	14.1	0.39	0.02	0.22	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	11	84	02H	1	30	Repeat		0.44	49.0	19.1	0.44	45.0	17.5	0.82	-0.27	0.17	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	11	87	01H	1	30	Repeat		0.56	88.0	53.7	0.38	62.0	49.7	2.05	-0.19	0.19	6100	0.000	5517	0.000	6100	0.000	4754	0.000
2004	2	12	77	01H	1	29	Repeat	IDOD	0.47	63.0	39.7	0.40	54.0	36.4	1.40	-0.26	0.14	6100	0.000	6100	0.000	6100	0.000	5567	0.000
2004	2	13	10	01H	1	31	Repeat	>40% out TSP	0.15	55.0	30.7	0.15	55.0	30.7	1.37	-0.44	-0.29	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	13	34	01H	1	31	Repeat		0.29	99.0	47.6	0.20	52.0	38.0	1.19	0.07	0.27	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	13	44	01H	1	31	Repeat		0.35	69.0	54.3	0.24	62.0	50.5	1.71	-0.09	0.15	6100	0.000	5913	0.000	6100	0.000	5299	0.000
2004	2	13	60	02H	1	29	Repeat		0.36	83.0	40.0	0.30	48.0	32.3	1.34	-0.16	0.14	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	13	84	01H	1	30	Repeat		0.10	33.0	19.2	0.08	22.0	15.8	0.49	-0.02	0.06	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	13	84	01H	2	30	Repeat		0.08	77.0	28.3	0.06	27.0	12.0	0.27	-0.01	0.05	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	14	16	04H	1	31	Repeat		0.19	42.0	23.8	0.13	27.0	16.3	0.69	-0.08	0.05	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	14	45	01H	1	31	Repeat		0.14	30.0	15.9	0.06	20.0	12.4	0.43	-0.02	0.04	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	14	58	04H	1	46	New		0.13	45.0	17.8	0.11	20.0	12.0	0.51	0.14	0.25	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	14	68	01H	1	29	Repeat		0.40	17.0	12.9	0.40	20.0	15.2	0.70	-0.24	0.16	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	14	70	01H	1	29	Repeat		0.09	54.0	22.9	0.09	28.0	11.9	0.25	-0.10	-0.01	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	14	74	01H	1	29	Repeat		0.28	25.0	16.1	0.28	25.0	16.1	1.01	-0.27	0.01	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	16	12	05H	1	31	Repeat		0.11	45.0	23.7	0.06	22.0	14.7	0.47	-0.04	0.02	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	16	59	02H	1	29	Repeat		0.40	79.0	49.7	0.28	63.0	44.4	2.29	-0.06	0.22	6100	0.000	6100	0.000	6100	0.000	5416	0.000
2004	2	16	60	02H	1	47	New		0.12	31.0	17.7	0.12	20.0	11.4	0.45	-0.25	-0.13	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	16	82	01H	1	30	Repeat		0.25	52.0	26.0	0.23	20.0	9.8	0.63	-0.07	0.16	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	16	82	04H	1	30	Repeat		0.27	77.0	40.7	0.21	39.0	21.8	0.83	-0.04	0.17	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	16	85	02H	1	30	Repeat		0.29	69.0	36.6	0.27	45.0	28.0	0.62	-0.29	-0.02	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	16	87	02H	1	30	Repeat		0.23	55.0	37.6	0.21	55.0	36.5	1.08	-0.05	0.16	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	16	88	02H	1	30	Repeat		0.29	42.0	31.4	0.22	42.0	30.9	1.18	-0.10	0.12	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	17	9	06H	1	31	Repeat		0.09	73.0	34.9	0.09	39.0	18.6	0.65	-0.11	-0.02	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	17	54	01H	1	29	Repeat		0.43	66.0	43.2	0.37	51.0	40.8	1.75	-0.12	0.25	6100	0.000	6100	0.000	6100	0.000	5388	0.000
2004	2	17	59	01H	1	29	Repeat		0.37	76.0	41.8	0.28	48.0	35.1	1.68	-0.06	0.22	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	17	66	01H	1	29	Repeat		0.61	76.0	42.5	0.40	51.0	35.4	2.29	-0.26	0.14	6100	0.000	6100	0.000	6100	0.000	5672	0.000
2004	2	17	67	01H	1	29	Repeat		0.15	39.0	24.5	0.15	28.0	17.6	0.88	-0.34	-0.19	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	17	88	02H	1	30	Repeat		0.31	33.0	17.2	0.29	20.0	10.4	0.61	-0.06	0.23	6100	0.000	6100	0.000	6100	0.000	6100	0.000

Table 5 - 1R12 PWSCC ARC Summary of Analysis Results

									Unadjusted NDE			Adjusted NDE						EOC 12 CM (WEC Burst Model)				EOC 13 OA (ANL/TW Burst Model)			
Insp Year	SG	Row	Col	TSP	Crack No.	Cal	1R12 category	Reason for 1R12 plugging	Length (in.)	Max. Depth (%)	Avg. Depth (%)	Length (in.)	Max. Depth (%)	Avg. Depth (%)	Volts	From	To	FS Burst Press psi	FS Leakage gpm	Total Length Burst Press. psi	Total Length Leakage gpm	FS Burst Press psi	FS Leakage gpm	Total Length Burst Press. psi	Total Length Leakage gpm
2004	2	18	64	03H	1	29	Repeat		0.14	33.0	15.7	0.09	22.0	12.1	0.55	-0.17	-0.08	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	19	31	04H	1	31	Repeat		0.11	39.0	23.5	0.11	39.0	23.5	0.37	-0.05	0.06	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	19	34	02H	1	31	Repeat		0.54	84.0	44.6	0.46	52.0	40.4	2.54	-0.17	0.29	6100	0.000	6100	0.000	6100	0.000	5150	0.000
2004	2	19	74	02H	1	29	Repeat		0.19	76.0	43.9	0.08	33.0	24.0	0.55	-0.12	-0.04	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	20	48	03H	1	31	Repeat		0.30	45.0	27.4	0.28	33.0	19.1	0.64	-0.16	0.12	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	20	77	01H	1	29	Repeat		0.35	51.0	36.1	0.31	42.0	33.6	1.11	-0.20	0.11	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	21	38	01H	1	31	Repeat		0.39	92.0	55.4	0.24	52.0	42.6	1.98	-0.09	0.15	6100	0.000	6100	0.000	6100	0.000	5768	0.000
2004	2	21	57	01H	1	29	Repeat		0.50	69.0	42.7	0.36	54.0	39.9	2.02	-0.15	0.21	6100	0.000	6100	0.000	6100	0.000	5520	0.000
2004	2	21	60	02H	1	29	Repeat		0.26	36.0	17.5	0.24	20.0	12.8	0.66	-0.25	-0.01	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	21	65	02H	1	29	Repeat		0.56	97.0	45.4	0.39	42.0	31.7	1.92	-0.12	0.27	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	22	42	01H	1	31	Repeat		0.30	59.0	36.4	0.25	49.0	33.8	1.65	0.01	0.26	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	22	54	02H	1	29	Repeat	IDOD	0.37	100.0	53.0	0.33	60.0	48.1	2.43	-0.12	0.21	6100	0.000	5713	0.000	6100	0.000	4996	0.000
2004	2	22	55	03H	1	29	Repeat		0.28	63.0	35.5	0.26	48.0	33.4	1.28	-0.06	0.20	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	23	25	03H	1	31	Repeat		0.28	42.0	25.7	0.28	33.0	20.2	0.98	-0.28	0.00	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	23	54	01H	1	29	Repeat		0.15	39.0	24.6	0.13	22.0	12.6	0.45	0.06	0.19	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	23	79	01H	1	49	New		0.09	77.0	32.9	0.07	24.0	14.8	0.39	-0.12	-0.05	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	23	82	01H	1	30	Repeat	IDOD	0.10	45.0	29.4	0.08	27.0	17.7	0.49	0.14	0.22	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	24	77	01H	1	29	Repeat		0.15	45.0	24.5	0.13	28.0	19.9	0.60	-0.15	-0.02	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	25	17	02H	1	31	Repeat		0.26	69.0	40.7	0.21	33.0	24.9	0.92	-0.28	-0.07	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	25	50	02H	1	29	Repeat		0.46	63.0	43.9	0.37	51.0	43.6	2.47	-0.19	0.18	6100	0.000	6100	0.000	6100	0.000	5183	0.000
2004	2	25	55	02H	1	29	Repeat		0.11	33.0	24.4	0.11	33.0	24.4	0.47	0.14	0.25	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	25	74	01H	1	29	Repeat		0.28	76.0	48.4	0.19	60.0	42.3	1.22	-0.35	-0.16	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	25	79	02H	1	76	New		0.08	17.0	12.3	0.10	20.0	13.0	0.45	-0.15	-0.05	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	25	85	04H	1	30	Repeat		0.27	49.0	24.7	0.23	20.0	10.8	0.62	-0.15	0.08	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	25	87	04H	1	30	Repeat		0.31	73.0	50.0	0.29	59.0	48.4	1.07	-0.20	0.09	6100	0.000	5862	0.000	6100	0.000	5170	0.000
2004	2	26	22	04H	1	31	Repeat		0.33	69.0	45.3	0.26	62.0	41.3	1.69	-0.06	0.20	6100	0.000	6100	0.000	6100	0.000	5798	0.000
2004	2	26	39	02H	1	31	Repeat		0.13	59.0	39.7	0.09	36.0	24.9	0.78	-0.03	0.06	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	26	73	01H	1	29	Repeat		0.32	90.0	44.9	0.20	48.0	37.8	1.86	-0.12	0.08	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	26	79	01H	1	29	Repeat		0.37	57.0	41.4	0.24	51.0	38.3	1.08	-0.10	0.14	6100	0.000	6100	0.000	6100	0.000	5907	0.000
2004	2	27	55	01H	1	29	Repeat		0.11	76.0	44.2	0.07	36.0	22.4	0.49	0.21	0.28	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	27	56	01H	1	29	Repeat		0.09	22.0	12.6	0.09	20.0	11.4	0.82	-0.23	-0.14	6100	0.000	6100	0.000	6100	0.000	6100	0.000

Table 5 - 1R12 PWSCC ARC Summary of Analysis Results

									Unadjusted NDE			Adjusted NDE						EOC 12 CM (WEC Burst Model)				EOC 13 OA (ANL/TW Burst Model)			
Insp Year	SG	Row	Col	TSP	Crack No.	Cal	1R12 category	Reason for 1R12 plugging	Length (in.)	Max. Depth (%)	Avg. Depth (%)	Length (in.)	Max. Depth (%)	Avg. Depth (%)	Volts	From	To	FS Burst Press psi	FS Leakage gpm	Total Length Burst Press. psi	Total Length Leakage gpm	FS Burst Press psi	FS Leakage gpm	Total Length Burst Press. psi	Total Length Leakage gpm
2004	2	27	63	02H	1	29	Repeat		0.33	54.0	39.7	0.28	51.0	39.2	1.10	-0.30	-0.02	6100	0.000	6100	0.000	6100	0.000	5763	0.000
2004	2	27	63	02H	2	29	Repeat		0.66	66.0	33.0	0.59	51.0	31.4	1.08	-0.25	0.34	6100	0.000	6100	0.000	6100	0.000	5558	0.000
2004	2	27	64	03H	1	29	Repeat		0.25	39.0	21.9	0.09	22.0	14.7	0.53	-0.13	-0.04	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	27	65	02H	1	42	Repeat		0.40	82.0	38.1	0.40	35.0	24.5	0.98	-0.18	0.22	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	27	67	01H	1	29	Repeat		0.38	99.0	44.9	0.31	51.0	40.9	1.75	-0.33	-0.02	6100	0.000	6100	0.000	6100	0.000	5526	0.000
2004	2	27	67	04H	1	29	Repeat		0.26	39.0	23.8	0.20	30.0	18.6	0.52	-0.22	-0.02	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	27	69	01H	1	29	Repeat		0.52	100.0	53.2	0.34	63.0	49.4	2.36	-0.27	0.07	6100	0.000	5619	0.000	6100	0.000	4897	0.000
2004	2	27	69	01H	2	29	Repeat		0.24	45.0	26.1	0.21	28.0	16.1	0.76	-0.05	0.16	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	28	47	03H	1	31	Repeat		0.26	49.0	32.6	0.22	36.0	23.7	0.74	0.01	0.23	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	28	66	02H	1	29	Repeat		0.11	51.0	30.8	0.11	36.0	21.8	0.36	-0.04	0.07	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	29	24	03H	1	31	Repeat		0.34	63.0	37.4	0.32	47.0	35.8	1.22	0.10	0.42	6100	0.000	6100	0.000	6100	0.000	5883	0.000
2004	2	29	51	02H	1	29	Repeat		0.19	45.0	28.9	0.15	28.0	18.4	0.73	-0.06	0.09	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	29	66	01H	1	29	Repeat		0.35	57.0	35.5	0.24	54.0	31.1	1.42	-0.08	0.16	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	30	56	01H	1	29	Repeat		0.63	100.0	58.6	0.50	63.0	51.2	2.71	-0.39	0.11	6100	0.000	5225	0.000	6100	0.000	4350	0.000
2004	2	30	62	01H	1	29	Repeat		0.09	42.0	26.8	0.07	28.0	16.5	0.48	-0.15	-0.08	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	30	62	01H	2	29	Repeat		0.11	28.0	18.2	0.09	20.0	13.2	0.35	0.01	0.10	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	30	67	02H	1	29	Repeat		0.27	83.0	56.9	0.25	73.0	54.9	2.16	-0.30	-0.05	6100	0.000	5527	0.000	6100	0.000	4933	0.000
2004	2	31	37	03H	1	32	Repeat		0.23	58.0	36.6	0.21	34.0	22.5	0.45	-0.12	0.09	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	31	47	02H	1	31	Repeat		0.55	100.0	62.8	0.41	66.0	56.2	2.91	-0.24	0.17	6100	0.000	4964	0.000	6100	0.000	4155	0.000
2004	2	31	53	02H	1	29	Repeat		0.41	100.0	58.7	0.22	66.0	46.8	2.14	-0.23	-0.01	6100	0.000	6100	0.000	6100	0.000	5586	0.000
2004	2	31	66	04H	1	29	Repeat		0.24	36.0	17.7	0.18	30.0	18.0	0.97	-0.01	0.17	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	31	68	01H	1	29	Repeat		0.30	42.0	30.8	0.28	39.0	28.6	0.84	-0.07	0.21	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	31	78	05H	1	30	Repeat	PVN at 6C	0.15	45.0	33.7	0.15	36.0	27.0	0.68	0.51	0.66	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	32	30	02H	1	31	Repeat		0.30	66.0	50.4	0.30	49.0	37.4	0.87	-0.24	0.06	6100	0.000	6100	0.000	6100	0.000	5831	0.000
2004	2	32	37	03H	1	31	Repeat		0.15	59.0	36.3	0.13	39.0	22.1	0.50	-0.01	0.12	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	32	44	04H	1	31	Repeat		0.24	45.0	27.0	0.22	45.0	27.4	1.02	-0.23	-0.01	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	32	47	03H	1	32	Repeat		0.24	67.0	45.0	0.22	58.0	43.1	1.47	-0.22	0.00	6100	0.000	6100	0.000	6100	0.000	5904	0.000
2004	2	32	62	01H	1	29	Repeat		0.18	57.0	30.6	0.13	28.0	20.0	0.53	-0.07	0.06	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	33	57	02H	1	29	Repeat		0.18	60.0	43.9	0.14	42.0	29.3	0.89	0.07	0.21	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	33	68	02H	1	29	Repeat		0.11	76.0	44.5	0.06	48.0	30.0	0.55	0.03	0.09	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	33	72	04H	1	29	Repeat		0.26	79.0	41.7	0.18	42.0	24.7	0.72	-0.04	0.14	6100	0.000	6100	0.000	6100	0.000	6100	0.000

Table 5 - 1R12 PWSCC ARC Summary of Analysis Results

									Unadjusted NDE			Adjusted NDE						EOC 12 CM (WEC Burst Model)				EOC 13 OA (ANL/TW Burst Model)			
Insp Year	SG	Row	Col	TSP	Crack No.	Cal	1R12 category	Reason for 1R12 plugging	Length (in.)	Max. Depth (%)	Avg. Depth (%)	Length (in.)	Max. Depth (%)	Avg. Depth (%)	Volts	From	To	FS Burst Press psi	FS Leakage gpm	Total Length Burst Press. psi	Total Length Leakage gpm	FS Burst Press psi	FS Leakage gpm	Total Length Burst Press. psi	Total Length Leakage gpm
2004	2	34	36	03H	1	31	Repeat		0.24	52.0	31.3	0.24	33.0	19.8	0.74	-0.15	0.09	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	34	42	02H	1	31	Repeat		0.13	30.0	19.5	0.13	24.0	15.6	0.42	0.06	0.19	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	34	47	02H	1	31	Repeat		0.15	55.0	34.9	0.11	39.0	27.4	0.89	0.00	0.11	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	34	49	02H	1	31	Repeat	fail OA burst	0.53	100.0	77.4	0.42	100.0	71.9	4.20	-0.27	0.15	6100	0.000	3834	0.063	6100	0.000	3226	0.339
2004	2	34	51	06H	1	29	Repeat		0.10	86.0	44.8	0.06	39.0	25.0	0.42	0.06	0.12	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	34	53	02H	1	29	Repeat		0.52	100.0	54.3	0.32	57.0	46.9	2.03	-0.17	0.15	6100	0.000	5885	0.000	6100	0.000	5205	0.000
2004	2	34	53	02H	2	29	Repeat		0.13	39.0	17.8	0.13	22.0	10.1	0.60	-0.10	0.03	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	34	55	01H	1	29	Repeat		0.39	83.0	46.9	0.27	48.0	38.5	2.05	-0.31	-0.04	6100	0.000	6100	0.000	6100	0.000	5866	0.000
2004	2	34	57	02H	1	29	Repeat	low OA burst	0.67	99.0	61.6	0.48	69.0	55.4	3.46	-0.29	0.19	6100	0.000	4833	0.000	6100	0.000	3940	0.000
2004	2	34	57	02H	2	29	Repeat	low OA burst	0.60	93.0	57.7	0.50	63.0	54.9	3.06	-0.32	0.18	6100	0.000	4927	0.000	6100	0.000	4003	0.000
2004	2	34	58	02H	1	29	Repeat		0.42	100.0	59.7	0.31	73.0	50.7	1.73	-0.25	0.06	6100	0.000	5630	0.000	6100	0.000	4892	0.000
2004	2	34	59	02H	1	29	Repeat		0.20	90.0	56.2	0.09	39.0	26.7	0.64	-0.01	0.08	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	34	65	02H	1	29	Repeat		0.16	39.0	20.4	0.12	30.0	16.3	0.43	-0.11	0.01	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	35	49	02H	1	32	Repeat		0.34	64.0	36.8	0.30	48.0	33.6	1.49	-0.16	0.14	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	35	52	03H	1	29	Repeat		0.31	60.0	25.0	0.26	28.0	16.7	0.84	-0.14	0.12	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	35	56	02H	1	29	Repeat		0.31	69.0	38.3	0.22	28.0	20.7	0.62	-0.01	0.21	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	35	70	02H	1	29	Repeat		0.24	51.0	32.9	0.22	36.0	21.8	0.99	-0.11	0.11	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	36	53	03H	1	29	Repeat	MixMode	0.32	51.0	31.2	0.32	30.0	18.4	0.82	-0.23	0.09	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	36	60	04H	1	29	Repeat		0.19	63.0	34.8	0.17	60.0	31.5	1.08	-0.17	0.00	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	37	53	02H	1	42	Repeat		0.60	67.0	46.9	0.54	60.0	44.2	2.26	-0.31	0.23	6100	0.000	5620	0.000	6100	0.000	4674	0.000
2004	2	37	69	01H	1	29	Repeat		0.17	45.0	30.9	0.11	33.0	21.9	0.85	-0.16	-0.05	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	37	69	01H	2	29	Repeat		0.13	60.0	29.0	0.07	25.0	17.9	1.00	-0.01	0.06	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	37	69	01H	3	29	Repeat		0.38	39.0	26.1	0.30	39.0	25.5	1.46	0.05	0.35	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	37	69	03H	1	29	Repeat		0.27	48.0	35.3	0.22	42.0	30.1	0.80	0.01	0.23	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	37	70	01H	1	29	Repeat		0.48	100.0	56.5	0.33	60.0	45.7	1.93	-0.16	0.17	6100	0.000	5901	0.000	6100	0.000	5169	0.000
2004	2	37	73	03H	1	29	Repeat		0.27	48.0	30.4	0.17	33.0	23.9	0.82	-0.07	0.10	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	37	74	03H	1	30	Repeat		0.41	84.0	41.9	0.32	45.0	36.5	1.38	-0.12	0.20	6100	0.000	6100	0.000	6100	0.000	5871	0.000
2004	2	38	66	01H	1	29	Repeat		0.25	48.0	30.1	0.25	42.0	26.3	0.94	-0.02	0.23	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	2	43	49	03H	1	31	Repeat		0.28	81.0	42.8	0.26	55.0	39.9	1.33	-0.22	0.04	6100	0.000	6100	0.000	6100	0.000	5853	0.000
2004	4	17	24	01H	1	30	Repeat		0.09	22.0	14.1	0.09	20.0	12.8	0.25	0.28	0.37	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	4	20	25	01H	1	30	Repeat		0.18	24.0	13.9	0.14	20.0	10.6	0.25	-0.69	-0.55	6100	0.000	6100	0.000	6100	0.000	6100	0.000

Table 5 - 1R12 PWSCC ARC Summary of Analysis Results

									Unadjusted NDE			Adjusted NDE						EOC 12 CM (WEC Burst Model)				EOC 13 OA (ANL/TW Burst Model)			
Insp Year	SG	Row	Col	TSP	Crack No.	Cal	1R12 category	Reason for 1R12 plugging	Length (in.)	Max. Depth (%)	Avg. Depth (%)	Length (in.)	Max. Depth (%)	Avg. Depth (%)	Volts	From	To	FS Burst Press psi	FS Leakage gpm	Total Length Burst Press. psi	Total Length Leakage gpm	FS Burst Press psi	FS Leakage gpm	Total Length Burst Press. psi	Total Length Leakage gpm
2004	4	21	67	05H	1	30	Repeat		0.19	72.0	42.9	0.17	50.0	31.7	0.75	-0.17	0.00	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	4	21	76	01H	1	30	Repeat		0.15	35.0	25.2	0.15	35.0	25.2	0.61	-0.16	-0.01	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	4	21	84	01H	1	30	Repeat		0.18	69.0	39.6	0.09	41.0	27.7	0.70	0.04	0.13	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	4	26	37	06H	1	30	Repeat		0.09	33.0	23.5	0.11	33.0	21.4	1.03	0.04	0.14	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	4	35	36	02H	1	30	Repeat		0.15	19.0	11.3	0.15	20.0	11.9	0.39	0.13	0.28	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	4	35	56	03H	1	30	Repeat		0.13	14.0	7.3	0.13	20.0	10.4	0.32	-0.25	-0.12	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	4	35	56	03H	2	30	Repeat		0.12	41.0	24.1	0.10	33.0	17.9	0.33	0.00	0.10	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	4	35	61	02H	1	30	Repeat		0.11	44.0	20.0	0.11	29.5	20.0	0.34	-0.07	0.04	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	4	35	68	03H	1	30	Repeat		0.20	59.0	40.3	0.18	59.0	39.9	0.48	-0.16	0.02	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	4	38	69	02H	1	30	Repeat		0.13	44.0	31.7	0.13	35.0	25.2	0.51	-0.01	0.12	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	4	38	72	01H	1	30	Repeat		0.14	59.0	41.1	0.12	44.0	31.7	0.45	0.24	0.36	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	4	39	48	03H	1	30	Repeat		0.14	24.0	16.3	0.14	21.5	14.6	0.30	0.08	0.22	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	4	39	58	01H	1	30	Repeat		0.31	53.0	32.0	0.29	53.0	31.3	1.05	0.07	0.36	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2004	4	46	42	01H	1	30	Repeat		0.12	38.0	27.5	0.10	35.0	25.4	0.40	-0.10	0.00	6100	0.000	6100	0.000	6100	0.000	6100	0.000

Table 6 - Cycle 12 Growth Rates and Comparison of Condition Monitoring versus Prior Cycle OA Projections

						Total Length Burst Pressure CM vs OA Comparison							Growth Rate/EFPY				>95% value used in prior cycle OA?				
SG	Row	Col	TSP	Crack No.	1R12 category	CM (WEC) psi	CM (ANL/TW) psi	Prior Cycle OA Projection (WEC) psi	Prior Cycle OA Projection (ANL/TW) psi	CM - OA (WEC)	CM - OA (ANL/TW)	WEC CM – ANL/TW OA	Length inch	MD %	AD %	Volts	Length	MD %	AD %	Max volts change from <1v to >1v?	deplug in 1R11?
1	3	28	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	1.9	1.4	0.06					
1	4	41	01H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	0.0	-0.4	0.05					
1	14	28	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.04	3.1	3.0	0.01					
1	15	16	02H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.04	-1.2	-1.4	-0.02					
1	15	76	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	3.1	0.0	0.08					
1	17	16	02H	1	New	6100	6100														
1	19	15	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.04	0.0	-1.5	0.12				Yes	
1	20	28	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.04	1.2	0.1	0.11					
1	20	29	02H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	1.9	3.1	0.09					
1	20	33	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	0.0	3.3	0.04					
1	21	13	03H	1	New	6100	6100														
1	21	51	02H	1	New	6100	6100						-0.04	-2.5	-2.3	0.04					
1	21	54	01H	1	New	6100	6100														
1	22	23	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.04	1.2	0.6	0.14					
1	22	23	02H	2	Repeat	6100	6100	6100	6100	0	0	0	0.01	1.2	-1.0	0.03					
1	22	23	02H	3	New	6100	6100														
1	23	14	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	0.6	-2.5	-0.01					
1	24	67	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.07	6.8	7.1	0.17					
1	25	57	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.03	-1.9	-3.5	0.12					
1	26	25	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.09	7.5	3.3	0.19	Yes				
1	27	75	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	2.2	0.2	0.11					
1	28	27	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.03	10.6	7.8	0.26				Yes	
1	29	37	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	3.1	1.3	0.07					
1	30	21	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.06	1.2	0.8	0.07					
1	30	59	02H	1	New	6100	6100														
1	30	67	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	5.0	4.7	0.09				Yes	
1	34	24	03H	1	Repeat	6100	6100						0.02	4.3	-0.6	0.13					
1	34	24	03H	2	Repeat	6100	6100						-0.02	-0.9	-3.4	0.05					
1	35	59	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.00	9.3	5.6	0.16				Yes	
1	38	41	04H	1	Repeat	6100	6100	6100	6100	0	0	0	0.08	-0.6	-4.7	0.22	Yes				

Table 6 - Cycle 12 Growth Rates and Comparison of Condition Monitoring versus Prior Cycle OA Projections

						Total Length Burst Pressure CM vs OA Comparison							Growth Rate/EFPY				>95% value used in prior cycle OA?				
SG	Row	Col	TSP	Crack No.	1R12 category	CM (WEC) psi	CM (ANL/TW) psi	Prior Cycle OA Projection (WEC) psi	Prior Cycle OA Projection (ANL/TW) psi	CM - OA (WEC)	CM - OA (ANL/TW)	WEC CM – ANL/TW OA	Length inch	MD %	AD %	Volts	Length	MD %	AD %	Max volts change from <1v to >1v?	deplug in 1R11?
1	39	57	02H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	-1.9	-2.6	-0.03					
2	2	10	03H	1	Repeat	6100	6100	5911	5680	189	420	420	0.04	-1.9	-2.8	-0.04					Yes
2	2	28	03H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	6.2	6.3	0.11					Yes
2	2	76	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	-0.6	2.2	0.06					
2	2	78	01H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.03	0.0	-0.9	0.05					
2	2	79	03H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	0.0	0.5	-0.04					
2	2	90	04H	1	Repeat	6100	6100	6100	6100	0	0	0	0.00	2.5	-0.7	-0.31					Yes
2	2	90	04H	2	Repeat	6100	6100	6100	6100	0	0	0	0.05	-0.6	-4.0	-0.51					Yes
2	2	92	05H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	8.1	4.5	-0.03					
2	2	92	05H	2	Repeat	6100	6100	6100	6100	0	0	0	-0.02	0.0	-4.0	-0.05					
2	2	92	05H	3	Repeat	6100	6100	6100	6100	0	0	0	-0.02	0.0	0.8	0.02					
2	2	93	04H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	-3.1	-4.0	-0.05					
2	3	46	7C	1	New	6100	6100														
2	4	54	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.00	-6.5	-6.2	0.04					Yes
2	4	57	01H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.04	-0.6	-0.7	-0.04					
2	4	58	01H	1	New	6100	6100						0.00	-6.2	-0.4	0.25					
2	4	58	01H	2	Repeat	6100	6100	5412	4976	688	1124	1124	0.02	-13.0	-1.9	0.04					Yes
2	4	58	01H	3	Repeat	5712	5460	5186	4913	914	1187	1187	-0.01	2.5	3.8	0.26					Yes
2	4	84	01H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	7.5	6.1	0.02					
2	5	39	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	0.6	6.1	0.12				Yes	Yes
2	5	65	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	9.9	7.6	0.12					
2	5	66	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	3.7	2.1	0.03					
2	5	77	05H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	8.1	3.3	0.09					
2	5	78	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.06	11.2	3.6	-0.06					Yes
2	5	93	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.06	3.7	1.3	0.07					
2	6	55	7C	1	New	6100	6100														
2	6	74	03H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.07	-4.3	-1.9	-0.19					
2	6	74	03H	2	New	6100	6100														
2	7	31	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	4.0	7.5	0.08					
2	7	31	7C	1	New	5703	5458														
2	7	53	03H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	-1.2	-3.4	0.00					Yes

Table 6 - Cycle 12 Growth Rates and Comparison of Condition Monitoring versus Prior Cycle OA Projections

						Total Length Burst Pressure CM vs OA Comparison							Growth Rate/EFPY				>95% value used in prior cycle OA?				
SG	Row	Col	TSP	Crack No.	1R12 category	CM (WEC) psi	CM (ANL/TW) psi	Prior Cycle OA Projection (WEC) psi	Prior Cycle OA Projection (ANL/TW) psi	CM - OA (WEC)	CM - OA (ANL/TW)	WEC CM – ANL/TW OA	Length inch	MD %	AD %	Volts	Length	MD %	AD %	Max volts change from <1v to >1v?	deplug in 1R11?
2	7	68	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	2.5	4.2	0.10					
2	8	4	05H	1	New	6100	6100														
2	8	15	02H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.05	11.2	12.7	0.06			Yes	Yes	
2	8	48	01H	1	New	6100	6100														
2	8	55	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.00	4.3	7.7	0.22				Yes	Yes
2	8	57	01H	1	Repeat	5734	5507	5250	4972	484	536	762	0.02	2.5	3.9	0.14					Yes
2	8	61	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.07	14.9	13.1	0.18		Yes	Yes	Yes	
2	8	61	02H	2	Repeat	6100	6100	6100	6100	0	0	0	0.02	-1.2	1.4	0.19					
2	8	61	02H	3	Repeat	6100	6100	6100	6100	0	0	0	0.02	-1.2	-2.6	0.17					
2	8	66	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	11.8	11.5	0.00					
2	8	93	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	3.7	0.3	0.14					
2	9	27	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	2.5	2.9	0.01					Yes
2	9	30	01H	1	Repeat	5628	5430	5279	5071	349	359	557	0.02	5.0	5.0	0.12					Yes
2	9	38	02H	1	Repeat	5891	5627	5323	5069	568	558	822	0.01	5.0	3.5	0.25					Yes
2	9	45	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	0.0	-1.1	-0.02					Yes
2	9	53	01H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	-3.1	1.0	0.04					Yes
2	9	56	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	10.9	9.4	0.24				Yes	
2	9	82	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.04	1.9	0.0	-0.14					Yes
2	10	49	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.07	1.2	-1.0	-0.05					Yes
2	10	62	01H	1	Repeat	6100	6100	5816	5623	284	478	478	0.02	1.9	0.7	0.02					Yes
2	10	67	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.08	1.2	1.9	0.08	Yes				
2	10	68	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.04	1.9	1.2	0.09					Yes
2	10	69	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	0.0	1.9	0.01					
2	10	80	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	2.5	2.1	0.16					
2	10	85	04H	1	Repeat	6100	6100	6100	6100	0	0	0	0.00	9.3	7.0	0.01					
2	11	20	02H	1	Repeat	6100	6100	5918	5784	182	316	316	0.01	5.0	3.0	0.39				Yes	Yes
2	11	45	01H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.03	19.9	6.9	0.04		Yes		Yes	
2	11	66	03H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	3.1	2.4	0.04					
2	11	71	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	5.6	4.8	-0.02					Yes
2	11	71	01H	2	Repeat	6100	6100	6100	6100	0	0	0	0.01	5.0	2.4	-0.01					Yes
2	11	71	01H	3	Repeat	6100	6100	6100	6100	0	0	0	0.01	-11.8	-6.7	-0.12					Yes

Table 6 - Cycle 12 Growth Rates and Comparison of Condition Monitoring versus Prior Cycle OA Projections

						Total Length Burst Pressure CM vs OA Comparison							Growth Rate/EFPY				>95% value used in prior cycle OA?				
SG	Row	Col	TSP	Crack No.	1R12 category	CM (WEC) psi	CM (ANL/TW) psi	Prior Cycle OA Projection (WEC) psi	Prior Cycle OA Projection (ANL/TW) psi	CM - OA (WEC)	CM - OA (ANL/TW)	WEC CM – ANL/TW OA	Length inch	MD %	AD %	Volts	Length	MD %	AD %	Max volts change from <1v to >1v?	deplug in 1R11?
2	11	71	01H	4	Repeat	6100	6100	6100	6100	0	0	0	0.05	1.2	1.2	-0.12					Yes
2	11	84	02H	1	Repeat	6100	6100						0.02	14.0	4.0	-0.08					Yes
2	11	87	01H	1	Repeat	5517	5335	5730	5603	-213	-267	-86	0.07	5.6	8.1	-0.27					Yes
2	12	77	01H	1	Repeat	6100	6100	6100	5702	0	398	398	0.04	5.6	2.4	0.07					Yes
2	13	10	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.03	14.3	6.9	0.26				Yes	
2	13	34	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	4.3	5.4	-0.04					Yes
2	13	44	01H	1	Repeat	5913	5872	5371	5248	542	624	665	-0.03	6.8	5.0	0.12					Yes
2	13	60	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.03	4.3	5.3	-0.09					Yes
2	13	84	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	1.2	1.8	0.02					
2	13	84	01H	2	Repeat	6100	6100	6100	6100	0	0	0	-0.03	3.7	0.6	-0.04					
2	14	16	04H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	-1.2	1.3	0.14					
2	14	45	01H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.02	0.0	0.5	0.05					
2	14	58	04H	1	New	6100	6100						0.02	0.0	0.6	0.12					
2	14	68	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.00	0.0	1.8	-0.06					
2	14	70	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	5.0	-0.1	-0.07					
2	14	74	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.04	1.2	0.7	-0.17					Yes
2	16	12	05H	1	Repeat	6100	6100	6100	6100	0	0	0	0.00	-0.9	-0.5	-0.08					
2	16	59	02H	1	Repeat	6100	6100	5857	5784	243	316	316	0.04	6.2	3.6	0.28					Yes
2	16	60	02H	1	New	6100	6100						0.02	0.0	0.2	0.08					
2	16	82	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	0.0	-0.7	-0.12					Yes
2	16	82	04H	1	Repeat	6100	6100	6100	6100	0	0	0	0.00	3.1	1.4	-0.23					Yes
2	16	85	02H	1	Repeat	6100	6100						-0.01	7.5	5.0	-0.12					Yes
2	16	87	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.00	9.9	4.5	-0.11					Yes
2	16	88	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	-3.1	-1.7	-0.08					Yes
2	17	9	06H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	4.3	1.6	-0.02					Yes
2	17	54	01H	1	Repeat	6100	5902	5435	5281	665	621	819	0.04	0.6	0.8	0.52				Yes	Yes
2	17	59	01H	1	Repeat	6100	6100	6100	5863	0	237	237	0.02	2.5	0.4	-0.12					Yes
2	17	66	01H	1	Repeat	6100	6100	6100	5809	0	291	291	0.02	9.3	4.1	-0.24					Yes
2	17	67	01H	1	Repeat	6100	6100														Yes
2	17	88	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	0.0	-0.1	-0.18					Yes
2	18	64	03H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.06	-2.5	-2.9	-0.09					Yes

Table 6 - Cycle 12 Growth Rates and Comparison of Condition Monitoring versus Prior Cycle OA Projections

						Total Length Burst Pressure CM vs OA Comparison							Growth Rate/EFPY				>95% value used in prior cycle OA?				
SG	Row	Col	TSP	Crack No.	1R12 category	CM (WEC) psi	CM (ANL/TW) psi	Prior Cycle OA Projection (WEC) psi	Prior Cycle OA Projection (ANL/TW) psi	CM - OA (WEC)	CM - OA (ANL/ TW)	WEC CM – ANL/ TW OA	Length inch	MD %	AD %	Volts	Length	MD %	AD %	Max volts change from <1v to >1v?	deplug in 1R11?
2	19	31	04H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	8.7	5.1	-0.04					
2	19	34	02H	1	Repeat	6100	5733	5268	4968	832	765	1132	0.01	0.6	1.5	-0.04					Yes
2	19	74	02H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.03	7.5	8.0	0.09					
2	20	48	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.05	3.7	3.5	0.03					
2	20	77	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.05	3.7	4.2	-0.16					Yes
2	21	38	01H	1	Repeat	6100	6100	6100	5921	0	179	179	0.00	4.3	4.4	0.47					Yes
2	21	57	01H	1	Repeat	6100	6100	5134	4874	966	1226	1226	-0.02	-1.2	-1.1	-0.22					Yes
2	21	60	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.00	-2.5	-1.2	-0.04					
2	21	65	02H	1	Repeat	6100	6100	5716	5432	385	668	668	0.02	-8.7	-1.4	0.36					Yes
2	22	42	01H	1	Repeat	6100	6100	5938	5692	162	408	408	-0.05	2.5	0.9	-0.10					Yes
2	22	54	02H	1	Repeat	5713	5548	5527	5414	187	134	299	0.04	4.3	4.1	0.51					Yes
2	22	55	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.03	5.0	3.0	0.16					
2	23	25	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	8.1	4.6	0.04					
2	23	54	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	1.2	1.7	0.07					
2	23	79	01H	1	New	6100	6100														
2	23	82	01H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	0.0	-0.2	0.01					
2	24	77	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.00	4.3	4.3	0.11					
2	25	17	02H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	2.5	4.4	0.05					
2	25	50	02H	1	Repeat	6100	5776	5119	4953	981	824	1147	-0.04	-1.2	3.6	0.44					Yes
2	25	55	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	7.5	6.8	0.07					
2	25	74	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.07	15.5	11.3	0.34		Yes		Yes	
2	25	79	02H	1	New	6100	6100														
2	25	85	04H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	-6.8	-8.9	-0.15					
2	25	87	04H	1	Repeat	5862	5754	6100	6100	-238	-346	-238	0.06	12.4	12.1	-0.18					Yes
2	26	22	04H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	11.2	5.7	0.01					Yes
2	26	39	02H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	5.6	4.4	0.02					
2	26	73	01H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.02	3.7	5.4	0.21					Yes
2	26	79	01H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.03	11.8	9.8	0.18				Yes	
2	27	55	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.00	9.9	6.1	-0.07					
2	27	56	01H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	-2.5	-2.9	0.06					
2	27	63	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.08	8.1	6.0	0.18	Yes			Yes	Yes

Table 6 - Cycle 12 Growth Rates and Comparison of Condition Monitoring versus Prior Cycle OA Projections

						Total Length Burst Pressure CM vs OA Comparison							Growth Rate/EFPY				>95% value used in prior cycle OA?				
SG	Row	Col	TSP	Crack No.	1R12 category	CM (WEC) psi	CM (ANL/TW) psi	Prior Cycle OA Projection (WEC) psi	Prior Cycle OA Projection (ANL/TW) psi	CM - OA (WEC)	CM - OA (ANL/ TW)	WEC CM – ANL/ TW OA	Length inch	MD %	AD %	Volts	Length	MD %	AD %	Max volts change from <1v to >1v?	deplug in 1R11?
2	27	63	02H	2	Repeat	6100	6100	6100	5822	0	278	278	0.07	8.1	3.9	0.06				Yes	Yes
2	27	64	03H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.02	1.2	2.8	0.07					
2	27	65	02H	1	Repeat	6100	5678	6100	6100	0	-422	0	0.10	-0.6	-2.0	0.24	Yes				Yes
2	27	67	01H	1	Repeat	6100	6100	5648	5535	452	565	565	0.01	0.6	3.2	0.13					Yes
2	27	67	04H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	4.3	2.9	0.03					Yes
2	27	69	01H	1	Repeat	5619	5456	5178	4981	441	475	638	-0.01	6.2	4.6	-0.04					Yes
2	27	69	01H	2	Repeat	6100	6100	6100	6100	0	0	0	0.02	0.0	0.9	-0.02					Yes
2	28	47	03H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	3.7	1.2	-0.02					Yes
2	28	66	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	5.6	5.4	0.03					
2	29	24	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	7.5	6.1	0.15				Yes	Yes
2	29	51	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.03	0.6	-0.2	0.15					
2	29	66	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.06	-6.8	-5.3	0.10					Yes
2	30	56	01H	1	Repeat	5225	4966	4817	4553	408	413	672	0.00	4.3	5.3	0.01					Yes
2	30	62	01H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	5.0	3.3	0.01					
2	30	62	01H	2	Repeat	6100	6100	6100	6100	0	0	0	0.01	0.0	1.7	0.04					
2	30	67	02H	1	Repeat	5527	5483	5593	5520	-66	-37	7	0.04	6.8	5.3	0.34					Yes
2	31	37	03H	1	Repeat	6100	6100						0.01	5.0	1.3	-0.12					
2	31	47	02H	1	Repeat	4964	4755	4564	4319	400	436	645	-0.01	5.0	5.0	0.35					Yes
2	31	53	02H	1	Repeat	6100	6100	6100	5834	0	267	267	-0.01	8.1	6.5	0.35					Yes
2	31	66	04H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	1.2	0.2	-0.12					Yes
2	31	68	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.06	9.0	9.0	-0.04					Yes
2	31	78	05H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	-1.2	-1.1	0.15					
2	32	30	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.05	9.9	13.1	-0.01			Yes		Yes
2	32	37	03H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	9.3	3.1	0.05					
2	32	44	04H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	3.7	0.9	-0.03					Yes
2	32	47	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	6.2	3.6	-0.10					Yes
2	32	62	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	2.5	2.0	0.06					
2	33	57	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	-8.7	-4.8	-0.09					Yes
2	33	68	02H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	9.9	7.6	0.09					
2	33	72	04H	1	Repeat	6100	6100	6100	6100	0	0	0	0.00	3.1	0.6	-0.15					Yes
2	34	36	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	8.1	4.9	0.06					

Table 6 - Cycle 12 Growth Rates and Comparison of Condition Monitoring versus Prior Cycle OA Projections

						Total Length Burst Pressure CM vs OA Comparison							Growth Rate/EFPY				>95% value used in prior cycle OA?				
SG	Row	Col	TSP	Crack No.	1R12 category	CM (WEC) psi	CM (ANL/TW) psi	Prior Cycle OA Projection (WEC) psi	Prior Cycle OA Projection (ANL/TW) psi	CM - OA (WEC)	CM - OA (ANL/TW)	WEC CM – ANL/TW OA	Length inch	MD %	AD %	Volts	Length	MD %	AD %	Max volts change from <1v to >1v?	deplug in 1R11?
2	34	42	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	2.5	2.2	-0.05					
2	34	47	02H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.02	1.9	2.9	0.02					Yes
2	34	49	02H	1	Repeat	3834	3561	4382	4153	-548	-592	-319	0.00	15.5	13.7	0.24		Yes	Yes		Yes
2	34	51	06H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.02	0.6	2.7	0.02					
2	34	53	02H	1	Repeat	5885	5744	5397	5254	488	491	631	0.01	4.3	3.7	0.23					Yes
2	34	53	02H	2	Repeat	6100	6100	6100	6100	0	0	0	0.01	-8.1	-5.6	0.14					Yes
2	34	55	01H	1	Repeat	6100	6100	5821	5637	279	463	463	0.01	-3.1	0.8	0.11					Yes
2	34	57	02H	1	Repeat	4833	4578	4508	4207	325	371	626	0.02	6.2	4.6	0.22					Yes
2	34	57	02H	2	Repeat	4927	4592	4463	4199	464	393	727	0.02	2.5	4.2	0.17					Yes
2	34	58	02H	1	Repeat	5630	5469	5759	5686	-129	-217	-56	0.06	6.8	5.2	0.23					Yes
2	34	59	02H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.02	4.3	5.6	-0.04					Yes
2	34	65	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	6.2	1.1	0.04					
2	35	49	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	5.6	5.0	0.06					Yes
2	35	52	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.04	5.0	2.5	0.04					
2	35	56	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	5.0	6.1	0.04					
2	35	70	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.03	-11.8	-8.3	-0.06					
2	36	53	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.05	-3.4	-2.8	0.11					Yes
2	36	60	04H	1	Repeat	6100	6100	6100	6100	0	0	0	0.04	19.3	9.8	0.10		Yes		Yes	
2	37	53	02H	1	Repeat	5620	5276	4890	4536	729	740	1084	0.02	2.5	1.7	0.46					Yes
2	37	69	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.00	3.1	1.8	0.01					Yes
2	37	69	01H	2	Repeat	6100	6100	6100	6100	0	0	0	-0.02	-6.8	-0.9	-0.16					Yes
2	37	69	01H	3	Repeat	6100	6100	6100	6100	0	0	0	0.02	1.9	-0.2	-0.15					Yes
2	37	69	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.04	11.8	10.9	-0.06					Yes
2	37	70	01H	1	Repeat	5901	5747	5387	5237	514	510	664	0.01	4.3	3.2	0.14					Yes
2	37	73	03H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	3.7	1.9	-0.01					
2	37	74	03H	1	Repeat	6100	6100	5900	5617	201	483	483	-0.02	1.9	3.1	-0.23					Yes
2	38	66	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.04	4.3	2.2	0.05					
2	43	49	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	4.3	4.6	0.01					Yes
4	17	24	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	0.0	2.9	-0.03					
4	20	25	01H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	-0.6	-2.6	0.02					
4	21	67	05H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	8.7	5.4	0.04					

Table 6 - Cycle 12 Growth Rates and Comparison of Condition Monitoring versus Prior Cycle OA Projections

						Total Length Burst Pressure CM vs OA Comparison							Growth Rate/EFPY				>95% value used in prior cycle OA?				
SG	Row	Col	TSP	Crack No.	1R12 category	CM (WEC) psi	CM (ANL/TW) psi	Prior Cycle OA Projection (WEC) psi	Prior Cycle OA Projection (ANL/TW) psi	CM - OA (WEC)	CM - OA (ANL/ TW)	WEC CM – ANL/ TW OA	Length inch	MD %	AD %	Volts	Length	MD %	AD %	Max volts change from <1v to >1v?	deplug in 1R11?
4	21	76	01H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.01	2.8	3.2	0.05					
4	21	84	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	3.7	4.6	0.05					
4	26	37	06H	1	Repeat	6100	6100	6100	6100	0	0	0	0.00	-9.3	-5.8	-0.24					
4	35	36	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.03	-0.6	-0.7	0.00					
4	35	56	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.02	-0.6	-2.2	0.06					
4	35	56	03H	2	Repeat	6100	6100	6100	6100	0	0	0	-0.01	5.6	0.4	-0.02					
4	35	61	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	2.2	1.4	0.06					
4	35	68	03H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.04	7.5	4.7	0.01					
4	38	69	02H	1	Repeat	6100	6100	6100	6100	0	0	0	0.03	0.0	3.5	0.07					
4	38	72	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.00	6.8	6.1	-0.03					
4	39	48	03H	1	Repeat	6100	6100	6100	6100	0	0	0	0.01	0.9	0.2	0.02					
4	39	58	01H	1	Repeat	6100	6100	6100	6100	0	0	0	0.03	11.2	4.2	0.12				Yes	
4	46	42	01H	1	Repeat	6100	6100	6100	6100	0	0	0	-0.03	3.7	4.2	0.01					

Notes:

For repeat PWSCC in SG 1-1 R34C24 3H, it was originally sized as 1 SAI in 1R11. Based on sizing as 2 SAI in 1R12, 1R11 relook was performed and was sized as 2 SAI. No CMOA comparison was performed.

For repeat PWSCC in SG 1-2 R11C84, 2H R16C85 2H, R31C37 3H, R17C67 1H: These were each originally sized as 2 SAI in 1R11. Based on sizing as 1 SAI in 1R12, 1R11 relook was performed and they were sized as 1 SAI, except for R17C67 for which lookup could not conclusively report one of the original SAIs. No CMOA comparison was performed.

Figure 1

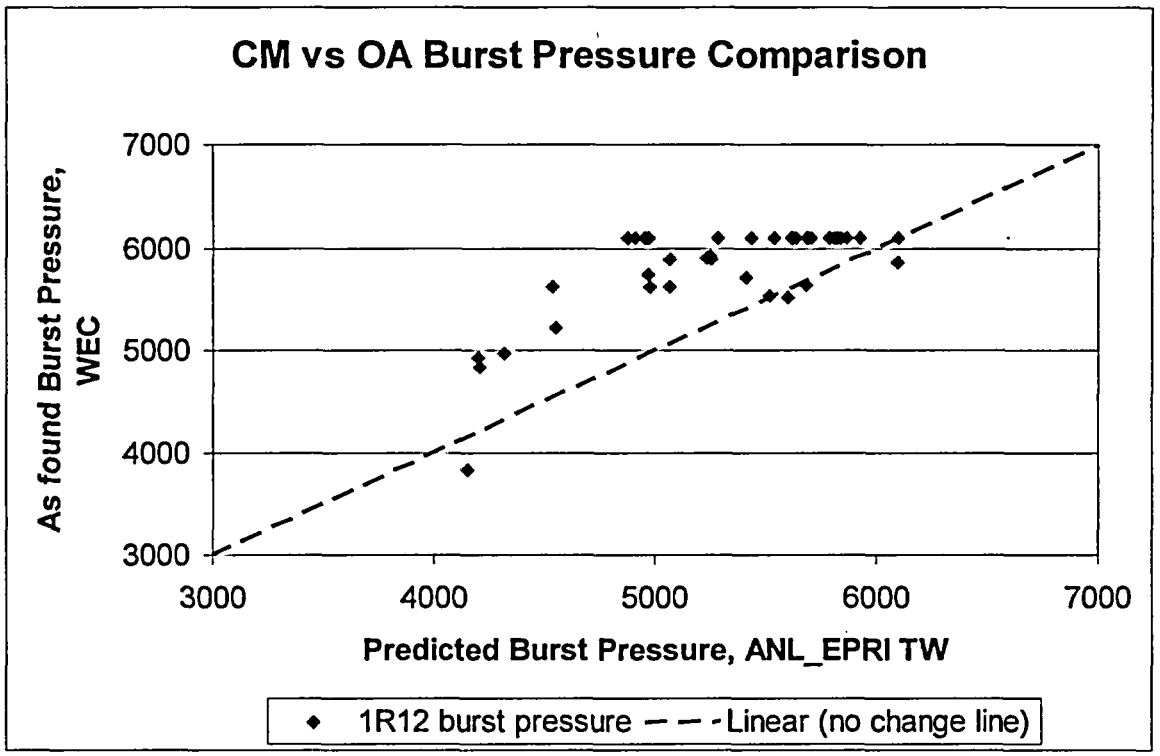


Figure 2

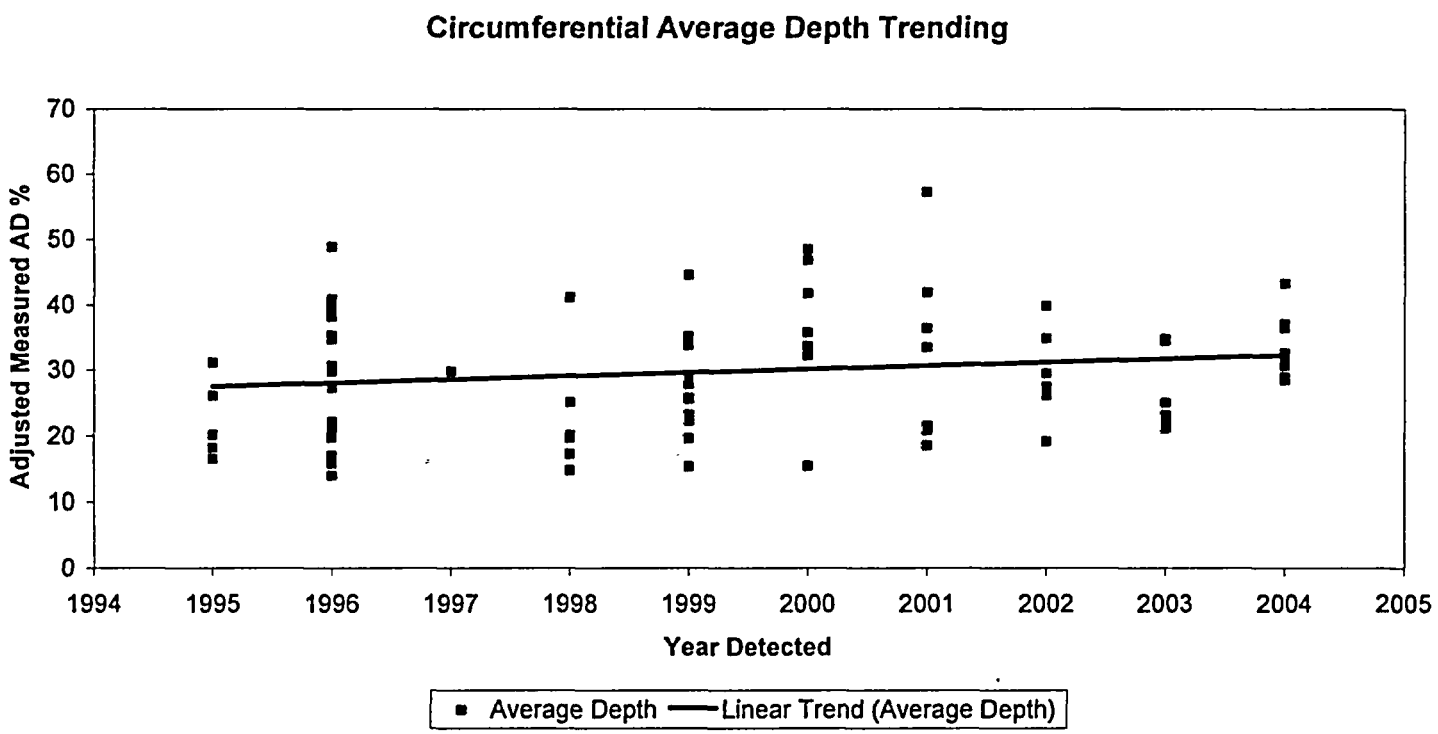


Figure 3

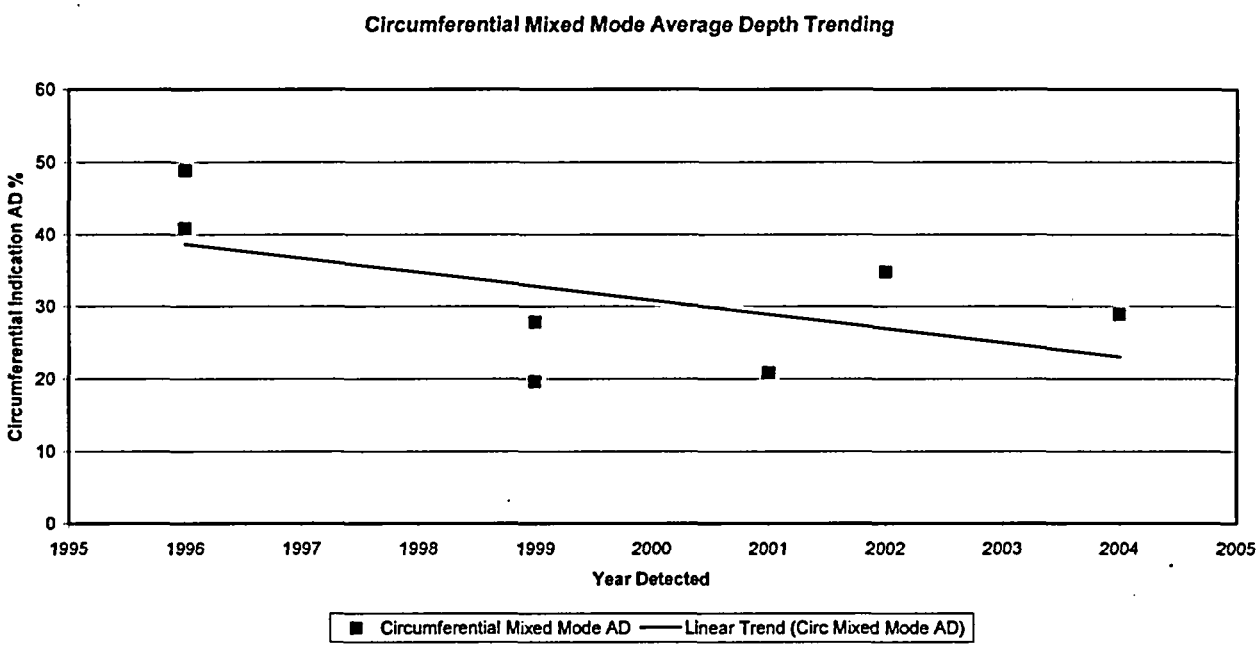
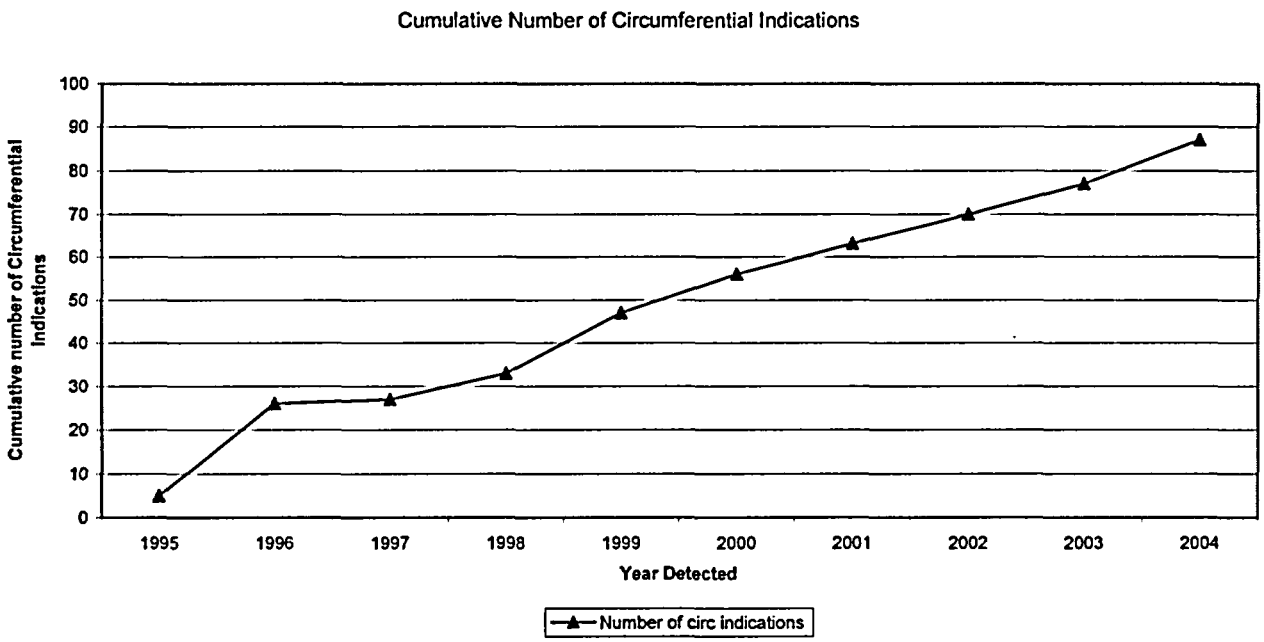


Figure 4



ATTACHMENT 1 TO ENCLOSURE 2
SPECIAL REPORT 04-02

WESTINGHOUSE REPORT
"DIABLO CANYON LIGAMENT TEARING AND LEAK RATE MODEL"

Diablo Canyon Ligament Tearing & Leak Rate Model

1.0 Introduction

The development of depth based alternate repair criteria (ARC) for the disposition of axial primary water stress corrosion cracking (PWSCC) of steam generator (SG) tube indications at dented tube support plate (TSP) intersections in Westinghouse Model 51 SGs with drilled hole TSPs was documented in Reference 1. Reference 2 provided information inclusive of and in addition to that of Reference 1 to support the technical bases for the use of the PWSCC ARC in the presence of potential mixed mode indications. A significant feature of the PWSCC ARC methodology is a model for predicting radial ligament tearing of the axial indications to obtain the associated leak rate during postulated steam line break (SLB) conditions. A proviso of the implementation of the PWSCC ARC at the Diablo Canyon Nuclear Power Plant (DCPP) is the comparison of model predicted leak rates to those obtained by testing indications in tube sections removed from the DCPP SGs. Sections from one tube, R20C54 HL, in SG 11 were removed during the 1R12 (Unit 1, Refueling Outage 12) outage at the DCPP for examination and testing. Destructive examination of the tube sections was performed by Areva, Framatome ANP, and the results of the examinations were provided to the Nuclear Services Division of the Westinghouse Electric Company for comparison with predictions from the analytic model. It is noted that the degradation morphology of the removed tube was outside diameter stress corrosion cracking (ODSCC), however, the structural model is such that either mode of cracking can be analyzed, as is the leak rate model. The difference in the structural analysis being the presence of a pressure load on the flanks of internal cracks.

Section 2.0 of this letter provides a description of the procedure used for the simulation of primary-to-secondary leak rates through the tube degradation during a postulated steam line break (SLB) event. Section 3.0 provides a description of the model and statistics for the ligament tearing analysis of part-throughwall axial cracking in SG tubes. The information in both of those sections is a repeat of the discussions of References 1 and 2 and is included herein to familiarize the reader with the features of the leak rate and ligament tearing models. The same discussions were included in the Reference 3 letter which was prepared to document similar analyses of tube sections removed from a Unit 2 SG 4, a.k.a. SG 2-4. In those cases the PWSCC ARC leak rate predictions were well in excess of those obtained in the testing laboratory. The evaluation of the degraded regions of the pulled tube sections is provided in Section 4.0 and a summary of the analysis results in provided in Section 5.0. References for the evaluation are listed in Section 6.0.

2.0 Monte Carlo Simulation of Degradation Leak Rates

A Monte Carlo simulation model is applied for estimating the leak rate through degraded tubes during a postulated steam line break (SLB) event. The Monte Carlo model uses the NDE crack profiles obtained for each indication including simulation sample adjustments for maximum depth and length NDE uncertainties for condition monitoring evaluations, and maximum depth and length NDE uncertainties and maximum depth growth for operational assessments. Calculations

may be performed to obtain the leakage distribution for a single indication or for the entire SG indication distribution. The Monte Carlo leakage model includes the following features:

1. The crack profile is searched for the longest lengths that would be predicted to break through by ligament tearing at SLB conditions. The profile is evaluated three times. The weakest radial ligament of the crack will usually be near the center of the crack. Once that torn length has been identified, the profile of the crack above and below the torn length is evaluated to determine if a second or third location is anticipated to tear.

2. The ANL (Argonne National Laboratories) model, Reference 6 for ligament tearing is used to estimate the throughwall length(s) of the indication, see Section 3.0.

3. The Westinghouse computer code CRACKFLO is used to calculate a model value of the leak rate using the throughwall length(s) calculated using the ANL ligament tearing model.

4. The leak rate correlation and attendant error distribution of Reference 2 is applied to calculate a random value of the leak rate about the model regression line.

5. The distribution of leak rates from each of the random samples is developed and evaluated at the required confidence level for the analysis (see Section 7 of Reference 2 for ARC requirements on confidence levels).

6. The combined use of a ligament tearing model and CRACKFLO leak rates results in a conservative overestimate of the leak rate.

As described in Section 6.2.1 of Reference 2, the CRACKFLO crack opening model includes a calculation for crack extension at the crack tip, which is also effectively part of the ligament tearing effect. Leakage is therefore based on a longer length than that obtained only from the ligament tearing model and the predicted leak rates are inherently conservative. In addition, PWSCC cracks are initiated in SG tubes as multiple microcracks which grow to link up with other microcracks to form the overall macrocrack. Crack depths vary significantly between microcracks such that non-throughwall depths vary sharply over short spans. As a consequence, leak tests of corrosion induced cracks rarely show ligament tearing for more than about 2% of the wall thickness where the depth is the largest. The ligament tearing models are based on uniform average depths and typically predict breakthrough at shallower depths and longer lengths than found in tests of corrosion cracks. This effect adds further conservatism to the predicted leak rates. That is, leak rates would be over-predicted due to the CRACKFLO crack extension beyond that of the ANL ligament tearing model and due to the analytical models predicting more ligament tearing than indicated by leak tests of corrosion cracks with non-uniform depth profiles.

3.0 Ligament Tearing Model

The ligament tearing model for part-throughwall cracks is based on modifying the stress intensity magnification factor presented in Reference 4 to be used for predicting the burst pressure of SG tubes with axial, throughwall cracks. The pressure to cause burst of a tube with a single

throughwall axial crack, P_B, is predicted by the following equation,

$$P_B = \frac{P_0}{m}, \tag{1}$$

where P_0 is the burst pressure of the non-degraded tube and m is referred to as the hoop stress or fracture mechanics stress intensity magnification factor. The factor m is also referred to as the bulging factor because it accounts for radial outward deformation of the crack flanks as a function of the crack length, L, the mean radius of the tube, R_m, and the thickness of the tube, t. Reference 4 reported m to be predicted by the following,

$$m = 0.614 + 0.386\, e^{-1.25\lambda} + 0.481\, \lambda, \tag{2}$$

where λ is the normalized crack length given by,

$$\lambda = \frac{0.9089\, L}{\sqrt{R_m\, t}}. \tag{3}$$

This expression for m was the result of a regression analysis of data obtained from numerical solutions of theoretical models of axial cracks. Hence, it represents a theoretical solution to the problem of burst of axially cracked tubes. The constant in the numerator is a function of the Poisson's ratio of the material.

3.1 Ligament Tearing Breakthrough Model

The authors of Reference 5 reported reviewing several models for predicting the pressure required for tearing the remaining ligament of a part-throughwall axially cracked tube based on modifying the Equation 1 formulation to use a part-throughwall stress intensity magnification factor, m_p, instead of m. The inverse of the stress intensity magnification factor is a failure or tearing pressure reduction factor, herein designated by ξ. Thus, the pressure required to tear the remaining radial ligament of a part-throughwall axial crack, P_T, is found as,

$$P_T = \frac{P_0}{m_p} = \xi P_0. \tag{4}$$

Reference 5 also presented a review of various formulations for m_p and recommended a final expression for m_p as a function the relative depth of the crack, h (the ratio of the depth, d, to the thickness of the tube), and the throughwall axial crack magnification factor as,

$$m_p = \frac{1 - \alpha\, h/m}{1 - h}, \text{ where } \alpha = 1 + 0.852\, h^2\left(1 - \frac{1}{m}\right). \tag{5}$$

Reference 5 further designated this model as the ANL model. The coefficient of 0.852 used in Equation 5 was originally reported as 0.9 in Reference 6. Subsequent examination of the original calculation revealed that some minor changes in the computation were required to account for

temperature affects on the material properties (the tensile tests were performed at room temperature and the burst tests at 600°F), the radius used for the normalized crack length, e.g., minimum or mean, the radius used for the non-degraded burst pressure, and the number of data for which ANL depth measurements were available. The revised coefficient was obtained via Reference 7. Latter test data obtained by ANL personnel do not contradict the use of the above value, although specific values may be selected to reduce the error associated with depths in a specific range. The non-degraded burst pressure is computed as,

$$P_0 = 0.595\ (S_Y + S_U)\frac{t}{R_m}, \tag{6}$$

based on a large amount of Westinghouse and industry data, including the results used in the ANL computation, see Reference 8.

The limit of m_p as h goes to 1, i.e., corresponding to a throughwall crack, is infinity, and the ligament tearing pressure is then zero. Results obtained from the model for three different crack lengths are illustrated on Figure 3. For very long cracks, say greater than 1.5 inches, the model is linear between the non-degraded burst pressure for zero depth and zero tearing pressure for 100% depth. For shorter cracks the shape of the curve becomes more and more convex as shown on Figure 3. As the length of the crack approaches zero, the location of the maximum rate of change of the slope, i.e., the *knee* of the curve, tends to the non-degraded burst pressure as the depth approaches 100%.

The critical crack length as a function of crack depth for the postulated SLB differential pressure for nominal and 95/95 lower tolerance limit (LTL) material properties is presented on Figure 4. A curve for the critical crack length for ligament tearing under typical normal operating conditions is also presented. It may be concluded from the figure that the effect of material property variations is small for depths greater than about 90% throughwall.

The ligament tearing model was derived to predict the behavior of part-throughwall, rectangular shaped, axial cracks. The comments of Section 5 of Reference 2 regarding the shape of real cracks also apply to the prediction of the ligament failure pressure. The approach used to predict the ligament tearing pressure is the same as that used to predict the tube burst pressure, with the exception that the ANL model is used. Since the intent is to predict ligament tearing, no calculations of the burst pressure of the resulting 100% throughwall axial crack are performed for the leak rate evaluations. Following the naming of the burst pressure algorithm, the leak rate algorithm was designated as the *weak leak* model.

The end goal of the weak leak model is different from that of the burst pressure model. In order to estimate the leak rate, the likely throughwall crack length for a given applied pressure must be known. Hence, the model is applied to all possible sub-cracks from the original profile and the ligament tearing pressures are calculated. The length of the sub-crack with a ligament tearing pressure just less than (not more than) the SLB differential pressure may then be used for the leak rate calculation. Following identification of this longest throughwall length due to break through at SLB conditions, the crack profile is searched to identify the next two largest sub-lengths either above or below the longest throughwall length that would also be predicted to break through at

SLB conditions. The lengths predicted to be throughwall are then included in the SLB leak rate analysis. Because the profile information is based on discrete increments, the appropriate sub-crack to evaluate is the one with the minimum tearing pressure that is greater than or equal to the given critical pressure. This means that the length returned is greater than or equal to that corresponding to the tearing pressure exactly matching the critical pressure. Because the leak rate from axial cracks varies approximately with the third to fourth power of the crack length, the subsequent leak rate calculation is conservative.

It is possible for multiple, distinct sub-cracks to exist with ligament tearing pressures equal to the SLB pressure. In this case the leak rate calculation would normally be performed for all such sub-cracks and the total leak rate found as the sum of the individual values. However, the presence of such cracks is judged to be a rare event although the model considers the longest and next two largest sub-cracks with a ligament tearing pressure nearest to, but greater than or equal to, the applied SLB pressure. For the rare case of two sub-cracks having the potential for ligament tearing, the longest sub-crack leak rate can be expected to be significantly higher than that of a shorter crack due to the leak rate dependence on throughwall crack length to a power of 3 to 4. Due to both low frequency of occurrence and lower leak rate of a second sub-crack with leakage, the leakage from a potential second sub-crack can be ignored. As discussed above in Section 6.4.1 of Reference 2, the leakage model already incorporates conservative leak rate predictions and efforts to calculate the breakthrough length for a second, shorter sub-crack are not necessary, but are included in the analysis.

3.2 Ligament Tearing Throughwall Model

The use of the ligament tearing model for throughwall cracks is inherently conservative because of the manner in which the model represents the crack as an equivalent rectangle. This is illustrated by considering the case where there is a 100% throughwall portion of the crack being evaluated as shown on the upper portion of Figure 2. One of the crack segments analyzed will consist only of the 100% throughwall region (the ligament tearing pressure will be zero in this case). The next segment analyzed will consist of the 100% throughwall length plus the inspection increment at one end of that segment, etc. Other segments analyzed will consist of the 100% throughwall length plus inspection increments at each end of the crack being analyzed as shown on the lower portion of Figure 2. To make a rectangular representation of the crack section being analyzed, the incremental material will be treated as being much narrower in order to extend it over the length of the rectangle while keeping the area of the crack constant. This means that the analysis will likely predict tearing of that incremental ligament even if it is quite wide.

The following example situation illustrates the foregoing discussion. The geometry considered is that of a 7/8" by 0.050" SG tube with a 0.3" long throughwall axial crack segment, an inspection increment of 0.030", and an adjacent crack depth of 50%. The geometry of the throughwall portion and the next increment will be that of a rectangle with a length of 0.33" and a depth of 95%. This is similar to the situation that develops as shown on Figure 2. It is very likely that such a narrow ligament would be predicted to tear at a significantly lower pressure than needed to actually extend the crack. This feature of the model is particularly relevant to the evaluation of the tube sections removed from the DCPP SG because one of them contains a throughwall segment.

In summary, the model provides a conservatively inaccurate prediction of the extension length of an existing throughwall crack, and would be expected to always over-predict the length associated with tearing in that case, because implementation involves averaging ligament material over a sub-length of the crack profile and the area of the material at the ends of the idealized rectangular profile is used to develop an average uniform depth that includes the throughwall portion of the crack.

4.0 Diablo Canyon Pulled Tube Evaluations

The destructive examination of the tube degradation consisted of the performance of leak rate tests up to a pressure of 2750 psi at room temperature, i.e., 70°F, which was commensurate with simulating the SLB pressure of 2405 psi at 600 to 603°F.[1] There was no perceived tearing of the crack in the R20C54-1H tube section. The ODSCC found by the destructive examination of the R20C54-2H tube segment consisted of only shallow cellular corrosion patches that were classified as NDD (no detectable degradation) in the field bobbin and +Point eddy current evaluations, thus negating the need for any analysis. The results are discussed in the following two sections for the destructive and nondestructive examination profiles respectively. Heat tinting was performed following the simulated SLB leak testing in the laboratory and prior to burst pressure testing to permit separate measurement of the size of any tearing that might occur during the leak testing. Thus, any ductile tearing that might have occurred up to the simulated SLB pressure was tinted to differentiate it from the ductile tearing that occurred during the burst testing. One of the results from Reference 9 was that no ductile tearing took place up to the simulated SLB pressure.

The information used herein was obtained from References 9 and 10. Reference 9 provides a complete description of the tube examination process and results. Reference 10 documented the results from the leak rate tests performed in the laboratory. A summary of the examination results is provided in Table 1.

4.1 Destructive Examination Profile Evaluation

The profile obtained from the destructive examination of the R20C54-1H cracked tube section is illustrated on Figure 5. There was no ductile tearing in the axial or circumferential directions under SLB conditions; the only tearing occurred in the axial direction during the burst testing of the tube section. The initial throughwall portion of the crack was 0.12 inch long. The distribution of torn lengths resulting from the analysis using the ligament tearing model for the destructive examination profile is shown on Figure 7. The average of the simulated torn lengths was 0.196 inch even though no tearing occurred during the actual test of the tube section, i.e., the throughwall length remained at 0.12 inch. Because of the steep nature of the ends of the crack, the 95th percentile torn length was also 0.196 inch.

The measured leak rate at a test pressure of 2750 psi at 70°F was found to be 0.002 gpm. The adjusted value for ODSCC was calculated to be 0.00074 gpm at a differential pressure of 2405 psi at 600°F when condensed to ambient conditions, i.e., at a density corresponding to 70°F. The leak rate adjustment procedure documented in Appendix B of References 11 and 12 was used. The

[1] The test pressure is increased by the ratio of the material strength properties at operating conditions to those at room temperature, usually about 10%, plus an allowance for potential measurement error.

results from a simulation of ligament tearing and leak rate are shown on Figure 7 for the crack lengths and Figure 8 for the leak rates. The median, average, and 95th percentile leak rate values from the model of Reference 2 were 0.003, 0.006 and 0.020 gpm respectively.

4.2 Nondestructive Examination Profile Analysis

The analysis was repeated using the profiles based on amplitude sizing of the information from the eddy current inspection. The amplitude sizing correlation is the same as that applied for the ligament tearing analysis for the DCPP 2 pulled tubes, see Reference 3, which was found to result in good agreement between the NDE and destructive examination profiles. The NDE sizing of the crack in the R20C54-1H tube section was found to be conservative as illustrated on Figure 6, with good agreement between the estimated throughwall length of 0.13 inch relative to the destructive examination result of 0.12 inch. The NDE uncertainty values from Reference 2 were used for the simulations even though the cracks were ODSCC. There is a lack of ODSCC amplitude sizing information and the intent of the analysis was to simulate the level of uncertainty that would be associated with the application of the PWSCC ARC. A consequence of using the NDE uncertainties is that most of the simulations resulted in predicting that tearing of the remaining ligament would not occur for 47% of the simulations analyzed. The intercept of true to NDE depth correlation, i.e., the linear 1st order regression, line is at about -1% with a slope of 0.94. This means that the depth of the 100% portion of the profile will be ≤ 93% for about 50% of the simulations. Because the associated lengths of the deepest portion of the profile are relatively short, ligament tearing is not predicted to occur for most of the simulations at a differential pressure of 2405 psi. One of the random simulated profiles is illustrated on Figure 9, a case that did exhibit tearing at 2405 psi. However, the average torn length of the random indications that were predicted to exhibit tearing was calculated to be 0.438 inch. The simulated median, average and 95th percentile leak rates were 0.004, 0.139 and 0.513 gpm respectively. The distribution of torn lengths is illustrated on Figure 10 and the distribution of predicted SLB leak rates is shown on Figure 11. In summary, the leak rate used in the condition monitoring evaluation of the flaw, i.e., the 95th percentile leak rate from the NDE profile, was estimated to be almost 700 times greater than found from the destructive examination. The expected or average leak rate was calculated to be almost 70 times greater than that from the destructive examination.

5.0 Summary

Summary results from the analyses of the tube sections are provided in Table 1. The torn lengths from the SLB leak test were significantly less than that predicted by the ligament tearing analysis used in the leak rate model.

There was no ligament tearing of the R20C54-1H crack during the SLB pressure testing. The original throughwall length was 0.120 inch and the predicted average ligament tearing length increase was 0.076 inch based on the analyses performed using the DE profile. The average torn length using the NDE profile was calculated to be 0.438 inch. The predicted leak rate for the condition monitoring analysis using the NDE developed profile was almost 700 times the value observed during the SLB leak test.

In conclusion, the ligament tearing and leak rate model combination being used for the prediction of leak rates from PWSCC cracks yields very conservative results relative those from the destructive examination.

6.0 References

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11. NP-7480-L, Volume 1, Revision 2, "Steam Generator Tubing Outside Diameter Stress Corrosion Cracking at Tube Support Plates – Database for Alternate Repair Limits, Volume 1: 7/8 Inch Diameter Tubing," EPRI, Palo Alto, CA, August 1996.
12. NP-7480-L, Volume 2, Revision 1, "Steam Generator Tubing Outside Diameter Stress Corrosion Cracking at Tube Support Plates – Database for Alternate Repair Limits, Volume 1: 3/4 Inch Diameter Tubing," EPRI, Palo Alto, CA, August 1996.

Table 1: Tearing and Leak Evaluations Data & Analysis Results Summary		
Category	Property	Tube Section R20C54-1H
Tube Properties	Average Diameter (inch)	0.873
	Average Thickness (inch)	0.0525
	Elastic Modulus at 600°F (psi)	$28.7 \cdot 10^6$
Laboratory Examination Results	Yield Strength (psi)	53,028
	Ultimate Strength (psi)	105,643
	Burst Pressure (psi)	5,819
	Corrosion TW Length (inch)	0.120
	SLB Torn TW Length (inch)	0.120
	Leak Rate at 2750 psi & 70°F (gpm)	0.002
ARC Evaluation Results, 2405 psi		
ODSCC ARC	Leak at 600°F (gpm at 70°)	0.00074
Analysis of the Destructive Examination Profile	Average Torn Length (inch)	0.196
	ODSCC Median Leak (gpm)	0.003
	ODSCC Average Leak (gpm)	0.006
	ODSCC 95/50 Leak (gpm)	0.020
Analysis of the Nondestructive Examination Profile	NDE 100% TW Length (inch)	0.130
	Average Torn Length (inch) [1]	0.438
	ODSCC Median Leak (gpm)	0.004
	ODSCC Average Leak (gpm)	0.139
	ODSCC 95/50 Leak (gpm)	0.513

Notes:
1. Calculated for the simulated indications that tore.

Table 2: Crack Profile Data for R20C54-1H Intergranular Cracking	
Axial Distance	Depth %TW
0.0000	0.0%
0.0231	25.0%
0.0649	22.3%
0.0847	41.7%
0.1052	40.9%
0.1267	52.6%
0.1449	45.1%
0.1837	55.7%
0.1865	73.1%
0.2178	74.5%
0.2349	66.6%
0.2593	84.5%
0.2746	90.0%
0.2879	100.0%
0.3337	100.0%
0.3562	100.0%
0.4091	100.0%
0.4481	97.5%
0.4551	95.0%
0.4830	69.7%
0.5039	49.5%
0.5188	28.8%
0.5237	39.5%
0.5320	25.1%
0.5470	7.5%
0.5508	15.4%
0.5864	25.5%
0.6160	16.3%
0.6247	16.7%
0.6489	0.0%
0.6724	0.0%
0.6769	7.5%
0.6818	0.0%
0.6883	0.0%
0.6936	7.3%
0.7005	0.0%

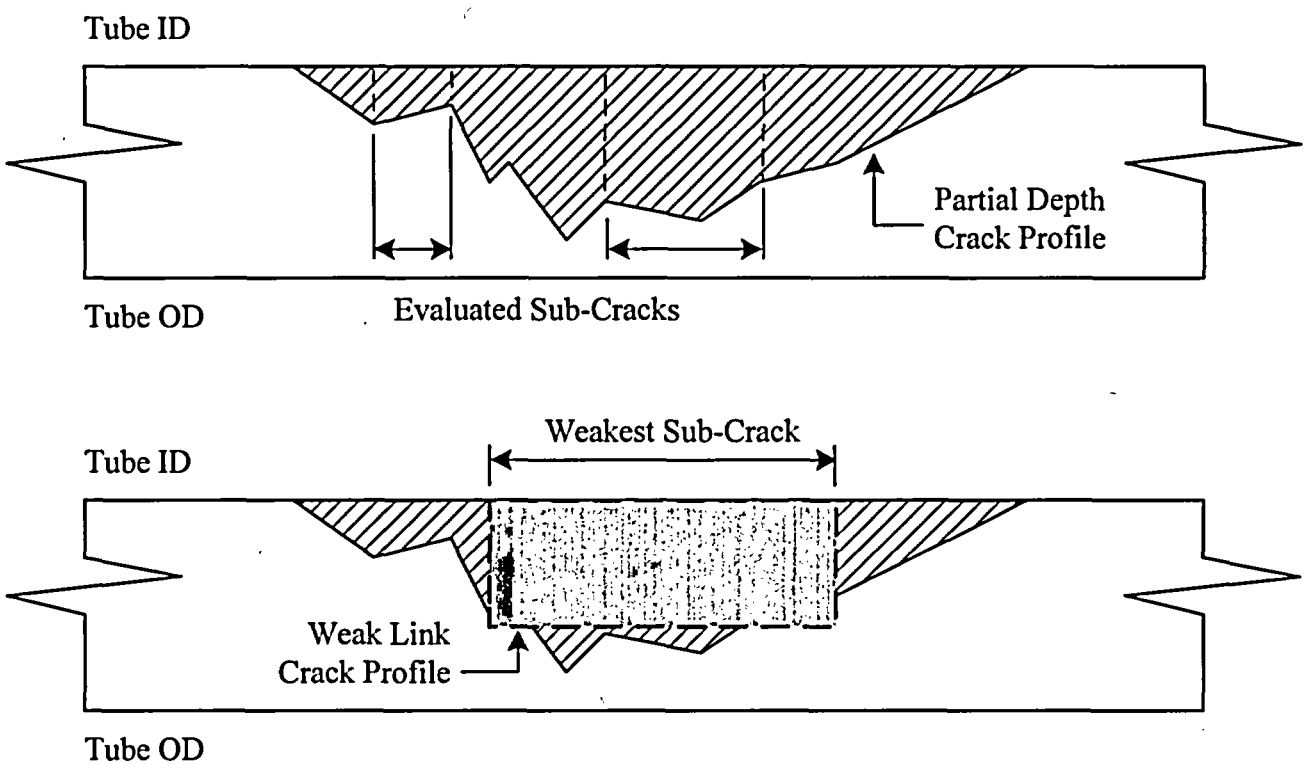

Figure 1: Representative part-throughwall axial crack profile with evaluated and weakest sub-crack profile shown.

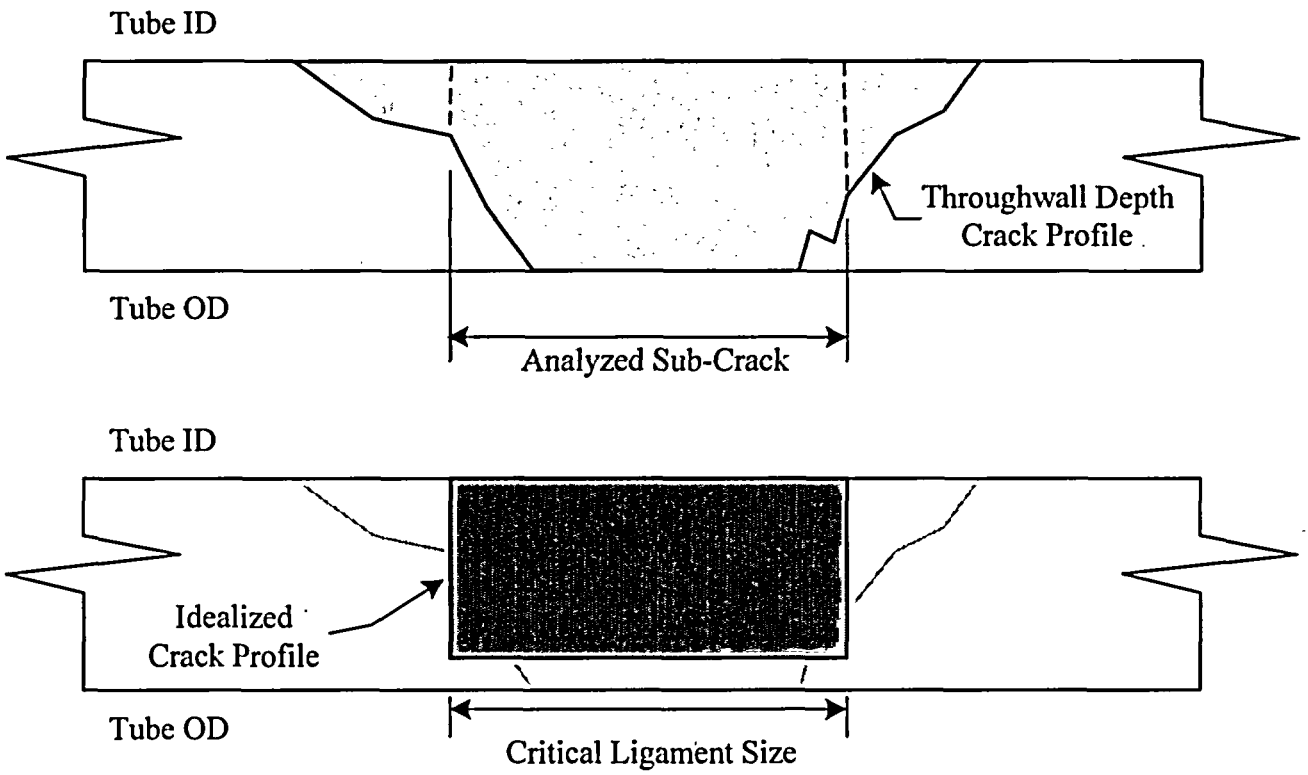

Figure 2: Representative throughwall axial crack profile with evaluated and critical idealized profile shown.

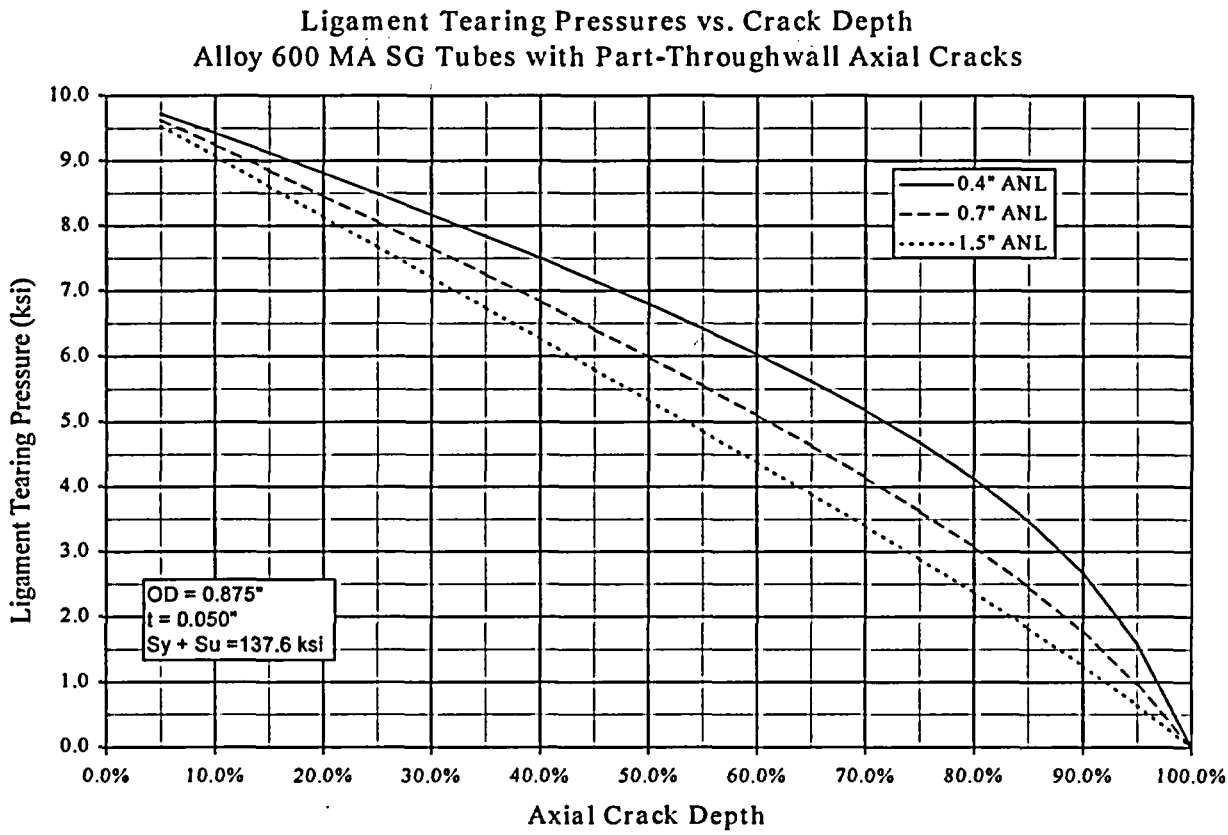

Figure 3: Ligament Tearing Pressure vs. Crack Length, Reference 2

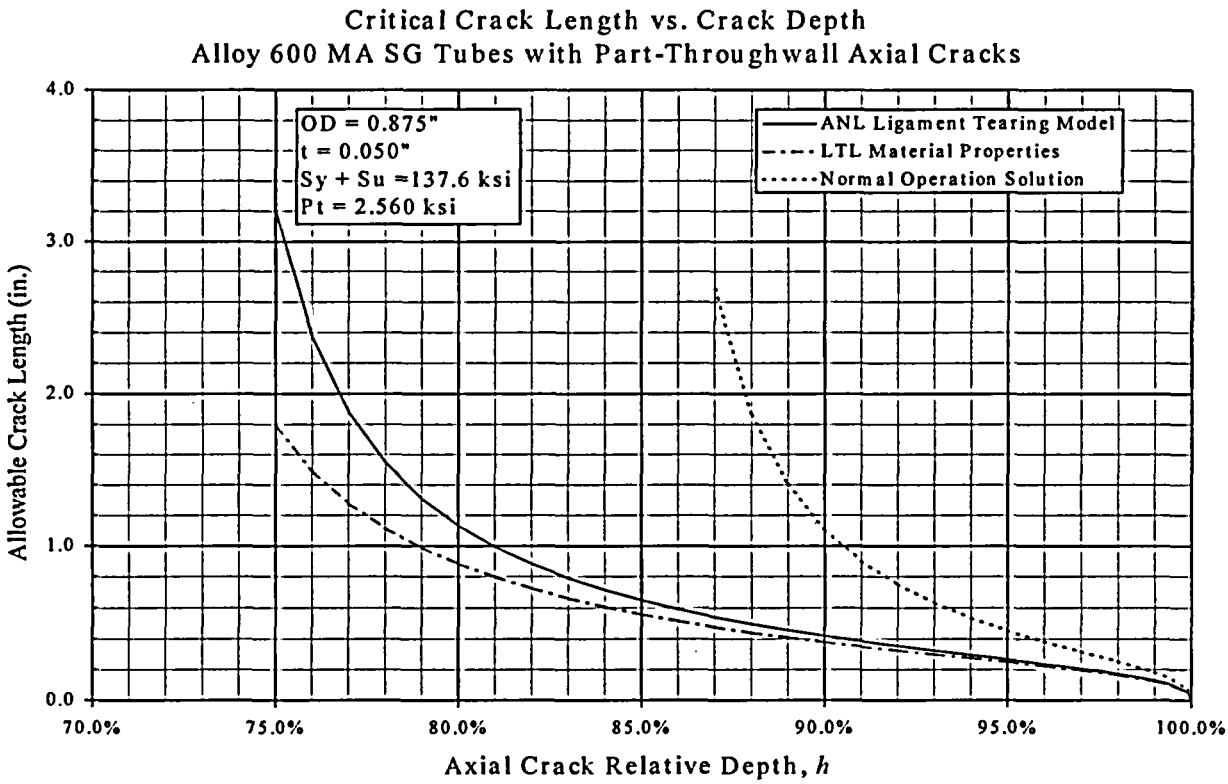

Figure 4: Critical Crack Length vs. Crack Depth, Reference 2

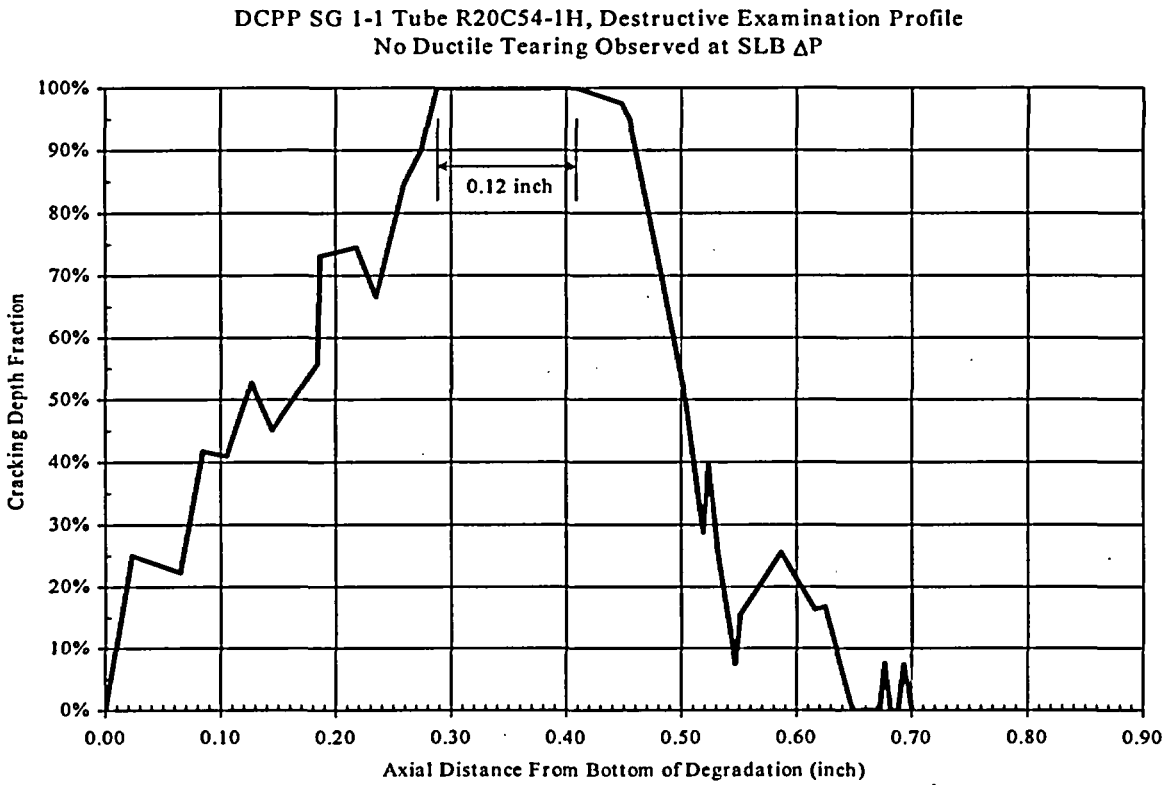

Figure 5: R20C54-1H Destructive Examination Depth Profile

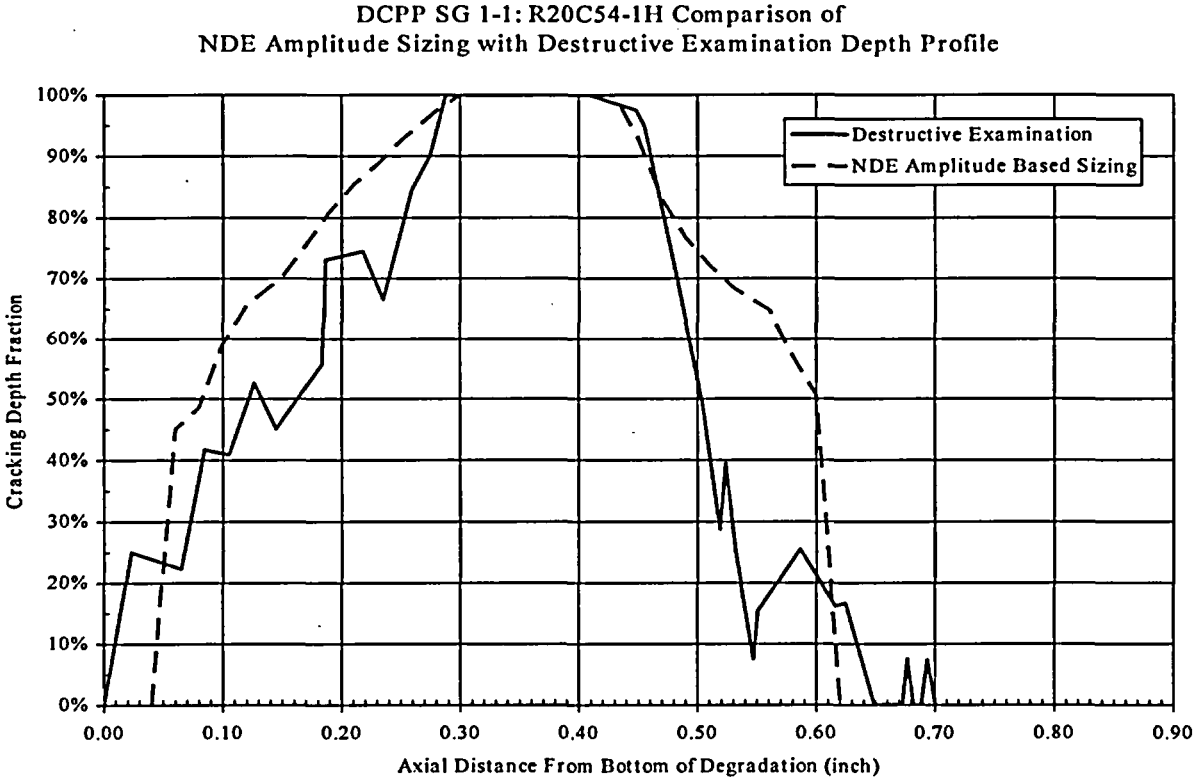

Figure 6: R20C54-1H NDE Versus DE Depth Profile

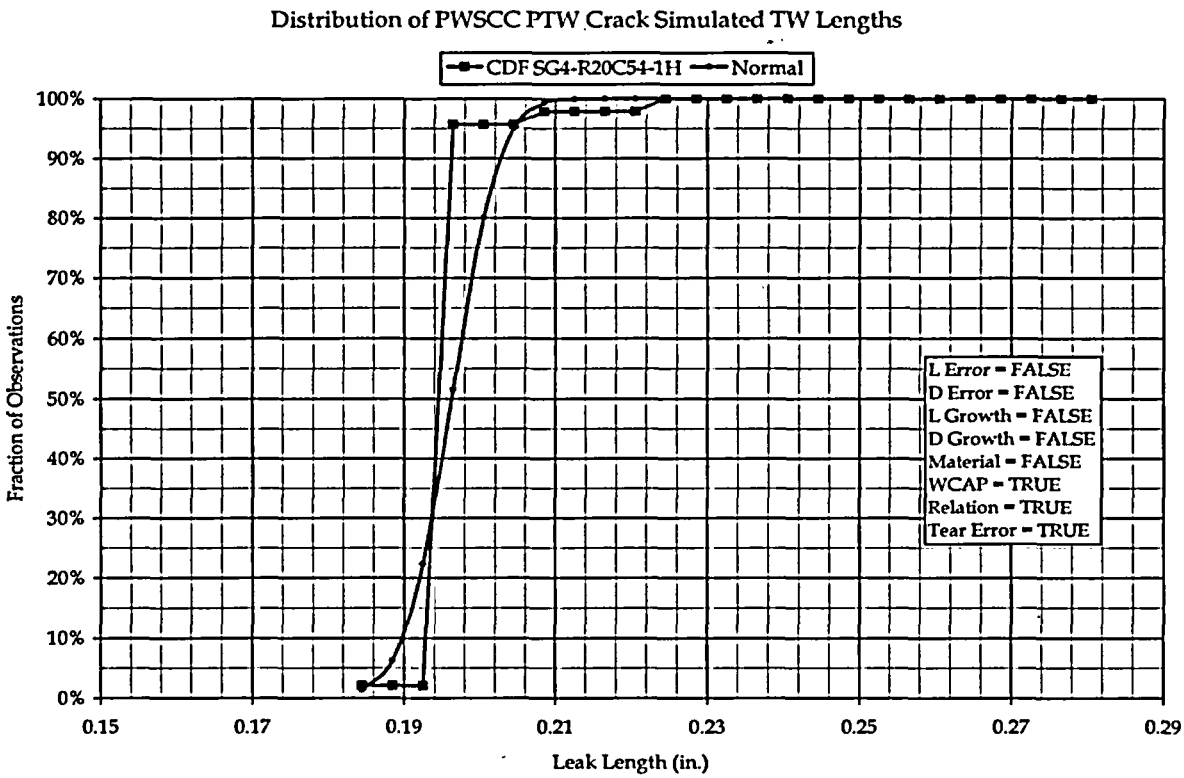

Figure 7: Distribution of R20C54-1H Simulated Torn Lengths

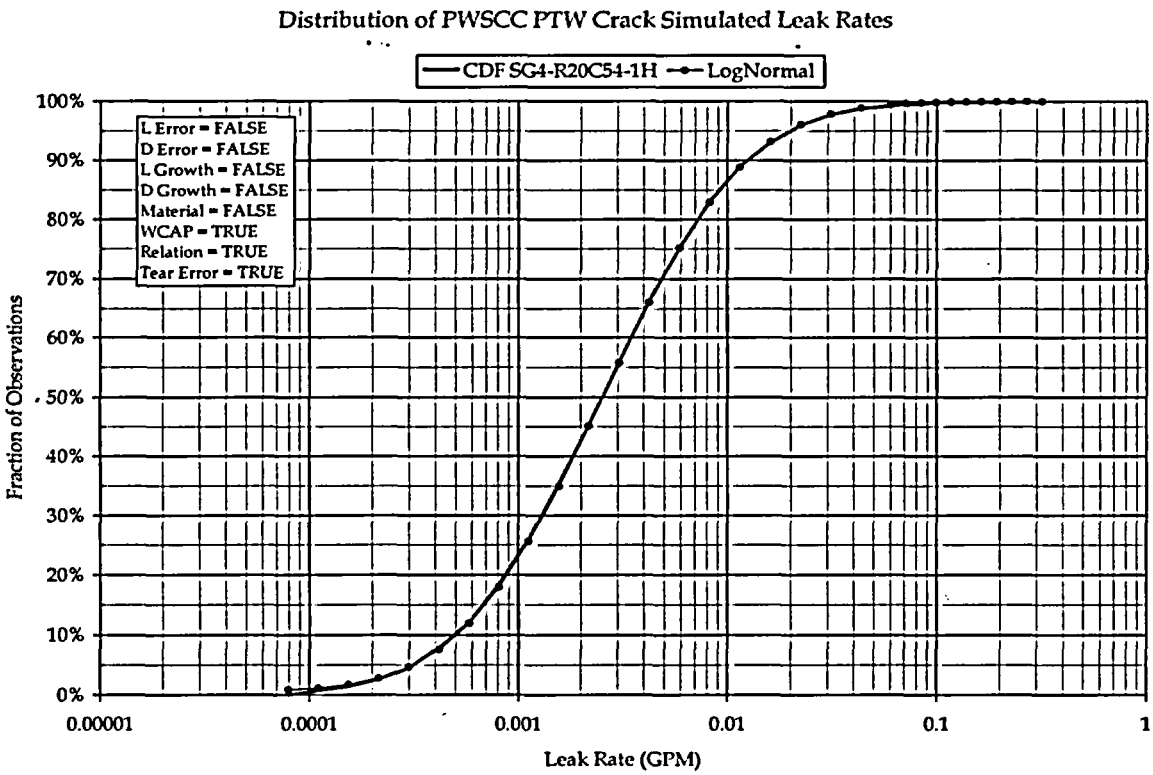

Figure 8: Distribution of R20C54-1H SLB Leak Rates

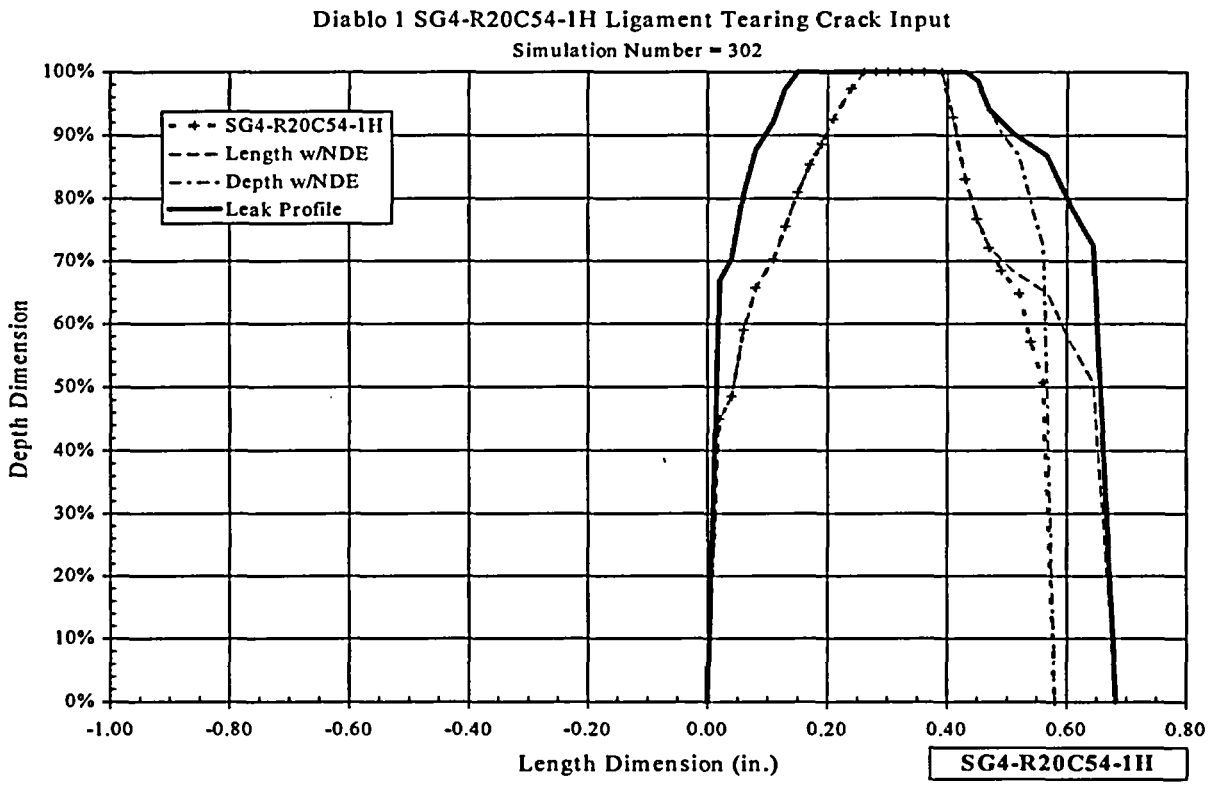

Figure 9: Sample Simulated R20C54-1H NDE Profile

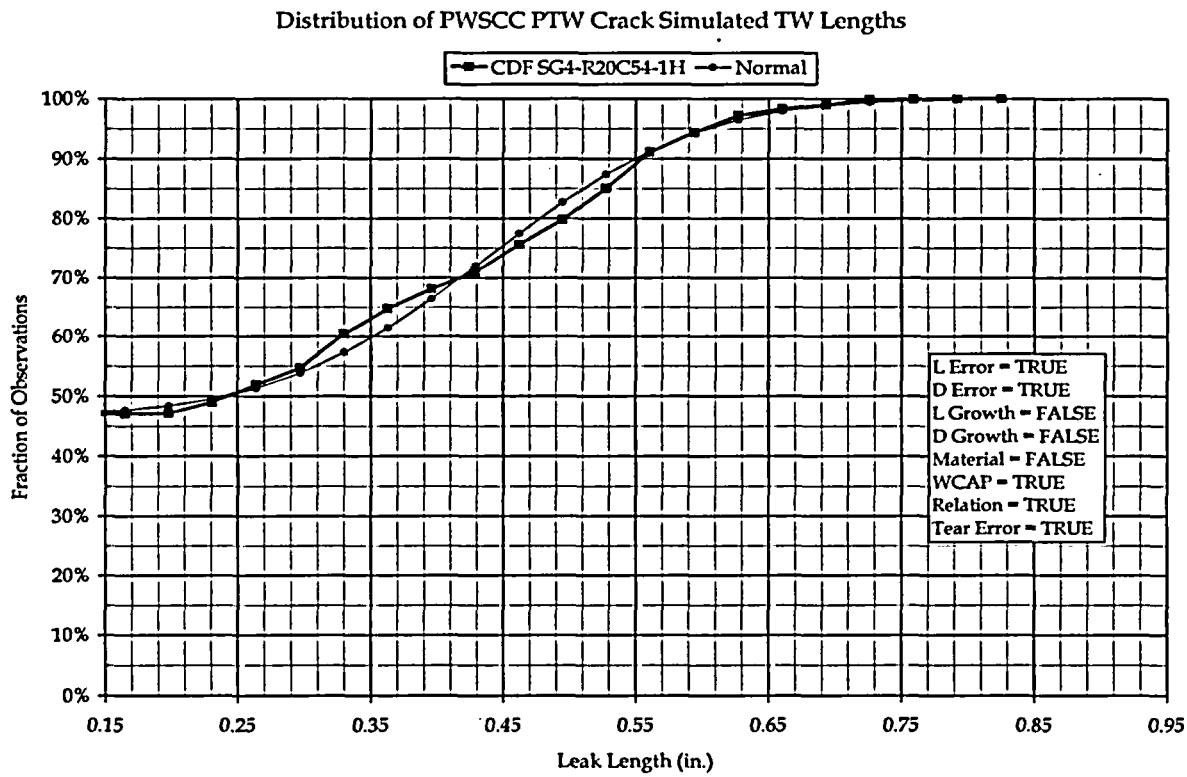

Figure 10: NDE Profile Distribution of R20C54-1H Torn Lengths

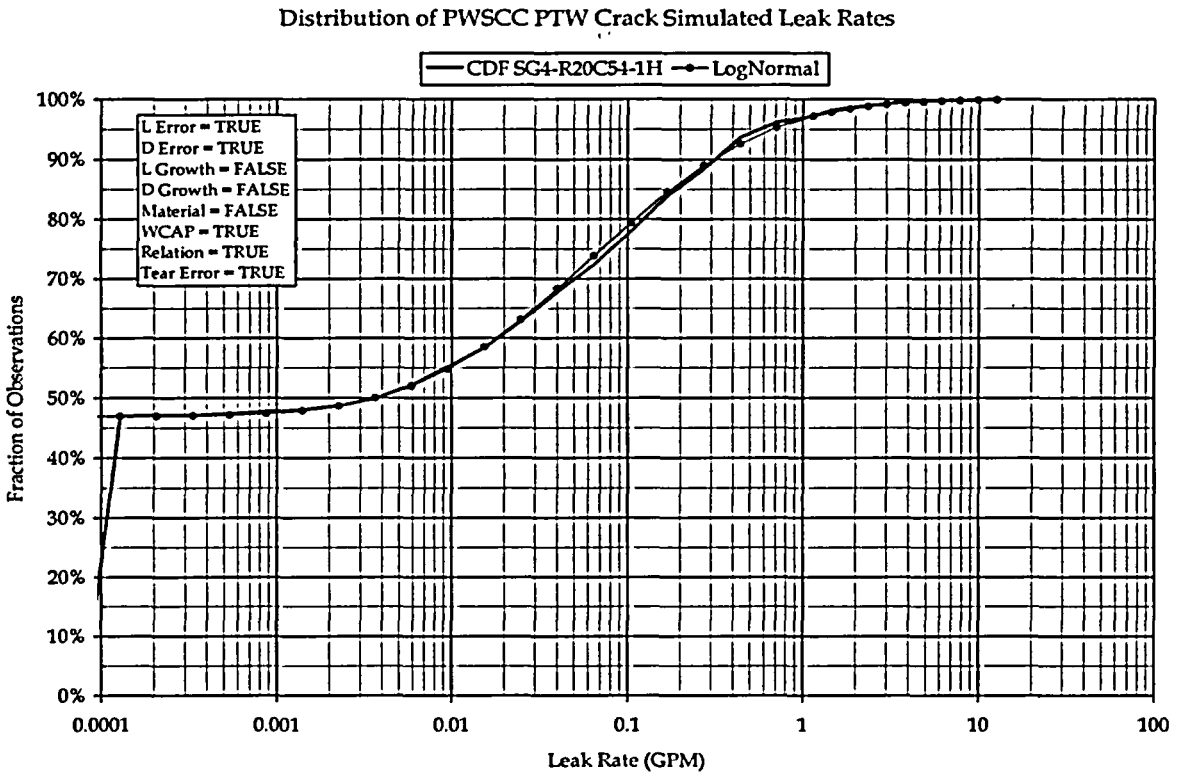

Figure 11: NDE Profile Distribution of R20C54-1H Leak Rates

ENCLOSURE 3
SPECIAL REPORT 04-02

STEAM GENERATOR CONDITION MONITORING AND OPERATIONAL ASSESSMENT REPORT DIABLO CANYON POWER PLANT UNIT 1 TWELFTH REFUELING OUTAGE (1R12)

1.0 Summary

During the Unit 1 twelfth refueling outage (1R12), greater than 1 percent of inspected tubes in steam generator (SG) 1-1 and SG 1-4 were defective and required plugging. PG&E submitted licensee event report (LER) 1-2004-001 to the NRC via letter DCL-04-056 dated May 10, 2004 to report this condition. If greater than 1 percent of inspected tubes in any SG exceed the repair criteria, Nuclear Energy Institute (NEI) 97-06, Revision 1, requires that a Condition Monitoring (CM) report be submitted to the NRC within 120 days after returning the SG to service. This report provides a SG tube CM assessment for Unit 1 Cycle 12 based on 1R12 tube inspection results. For information, this report also provides an Operational Assessment (OA) for Unit 1 Cycle 13 based on the 1R12 tube inspection results.

For degradation subject to alternate repair criteria (ARC), PG&E follows the tube integrity assessment requirements of Diablo Canyon Power Plant (DCPP) technical specifications (TS) and NRC-approved licensing bases. The W* ARC report, PWSCC ARC report, and voltage-based ARC report are provided in separate enclosures in this letter. For all other degradation, PG&E follows the tube integrity assessment guidance provided in Electric Power Research Institute (EPRI) Report TR-107621, "Steam Generator Integrity Assessment Guidelines," Revision 1, dated March 2000.

Condition Monitoring

NEI 97-06, Revision 1, structural and leakage performance criteria for condition monitoring were satisfied at the end of Unit 1 Cycle 12 (EOC 12). This conclusion is based on assessing the 1R12 as-found conditions of the tubing on a degradation-specific basis. Unit 1 Cycle 12 had an actual duration of 1.61 effective full power years (EFPY). Probabilistic structural criteria applied in voltage-based repair criteria are defined in GL 95-05, not in NEI 97-06.

- Structural integrity performance criteria: $3\Delta P_{NO}$ and $1.4\Delta P_{SLB}$ are the burst margin requirements for free span degradation and degradation confined to the tube support plate (TSP) crevice, respectively. Structural integrity performance criteria were satisfied at EOC 12. Voltage-based repair criteria probability of burst (POB) for EOC 12 was less than the GL 95-05 1% reporting threshold, as described in a separate enclosure, and structural integrity for axial ODSCC at TSPs was satisfied at EOC 12.

- Accident-induced leakage performance criteria: Accident-induced leakage assessments are based on the steam line break (SLB) differential pressure.

  - For degradation subject to ARC, the maximum allowable SLB induced leak rate limit is 10.5 gpm in a faulted SG, based on an analysis which uses current licensing basis assumptions and is approved by the NRC. As described in Enclosure 1, the aggregate EOC 12 SLB leak rate from ARC degradation (PWSCC ARC, W* ARC, GL 95-05 voltage-based ARC) and non-ARC degradation in the limiting SG is 0.99 gpm. This leak rate is less than the 10.5 gpm acceptance limit. Therefore, accident-induced leakage integrity performance criteria for ARC were satisfied at EOC 12.

  - For degradation not subject to ARC, the maximum allowable SLB-induced leak rate is 1 gpm in a faulted SG per NEI 97-06. The DCPP-specific non-ARC SLB-induced leak rate limit is 0.72 gpm at room temperature. There is no EOC 12 SLB leakage attributed to any non-ARC degradation, based on results of in situ leak testing of U-bend circumferential primary water stress corrosion cracking (PWSCC) indications. Therefore, accident-induced leakage integrity performance criteria for non-ARC were satisfied at EOC 12.

- Operational leakage performance criterion: Primary-to-secondary leakage through any one SG must be limited to 150 gallons per day (gpd). This limit is reflected in DCPP TS. A small leak was detected in Unit 1 Cycle 12, peaking at about 1 gpd, which is well below the 150 gpd limit. Therefore, the operational leakage performance criterion was satisfied at EOC 12. The leak was initially detected in Unit 1 Cycle 9 and continued in cycles 10, 11, and 12. The leak rate never exceeded 5 gpd, and therefore increased monitoring was not necessary in accordance with the EPRI primary to secondary leak guidelines. SG 1-4 was determined to be the highest contributor to leakage based on steam generator blowdown sampling. As discussed in this enclosure, this primary to secondary leakage is attributed to throughwall indications in SG tubes due to U-bend circumferential PWSCC indications. SG tube plugging performed in 1R12 has essentially eliminated the primary to secondary leakage in Unit 1 Cycle 13.

Operational Assessment

NEI 97-06, Revision 1, structural and leakage performance criteria for condition monitoring are projected to be satisfied at the end of Unit 1 Cycle 13 (EOC 13). This conclusion is based on assessing the projected EOC 13 conditions of the tubing on a degradation-specific basis. Unit 1 Cycle 13 has a projected duration of 1.36 EFPY. Probabilistic structural criteria applied in voltage-based repair criteria are defined in GL 95-05, not in NEI 97-06.

- Structural integrity performance criteria: $3\Delta P_{NO}$ and $1.4\Delta P_{SLB}$ are the burst margin requirements for free span degradation and degradation confined to the TSP

crevice, respectively. Structural integrity performance criteria will be satisfied at EOC 13. Voltage-based repair criteria POB for EOC 13 is projected to be less than the 1% reporting threshold in GL 95-05, as described in a separate enclosure, using a conservative probability of detection (POD) of 0.6.

- Accident-induced leakage performance criteria: Accident-induced leakage assessments are based on the steam line break (SLB) differential pressure.
  - For degradation subject to ARC, the maximum allowable SLB induced leak rate limit is 10.5 gpm in a faulted SG, based on an analysis which uses current licensing basis assumptions and is approved by the NRC. As described in Enclosure 1, the aggregate EOC 13 SLB leak rate from ARC degradation (PWSCC ARC, W* ARC, GL 95-05 voltage-based ARC) and non-ARC degradation in the limiting SG is 4.35 gpm. This leak rate is less than the 10.5 gpm acceptance limit.
  - For degradation not subject to ARC, the maximum allowable SLB-induced leak rate is 1 gpm in a faulted SG per NEI 97-06. The DCPP-specific non-ARC SLB-induced leak rate limit is 0.72 gpm at room temperature. No non-ARC accident-induced leakage is postulated at EOC 13.

2.0 Introduction

Steam Generator Background

DCPP Units 1 and 2 use Westinghouse Model 51 SGs with explosively expanded (WEXTEX) transitions. The SGs contain Alloy 600 Mill Annealed (MA) tubing. The nominal outside diameter of the tubing is 0.875 inch with a 0.050-inch nominal wall thickness. The DCPP Unit 1 and 2 SGs have historically operated with a nominal hot leg temperature (T_{hot}) of 603 degrees F. Starting with Cycle 11, Unit 1 has operated at a nominal T_{hot} of 604 degrees F due to an uprate. Unit 2 continues to operate with a nominal T_{hot} of 603 degrees F. The commercial operation dates for Units 1 and 2 are May 1985 and March 1986, respectively.

Starting with DCPP Unit 2 Cycle 8 and Unit 1 Cycle 9, the cycle lengths were extended to nominal 20-month operation. Prior to that time, the units operated on 18-month fuel cycles.

PG&E has implemented several initiatives to minimize primary water stress corrosion cracking (PWSCC) and outside diameter stress corrosion cracking (ODSCC). Primary side initiatives include U-bend heat treatment, WEXTEX tubesheet shotpeening, and zinc injection. Secondary chemistry initiatives include: copper removal program; ethanol amine (ETA) to control pH; increased hydrazine levels; molar ratio control program to prevent excess alkalinity; boric acid addition program (including boric acid soaks at startup to mitigate denting and ODSCC at TSPs); tube sheet sludge lancing

every outage; SG blowdown is maintained at 1 percent of the main steam flow rate; condensate polishers were installed and emergency (plant curtailment) procedures issued to protect against seawater condenser tube leaks; chemical cleaning in 1R12.

Technical Specification Repair Criteria

DCPP TS require plugging of any tube that has degradation greater than or equal to 40 percent of the nominal tube wall thickness, unless ARC are implemented. Several ARC are implemented in DCPP Units 1 and 2:

- In March 1998, the DCPP TS were revised to allow implementation of ARC for ODSCC at TSPs pursuant to NRC Generic Letter (GL) 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking." The ODSCC ARC TS changes were granted by the NRC in LA 124/122 dated March 12, 1998, in response to license amendment request (LAR) 97-03. ODSCC ARC was implemented starting in 2R8 for Unit 2 and 1R9 for Unit 1.

- In February 1999, the DCPP TS were revised to allow implementation of W* ARC for axial PWSCC in the WEXTEX tubesheet region. The W* ARC TS for Cycles 10 and 11 were granted by the NRC in LA 129/127 dated February 19, 1999 (in response to LAR 97-04). The W* ARC TS for Cycles 12 and 13 were granted by the NRC in LA 151 dated April 29, 2002 (in response to LAR 01-03). W* ARC was implemented starting in 1R9 and 2R9.

- In May 2002, the DCPP TS were revised to allow implementation of ARC for axial PWSCC at dented TSPs. The PWSCC ARC TS changes were granted by the NRC in LA 152 dated May 1, 2002 (in response to LAR 00-06 Supplement 3). PWSCC ARC was implemented starting in 2R11 and 1R11. Validated depth sizing of axial PWSCC at dented TSP intersections was previously implemented in 1R9 and 1R10 for Unit 1, and 2R9 and 2R10 for Unit 2, such that axial PWSCC less than the TS limit of 40 percent maximum depth limit was allowed to remain in service.

Other than degradation subject to ARC, all crack-like indications are required to be plugged on detection by a rotating coil probe, regardless of depth measurements. Cold leg thinning and antivibration bar (AVB) wear are sized by bobbin and allowed to remain in service if less than 40 percent.

Degradation Assessment

NEI 97-06, Revision 1, requires completion of a degradation assessment (of both existing and potential degradation mechanisms) prior to each inspection. A degradation assessment, inspection/expansion plan, and tube repair plan were prepared and issued before 1R12. A summary of the inspection plan and actual expansion scope is provided in Table 1. The degradation assessment provides a summary of the EPRI

nondestructive examination (NDE) techniques used in 1R12, including detection and sizing capabilities. The SG tube inspection contractor (Framatome-ANP) performed a site specific technique qualification to demonstrate that the EPRI techniques are applicable for use at DCPP. The degradation assessment was revised during 1R12 to assess a new DCPP Unit 1 tube degradation mechanism that was detected in 1R12 (i.e., PWSCC in the plug expansion region of deplugged tubes).

Secondary Side Pressure Testing

As discussed earlier, the Unit 1 primary to secondary leak rate of about 1 gpd was determined to be coming from SG 1-4. EPRI SG Integrity Assessment Guidelines Revision 1 (EPRI TR-107621-R1), Section 10.2, states that secondary side testing should be considered to identify leaking tubes if the primary to secondary leak rate exceeds 5 gpd. PG&E decided to proactively perform secondary pressure testing in SG 1-4 even though the leak rate was much less than 5 gpd. The secondary side and steam lines were filled with water to the gagged main steam isolation valves and over pressurized with nitrogen. The pressure was initially held at 200 psi, then increased and held at about 200 psi intervals, until a final pressure of 600 psi was reached. At each pressure, the tubesheet face was scanned and observed for evidence of tube or plug leakage.

No tubes were observed to have leakage or moisture. As discussed in Enclosure 1, one tube was noted to have boric acid near the tube end, leading to the discovery of PWSCC in the plug expansion region in deplugged tubes.

In Situ Pressure Testing Program

PG&E's in situ pressure test program follows commitments made to the NRC in support of ARC and also follows the guidelines in EPRI Report 1007904, Steam Generator In Situ Pressure Test Guidelines, Revision 2, August 2003. The purpose of in situ pressure testing is generally to support condition monitoring. The degradation assessment documents the degradation-specific voltage screening threshold values that were applied in 1R12, consistent with NRC commitments and the EPRI guidelines.

With respect to ARC commitments, in situ test screening of W* ARC axial PWSCC indications located in the WEXTEX region, and PWSCC ARC axial PWSCC indications that extend outside the dented TSP crevice, were performed as described in Enclosures 1 and 2, respectively. No in situ testing was required for these ARC programs. In situ test screening of axial ODSCC indications subject to voltage-based ARC is not required, as these indications are confined to the TSP crevice which limits the applicability of the in situ test to SLB conditions (at SLB, the TSPs are assumed to be displaced from the crack indications).

With respect to non-ARC degradation, all degradation was screened for the need for in situ pressure testing. Based on this screening, 9 tubes with U-bend circumferential

PWSCC were in situ pressure tested. The results of this testing is provided in Table 5 and discussed in a later section. All tubes that were in situ pressure tested were plugged.

Tube Pull

In support of continued implementation of voltage-based ARC for axial ODSCC at TSPs, EPRI report NP-7480-L, Addendum 5 requires that a pulled tube specimen (minimum of two intersections) be obtained at the refueling outage following accumulation of three operating cycles from the previous tube pull. The previous (initial) Unit 1 tube pull for axial ODSCC at TSPs was performed in 1R9. Therefore, a tube pull for axial ODSCC at TSPs was scheduled for 1R12. The primary emphasis for selecting an intersection for removal was to fill a bin with an open target indication voltage, i.e., bins greater than 3 volts.

In 1R12, one tube (two intersections) was pulled: SG 1-1 R20C54 1H (axial ODSCC with 5.6 bobbin volts) and 2H (NDD). The destructive examination results are provided in a separate enclosure. Results of the laboratory leak tests showed very small leakage at SLB conditions, and burst tests demonstrated burst margins greater than the deterministic 1.4 ΔP_{SLB} acceptance limit. The tube was pulled after chemical cleaning, and large TSP breakaway forces were measured, consistent with previous DCPP Units 1 and 2 tube pulls and consistent with expectation of packed TSP crevices.

Tube Repairs

Following eddy current inspections, 193 tubes were plugged. Framatome-ANP alloy 690 roll plugs were used in both legs, with the exception of SG 1-1 R20C54 pulled tube, for which a Framatome-ANP alloy 690 weld plug was used in the hot leg. Table 2 provides the 1R12 plugging breakdown for each SG and reasons for plugging.

Eighty-five tubes were plugged due to circumferential PWSCC indications in rows 5 to 8 U-bends in SGs 1-3 and 1-4. Framatome-ANP stabilization analysis determined that none of the tubes needed stabilization. However, all tubes with PWSCC indications in the largest U-bends (rows 7 and 8) were preventively stabilized.

Thirteen tubes with circumferential indications at the top of tubesheet and dented TSP intersections were plugged. Westinghouse stabilization analysis determined that 3 of these tubes required stabilization, as identified in Table 6, and these 3 tubes were stabilized.

1R12 Damage Mechanisms

Tables 2, 3, and 4 provide the number of SG tubes plugged in 1R12 and historical tubes plugged in Unit 1.

The following degradation mechanisms were detected in 1R12 and are assessed for SG tube integrity in this report. New degradation mechanisms for Unit 1 are noted as "new".

- Axial PWSCC in hot leg WEXTEX tubesheet region (W* ARC, see Enclosure 1)
- Axial PWSCC at hot leg dented TSP intersections (PWSCC ARC, see Enclosure 2)
- Axial ODSCC at hot leg TSP intersections (Voltage-based ARC, see Enclosure 4))
- Circumferential PWSCC in Rows 5 through 8 U-bends (New)
- Circumferential ODSCC at hot leg dented TSP intersections
- Combined axial ODSCC and axial PWSCC at hot leg TSP intersections (ID/OD)
- Combined axial PWSCC and circumferential ODSCC at hot leg TSP intersections (PWSCC Mix Mode, see Enclosure 2)
- Combined axial ODSCC and circumferential ODSCC at hot leg TSP intersections (ODSCC Mix Mode)
- Circumferential ODSCC in hot leg WEXTEX top of tubesheet region
- Circumferential PWSCC in hot leg WEXTEX top of tubesheet region
- Cold leg thinning at cold leg TSP intersections
- AVB wear in U-bend region
- TSP ligament cracking

This report also provides inspection results of the following potential degradation mechanisms that were not detected in 1R12.

- Potential axial and circumferential PWSCC in Row 1 and 2 U-bends
- Potential axial PWSCC in high row U-bends
- Potential stress corrosion cracking at free span dings
- Potential tube damage due to loose parts and foreign objects

Six tubes were plugged preventively in 1R12 due to permeability variation (PVN) signals in the straight legs, and CM OA is not required.

Assessment of 1R12 Chemical Cleaning on Cycle 13 OA

Chemical cleaning (CC) was conducted for the first time in Unit 1 in 1R12, with two SGs being cleaned at a time. In SGs 1-1 and 1-2, CC was performed prior to SG tube eddy current inspections. In SGs 1-3 and 1-4, CC was performed after eddy current inspections. The following table provides the amount of sludge and scale removed in each SG.

Sludge (pounds) Removed by Chemical Cleaning in 1R12

	SG 1-1 and SG 1-2	SG 1-3 and SG 1-4
Chemical Cleaning	8705	8317
Sludge Lancing	619	1377
Total (pounds)	9324	9694

CC was effective at removing tube scale and sludge. This was apparent from post-CC upper bundle in bundle (UBIB) video probe inspections. A separate TSP crevice cleaning step was not performed, so crevice deposits were not affected by CC.

Chemical cleaning could potentially affect detection capability of ODSCC damage mechanisms, as well as ODSCC growth rates over Cycle 13. There are three active ODSCC damage mechanisms in DCPP Unit 1: axial ODSCC at TSP intersections, circumferential ODSCC at hot leg dented TSP intersections, and circumferential ODSCC at the hot leg top of tubesheet. There are no active ODSCC damage mechanisms in the free spans of tubing.

Enclosure 4 provides an assessment of CC on TSP axial ODSCC in support of voltage-based ARC, and concludes that CC had no significant influence on detection capability or growth rates. This was based on a sample of tubes in SG 1-2 that were bobbin inspected both prior to and after CC.

CC did not affect the Plus Point detection capability of circumferential ODSCC at dented TSPs, nor would growth rates be affected over the next cycle, because the indications are generally confined to the crevice, as shown in Table 6. CC did not affect the Plus Point detection capability of circumferential ODSCC at the top of tubesheet based on the small number of indications detected in SGs 1-1 and 1-2 (two and none, respectively, see Tables 2 and 6), which were inspected after CC. CC could potentially reduce the initiation and growth of ODSCC at the top of tubesheet in future cycles, although the current rates are very low. Therefore, the cycle 13 OA does not need to consider the affects of chemical cleaning on ODSCC damage mechanisms.

Assessment of Cycle 13 Higher RCS Lithium on PWSCC Degradation for Cycle 13 OA

In Unit 1 Cycle 13, PG&E is operating at elevated pH primary side water chemistry, resulting in higher lithium concentrations, with lithium greater than 3.7 ppm for a majority of the cycle. In Westinghouse report STD-MCE-061 Revision 1, dated February 7, 2004, Westinghouse evaluated the potential affects of operating at higher lithium on PWSCC degradation at DCPP Units 1 and 2, and concluded that there would be no significant effect on PWSCC growth rates. Therefore, the OA for all PWSCC damage mechanisms does not need to assume increased growth rates due to higher lithium concentrations. The report also concludes that higher lithium could have a potential adverse affect on PWSCC initiation. The report addressed this possible consequence on PWSCC susceptible locations, including axial PWSCC within the tubesheet (W* ARC), axial PWSCC at dented TSPs (PWSCC ARC), and U-bend

circumferential PWSCC. The report concludes that a small number of potential newly initiated PWSCC indications would not result in any meaningful change to the probability of burst or leak rate during a postulated SLB event. Therefore, the Cycle 13 OA does not need to consider the potential for newly initiated PWSCC indications due to higher lithium concentrations in order to adequately assess tube structural and leakage integrity.

NRC Reporting and NRC Inspection

LER 1-2004-001 dated May 10, 2004, was submitted to the NRC via PG&E letter DCL-04-056 prior to the SGs return to service, to report the following conditions as required by the DCPP Technical Specification (TS).

TS 5.5.9, "Steam Generator (SG) Tube Surveillance Program," Table 5.5.9-2, requires that the results of each SG tube inspection be classified as Category C-3 if more than one percent of the total tubes inspected are defective. Results of SG tube inspections that are classified as Category C-3, require NRC notification in accordance with 10 CFR 50.72(b)(2). SG 1-1 and SG 1-4 were determined to be in Category C-3 following completion of eddy current testing. TS 5.6.10.c requires the results of SG tube inspections, which fall into Category C-3, to be reported in a special report to the Commission within 30 days and prior to resumption of plant operation. "This report shall provide a description of investigations conducted to determine cause of the tube degradation and corrective measures taken to prevent recurrence."

TS 5.6.10.d requires that for implementation of ODSCC ARC, the NRC be notified prior to returning the SG to service if indications are identified that are circumferential or attributable to PWSCC.

3.0 Axial PWSCC in WEXTEX Region

Axial PWSCC in the WEXTEX tubesheet region is assessed under W* ARC. Enclosure 1 provides the CM OA for axial PWSCC in the WEXTEX region pursuant to W* ARC requirements.

4.0 Axial PWSCC at Dented TSP Intersections

Axial PWSCC at dented TSP intersections is assessed under PWSCC ARC. Enclosure 2 provides the CM OA for axial PWSCC at dented TSP intersections pursuant to PWSCC ARC requirements.

5.0 Axial ODSCC at TSP Intersections

Axial ODSCC at TSP intersections is assessed under ODSCC ARC. Enclosure 4 provides the CM OA for axial ODSCC at TSP intersections pursuant to GL 95-05 requirements. Enclosure 5 provides the destructive examination report for the 1R12

pulled tube in R20C54 in SG 1-1, which contained TSP axial ODSCC, in support of continued implementation of GL 95-05.

6.0 Circumferential PWSCC in Row 5 to Row 8 U-Bends

Background

In 2R11, a secondary side pressure test in SG 2-4 identified leakage in the R5C62 U-bend region. Subsequent Plus Point inspection detected several short circumferential crack-like indications on the ID of the row 5 U-bend, extending from the hot leg tangent point to the cold leg tangent point. Because industry had never performed extensive high row U-bend inspections with a rotating probe, and this was a first of a kind degradation mechanism in both domestic and foreign plants, a critical area could not be immediately determined to limit the Plus Point inspection scope. As a result, the U-bend Plus Point inspection program was expanded to include 100% of the U-bend regions of all rows (rows 3 through 46) in each SG. A total of 12 tubes were identified to have similar circumferential indications, ranging from Row 3 to Row 10. Each SG had at least one indication. The indications were located on the flanks of the tube. Video probe inspections confirmed the presence of circumferential ID cracking. The tubes were in situ leak and proof tested, and only R5C62 exhibited leakage at SLB differential pressure (about 0.003 gpm at room temp). There were no tube bursts at 3 times normal operating differential pressure ($3\Delta P_{NO}$). The tubes were stabilized and plugged.

The root cause of the indications was attributable to circumferential PWSCC due to high residual stresses inherent to the tube bending process, as documented in a formal root cause report issued by PG&E.

Following the 2R11 experience, the Westinghouse Owner's Group (WOG) issued a report on September 15, 2003, which defined a critical area for this damage mechanism and provided inspection and expansion recommendations for similar Model 51 SGs. The WOG report demonstrates that U-bend circumferential flaw development is related to longitudinal residual stress, which is dependent on row (bend radius). Based on finite element analysis and plots of longitudinal strain versus row, longitudinal stress is significantly reduced from row 5 to row 10, and further reduced from row 10 to row 20. The WOG report defines the critical area (CA) for circumferential PWSCC as Rows 3 to 8, and the buffer zone as Rows 9 and 10, and recommends a 100% Plus Point (or equivalent) inspection of Rows 3 to 10 for the initial inspections. If circumferential PWSCC is detected in rows 9 or higher, expansion of the Plus Point inspection is required in accordance with the WOG guidelines.

1R12 Inspection Results

In 1R12, PG&E performed the first time Plus Point inspection of greater than row 3 U-bends. The WOG inspection criteria were followed. 100% of rows 3 to 10 U-bends

were Plus Point inspected. Circumferential PWSCC indications were detected in 85 tubes, limited to rows 5 through 8 in SGs 1-3 and 1-4 (Huntington tubing). No indications were detected in SGs 1-1 and 1-2 (Blairsville tubing). Most of the tubes contained multiple indications, with a total of 402 indications detected. All indications were located in the ridge of probe liftoff signals, similar to the Unit 2 indications, which were shown to be oriented on the flanks of the tubing based on Unit 2 video inspections. The indications had short circumferential extents, limited to about 0.25 inches.

Tables 8, 9, and 10 provide the number of tubes with circumferential PWSCC, number of PWSCC indications, and maximum PWSCC voltage, respectively, as a function of tube row. This data illustrates a decreasing trend of both numbers and voltages as tube row and bend radius increases, validating the basis of the WOG report inspection recommendations.

Table 11 identifies the tube locations with circumferential PWSCC in rows 5 through 8 U-bends, and number of Plus Point indications in each tube location. Table 12 provides the Plus Point voltages, maximum depths, and lengths of each indication. The Plus Point probe does not have quantified sizing capability in U-bends, so the depths and lengths are estimates. The longest reported length was 42 degrees, much less than the Rows 1 through 10 U-bend 100% throughwall structural limit length of 190 degrees for the limiting combined SLB and safe shutdown earthquake (SSE) structural loads which bound $3\Delta P_{NO}$ conditions (WCAP-15147 Revision 2, "Regulatory Guide 1.121 Analysis for Diablo Canyon Units 1 and 2 to Define Structural Limits for Various Modes of Degradation.") This difference allows for some margin for NDE uncertainty.

All indications were screened in accordance with the guidance in EPRI Report 1007904, Steam Generator In Situ Pressure Test Guidelines, Revision 2, August 2003. The pre-established voltage screening threshold leakage value for U-bend circumferential PWSCC was 1.73 volts Plus Point, based on the data in Table B-16 of the EPRI guidelines and as supplemented by industry U-bend in situ test data compiled in 2003 (including the DCPP Unit 2 R5C62 U-bend leaker discovered in 2003). A total of 9 tubes with U-bend circumferential PWSCC indications had Plus Point voltages in excess of 1.73 volts, and were in situ pressure tested. Table 5 identifies the tubes that were tested, number of Plus Point indications, Plus Point voltage, the test pressures, and leak rate results. None of the PWSCC indications leaked at NOP or SLB pressures. Four of the tubes leaked slightly at pressures in excess of 3750 psi, well above SLB pressure of 2405 psi. At $3\Delta P_{NO}$, no burst occurred and very small leak rates were measured. Based on these results at EOC 12, no SLB accident-induced leakage is attributed to U-bend circumferential PWSCC, and structural margins were maintained. It is believed that the SG 1-4 operational leakage may have been due to leakage from one or all of these 4 tubes even though no leakage was identified in the in situ tests and NOP and SLB pressures. The Plus Point voltage of 3.52 volts for R5C67 is higher than the 3.04 volts found for the R5C62 leaker in Unit 2. The operating leak

rate of about 1 gpd during Cycle 12 is near the threshold of measurement for in situ leakage testing.

Operational Assessment

The $3\Delta P_{NO}$ structural limit for 100% throughwall circumferential cracking in rows 1 to 10 U-bends based on combined SLB and SSE loads is 190 degrees, not accounting for NDE uncertainty, per WCAP-15147 Revision 2.

The growth rate of circumferential PWSCC in rows 5 through 8 cannot be quantified because there is no back-to-back Plus Point data for these indications. However, even though the bobbin coil cannot reliably detect circumferential indications, a historical bobbin data lookup review of prior inspections was performed for some of the larger U-bend indications. The bobbin data lookup was conducted knowing the exact flaw locations based on 1R12 Plus Point inspections. The historical bobbin data review identified several SG 1-4 indications in history. R6C28, R6C65, and R5C70 were traceable back to 1R6 (1994). R6C38, R6C46, and R5C67 were traceable back to 1R8 (1997). This indicates that the indications had slow growth. Moreover, the analytical and test information indicates that cracks should remain short, i.e., once away from the flanks of the tube, the residual stresses become compressive and crack growth in the hoop direction would be expected to stop.

There is a large database of growth rates for axial PWSCC at dented TSPs, as discussed in Enclosure 2 for PWSCC ARC. For the growth rate data set used in the PWSCC ARC cycle 13 operational assessment, the 95 percentile growth rates per EFPY are bounded by 0.09 inch for length, 12% for maximum depth, and 10% per EFPY for average depth. There is a smaller growth rate database for circumferential PWSCC at dented TSPs. As discussed in Section 7 of this enclosure, the 95 percentile growth rates per EFPY for circumferential PWSCC at dented TSPs are 15 degrees, 19% maximum depth, and 14% average depth. These numbers are essentially the same as axial PWSCC at dents, and are therefore used in the operational assessment for circumferential PWSCC in U-bends. Considering that bobbin indications could be traced to 1994, and that Unit 1 has accumulated greater than 8 EFPY since 1994, a circumferential PWSCC indication at 1R12 would have to be at least 120 degrees after applying a growth rate of 15 degrees per EFPY. This length is much longer than the reported lengths in 1R12, and thus the growth rate represents a conservative upper bound prediction, even though growth in the hoop direction would be expected to stop as discussed above.

The assumed detection threshold for circumferential PWSCC in Rows 3 and higher is 41 degrees, corresponding to the maximum length of the 1R12 indications. Adding 15 degrees per EFPY arc length growth over 1.36 EFPY to the detection threshold results in a projected EOC 13 circumferential PWSCC indication of 61 degrees. This length is much less than the 190 degree structural limit, thus allowing large margins for NDE length measurement uncertainty. In addition, the axial stress field in the flanks of the U-

bends is very limited in circumferential extent, which is consistent with the short flaw lengths found for previously uninspected tubes. Consequently, the potential circumferential extent is much less than the structural limit. Therefore, structural margins would be maintained at EOC 13.

The possibility of circumferential PWSCC in Rows 11 and higher U-bends at EOC 13 is unlikely, given the decreasing residual stresses in higher rows, the 1R12 Plus Point NDD condition for Rows 9 and 10 U-bends, and the 1R12 Plus Point NDD condition for the 20% sample inspection of tubes in rows 13 to 17 U-bends (see section 17).

Because Plus Point inspections were performed in 100% of Rows 1 to 10 U-bends and secondary side pressure testing was performed in SG 1-4 to assist in identification of throughwall indications, it is reasonable to assume that all 100% throughwall U-bend indications were detected and plugged. The Plus Point detection threshold for circumferential PWSCC maximum depth is estimated at about 45% based on evaluations conducted in the 2R11 CMOA report, and is similar to the 45% threshold of detection of circumferential ODSCC as reported in section 7 of this enclosure. Adding 19% per EFPY maximum depth growth over 1.36 EFPY results in an EOC 13 maximum depth of 71%. Therefore, leakage integrity would be maintained for cycle 13. This conclusion is further supported by the fact that none of the indications, which were present for 8 EFPY based on the bobbin historical review, had measurable leakage at SLB pressure differentials in the in situ tests.

In conclusion, no circumferential PWSCC indications in U-bends are expected that would challenge structural integrity performance criteria through EOC 13. In addition, no leakage should be postulated in a faulted SG following a SLB at EOC 13 due to the extremely low probability that indications would tear ligaments and pop through in one cycle. This conclusion is validated based on the results of in situ pressure testing results in 1R12, which demonstrated structural integrity at $3\Delta P_{NO}$ conditions and no SLB leakage.

7.0 Circumferential ODSCC at Dented TSP Intersections

Ten circumferential ODSCC indications (in 9 tubes) were detected by Plus Point at dented hot leg TSP intersections, as listed in Table 6. All the circumferential indications (SCI) were plugged. All the of the dent voltages at which circumferential cracking was detected were greater than 4 volts, except for SG 1-1 R29C46 1H, which was located at a 0.51 volt dented TSP.

No circumferential PWSCC at dented TSPs was detected by Plus Point, so this damage mechanism is considered non-active for Unit 1 Cycle 12 and Cycle 13. Nonetheless, growth rates and detection thresholds for this damage mechanism are considered in this section for completeness, and are based on the most recent evaluation for circumferential PWSCC at dents documented in the 2R11 90 day CMOA report (Enclosure 3 of DCL-03-076).

The SCI were sized using the technique described in Appendix B of WCAP-15573, Revision 1. The depth profiles were then processed for corrections in accordance with the depth adjustment rules in Section 4.10.4 of WCAP-15573, Revision 1. The adjusted NDE results were corrected for 95 percentile NDE uncertainty using the NDE uncertainty regression parameters in Tables 4-19 to 4-21 in WCAP-15573, Revision 1. The adjusted NDE and adjusted NDE with uncertainty results are listed in Table 6.

The $3\Delta P_{NO}$ structural limit for a straight leg SCI is about 264 degrees, assuming a 100% throughwall defect. The longest NDE length was 60.6 degrees, and is adjusted to 185.5 degrees after applying large 95 percentile NDE uncertainties. This length is less than the 264 degree structural limit. Therefore, structural integrity was satisfied at EOC 12.

The maximum Plus Point voltage of the 1R12 TSP circumferential ODSCC indications was 0.63 volts, much less than the 1.31 volt threshold for leak testing of circumferential ODSCC indications at explosive expansions (approximately equivalent to a dented TSP) documented in the EPRI In Situ Pressure Test Guidelines. In addition, the largest NDE maximum depth was 78.2 percent, including 95 percent NDE uncertainty. Based on these NDE measurements, the circumferential indications were shallow and no SLB leakage should be postulated for these indications at EOC 12.

Per WCAP-15573, Revision 1, Section 4.13, the largest projected EOC average depth based on the detection threshold and growth is 64 percent for ODSCC. The largest average depth detected in 1R12 was 43.2 percent with no NDE uncertainty added, and 58.5 percent with 95 percent NDE uncertainty. Thus, the projected EOC indications bound the largest indications found in 1R12.

Operational Assessment

Nine of the ten TSP intersections containing circumferential ODSCC were also inspected by Plus Point in 1R11 and six were detectable in 1R11 data based on a lookup. The growth rates were very small as noted in Table 6. Adding these 1R12 ODSCC data points to the existing database from WCAP-15573 Revision 1, plus data points from 1R11 and 2R11, results in the following growth rates:

Post-1R12 95% Probability Growth Rates per EFPY for TSP Circumferential Cracking
Kunin Minima Distribution

	PWSCC	ODSCC
Average Depth	14%	9.5%
Maximum Depth	19%	13%
Length	15 deg	22.5 deg
Number of DCPP data points in growth distribution	24	15

The limited data would indicate that PWSCC depth growth rates are larger than ODSCC. However, due to the small population of ODSCC growth data points, the ODSCC growth is conservatively assumed to be the same as PWSCC.

The average depth (AD) growth data at 95% cumulative probability can be combined with the estimated detection thresholds derived from destructive examination (35% AD detection threshold estimated for ODSCC, no NDE uncertainty is necessary for a detection threshold) to obtain a deterministic projection of expected EOC 13 average depths. The 35% AD detection threshold is conservative because: based on the 1R11 lookups, the largest average depth of a TSP ODSCC circumferential indication at 1R11 was 32%; and, of the 3 lookups that were NDD in 1R11, the largest average depth at 1R12 was 32%.

The projected EOC 13 average depths are given in the following table.

Average Depth Comparison of EOC Projected TSP ODSCC Circumferential Indications with Largest Measured Indications

	PWSCC (non active)	ODSCC
Detection threshold for Average Depth	31%	35%
+95% AD growth over 1.36 EFPY cycle	19%	19%
Projected EOC 13 Average Depth	50%	54%
Largest Average Depth found to date	49%	57%

From the above table, the projected ODSCC EOC 13 average depth of 54% is less than the largest indication found to date because of the short cycle length expected for Unit 1 Cycle 13 (1.36 EFPY). Assuming that this flaw is 54% average depth over 360 degrees results in a very conservative EOC 13 projection of 54 percent degraded area (PDA). This conservative projection is less than the straight leg circumferential indication structural limit of 73 PDA, provided in WCAP-15147 Revision 2. Since the largest circumferential crack angle found at 1R12 was 185 degrees including adjustment for angle uncertainty at 95% probability, the assumption that the projected EOC 13 indication is 360 degrees is extremely conservative.

Similar to above, the maximum depth (MD) growth data at 95% cumulative probability can be combined with the estimated detection thresholds derived from destructive examination (45% MD detection threshold estimated for ODSCC, no NDE uncertainty is necessary) to obtain a deterministic projection of expected EOC 13 maximum depths. The 45% MD detection threshold is conservative because: based on the 1R11 lookups, the largest MD of a TSP ODSCC circumferential indication at 1R11 was 40%; and, of the 3 lookups that were NDD in 1R11, the largest MD at 1R12 was 44%.

The projected EOC 13 maximum depths are given in the following table.

Maximum Depth Comparison of EOC Projected TSP Circumferential Indications with Largest Measured Indications

	PWSCC (non active)	ODSCC
Detection threshold for Maximum Depth	45%	45%
+95% MD growth over 1.36 EFPY cycle	26%	26%
Projected EOC 13 Maximum Depth	71%	71%
Largest Maximum Depth found to date	68%	72%

The projected ODSCC EOC 13 maximum depth of 71% presents no challenge to SLB leakage integrity. As discussed above, this projection is less than the largest indication found to date because of the short cycle length expected for Unit 1 Cycle 13 (1.36 EFPY).

Based on the comprehensive inspection of dented TSP intersections during 1R12, the slow rate of circumferential degradation growth, acceptably low detection threshold, the limited maximum angular extent associated with circumferential cracks, and large structural margin associated with circumferential indications, no TSP circumferential indications are expected that would challenge structural performance criteria at EOC 13. Since the largest projected maximum depth is not near throughwall, it is also unlikely that TSP circumferential indications will tear ligaments and pop through over the next cycle. Therefore, no leakage is postulated in a faulted SG following a SLB at EOC 13.

8.0 Combined Axial PWSCC and Axial ODSCC at Dented TSP intersections (ID/OD Indications)

Six tubes contained axial PWSCC and axial ODSCC (ID/OD) indications located at the same dented TSP intersection. These tubes were plugged because this type of flaw combination is excluded from both PWSCC ARC and ODSCC ARC application. All of these intersections had axial PWSCC indications that were left inservice in the prior inspection (1R11) using the PWSCC ARC.

PG&E letter to the NRC dated August 22, 2002 (letter DCL-02-098) derived a bounding conservative hoop direction ligament length of 0.1 inch (2 times the tube wall thickness of 0.050 inch), such that if this separation distance is met or exceeded, there is no interaction relative to either burst pressure or leak rate.

Based on review of the eddy current data and terrain maps for all 6 ID/OD intersections, the axial PWSCC and axial ODSCC components are separated by hoop direction ligament gaps. The shortest gap is 55 degrees (0.42 inch). This separation distance exceeds the required hoop direction ligament thickness of 0.1 inch. Therefore, the flaws are treated independently for CM, under their respective ARC, for structural and leakage integrity.

Operational Assessment

Extent of Inspection at Dented TSP Intersections

All ID and OD bobbin indications in any size dent were Plus Point inspected. In addition, as discussed in the PWSCC ARC enclosure, a detailed Plus Point inspection program of dented intersections was conducted, which included 100% inspection of greater than 2 volt dents up to highest TSP with any PWSCC indication.

Based on the extent of the inspection and repair of all detected combined ID/OD indications, any potential combined PWSCC and ODSCC indications left in service at dented TSP intersections would have one of the indications below the detection threshold of the Plus Point coil or both of the ID/OD indications would be new indications. The Plus Point detection threshold would be expected to be less than 30% and 20% maximum depth for ODSCC and PWSCC axial indications, respectively. As a consequence of the low detection thresholds and modest crack depth and length growth rates for both axial PWSCC and ODSCC (see PWSCC ARC report and ODSCC ARC report in separate enclosures), deep new indications would not be expected at EOC 13.

Number of Occurrences of Combined Axial PWSCC and ODSCC Indications

As discussed above, a total of 6 tubes were reported in the 1R12 inspection with combined axial PWSCC and axial ODSCC (ID/OD) indications located at the same dented TSP intersection. These tubes were plugged because this type of flaw combination is excluded from both PWSCC ARC and ODSCC ARC application.

All data on combined ID/OD indications through 1R12 are given in Table 7. A total of 88 TSP intersections have been identified with combined ID/OD indications, 9 for Unit 2 and 79 for Unit 1. 50 of these TSP intersections were in tubes that were previously inactive, i.e., tubes that were de-plugged and then re-plugged in the same outage. Therefore, only 38 TSP intersections were in previously active tubes.

Dependence of Combined Axial PWSCC and ODSCC Indications on Dent Voltage

The vast majority (86 out of 88) of the ID/OD intersections have small dents, less than 5 volts. The two intersections with greater than 5 volt dents were associated with deplugged tubes.

The dominance of axial ODSCC at non-dented TSP intersections or intersections with small dents is expected based upon experience in eddy current examination of > 5 volt dents as part of ODSCC ARC applications. Few indications have been reported in > 5 volt dents under ARC applications for many plants. For DCPP Units 1 and 2, axial ODSCC has been detected in only 18 intersections with >5 volt dents, with the first occurrences in 1R9 and 2R9, none in 2R11, and 6 in 1R12. This number is small when

compared to the large number of Plus Point inspections of greater than 5 volt dents, and also small when compared to the number of ODSCC signals detected in both units (greater than 1000 indications in each unit since 1R11/2R11). When the intersection is highly dented, corrodents can be expected to have increased difficulty in concentrating within the crevice, and axial ODSCC is very infrequent in large dents. Consequently, the potential occurrence of combined ID/OD indication can be expected to be dominantly limited to dents < 5 volts as supported by DCPP Units 1 and 2 inspection results. This limits the potential population of TSP intersections with significant potential for combined ID/OD indications, and also increases the likelihood of bobbin detection in less than 5 volt dents.

Crack Sizes for Combined Axial PWSCC and ODSCC Indications

The Plus Point sizing of all PWSCC indications at TSP intersections with ODSCC indications are given in Table 7. Table 7 also provides the Plus Point and bobbin voltages for the ODSCC indications. The listed bobbin voltage is either the bobbin DOS indication voltage or, if the bobbin indication was not detectable, an inferred voltage based on the largest Plus Point voltage indication. The largest maximum and average depths for the PWSCC indications in previously active tubes at these intersections are shallow, only 60% and 48%, respectively. New PWSCC indications are also small as discussed below. The largest voltages for the ODSCC indications at intersections with PWSCC in active tubes are 4.58 bobbin DOS volts, which is influenced by both the PWSCC and ODSCC axial cracks, and 2.66 Plus Point volts (2R11 SG 2-2 R22C67). The 4.58 bobbin voltage is well below the ODSCC ARC structural limit of about 9 volts, and would have less than a 50% probability of leaking as a free span indication, per the ODSCC ARC correlations. The 2.66 Plus Point volts is less than the 2.75 volt threshold applied for amplitude sizing of ODSCC indications that has been found to result in good agreement with Diablo Canyon pulled tube throughwall lengths. The other ID/OD indications in Table 7 are small, and it can be expected that all indications found to date at TSP intersections with combined ID/OD cracks have large structural margins and no leakage.

New Indication Crack Sizes and Growth Rates

Since either the PWSCC or ODSCC indication or both indications must be a new indication, new indication crack sizes are of interest for assessing potential interaction between the ID and OD indications. Both the ID and OD new indications are small. The largest maximum and average depths for all new PWSCC indications at any TSP intersection in 1R12 are 56% and 43%, respectively. The largest new ODSCC indication at any TSP intersection in 1R12 has a bobbin coil voltage of 1.77 volt. The average ODSCC bobbin voltage for new indications in 1R12 is 0.48 volts. The largest new ODSCC indication at a TSP with ID/OD indications in Table 7 had a bobbin DOS voltage of 1.29 volts, which is influenced by both the PWSCC and ODSCC indications, and a largest Plus Point voltage of 0.38 volts. The largest new PWSCC indication at a TSP with ID/OD indications in Table 7 had a maximum depth of 45%. Since both the

new PWSCC and ODSCC indications are small, the structural influence of a new ID or OD indication interacting with an indication left in service would be small even under the very low likelihood of closely spaced indications.

The PWSCC maximum depth, average depth, and length growth rate distributions from Unit 1 Cycle 12 are provided in a separate enclosure, and are small. The Unit 1 Cycle 12 ODSCC bobbin voltage growth distributions for new indications and prior indications indicate that new indication growth is considerably smaller than growth for prior indications. The upper 95% growth/EFPY for new ODSCC indications in Unit 1 Cycle 12 is 0.31 volts. Based on the modest growth rates for new PWSCC and ODSCC indications, any new indications occurring to obtain combined ID and OD flaws at the same intersection would continue to be small indications.

Separation Distances Between Axial PWSCC and ODSCC Indications

Based on review of the eddy current data and terrain maps for DCPP Units 1 and 2 intersections with combined ID/OD indications, the axial PWSCC and axial ODSCC components are separated by hoop direction ligament gaps in excess of 30° (0.23"). The angles separating the PWSCC and ODSCC indications are given in Table 7. The separation distances are measured as distances between the peak amplitude responses, which is preferred given the width of an RPC response. The lowest separation angle found in DCPP Units 1 and 2 is 34° (0.26"), found at 1R11. The separation angles between axial PWSCC and ODSCC indication are predominantly in the 40° to 90° range. This range of separation angles can be expected based upon the separation distances between the locations of maximum hoop stress on the tube ID and OD at dented TSP intersections, as previously discussed in DCL-02-098.

Conclusions Relative to Closely Spaced Axial PWSCC and ODSCC Indications at Dented TSP Intersections

Based on the assessments provided in DCL-02-98, the potential for closely spaced axial PWSCC and ODSCC macrocracks at the same dented TSP intersection is negligible due to the high compressive OD hoop stresses near the minor axis of dent ovalization where the PWSCC occurs. Even the potential for shallow ODSCC microcracks is negligible unless formed prior to the denting, which occurred in the first cycle of operation for the Diablo Canyon SGs. Consequently, combined PWSCC and ODSCC indications at the same dented TSP intersection would have no impact on the operational assessment, and separate operational assessments for the individual indications are appropriate.

9.0 Combined Axial PWSCC and Circumferential ODSCC at Dented TSP Intersections (PWSCC Mixed Mode Indications)

One dented TSP intersection containing a circumferential ODSCC indication and an axial PWSCC indication, termed PWSCC mixed mode indication, was detected and

plugged in 1R12. The location was SG 1-2 R36C53 3H. The indications were not interacting. The CM OA of this degradation is provided in Enclosure 2 pursuant to PWSCC ARC requirements.

10.0 Combined Axial ODSCC and Circumferential ODSCC at Dented TSP Intersections (ODSCC Mixed Mode Indications)

Two dented TSP intersections containing circumferential ODSCC and axial ODSCC indications, termed ODSCC mixed mode indications, were detected and plugged in 1R12. The locations were SG 1-1 R29C46 1H and SG 1-2 R17C45 1H. Table 6 provides the circumferential indication data.

The R17C45 axial ODSCC indication (single axial indication, SAI) was previously detected by Plus Point in 1R10 and 1R11 as AONDB, and was left in service in cycles 11 and 12 under ODSCC ARC because the inferred bobbin voltage was less than 2 volts. Upon detection of the circumferential ODSCC indication in 1R12, the circumferential indication was detectable in 1R11 based on a lookup of 1R11 data.

The R29C46 axial ODSCC indication was previously detected by bobbin in 1R10 and 1R11 and was left in service in cycles 11 and 12 under ODSCC ARC because the bobbin voltage was less than 2 volts. In 1R12, based on the first time Plus Point inspection of this intersection, 3 SAIs were identified. Because there was no prior Plus Point data at this intersection, no prior cycle lookup was conducted for the circumferential ODSCC indication that was detected in 1R12.

Based on review of the 1R12 data, a separation distance of 0.31 inch was measured, which exceeds the 0.25 inch separation distance requirement for mix mode affects, therefore the indications are treated as non-interacting based on the PWSCC mixed mode indication guidance of WCAP-15573, Revision 1. Even if treated as interacting, the NDE average depths of the circumferential flaws are about 53 percent (R17C45) and 60 percent (R29C46), including 95 percent uncertainty for mixed mode effects, which are less than the 75 percent average depth threshold value for mixed mode effects as defined for PWSCC ARC mixed mode requirements in WCAP-15573, Revision 1. In addition, neither the axial or circumferential indication is 100 percent throughwall at any point. The maximum depths of the circumferential indications are 64 percent (R17C45) and 73 percent (R29C46), including 95 percent NDE uncertainty. The Plus Point voltages of the axial ODSCC indications are 0.24 volt (R17C45) and 0.26, 0.28, and 0.29 volts (R29C46), indicating shallow flaws.

Based on this ODSCC mixed mode assessment, there is no potential impact on the axial ODSCC indications burst pressure or leakage for condition monitoring.

Operational Assessment

As discussed above, an ODSCC mixed mode indication is defined as an axial ODSCC indication located at the same TSP intersection as a circumferential indication. The TSP intersection must be dented for occurrence of an ODSCC mixed mode indication. In addition to the two non-interacting ODSCC mixed mode indications detected in 1R12, there has been one prior ODSCC mixed mode indication to date in DCPP Unit 1 (detected in 1R11, and defined as interacting because a return to null was not discernable). There have been no ODSCC mixed mode indications in DCPP Unit 2.

The OA for ODSCC mixed mode indications applies similar criteria to the OA for PWSCC mixed mode indications defined in WCAP-15573 Revision 1. That is:

- If an interacting mixed mode indication is found to have led to a reduction in the axial indication burst pressure by more than 10 percent and to less than 4000 psi, or to have caused an indication to not satisfy burst margin requirements, corrective actions will be taken to adjust burst margin requirements for the operational assessment. The circumferential component of the 1R11 ODSCC mixed mode indication was 49.5% average depth, including NDE uncertainty for mixed mode effects, which is less than the 75% average depth threshold for mixed mode burst affects. Therefore, no OA corrective actions are required for structural integrity.

- If an interacting mixed mode indication is found, and the axial indication CM predicts SLB leakage at 95/50, and the circumferential indication has > 50% average depth, including uncertainty, then the SLB leak rate for an operational assessment should be increased for each SG by a leakage multiplier. Because the circumferential component of the 1R11 ODSCC mixed mode indication was 49.5% average depth, less than the 50% average depth threshold for mixed mode leakage affects, no OA corrective actions are required for leakage integrity. In addition, no leakage should be predicted from the axial ODSCC components because of the small Plus Point voltages found (0.44 volts for the 1R11 indication is the largest voltage), which are indicative of shallow flaws.

In Unit 1 Cycle 13, there is a low likelihood of interacting ODSCC mixed mode indications developing that could affect leakage or burst margins of the axial ODSCC flaw, based on the following assessment. Potential TSP circumferential cracking in Unit 1 Cycle 13 should mainly occur in greater than 2 volt dents. The circumferential indication at a small 0.51 volt dent at R29C46 1H is the first time observation of circumferential indication at a less than 2 volt dent at DCPP Units 1 and 2. Nonetheless, potential circumferential indications at all dent sizes are considered. Of the 1365 ODSCC intersections that were returned to service in 1R12, 296 were at dented intersections. 95 of these intersections contained dents ≤2.0 volt and 201 of these intersections contained dents >2.0 volt. All of these were inspected by Plus Point to verify that no axial PWSCC or circumferential indications were detectable. Of these ODSCC indications at dented TSPs, the largest bobbin amplitude was 1.78 volt. (Note: This indication had a small corresponding Plus Point amplitude of 0.26 volt. The largest

Plus Point amplitude from this population was 0.99 volt with a corresponding bobbin amplitude of 1.28 volt.)

The largest Cycle 12 upper 95% growth rate per EFPY is 0.55 volts/EFPY (based on SG 11). Adding this growth rate to the largest 1.78 volt BOC 12 flaw at a dented TSP results in an EOC 13 flaw of 2.53 volts.

Assuming the largest projected EOC 13 circumferential indication (53% average depth from section 7) interacts with a projected EOC 13 axial ODSCC indication of 2.53 volts:

- The axial ODSCC indication burst margin would not be affected because the 53% circumferential average depth is less than the 75% average depth threshold for mixed mode burst affects and a 2.53 bobbin volt ODSCC indication has a large margin against burst compared to the approximate 9 volt structural limit.

- The axial ODSCC indication SLB leak rate margin would not be affected because a 2.53 bobbin volt ODSCC indication has only about 11% probability of leaking as a free span indication, per the ODSCC ARC correlations. In addition, the largest Plus Point voltage of 0.99 volt found at a dented TSP is well below the 2.75 volts typical of a throughwall indication for axial ODSCC.

11.0 Circumferential ODSCC in WEXTEX Region

Three circumferential ODSCC indications (SCI) in the hot leg top of tubesheet WEXTEX transition region were detected by Plus Point in 1R12. The Plus Point data are listed in Table 6.

The SCI were sized using the technique described in Appendix B of WCAP-15573, Revision 1. The depth profiles were then processed for corrections in accordance with the depth adjustment rules in Section 4.10.4 of WCAP-15573, Revision 1. The adjusted NDE results were corrected for 95 percent NDE uncertainty using the NDE uncertainty regression parameters in Tables 4-19 to 4-21 in WCAP-15573, Revision 1. The adjusted NDE and adjusted NDE with uncertainty results are listed in Table 6.

As noted in Table 6, the locations of the SCI were within 0.01 to 0.10 inch above the top of tubesheet, within expansion transition region. The SCI were located in WEXTEX Zone 4 (center region) of the top of tubesheet. Zone 4 is noted to have the most tube scale buildup prior to chemical cleaning in 1R12.

The $3\Delta P_{NO}$ structural limit for an SCI is about 264 degrees, assuming a 100 percent throughwall defect. The longest measured length was 54.1 degrees, and adjusted to 182.8 degrees after applying large 95 percent NDE uncertainties. This length is less than the 264 degree structural limit under the very conservative assumption that the indication is uniformly throughwall. Therefore, structural integrity was satisfied at EOC 12.

The largest measured Plus Point voltage was 0.29 volts, much less than the 1.31 volt threshold for leak testing of circumferential ODSCC in transitions as documented in EPRI report 1007904. Based on this voltage, the SCI were shallow and no SLB leakage should be postulated for this degradation at EOC 12. The deepest SCI has a high NDE adjusted maximum depth of 98.7 percent. However, the deep depth at this low voltage is not realistic and is most likely due to difficulties in sizing indications below about 0.5 volts.

Operational Assessment

Two of the three 1R12 WEXTEX transition circumferential ODSCC indications could be detected and sized in the prior outage data based on a lookup analysis. The lookup sizing used the same WCAP-15573 Revision 1 sizing techniques. The growth rates per EFPY were negligible, as listed in Table 6. There is limited DCPP Units 1 and 2 growth data (about 7 data points) for WEXTEX transition circumferential ODSCC using the WCAP-15573 Revision 1 sizing techniques. Growth rates for DCPP top of tubesheet circumferential ODSCC indications may not be reliable due to the small voltages.

Because of this limited growth data, the growth rates per EFPY are conservatively assumed to be the same as TSP circumferential PWSCC (per section 7, 14% for average depth and 19% for maximum depth). Conservatively assuming the same detection thresholds as for TSP circumferential ODSCC (per section 7, 35% for average depth and 45% for maximum depth), the projected EOC 13 average depth and maximum depth would be 54% and 71%, respectively. Circumferential indications of this size present no challenge to structural and leakage integrity, as described in the previous section regarding TSP circumferential indications. The 1R12 WEXTEX transition circumferential ODSCC indications have a maximum voltage of only 0.29 volts, rendering phase angle based depth sizing unreliable for comparison with projected EOC depths.

Based on the 100% Plus Point inspection of the hot leg WEXTEX region, observations of small numbers of circumferential indications, very small growth rates, and large structural margin, there is a low probability that ODSCC circumferential indications located in the WEXTEX transition zone will challenge the $3\Delta P_{NO}$ structural integrity performance criteria through EOC 13. Also, there is a low probability that circumferential ODSCC indications in the WEXTEX transition zone would grow through-wall in a cycle, and no leakage should be postulated in a faulted SG following a SLB at EOC 13.

12.0 Circumferential PWSCC in WEXTEX Region

One circumferential PWSCC indication (SCI) in the hot leg top of tubesheet WEXTEX transition region was detected by Plus Point in 1R12 in SG 1-1 R6C39. The Plus Point data is listed in Table 6.

The SCI was sized using the technique described in Appendix B of WCAP-15573, Revision 1. The depth profiles were then processed for corrections in accordance with the depth adjustment rules in Section 4.10.4 of WCAP-15573, Revision 1. The adjusted NDE results were corrected for 95 percent NDE uncertainty using the NDE uncertainty regression parameters in Tables 4-19 to 4-21 in WCAP-15573, Revision 1. The adjusted NDE and adjusted NDE with uncertainty results are listed in Table 6.

As noted in Table 6, the location of the SCI was just below the top of tubesheet, within the WEXTEX transition. The SCI was located in WEXTEX Zone 4 (center region) of the top of tubesheet. Zone 4 is noted to have the most tube scale buildup prior to chemical cleaning in 1R12.

The $3\Delta P_{NO}$ structural limit for an SCI is about 264 degrees, assuming a 100 percent throughwall defect. The measured length was 39.1 degrees, and adjusted to 93.2 degrees after applying large 95 percent NDE uncertainties. This length is less than the 264 degree structural limit. Therefore, structural integrity was satisfied at EOC 12.

The measured Plus Point voltage was 0.74 volts, much less than the 1.25 volt threshold for leak testing of circumferential PWSCC in transitions as documented in EPRI report 1007904. Based on this voltage, the SCI was shallow and no SLB leakage should be postulated for this degradation at EOC 12. Even though the SCI has a very high NDE adjusted maximum depth of 100 percent, the deep depth at this low voltage is not realistic and is most likely due to difficulties in sizing indications with low voltages.

Operational Assessment

The SCI could be detected and sized in the prior outage data based on a lookup analysis. The lookup sizing used the same WCAP-15573 Revision 1 sizing techniques. The growth rate per EFPY is negligible, as listed in Table 6. There is limited DCPP Units 1 and 2 growth data for WEXTEX transition circumferential PWSCC using the WCAP-15573 Revision 1 sizing techniques. Growth rates for DCPP top of tubesheet circumferential PWSCC indications may not be reliable due to the small voltages.

Because of this limited growth data, the growth rates per EFPY are conservatively assumed to be the same as TSP circumferential PWSCC. Likewise, the same detection thresholds as for TSP circumferential PWSCC are assumed. Therefore, the projected EOC 13 average depth and maximum depth would be 50% and 71%, respectively. Circumferential indications of this size present no challenge to structural and leakage integrity, as described in the previous section regarding TSP circumferential indications. The R6C39 indication has a maximum voltage of only 0.74 volts, rendering phase angle based depth sizing unreliable for comparison with projected EOC depths.

Based on the 100% Plus Point inspection of the hot leg WEXTEX region, observations of small numbers of circumferential indications, very small growth rates, and large structural margin, there is a low probability that PWSCC circumferential indications located in the WEXTEX transition zone will challenge the $3\Delta P_{NO}$ structural integrity performance criteria through EOC 13. Also, there is a low probability that circumferential PWSCC indications in the WEXTEX transition zone would grow through-wall in a cycle, and no leakage should be postulated in a faulted SG following a SLB at EOC 13.

13.0 Cold Leg Thinning (CLT)

CLT indications at cold leg TSP intersections are detected by bobbin probes as part of the 100 percent full-length bobbin inspection. In outage inspections prior to 1R12, CLT indications were sized by bobbin (phase based depth sizing) using EPRI ETSS 96001.1, and CLT indications were plugged if bobbin indicated a depth greater than or equal to 40 percent through-wall.

PG&E and Westinghouse had determined that field indications sized by phase angle analysis were found to have deep indicated depths for low voltage indications, resulting in unnecessary tube plugging of low voltage CLT indications. Therefore, a project was undertaken to develop improved bobbin coil sizing techniques to support tube repair decisions, and to develop burst correlations to support tube integrity analyses for CLT indications in Westinghouse Model 51 SGs. The initial work was documented in Westinghouse report SG-SGDA-02-41, "Cold Leg Thinning Database for Tube Integrity Assessments and NDE Depth Sizing," October 31, 2002. In addition, to support implementation of the improved sizing techniques in 1R12, a performance demonstration was conducted at the start of 1R12 to incorporate analyst uncertainty into the correlations, and the results were documented in Westinghouse report SG-SGDA-04-17, "Diablo Canyon Performance Test Based NDE Sizing Uncertainties for Cold Leg Thinning Indications," April 15, 2004. The performance tests were conducted by 14 NDE analyst teams based upon "blind" analyses of 201 cold leg thinning samples that included noise additions that applied Diablo Canyon noise data to the laboratory simulations of cold leg thinning indications.

Report SG-SGDA-04-17 concluded that amplitude sizing of CLT indications is appropriate to establish the percent throughwall, with 4.5 volts as the upper limit for amplitude sizing. Above 4.5 volts, phase sizing is used to establish the percent throughwall. The 4.5 volt cutoff superseded the preliminary recommended cutoff of 1.9 volts provided in report SG-SGDA-02-41 based on the conclusion that amplitude sizing is more reliable than phase sizing below 4.5 volts for indications with high noise levels.

In 1R12, this new CLT sizing technique was used, in conjunction with the previously established repair limit of 40 percent through-wall. Bobbin indications at cold leg TSPs with prior outage Plus Point were sized by bobbin as CLT indications. Bobbin indications at cold leg TSPs in the CLT zone with no prior outage Plus Point were

inspected by Plus Point in 1R12. Volumetric indications confirmed by Plus Point in the CLT region were sized by bobbin. If Plus Point did not confirm the indication, the indication was left in service as a distorted OD signal (DOS).

In 1R12, 146 CLT indications were detected and sized by bobbin, of which none were greater than or equal to 40%, so none required plugging. All indications were limited to 1C and 2C TSPs. There were no indications exceeding the 4.5 volt cutoff, so all indications were sized by amplitude analysis.

The deepest indication identified in 1R12 was 37 percent through-wall. Applying the regression equation from SG-SGDA-04-17 to correct the NDE measurement to the actual depth for 95% NDE uncertainty based on the analyst performance test ($\%TW_{Actual} = \%TW_{Measured}*1.09 + 7.51$, with a standard deviation of 5.73), results in a CLT flaw of 57%.

Applying the lower 95% CLT burst correlation from Figure 8-11 of SG-SGDA-02-41 (correlation of burst pressure with the mean actual depth obtained from the NDE sizing correlation) yields a CLT burst pressure of 7853 psi, much greater than the 3367 psi burst pressure margin requirement for $1.4\Delta P_{SLB}$, where SLB differential pressure is 2405 psi. This analysis has applied the 95% uncertainty on the NDE measurement as a conservative value for the mean actual depth when applying the burst correlation. Therefore, the structural integrity performance criteria were satisfied for this bounding indication at EOC 12. Applying the lower 95% CLT ligament tearing correlation (also correlated with mean actual depth estimate) from Figure 8-16 of SG-SGDA-02-41 yields a CLT ligament tearing pressure in excess of 7000 psi, much greater than the 2405 psi SLB differential pressure and 3367 psi burst pressure margin requirement. Therefore, no SLB leakage is postulated for this bounding indication at EOC 12.

Operational Assessment

Fifteen new indications were detected in 1R12, and were re-evaluated in the 1R11 data for inclusion in the growth rate calculation, all of which were present. In addition, all repeat CLT indications were looked up in the 1R11 data and resized using the CLT sizing technique. No indications exceeded the 4.5 volt cutoff for amplitude analysis. NDE uncertainties were applied to estimate the mean actual depth for both 1R11 and 1R12 sizes prior to calculating the growth rates for the cycle, using the mean regression equation. 146 indications are in the Cycle 12 growth distribution, and the 95% growth rate per EFPY is 2.72%.

The largest BOC flaw corrected for 95% NDE uncertainty (57%), plus 2.72%/EFPY growth rate, results in a projected EOC 13 flaw size of 61% through-wall. Applying the lower 95% CLT burst correlation yields a CLT burst pressure of 7658 psi, much greater than the 3367 psi burst pressure margin requirement. Therefore, the structural integrity performance criteria were satisfied for this bounding indication at EOC 13. Applying the lower 95% CLT ligament tearing correlation yields a CLT ligament tearing pressure in

excess of 7000 psi, much greater than the 2405 psi SLB differential pressure and 3367 psi burst pressure margin requirement. Therefore, no SLB leakage is postulated for this bounding indication at EOC 13.

14.0 Antivibration Bar (AVB) Wear

AVB wear indications are detected by bobbin probes during the 100 percent full-length bobbin inspection. AVB wear indications are sized by bobbin using EPRI ETSS 96004.1. AVB wear indications are plugged if bobbin indicates a depth greater than or equal to 40 percent through-wall (TW). The $3\Delta P_{NO}$ structural limit for the worst case tube with AVB wear is about 65 percent as provided in WCAP-15147 Revision 2. The AVB wear repair limit of 40 percent allows for NDE uncertainty and flaw growth progression.

In 1R12, the bobbin coil inspection identified 267 AVB wear indications, of which 6 were greater than or equal to 40 percent and plugged. The deepest indication identified in 1R12 was 43%.

In accordance with EPRI ETSS 96004.1, sizing of AVB wear with bobbin coil has an NDE regression correlation (0.97*%TW+ 3.49%) with a standard error of 4.49%. Additionally, the standard error for analyst uncertainty is conservatively assumed as 7.04% (reference "Appendix G Generic NDE Information from CM/OA," extracted from "Capabilities of Eddy Current Analysts to Detect and Characterize Defects in SG Tubes," Doug Harris, presented at November 1996 EPRI NDE workshop. These uncertainties (technique and analyst) were combined (8.17%) and applied at 90/50 confidence (per "The Use and Misuse of ETSS and Analyst Uncertainty", Bob Keating, presented at February 2003 EPRI SG Integrity Workshop) to the limiting flaw detected at 1R12 (43%), resulting in a 55.7% size AVB wear flaw, which is less than the AVB wear structural limit of 65%. Therefore, the structural integrity performance criteria were satisfied for this bounding indication at EOC 12. Because AVB wear was too shallow to consider ligament tearing (pop through), no leakage is postulated in a faulted SG following a SLB at EOC 12. The largest 1R12 flaw size was less than the bounding flaw size projected in the prior cycle OA.

Operational Assessment

Seventeen new AVB wear indications were detected in 1R12, and were looked up in the 1R11 data for inclusion in the growth rate calculation, all of which were present. As a result, 267 indications are in the Cycle 12 growth distribution, and the 95% growth rate per EFPY is 2.48%.

The sum of the largest detected AVB wear indication remaining in service following 1R12 (39%), plus 2.48% per EFPY growth, plus 10.5% NDE uncertainty, calculated using the same method described above, results in a projected EOC 13 flaw size of

55.2% through-wall. This value is less than the AVB wear structural limit of 65%. The projected EOC 13 depth bounds the largest indication detected in 1R12.

In conclusion, no AVB wear indications are expected to challenge structural integrity performance criteria through EOC 13. In addition, no leakage should be postulated in a faulted SG following a SLB at EOC 13 due to the extremely low probability that AVB wear indications would tear ligaments and pop through in one cycle.

15.0 Tube Support Plate (TSP) Ligament Thinning

Starting in 1R8 and 2R8, PG&E implemented an inspection program to detect degradation of steam generator TSPs. A summary of this program was reported to the NRC in response to GL 97-06 (PG&E Letter DCL-98-046 dated March 27, 1998). Visual inspections performed in 1R8 confirmed several missing TSP ligaments. Westinghouse has concluded that the missing TSP ligaments are related to TSP drilled hole manufacturing anomalies. The TSP manufacturing practices employed at the time that the DCPP steam generators were produced used a stacked drilling procedure. Several TSPs were clamped together and drilled simultaneously. A review of the suspect ligament crack (SLC) locations indicates distinct location patterns, indicative of manufacturing anomalies of the automatic drilling equipment.

The eddy current inspection program consists of several steps: bobbin inspection to detect SLC; Plus Point 20% sample inspection of pre-existing Plus Point confirmed indications (referred to as "baseline" indications); and Plus Point inspection of newly detected bobbin SLC indications. Plus Point confirmed indications are called either ligament crack indication (LIC) or ligament gap indication (LIG). In 1R11, Plus Point inspection of 100% of the baseline indications in SG 1-1 and SG 1-4 was conducted to satisfy the 20% sample inspection commitments.

The following provides a summary of the 1R12 inspection results.

Baseline Inspection and Results

To ensure that the current TSP condition is not changing, Plus Point inspection of 100 percent of the baseline indications in all Unit 1 SGs was performed in 1R12, exceeding the 20 percent inspections as previously committed to the NRC. There were 236 inservice TSP intersections with ligament indications before 1R12.

In 1R12, Plus Point confirmed all of the baseline indications. For the repeat LIG indications, the gap measurements were compared to the prior outage gap measurements, and little change was indicated, thus indicating no change in the material condition of the TSPs.

Inspection for New Indications

Plus Point confirmed 33 new indications (24 LIC and 9 LIG). All of the new indications were detected in SGs 1-1 and 1-2, which were bobbin inspected after chemical cleaning. There were no new indications detected in SGs 1-3 and 1-4, which were bobbin inspected before chemical cleaning. It is possible that the chemical cleaning enhanced the bobbin detection capability of TSP ligament indications.

The preservice inspection (PSI) data was reviewed for the new indications, and 9 were traceable to the PSI data. Of the remaining 24 new indications, a lookup of the 1R11 bobbin data was performed, and 18 were traceable to the 1R11 data.

All new indications will continue to be monitored as required by plant procedures. Based on the 1R12 inspections and plugging, there are a total of 265 inservice TSP intersections with ligament indications: 115 with LIC indications, 146 with LIG indications, and 4 that contain both LIC and LIG indications.

Assessment of Plugging Criteria

The largest measured LIG gap was 119 degrees, less than the 146 degree threshold gap for preventive tube repair. As such, no additional tube plugging was required as a consequence of TSP ligament indications.

16.0 Potential Axial and Circumferential PWSCC in Row 1 and 2 U-Bends

SG tubes in Rows 1 and 2 U-bends were heat treated following one cycle of operation for Unit 2 and two cycles of operation for Unit 1 to relieve stresses and mitigate the potential for PWSCC in this location. One hundred percent of Rows 1 and 2 U-bends have been inspected each refueling outage. Bobbin probes were used in the first refueling outage inspection. Since then, these inspections were conducted with a single coil rotating probe. Starting in 2R7 and 1R8, a Plus Point probe was used to inspect Rows 1 and 2 U-bends.

PWSCC has been detected in the U-bend region of Row 1 tubes in all Unit 1 and Unit 2 SGs. The majority of row 1 PWSCC has been axial, with a small number of circumferential. Axial PWSCC has also been detected in Row 2 in SG 1-4 (1R8) and SG 2-3 (2R8). The last occurrence of Row 1 or 2 U-bend axial and circumferential PWSCC indications in Unit 1 have been 1R8 and 1R10, respectively.

In 1R12, 100% of Rows 1 and 2 U-bends were Plus Point inspected, and no indications were detected.

Due to the degradation free Row 1 and 2 U-bend region for Unit 1 for the last 2 cycles of operation based on 100% Plus Point inspection, PWSCC in Rows 1 and 2 U-bends

is not an active damage mechanism, and OA is not required for EOC 13 for this damage mechanism.

17.0 Potential Axial PWSCC in High Row U-Bends

Westinghouse WOG evaluation SG-SGDA-03-33 ("Generic Evaluation of U-Bend PWSCC Susceptibility for Model 51 SGs with Mill Annealed Alloy 600 Tubing") states that significant ovalities could be experienced in large radius (Rows 10 and higher) U-bends that could have resulted in significant residual stresses in the tubes. These residual stresses could lead to axial PWSCC in large radius U-bends. Manufacturing ovality in the report suggests that Row 13 to 16 ovality could exceed Row 3 to 9 ovality.

The report indicates that hoop residual stresses in large radius U-bends are similar to WEXTEX expansion transitions, while the Row 3 and 4 hoop residual stresses may exceed that of the WEXTEX expansion. The report correlates expected time of axial PWSCC development in U-bends as a function of PWSCC development at the top of tubesheet. A minimum recommendation for detection of axial PWSCC in large radius bends includes a 20% sample of Rows 13 through 17, or 90 tests per SG, since the inspection of Rows 3 through 10 may not have included the tubes with the largest ovalities. This scope was applicable for 1R12 (at 15.9 EFPY), because axial PWSCC in the WEXTEX region was first detected in Unit 1 in 1R6 about 7.14 EFPY, and the report postulates that Unit 1 high row U-bend axial PWSCC could initiate at 20.2 EFPY.

Based on the WOG recommendations, PG&E performed a first time Plus Point inspection of large radius (rows 10 and higher) U-bends in 1R12, consisting of 20% of U-bends in rows 13 to 17. No axial PWSCC degradation was detected in this exam, nor in the 100% Plus Point inspection of Rows 1 to 10 U-bends. Therefore, axial PWSCC in high row U-bends is not an active damage mechanism at DCPP Unit 1.

18.0 Potential Stress Corrosion Cracking at Free Span Dings

No occurrences of stress corrosion cracking at free span dings has been observed at DCPP Units 1 and 2, based on Plus Point sampling of free span dings every outage starting in 2R7 and 1R8. In 1R12, Plus Point inspection was performed on 100 percent of greater than 5 volt free span dings in the hot and cold legs and U-bends to verify that no PWSCC or ODSCC is occurring in free span dings. In addition, 100% of greater than or equal to 2 volt dings that are coincident with AVB structures in the U-bend region were Plus Point inspected, to address the potential masking effects of AVBs on bobbin coil flaw detection. In these exams, the Plus Point extent consisted of the entire length of free span between the support structures. No indications at free span dings were detected during this exam.

Bobbin coil was credited for detection of potential stress corrosion cracking in less than 5 volt free span dings. No DNI (ding with possible indication) calls were made in 1R12 based on the bobbin coil inspection.

Due to no degradation in free span tubing in Unit 1 for all prior cycles of operation based on Plus Point inspection of free span dings, SCC in free span dings is not an active damage mechanism, and OA is not required for EOC 13 for this damage mechanism.

19.0 Potential Tube Damage from Loose Parts and Foreign Objects

During the 100% full length bobbin examination, the bobbin data were reviewed for possible loose part (PLP) indications at the top of tubesheet in rows 1 and 2 and at the straight legs of the outer two peripheral rows and columns. During the 100% hot leg top of tubesheet Plus Point examination, the Plus Point data was reviewed for PLP at the top of tubesheet. In addition, several prior cycle PLP indications were Plus Point inspected, as discussed below.

Foreign object search and removal (FOSAR) visual examinations of the tube sheet annulus and blowdown lane regions are performed to identify loose parts following sludge lancing. When PLP signals are detected by eddy current, the locations are provided to FOSAR personnel for search and retrieval. When foreign objects are detected by FOSAR, the locations are provided to eddy current data analysis personnel for further review.

Prior cycle detected foreign objects

As discussed in Enclosure 3 of DCL-02-098 (1R11 90 day report), several PLPs detected by Plus Point in 1R11 were not detected during 1R11 FOSAR, and therefore were being tracked for continued evaluation in 1R12. The following discussion provides the resolution of these prior cycle PLPs and foreign objects.

In 1R11, PLP indications were detected by Plus Point at SG 1-3 R1C75, 0.5 inch above the hot leg top of tubesheet, and at SG 1-4 R32C17, 0.5 inch above the hot leg top of tubesheet. The 1R11 inspections were conducted prior to sludge lancing. The 1R11 FOSAR did not detect any loose parts at these locations. No 1R11 tube wear was detected by eddy current at these locations, and continued operation during Unit 1 Cycle 12 was determined to be acceptable. In 1R12, these tube locations were again Plus Point inspected, and this time no PLP signals were present. Therefore, it is concluded that the 1R11 sludge lancing removed the potential loose parts, as postulated in the 1R11 90 day report discussion.

In 1R11, a foreign object was detected by eddy current and FOSAR in SG 1-3 between tubes R1C49 and R1C50 at the hot leg top of tubesheet. The object appeared to be metallic, was about 0.4 inch by 0.75 inch, and was tightly lodged between the two tubes. Multiple attempts to dislodge the object were unsuccessful. The signal was traced to 1R9 and 1R10 based on Plus Point data review, and had not changed. Continued operation during Unit 1 Cycle 12 was determined to be acceptable because

no 1R11 tube wear was detected by eddy current and because the loose part was adhered to the tubesheet. In 1R12, prior to chemical cleaning and sludge lancing, this location was again Plus Point inspected, and once again a PLP signal was detected between these two tubes. 1R12 FOSAR was conducted after chemical cleaning and sludge lancing, and this location was specifically reviewed in detail. No foreign object was found. Therefore, it is presumed that the foreign object has been removed as part of the 1R12 chemical cleaning and sludge lancing operation.

In 1R11, a repeat PLP indication (from 1R9 and 1R10) was detected by bobbin and confirmed by Plus Point between SG 1-1 R30C78 and R31C78, 3 inches above the cold leg top of tubesheet. The 1R11 Plus Point inspection was performed after sludge lancing. FOSAR was not able to detect the foreign object in 1R11 nor in prior outages. Continued operation during Unit 1 Cycle 12 was determined to be acceptable because no tube wear was detected by eddy current. In 1R12, the PLP indication was again detected, and no tube wear was noted. Following chemical cleaning and sludge lancing, FOSAR attempts to find the foreign object were successful. The tubesheet was more completely drained than in prior outages, which improved the effectiveness of FOSAR detection of the object, located about 3 inches above the top of tubesheet. Water surface reflections from the video probe light source likely prevented the observation of the object during previous FOSAR attempts. Based on FOSAR videos, the metallic object is cylindrical, about 0.4 inches in diameter and 0.75 inch long, and has a hole (about 0.1 to 0.2 inch diameter) that runs through its center. The object is lodged tightly between 2 tubes, about 3 inches above the cold leg top of tubesheet. In letter PGE-04-50 dated April 23, 2004, Westinghouse performed a very conservative engineering assessment of the foreign object and concluded that continued SG operation with the object present in the secondary side will not affect SG tube integrity for at least one fuel cycle. Therefore, attempts to dislodge the object and cause a potentially loose part were discontinued, and the lodged object was left in place for Cycle 13. The SG tube surveillance procedure was revised to require continued Plus Point inspection monitoring of this location each subsequent outage.

Newly detected foreign objects

In 1R12, during FOSAR after chemical cleaning and sludge lancing, a foreign object was detected and retrieved from the hot leg annulus area in SG 1-1. The object was a small nail bent at the midpoint. The mass of the nail was judged to be insufficient to cause tube damage during plant operation. The 1R12 eddy current inspection did not detect this loose part, nor any tube wear that could be attributed to a loose part, thus supporting this engineering judgment.

In SG 1-3, after chemical cleaning and sludge lancing, FOSAR retrieved a 10 inch long hose fragment. It was determined that the fragment was from a hose used in the chemical cleaning process. During the chemical cleaning process, 1½ inch diameter rubber hoses were inserted through the upper manway and down through the swirl vane assembly in order to perform an upper bundle flush of the SG tube bundle.

Following sludge lancing, rubber debris was found on the sludge lance grit screen for SGs 1-3 and 1-4. It is speculated that during final blowdown, the hoses dislodged from the swirl vanes and whipped around, the whipping action frayed/broke off the tips of the hoses and fell down the outside of the wrapper to the tubesheet. In letter PGE-04-55 dated April 29, 2004, Westinghouse performed an evaluation of the missing hose sections on tube integrity and secondary side chemistry, in addition to the potential for the whipping action of the hose to have damaged any upper internals structures. The assessments support cycle 13 operation with hose sections or fragments remaining in the SG secondary side.

Table 1
1R12 SG Tube Inspections and Expanded Inspections

Table 1: 1R12 SG Tube Inspections and Expanded Inspections					
Item	Area	Probe	Initial Inspection Scope	Expansion Criteria	Expansion Scope
1	Full Length	Bobbin	100% (Except Rows 1 and 2 U-bends) (Note: Bobbin inspection is performed after CC in SGs 1-1 and 1-2, and before CC in SGs 1-3 and 1-4.)	N/A	NA
2	200 tube sample	Bobbin	In SG 1-2, sample inspection of tubes with TSP ODSCC and tubes with no degradation, performed pre-CC in support of GL 95-05 assessment of affect of CC on growth and BOC voltage.	NA	NA
3	WEXTEX TTS Region	+Point	100% of hot leg TTS	If a C-3 condition is identified in the hot leg TTS inspection, inspect 20% of the cold leg TTS region in the affected SG in the current or subsequent outage. The 20% inspection should be biased to an area where degradation has the greatest potential to occur.	NA
				If cold leg TTS crack-like indications are confirmed by Plus Point, perform inspections using one of the methods described in step 49 of STP M-SGTI.	NA
				If cold leg TTS non-crack-like indications are confirmed by Plus Point, perform inspections using one of the methods described in step 50 of STP M-SGTI.	NA
4	WEXTEX TTS Region	+Point	WEXTEX inspection extent is +2" to –8.5"	If initial inspection extent is less than flexible W* length, increase inspection extent.	NA
5		+Point	100% of hot leg WEXTEX Anomalies (NTE/PTE/BLG, PTE/NTE anomaly extent is +2" to tube end)	If crack-like indications (excluding W* indications) are found in the hot leg tubesheet anomalies, inspect 100% of the cold leg anomalies.	NA
6		+Point	100% of W* tubes having a previously identified indication within the W* length	NA	NA
7		+Point	100% of bobbin distorted tubesheet signals (DTS) in the W* length	NA	NA
8	Low Row U-bends	+Point	100% of Rows 1 and 2	NA – inspecting 100% of Rows 3 through 10 for High Row U-Bend inspections for circ PWSCC	NA
9	High Row U-bends for Circ PWSCC	+Point	100% of Rows 3 to 10	If circ PWSCC detected in Rows 9 or 10, expand to Row 20 at 100%.	NA
				If circ PWSCC detected in Rows 11 through 14, redefine critical area (CA) and buffer zone based on review of Figure 10 of WOG U-Bend report and application of a factor of two reduction in longitudinal strain, and inspect 100% of the new CA and buffer zone in the affected SGs.	NA
				If circ PWSCC detected in Rows 15 through 20, expand to 100% of all remaining rows in the affected SGs.	NA

Table 1: 1R12 SG Tube Inspections and Expanded Inspections

Item	Area	Probe	Initial Inspection Scope	Expansion Criteria	Expansion Scope
10	High Row U-bends for Axial PWSCC	+Point	20% of rows 13 to 17 in each SG	If axial PWSCC is detected in Rows 3 to 8 with NDD in Rows 9 and 10, then in the affected SG inspect 100% of Rows 11 to 16, 50% of Row 17, and 20% of Row 18.	NA
				If axial PWSCC is detected in Rows 9 to 10, then inspect 100% of Rows 11 to 25 in the affected SGs.	NA
				If axial PWSCC is detected in Rows 11 to 25, then review Figure 5 of the WOG U-Bend report to define a critical area and buffer zone based on tube ovality data, and inspect 100% of the CA and buffer zone in the affected SGs.	NA
				If axial PWSCC is detected in greater than Row 25, then inspect 100% of all rows in the affected SGs.	NA
11	≥ 5 Volt Dented TSP	+Point	• SG1-1: 100% 1H to 4H; 20% 5H to 7H • SG1-2: 100% 1H to 6H; 20% 7H • SG1-3: 20% 1H to 7H • SG1-4: 100% 1H to 6H; 20% 7H For any 20% sample, a minimum of 50 ≥ 5 volt dents shall be inspected. If the population of ≥ 5 volt dents at that TSP elevation is less than 50, then 100% of the ≥ 5 volt dents at that TSP shall be inspected.	If PWSCC (at any size dent), circumferential indications (at any size dent), or AONDB (at ≥5 volt dent) are detected at a TSP elevation where 100% inspections were not required, expand the Plus Point inspections (in a step-wise manner, 100% to affected TSP and 20% at next TSP) up through the hot leg side of the SG and down the cold leg side until a 20% sample is obtained that is free from PWSCC, circumferential cracking, or AONDB at ≥5 volt dent.	Because axial PWSCC was detected at 7C in SG 1-2, following expansion was required: SG 1-2: 100% 7H and 7C, 20% 6C
12	> 2 Volt and < 5 Volt Dented TSP	+Point	• SG1-1: 100% 1H to 4H; 20% 5H • SG1-2: 100% 1H to 6H; 20% 7H • SG1-3: 20% 1H • SG1-4: 100% 1H to 6H; 20% 7H For any 20% sample, a minimum of 50 > 2 volt and < 5 volt dents shall be inspected. If the population of > 2 volt and < 5 volt dents at that TSP elevation is less than 50, then 100% of the > 2 volt and < 5 volt dents at that TSP shall be inspected.	If PWSCC (at any size dent), circumferential indications (at any size dent), or ≥ 2 inferred volt AONDB (at >2 and <5 volt dent) are detected at a TSP elevation where 100% inspections were not required, expand the Plus Point inspections (in a step-wise manner, 100% to affected TSP and 20% at next TSP) up through the hot leg side of the SG and down the cold leg side until a 20% sample is obtained that is free from PWSCC, circumferential cracking, or ≥ 2 inferred volt AONDB.	Because axial PWSCC was detected at 7C in SG 1-2, following expansion was required: SG 1-2: 100% 7H and 7C, 20% 6C

Table 1: 1R12 SG Tube Inspections and Expanded Inspections					
Item	Area	Probe	Initial Inspection Scope	Expansion Criteria	Expansion Scope
13	≤ 2 Volt Dented TSP	+Point	NA. Note: Bobbin is used for detection of axial PWSCC in ≤2 volt dents, and +Point inspection of ≤ 2 volt dents is not required, unless expansion is required.	If a circ indication or ≥2 inferred volt AONDB is detected in a dent of "x" volts where x is less than 2.3 volts for 1R12, then expand Plus Point inspections to include 100% of dents greater than "x - 0.3" volts up to the affected TSP, plus 20% of dents greater than "x – 0.3" volts at the next higher TSP. "x" is defined as the lowest dent voltage where a circumferential rack or ≥ 2 volt inferred volt AONDB was detected in that SG. Note: For any 20% sample, a minimum of 50 "x – 0.3" volt dents shall be inspected. If the population of "x – 0.3" volt dents at that TSP elevation is less than 50, then 100% of the "x – 0.3" volt dents at that TSP shall be inspected.	Because circ indication at 0.51 volt dent was detected at 1H in SG 1-1, following expansion was required: SG 1-1: 100% of dents > 0.21v at 1H, 20% of dents > 0.21v at 2H.
14	Repeat PWSCC ARC indications at dents	+Point	100%	NA	NA
15	DIS	+Point	100% of distorted ID support plate bobbin signals (DIS) at dented TSP	NA	NA
16	Previously unreported dents (PUD)	+Point	100% of PUDs called in the current outage that are located at TSP elevations included in the scope of the dent inspection program	NA	NA
17	TSP inspection for ODSCC ARC	+Point	100% of bobbin distorted OD support signals (DOS) at dented intersections (no lower voltage cutoff)	NA	NA
18		+Point	100% of ≥ 2 volt DOS	NA	NA
19		+Point	100% of DOS ≥ 1.7 volt to <2 volt	NA	Precautionary only in SG 1-1 and 1-2: 100% of DOS >1.4 v to <1.7 v
20		+Point	DOS with suspected TSP ligament cracking (SLC)	NA	NA
21		+Point	Any bobbin indication, in the wedge region exclusion zone	NA	NA
22		+Point	DOS at 7th TSP exclusion zone	NA	NA
23		+Point	DOS that extend outside the TSP crevice	NA	NA
24		+Point	100% of hot leg intersections with > 2.3 volt SPR (mixed residual signal), and minimum of 5 largest hot leg SPR per SG.	NA	NA
25		+Point	TSP with copper signals	NA	NA
26		+Point	100% of prior cycle AONDB that continue to be NDD by bobbin in current inspection	NA	NA
27		+Point	100% of prior cycle TSP SAI-OD that are NDD by bobbin in current inspection	NA	NA
28	TSP Ligament Cracking	+Point	100% of existing baseline Plus Point confirmed TSP ligament cracking (LIC or LIG) indications.	NA	NA
29		+Point	100% of new bobbin SLC indications	NA	NA

Table 1: 1R12 SG Tube Inspections and Expanded Inspections					
Item	Area	Probe	Initial Inspection Scope	Expansion Criteria	Expansion Scope
30	Free Span Dings	+Point	100% of ≥5 volt dings (including hot leg, cold leg, and U-bend) Note: Credit bobbin for detection of SCC in <5 volt dings	N/A	N/A
31		+Point	100% of ≥ 2 volt dings in the U-bend that are coincident with AVB location	NA	NA
32	Free span bobbin indications (MBI, FSI, DNI)	+Point	100% of free span bobbin indications that are new or exhibit growth or change.	NA	NA
33	Cold leg thinning at TSP	+Point	New bobbin indication in CLT zone	N/A	N/A
34	Loose parts	+Point	If possible loose part (PLP) indication detected by eddy current, or if a loose part is detected by FOSAR, perform Plus Point to bound the loose part.	NA	NA

Table 2
Tubes Plugged in 1R12

LOCATION	MECHANISM	ORIENT	11	12	13	14	Total
WEXTEX Region	PWSCC	Axial	0	0	0	0	0
	PWSCC	Circ	1	0	0	0	1
	ODSCC	Circ	2	0	0	1	3
	Volumetric		0	0	0	0	0
Hot Leg TSP	PWSCC	Axial	0	3	0	0	3
	PWSCC	Circ	0	0	0	0	0
	ODSCC	Axial	34	13	12	15	74
	ODSCC	Circ	0	5	0	1	6
	PWSCC Mix Mode	Ax/Circ	0	1	0	0	1
	ODSCC Mix Mode	Ax/Circ	1	1	0	0	2
	PWSCC/ODSCC	Axial	2	4	0	0	6
	PWSCC/ODSCC	Circ	0	0	0	0	0
	Volumetric		0	0	0	0	0
Cold Leg TSP	Cold Leg Thinning		0	0	0	0	0
	Volumetric		0	0	0	0	0
Rows 1 and 2 U-bend	PWSCC	Axial	0	0	0	0	0
	PWSCC	Circ	0	0	0	0	0
	Preventive Data Quality		0	0	0	0	0
Row 3 to Row 8 U-bend	PWSCC	Circ	0	0	11	74	85
U-bend	AVB Wear		0	1	4	1	6
Preventive	Data Quality	PVN	0	6	0	0	6
Factory Plug			0	0	0	0	0
Restriction			0	0	0	0	0
Free span	SVI or SAI scratch		0	0	0	0	0
Fatigue (88-02)	Preventive		0	0	0	0	0
Implant Tubes			0	0	0	0	0
Tubes Plugged			40	34	27	92	193
% Plugged 1R12			1.18%	1.00%	0.80%	2.72%	1.42%

Note: Some tubes may be plugged for multiple degradation mechanisms. In these cases, the tube is listed in only one degradation mechanism category.

Table 3
DCPP Unit 1 Historical Tube Plugged by Mechanism and SG

LOCATION	MECHANISM	ORIENT	11	12	13	14	Total
WEXTEX Region	PWSCC	Axial	2	3	0	2	7
	PWSCC	Circ	5	4	0	1	10
	ODSCC	Circ	9	0	9	1	19
	Volumetric		3	0	5	4	12
Hot Leg TSP	PWSCC	Axial	38	37	0	15	90
	PWSCC	Circ	1	8	0	0	9
	ODSCC	Axial	55	45	21	25	146
	ODSCC	Circ	0	11	0	3	14
	PWSCC Mix Mode	Ax/Circ	0	5	0	0	5
	ODSCC Mix Mode	Ax/Circ	1	2	0	0	3
	PWSCC/ODSCC	Axial	12	69	0	0	81
	PWSCC/ODSCC	Circ	0	1	0	0	1
	Volumetric		1	2	1	3	7
Cold Leg TSP	Cold Leg Thinning		17	27	1	8	53
	Volumetric		2	1	1	1	5
Rows 1 and 2 U-bend	PWSCC	Axial	6	17	2	1	26
	PWSCC	Circ	7	5	0	1	13
	Preventive Data Quality		8	10	4	9	31
Row 3 to Row 8 U-bend	PWSCC	Circ	0	0	11	74	85
U-bend	AVB Wear		5	14	18	17	54
Preventive	Data Quality	PVN	0	7	0	0	7
Factory Plug			0	1	0	0	1
Restriction			0	3	0	0	3
Free span	SVI or SAI scratch		1	0	2	2	5
Fatigue (88-02)	Preventive		5	0	1	0	6
Implant Tubes			16	0	0	0	16
Tubes Plugged			194	272	76	167	709
% Plugged cumulative			5.73%	8.03%	2.24%	4.93%	5.23%

Note: Some tubes may be plugged for multiple degradation mechanisms. In these cases, the tube is listed in only one degradation mechanism category.

Table 4 - DCPP Unit 1 Tubes Plugged by Mechanism and Outage

	MECHANISM	ORIENT	Pre	1R1	1R2	1R3	1R4	1R5	1R6	1R7	1R8	1R9	1R10	1R11	1R12	UnPlug	Total
Cumulative EFPY				1.25	2.27	3.45	4.49	5.86	7.14	8.46	9.75	11.37	12.86	14.27	15.88		
Cycle EFPY				1.25	1.02	1.18	1.04	1.37	1.28	1.32	1.29	1.62	1.49	1.41	1.61		
WEXTEX Tubesheet	PWSCC	Axial							2	2	1	1	2	1	0	-2	7
	PWSCC	Circ								1	4		2	2	1		10
	ODSCC	Circ										2	9	5	3		19
	Volumetric	SVI								1	5	5	1	0	0		12
Hot Leg TSP	PWSCC	Axial							31	72	124	20	13	5	3	-178	90
	PWSCC	Circ								4	1	2	1	1	0		9
	ODSCC	Axial							7	8	44	10	18	37	74	-52	146
	ODSCC	Circ											5	3	6		14
	PWSCC Mix Mode	Ax/Circ										1		3	1		5
	ODSCC Mix Mode	Ax/Circ												1	2		3
	PWSCC/ODSCC	Axial									1	3	13	58	6		81
	PWSCC/ODSCC	Circ											1	0	0		1
	Volumetric	SVI									2	1		4	0		7
Cold Leg TSP	Thinning								10	14	2	11	12	4	0		53
	Volumetric	SVI									1	4			0		5
Row 1 and 2 U-bend	PWSCC	Axial				4		13	4		5				0		26
	PWSCC	Circ						4		1	4		4		0		13
	UB Data Quality				1								23	9	0	-2	31
Row 3 to Row 8 U-bend	PWSCC	Circ													85		85
U-bend	AVB Wear					2	1	12	8	12	3	1	3	6	6		54
Preventive	Data Quality	PVN											1		6		7
Factory Plug			1												0		1
Probe restriction						1			1					1	0		3
Free Span	SVI or scratch								1			4			0		5
Fatigue (88-02)	Preventive					5					1				0		6
Implant Tubes									4	2	1	9			0		16
Tubes Plugged			1	0	1	12	1	29	68	117	199	74	108	140	193		
Tubes Unplugged						-1						-40	-43	-150		-234	
Cum Tubes Plugged			1	1	2	13	14	43	111	228	427	461	526	516	709		
Cum Tubes Plugged (%)			0.01%	0.01%	0.01%	0.10%	0.10%	0.32%	0.82%	1.68%	3.15%	3.40%	3.88%	3.81%	5.23%		

Note: Some tubes may be plugged for multiple degradation mechanisms. In these cases, the tube is listed in only one degradation mechanism category.

Table 5
1R12 In Situ Pressure Test Summary of Circumferetial PWSCC in U-Bend Region

						Leak rates (gpm at room temperature)		
SG	Row	Col	# indications	Plus Point Max Volts	Max Depth % (phase analysis)	1750 psi NO dP	2750 psi SLB dP	4950 psi 3NO dP
14	5	67	17	3.52	93	0	0	0.0104
14	5	69	4	2.76	80	0	0	0.0028
14	5	70	9	2.08	92	0	0	0
14	6	17	1	1.87	75	0	0	0
14	6	18	2	1.84	77	0	0	0
14	6	24	20	1.83	75	0	0	0
14	6	38	12	2.3	74	0	0	0.0205
14	6	65	29	2.67	99	0	0	0.0021 (at 5000 psi)
14	6	79	7	1.97	96	0	0	0

Notes:
- All indications greater than 1.73 volts were in situ pressure tested.
- Actual NOP, SLB, and 3NO differential pressures are 1473 psi, 2405 psi, and 4419 psi. The actual test values of 1750 psi, 2750 psi, and 4950 psi account for thermal and gage corrections.

Table 6
1R12 Circumferential Indications at Dented Tube Support Plates and Top of Tubesheet

											Unadjusted NDE			Adjusted NDE			Adjusted for Upper 95% NDE Uncertainty			Adjusted for Upper 95% NDE Uncertainty Mix Mode Only			Growth Rate per EFPY (1.61)		
SG	Row	Col	Crack	Support	Location Inch	Circ Type	Stabilize	Dent Volt	Mixed Mode	Flaw Volt	Angle deg	MD %	AD %	Angle deg	MD %	AD %	Angle deg	MD %	AD %	Angle deg	MD %	AD %	Angle deg	MD %	AD %
11	6	39	1	TSH	-0.06	PWSCC		NA		0.74	39.1	100	87.2	39.1	97.0	78.7	93.2	100.0	79.0	NA	NA	NA	2.9	-1.2	-1.4
11	14	51	1	TSH	0.02	ODSCC		NA		0.19	27.4	49.0	27.6	27.4	40.0	28.6	171.8	64.3	49.3	NA	NA	NA			
11	17	62	1	TSH	0.01	ODSCC		NA		0.29	49.8	98.0	77.7	49.8	87.0	73.6	181.0	98.7	77.4	NA	NA	NA	2.1	0.6	-0.7
11	29	46	1	1H	0.01	ODSCC	Yes	0.51	Yes	0.63	51.4	64.0	52.5	51.4	59.0	43.2	181.7	78.2	58.5	143.3	78.2	60.1			
12	3	36	1	1H	-0.28	ODSCC		4.63		0.35	19.1	52.0	26.7	19.1	44.0	30.6	168.4	67.3	50.6	NA	NA	NA			
12	3	77	1	1H	0.27	ODSCC	Yes	5.67		0.28	40.9	45.0	22.4	40.9	42.5	31.5	177.4	66.2	51.1	NA	NA	NA	4.0	1.6	0.5
12	3	77	1	2H	-0.12	ODSCC	Yes	20.87		0.21	44.5	35.0	11.4	44.5	40.0	28.4	178.8	64.3	49.2	NA	NA	NA	3.9	0.0	-2.0
12	14	28	1	1H	-0.19	ODSCC		17.54		0.38	41.7	55.0	27.3	41.7	51.7	36.4	177.7	72.9	54.2	NA	NA	NA	14.7	7.3	3.9
12	17	45	1	1H	0.25	ODSCC	Yes	4.33	Yes	0.15	39.2	37.0	20.7	39.2	40.0	31.7	176.7	64.3	51.3	137.1	64.3	52.8	-6.0	0.0	-0.4
12	19	71	1	4H	0.33	ODSCC		7.73		0.20	32.7	41.0	17.2	32.7	40.0	30.8	174.0	64.3	50.7	NA	NA	NA			
12	24	48	1	1H	0.30	ODSCC		18.56		0.31	54.7	53.0	37.7	54.7	49.5	37.0	183.1	71.3	54.6	NA	NA	NA	7.1	5.9	3.1
12	36	53	1	3H	0.03	ODSCC		4.02	Yes	0.18	22.3	23.0	13.8	22.3	40.0	28.9	169.7	64.3	49.5	128.5	64.3	51.1	-0.1	0.0	0.3
14	15	47	1	TSH	0.10	ODSCC		NA		0.28	54.1	81.0	65.7	54.1	66.5	52.7	182.8	83.7	64.3	NA	NA	NA	0.6	-4.7	-4.2
14	43	57	1	1H	0.32	ODSCC		23.59		0.30	60.6	29.0	15.1	60.6	40.0	32.5	185.5	64.3	51.8	NA	NA	NA			

Note 1: SG 1-2 R36C53 3H also has an axial PWSCC indication at the same TSP intersection. Therefore this intersection is treated as PWSCC mix mode indication for PWSCC ARC considerations, and the column title "adjusted for upper 95% NDE uncertainty for mixed mode affects" is applicable for PWSCC ARC mixed mode interaction evaluation.
Note 2: SG 1-1 R29C46 1H and SG 1-2 R17C45 1H also have axial ODSCC indications at the same TSP intersection, therefore these intersections are treated as ODSCC mix mode indications, and the column title "adjusted for upper 95% NDE uncertainty for mixed mode affects" is applicable for CMOA mixed mode interaction evaluation.
Note 3: Growth rate based on adjusted NDE, not the NDE uncertainty adjusted NDE.
Note 4: SG 1-1 R29C46 1H was not previously Plus Point inspected in 1R11, so no growth data is available. All other locations were previously Plus Point inspected, and the tubes with no growth rate data were NDD in 1R11 lookup.
Note 5: Location (inch) is relative to the centerline of the tube support plate (e.g., 1H), for TSP indications, and relative to the top of tubesheet (TSH), for tubesheet indications.
Note 6: Tube stabilization determined per evaluation in Westinghouse letter PGE-04-46 dated April 20, 2004.

Table 7 - DCPP Units 1 and 2 Axial ODSCC and Axial PWSCC at Same TSP Intersection (ID/OD Flaws)																		
										PWSCC NDE Data					ODSCC NDE Data			
Insp.	SG	Row	Col	TSP	Dent Volt	ID/OD Separation Angle (Deg.)	Deplug	PWSCC New?	ODSCC New?	Crack No.	Length (in.)	MD (%)	AD (%)	Max. Volt	No. OD Cracks	DOS Bobbin Voltage	Inferred Bobbin Voltage	Largest +Point Volts
1R12	11	26	25	1H	1.95	55			New	1	0.28	49	33.2	1.31	1	NA	0.52	0.22
1R12	11	28	27	1H	2.29	67			New	1	0.34	52	33.1	1.22	2	NA	0.60	0.3
1R12	12	5	39	2H	0.69	86	1R11		New	1	0.19	36	28.5	1	1	0.36	NA	0.24
1R12	12	12	77	1H	1.5	55	1R11		New	1	0.4	54	36.4	1.4	2	NA	0.50	0.2
1R12	12	22	54	2H	2.14	60	1R11		New	1	0.33	60	48.1	2.43	1	NA	0.54	0.24
1R12	12	23	82	1H	1.47	66			New	1	0.08	27	17.7	0.49	2	0.26	NA	0.26
2R11	22	12	71	1H	4.63	61		New		1	0.11	37	24.6	0.39	1	NA	0.46	0.16
2R11	22	22	67	2H	0.63	53		New		1	0.23	38	24.8	0.91	2	4.58	NA	2.66
2R11	22	24	58	2H	2.02	147		New	New	1	0.07	20	12.8	0.29	1	NA	0.52	0.22
2R11	22	28	38	1H	1.56	55			New	1	0.16	33	17.6	0.44	2	0.86	NA	0.15
2R11	23	8	66	1H	1.42	78		New		1	0.11	20	14.5	0.43	1	0.62	NA	0.24
2R11	24	16	11	3H	1.27	83			New	1	0.26	30	17.2	0.72	1	0.63	NA	0.18
2R11	24	34	43	3H	4.63	63		New		1	0.39	36	22.8	0.65	3	1.73	NA	0.72
1R11	11	14	87	2H	0.51	71		New		1	0.09	30	20.8	0.29	1	0.62	NA	0.63
1R11	11	15	81	2H	1.2	82		New		1	0.19	21.5	12.4	0.5	1	0.75	NA	0.36
1R11	11	16	45	2H	1.32	71		New	New	1	0.14	34	22.1	0.84	2	1.29	NA	0.16
1R11	11	22	71	2H	0.83	81			New	1	0.11	40	28.6	0.67	1	NA	0.46	0.16
1R11	11	24	20	2H	1.43	49			New	1	0.07	43	22.7	0.71	1	0.81	NA	0.22
1R11	11	33	40	2H	0.86	59		New	New	1	0.26	45	28.7	1.13	2	1.26	NA	0.25
1R11	11	36	30	2H	0.56	46			New	1	0.17	43	30.5	1.34	2	NA	0.52	0.22
1R11	12	5	59	1H	1.02	49	1R11			1	0.34	43	32.4	1.3	2	NA	0.52	0.22
1R11	12	6	70	2H	1.54	71	1R11			1	0.11	36	25.8	0.79	2	NA	0.55	0.25
1R11	12	7	28	2H	2.33	64	1R11			1	0.07	20	12.4	0.31	1	NA	0.47	0.17
1R11	12	7	56	1H	1.13	90	1R11			1	0.26	43	34.3	2.2	1	NA	0.50	0.2
1R11	12	7	84	1H	2.19	53	1R11			1	0.34	45	35.6	3.06	1	NA	0.58	0.28
1R11	12	8	67	1H	1.2	64			New	1	0.2	29	16.9	0.88	1	NA	0.44	0.14
1R11	12	8	51	1H	1.48	76	1R11			1	0.18	32	19.2	0.69	1	0.51	NA	0.19
1R11	12	9	28	1H	2.53	71	1R11			1	0.16	47	30.3	1.47	2	NA	0.57	0.27
1R11	12	9	77	1H	2.45	95	1R11			1	0.23	39	23.4	1.34	1	0.62	NA	0.29
1R11	12	10	35	1H	1.34	80	1R11			1	0.11	51	33.4	1.65	1	NA	0.49	0.19
1R11	12	10	83	1H	6.72	60	1R11			1	0.27	64	37.5	1.15	2	NA	0.55	0.25
1R11	12	11	27	1H	2.13	49	1R11			1	0.5	29	18.7	0.86	1	NA	0.51	0.21
1R11	12	11	47	2H	2.32	73	1R11			1	0.21	36	26.7	1.06	1	NA	0.50	0.2
1R11	12	12	66	2H	2.21	80	1R11			1	0.13	45	30.9	1.51	1	NA	0.57	0.27
1R11	12	12	80	1H	1.04	49	1R11			1	0.07	20	12.9	0.6	1	0.45	NA	0.24
1R11	12	12	84	2H	0.73	64	1R11			1	0.29	42	31.1	1.5	1	0.55	NA	0.35
1R11	12	13	81	1H	3.18	49	1R11			1	0.13	23	16.5	0.88	1	0.43	NA	0.33
1R11	12	13	89	1H	2.33	57	1R11			1	0.4	53	41.3	2.97	1	0.56	NA	0.44

Table 7 - DCPP Units 1 and 2 Axial ODSCC and Axial PWSCC at Same TSP Intersection (ID/OD Flaws)																		
										PWSCC NDE Data					ODSCC NDE Data			
Insp.	SG	Row	Col	TSP	Dent Volt	ID/OD Separation Angle (Deg.)	Deplug	PWSCC New?	ODSCC New?	Crack No.	Length (in.)	MD (%)	AD (%)	Max. Volt	No. OD Cracks	DOS Bobbin Voltage	Inferred Bobbin Voltage	Largest +Point Volts
1R11	12	16	73	1H	18.03	47	1R10		New	1	0.12	21	15.2	0.64	1	NA	0.49	0.19
1R11	12	16	76	2H	0.52	64	1R10		New	1	0.18	20	9.7	0.39	1	0.05	NA	0.2
1R11	12	17	8	6H	2.95	75	1R11			1	0.23	24	15.6	0.81	1	NA	0.55	0.25
1R11	12	19	14	2H	1.34	84	1R11			1	0.18	44	35	1.73	1	NA	0.52	0.22
1R11	12	19	51	1H	1.21	76	1R11			1	0.57	54	44	3.24	1	NA	0.62	0.32
1R11	12	20	52	2H	2.55	83	1R11			1	0.23	43	28.3	0.91	1	NA	0.50	0.2
1R11	12	20	58	1H	0.65	55	1R11			1	0.54	57	40.3	2.09	1	NA	0.49	0.19
1R11	12	21	37	4H	2.25	80	1R11			1	0.25	34.5	24.2	0.88	1	NA	0.46	0.16
1R11	12	21	50	1H	2.38	56	1R11			1	0.76	57	47.1	2.04	1	NA	0.95	0.64
1R11	12	21	53	6H	2.52	56	1R11			1	0.62	64	50.7	1.97	1	NA	0.51	0.21
1R11	12	22	32	2H	1.44	51	1R11			1	0.27	54	42.1	2.28	2	NA	0.53	0.23
1R11	12	22	34	2H	0.69	51	1R11			1	0.18	42	31.3	1.03	3	NA	0.53	0.23
1R11	12	22	38	1H	4.7	65	1R11			1	0.08	30	22	0.58	2	NA	0.52	0.22
1R11	12	25	72	1H	2.06	77		New	New	1	0.09	24	17.3	0.48	1	NA	0.45	0.15
1R11	12	26	71	2H	1.4	75	1R11			1	0.42	42	30.5	1.68	1	NA	0.48	0.18
1R11	12	26	77	2H	0.71	68	1R11			1	0.44	50	38.9	1.87	1	0.81	NA	0.36
1R11	12	26	78	1H	1.29	68	1R11			1	0.32	50	38.6	2.43	1	NA	0.63	0.33
1R11	12	27	50	1H	1.95	34			New	1	0.11	27	17.4	0.88	1	NA	0.49	0.19
1R11	12	27	36	2H	0.54	58	1R11			1	0.09	20	12.5	0.77	1	NA	0.42	0.12
1R11	12	28	56	2H	0.75	79	1R11			1	0.25	40	29.2	1.12	1	NA	0.41	0.11
1R11	12	28	58	1H	1.67	72	1R11			1	0.6	60	44.9	3.05	1	NA	0.52	0.22
1R11	12	28	68	6H	1.26	57	1R11			1	0.08	21	10.9	0.56	1	0.32	NA	0.11
1R11	12	29	43	2H	1.34	69	1R11			1	0.24	39	31.1	1.86	2	0.62	NA	0.42
1R11	12	29	56	2H	1.34	106	1R11			1	0.25	34	24.6	1.82	1	NA	0.52	0.22
1R11	12	29	67	2H	3.02	83	1R11			1	0.36	48	36.9	2.11	1	NA	0.55	0.25
1R11	12	30	16	1H	0.9	48			New	1	0.15	41	28	0.7	1	NA	0.62	0.32
1R11	12	31	32	3H	1.67	69	1R11			1	0.11	20	9.7	0.32	1	NA	0.39	0.09
1R11	12	35	45	2H	1.82	95	1R11			1	0.29	48	35.7	1.41	1	0.43	NA	0.27
1R11	12	35	65	2H	2.36	46	1R11			1	0.31	48	37.4	1.88	3	NA	0.53	0.23
1R11	12	37	72	1H	1.65	76	1R11			1	0.17	34	24.5	0.93	1	NA	0.55	0.25
1R11	12	38	70	1H	2.42	61	1R11			1	0.09	20	15.6	0.52	1	NA	0.61	0.31
1R11	12	40	63	1H	0.87	83	1R11			1	0.11	21	9.9	0.46	1	NA	0.67	0.36
1R11	12	42	28	2H	1.41	69			New	1	0.11	32	20.1	0.88	1	NA	0.58	0.28
1R10	11	28	50	1H	0.35	47	1R10			1	0.09	29	19.1	0.64	2	0.96	NA	0.81
1R10	12	9	34	2H	2.02	44		New		1	0.09	21	13.3	0.41	2	0.76	NA	0.26
1R10	12	14	72	2H	2.92	58	1R10			1	0.42	38	16.3	1.04	1	NA	0.51	0.21
1R10	12	14	82	1H	1.55	61	1R10			1	0.05	20	10	0.39	1	NA	0.53	0.23
1R10	12	15	10	1H	1.76	90			New	1	0.21	24	14	0.48	1	0.44	NA	0.27

Table 7 - DCPP Units 1 and 2 Axial ODSCC and Axial PWSCC at Same TSP Intersection (ID/OD Flaws)																		
										PWSCC NDE Data					ODSCC NDE Data			
Insp.	SG	Row	Col	TSP	Dent Volt	ID/OD Separation Angle (Deg.)	Deplug	PWSCC New?	ODSCC New?	Crack No.	Length (in.)	MD (%)	AD (%)	Max. Volt	No. OD Cracks	DOS Bobbin Voltage	Inferred Bobbin Voltage	Largest +Point Volts
1R10	12	17	60	2H	2.92	51	1R10			1	0.17	22	7.2	0.56	1	NA	0.54	0.24
1R10	12	24	72	1H	1.24	82	1R10			1	0.26	22	15.5	0.4	1	0.27	NA	0.14
1R10	12	26	43	2H	2.12	70	1R10			1	0.26	30	15.4	0.81	1	NA	0.56	0.26
1R10	12	27	71	1H	1.86	74			New	1	0.23	39	25.4	1.12	2	NA	0.60	0.3
1R10	12	33	37	1H	2.01	79		New	new	1	0.11	20	12	0.38	1	NA	0.50	0.2
1R10	12	38	63	1H	2.35	79		New	new	1	0.14	22	13.9	0.78	1	NA	0.68	0.37
1R10	12	41	62	1H	0.82	109		New	new	1	0.21	27	17	0.54	1	NA	0.54	0.24
1R9	11	9	6	1H	0.95	79		New	New	1	0.13	37	27.2	0.38	1	0.35	NA	0.27
1R9	12	6	47	1H	0.77	44		New	New	1	0.12	26	16.7	0.35	1	0.34	NA	0.11
1R9	12	13	75	2H	2.23	53		New	New	1	0.11	20	11	0.42	1	0.37	NA	0.14
2R7	24	9	12	3H	1.84	89		New	New	1	0.32	23	17.8	1.64	1	1.25	NA	0.38
2R8	24	34	34	3H	2.96	57		New	New	1	0.16	35.5	26.4	0.38	1	NA	0.62	0.32
1R11	12	7	28	2H			1R11			2	0.1	24	14.9	0.55				
1R11	12	16	73	1H			1R10		New	2	0.15	20	12.3	0.5				
1R11	12	20	58	1H			1R11			2	0.19	54	44.4	2.23				
1R11	12	21	50	1H			1R11			2	0.56	64	39	1.65				
1R11	12	22	38	1H			1R11			2	0.61	48	38.7	2.19				
1R11	12	31	32	3H			1R11			2	0.34	48	40.6	1.67				
1R10	12	14	72	2H			1R10			2	0.07	20	12	0.58				

Table 8 - Number of Tubes with Circumferential PWSCC per Tube Row					
SG	Row 5	Row 6	Row 7	Row 8	Total
1-3	4	4	3		11
1-4	23	38	9	4	74
Total	27	42	12	4	85

Table 9 - Number of Circumferential PWSCC Indications per Tube Row					
SG	Row 5	Row 6	Row 7	Row 8	Total
1-3	21	4	3	NA	28
1-4	71	245	54	4	374
Total	92	249	57	4	402

Table 10 - Maximum Circumferential PWSCC Plus Point Voltage per Tube Row				
SG	Row 5	Row 6	Row 7	Row 8
1-3	1.42	1.13	1.07	NA
1-4	3.52	2.67	1.38	1.04

Table 11 - Circumferential PWSCC In Rows 5 through 8 U-bend Region			
SG	Row	Col	Number of Indications
13	5	32	1
13	5	73	3
13	5	75	14
13	5	77	3
13	6	10	1
13	6	25	1
13	6	29	1
13	6	94	1
13	7	19	1
13	7	48	1
13	7	61	1
14	5	27	2
14	5	28	6
14	5	48	1
14	5	50	1
14	5	51	1
14	5	52	1
14	5	53	1
14	5	54	1
14	5	55	1
14	5	56	1
14	5	57	1
14	5	58	1
14	5	59	1
14	5	60	1
14	5	61	1
14	5	63	1
14	5	64	5
14	5	65	8
14	5	66	3
14	5	67	17
14	5	68	3
14	5	69	4
14	5	70	9
14	6	13	1
14	6	17	1
14	6	18	2
14	6	22	2
14	6	24	20
14	6	26	7
14	6	28	5
14	6	29	1
14	6	30	2
14	6	33	1
14	6	34	2
14	6	36	1
14	6	38	12
14	6	40	21
14	6	41	7
14	6	42	14
14	6	45	1
14	6	46	22

Table 11 - Circumferential PWSCC in Rows 5 through 8 U-bend Region			
SG	Row	Col	Number of Indications
14	6	48	1
14	6	49	1
14	6	50	3
14	6	51	2
14	6	53	1
14	6	54	4
14	6	55	6
14	6	57	1
14	6	58	14
14	6	59	2
14	6	60	5
14	6	62	1
14	6	65	29
14	6	66	16
14	6	67	5
14	6	69	5
14	6	78	4
14	6	79	7
14	6	80	14
14	6	82	2
14	7	26	1
14	7	28	1
14	7	45	22
14	7	58	2
14	7	59	4
14	7	61	4
14	7	65	5
14	7	70	13
14	7	73	2
14	8	33	1
14	8	56	1
14	8	59	1
14	8	60	1

Note: Stabilization of these tubes is not required per analysis in Framatome-ANP letter FANPW-04-624 Rev 1 dated April 18, 2004. Nonetheless, all of the Row 7 and 8 tubes were preventively stabilized.

Table 12 – Plus Point Data for Circumferential PWSCC in Rows 5 through 8 U-Bend Region							
SG	Row	Col	Elev	Inch	Volts	Arc length degree	Max Depth %
13	5	32	7H	4.81	1.13	26	40
13	5	73	7H	19.7	0.72	21	47
13	5	73	7H	15.81	0.58	21	34
13	5	73	7H	17.46	0.57	21	37
13	5	75	7H	17.91	1.42	27	74
13	5	75	7H	12.18	1.31	21	74
13	5	75	7H	13.16	1.3	24	79
13	5	75	7H	14.15	1.28	24	82
13	5	75	7H	17.17	1.25	24	72
13	5	75	7H	16.64	1.19	24	74
13	5	75	7H	18.78	1.19	27	82
13	5	75	7H	21.91	1.01	27	56
13	5	75	7H	11.82	0.92	21	61
13	5	75	7H	10.47	0.86	21	50
13	5	75	7H	11.16	0.78	21	56
13	5	75	7H	10.85	0.77	18	72
13	5	75	7H	8.8	0.74	18	47
13	5	75	7H	4.22	0.73	18	34
13	5	77	7H	25.5	1.38	21	47
13	5	77	7H	24.93	0.93	18	50
13	5	77	7H	23.69	0.91	27	47
13	6	10	7H	4.84	1.03	26	45
13	6	25	7H	4.34	1.13	26	41
13	6	29	7H	4.53	0.94	17	30
13	6	94	7H	29.74	0.71	21	37
13	7	19	7H	4.59	1.07	23	30
13	7	48	7H	33.45	0.77	26	73
13	7	61	7H	4.05	0.5	35	54
14	5	27	7H	25.62	1.22	29	75
14	5	27	7H	26.1	0.73	21	36
14	5	28	7H	12.92	1.16	32	38
14	5	28	7H	24.84	1.04	30	49
14	5	28	7H	23.52	1.03	30	33
14	5	28	7H	5.74	0.61	21	46
14	5	28	7H	10.3	0.54	21	25
14	5	28	7H	6.44	0.44	19	30
14	5	48	7H	4.8	0.99	24	36
14	5	50	7H	4.94	1.27	26	46
14	5	51	7H	4.64	1	21	56
14	5	52	7H	4.64	1.14	29	46
14	5	53	7H	4.85	1.15	21	49
14	5	54	7H	4.61	0.79	26	36
14	5	55	7H	6.69	0.89	21	41
14	5	56	7H	5.19	0.78	26	36
14	5	57	7H	4.47	1.2	21	49
14	5	58	7H	4.62	0.81	29	33
14	5	59	7H	4.98	1.36	21	66
14	5	60	7H	4.56	0.84	29	44
14	5	61	7H	5.32	1.18	26	51
14	5	63	7H	4.72	0.84	23	51
14	5	64	7H	10.9	1.26	24	60
14	5	64	7H	18.84	0.88	24	30

Table 12 – Plus Point Data for Circumferential PWSCC in Rows 5 through 8 U-Bend Region							
SG	Row	Col	Elev	Inch	Volts	Arc length degree	Max Depth %
14	5	64	7H	8.76	0.82	26	38
14	5	64	7H	9.56	0.57	18	30
14	5	64	7H	26.38	0.4	21	25
14	5	65	7H	5.08	1.62	26	80
14	5	65	7H	26.37	1.37	24	63
14	5	65	7H	17.2	1.33	29	77
14	5	65	7H	13.3	1.04	24	73
14	5	65	7H	8.07	0.99	24	66
14	5	65	7H	16.85	0.86	21	71
14	5	65	7H	8.82	0.8	26	61
14	5	65	7H	12.43	0.62	24	59
14	5	66	7H	4.69	0.89	23	68
14	5	66	7H	4.94	0.84	26	49
14	5	66	7H	26.4	0.84	21	49
14	5	67	7H	26.34	3.52	26	93
14	5	67	7H	22.04	3.39	26	82
14	5	67	7H	21.16	3.25	24	84
14	5	67	7H	20.01	3.03	24	77
14	5	67	7H	5.19	2.43	34	82
14	5	67	7H	23.15	2.42	26	86
14	5	67	7H	23.54	2.37	29	84
14	5	67	7H	24.37	2.35	26	84
14	5	67	7H	21.58	2.32	24	73
14	5	67	7H	26.65	1.64	21	68
14	5	67	7H	8.88	1.56	26	73
14	5	67	7H	11	1.55	26	77
14	5	67	7H	10.39	1.51	24	84
14	5	67	7H	9.52	1.46	26	80
14	5	67	7H	10.71	0.94	24	75
14	5	67	7H	25.35	0.89	21	77
14	5	67	7H	19.3	0.61	26	38
14	5	68	7H	21.09	0.82	26	73
14	5	68	7H	4.82	0.8	26	62
14	5	68	7H	5.82	0.46	23	33
14	5	69	7H	4.5	2.76	26	80
14	5	69	7H	6.22	2.53	31	77
14	5	69	7H	26.12	1.25	21	59
14	5	69	7H	9.31	1.02	23	49
14	5	70	7H	5.35	2.08	29	81
14	5	70	7H	24.43	1.94	26	71
14	5	70	7H	4.9	1.89	26	81
14	5	70	7H	8.58	1.84	29	92
14	5	70	7H	7.45	1.63	34	73
14	5	70	7H	4.59	1.44	26	87
14	5	70	7H	6.62	1.4	34	76
14	5	70	7H	15.51	1.38	26	71
14	5	70	7H	10.14	0.84	24	46
14	6	13	7H	28.76	0.71	21	36
14	6	17	7H	29.52	1.87	28	75
14	6	18	7H	29.12	1.84	31	77
14	6	18	7H	29.84	1.18	31	71
14	6	22	7H	29.73	1.13	29	51
14	6	22	7H	26.38	0.4	23	33

Table 12 – Plus Point Data for Circumferential PWSCC in Rows 5 through 8 U-Bend Region							
SG	Row	Col	Elev	Inch	Volts	Arc length degree	Max Depth %
14	6	24	7H	29.29	1.83	29	75
14	6	24	7H	14.15	1.48	29	59
14	6	24	7H	3.84	1.27	24	75
14	6	24	7H	4.26	1.27	24	75
14	6	24	7H	24.12	1.23	26	63
14	6	24	7H	23.11	1.11	26	56
14	6	24	7H	7.48	1.03	26	71
14	6	24	7H	22.21	0.97	26	51
14	6	24	7H	11.76	0.96	24	61
14	6	24	7H	12.37	0.96	29	68
14	6	24	7H	7.92	0.94	24	66
14	6	24	7H	5.76	0.88	26	66
14	6	24	7H	6.06	0.88	26	66
14	6	24	7H	11.18	0.81	29	66
14	6	24	7H	8.42	0.78	24	63
14	6	24	7H	8.86	0.78	24	63
14	6	24	7H	16.53	0.77	24	44
14	6	24	7H	26.68	0.72	24	51
14	6	24	7H	10.1	0.69	26	66
14	6	24	7H	9.81	0.69	26	66
14	6	26	7H	29.25	1.59	26	71
14	6	26	7H	6.69	1.17	32	80
14	6	26	7H	4.02	0.93	26	66
14	6	26	7H	10.66	0.74	29	41
14	6	26	7H	10.28	0.74	29	41
14	6	26	7H	21.06	0.49	24	49
14	6	26	7H	5.85	0.44	16	31
14	6	28	7H	22.15	1.27	34	56
14	6	28	7H	21.43	1.14	31	54
14	6	28	7H	20.69	1.04	24	44
14	6	28	7H	28.67	0.93	26	49
14	6	28	7H	29.44	0.9	24	46
14	6	29	7H	29.59	1.14	26	52
14	6	30	7H	26.37	0.7	21	54
14	6	30	7H	29.78	0.61	26	22
14	6	33	7H	29.42	0.83	23	26
14	6	34	7H	29.3	1.34	18	53
14	6	34	7H	28.42	0.56	13	30
14	6	36	7H	29.48	1.68	23	72
14	6	38	7H	4.14	2.3	24	67
14	6	38	7H	4.54	2.25	21	74
14	6	38	7H	4.95	1.63	18	74
14	6	38	7H	29.35	1.54	29	74
14	6	38	7H	14.22	1.5	21	70
14	6	38	7H	5.25	1.47	26	74
14	6	38	7H	6.44	1.43	24	62
14	6	38	7H	28.26	1.3	26	70
14	6	38	7H	28.66	1.28	29	65
14	6	38	7H	13.48	1.12	24	65
14	6	38	7H	3.77	0.95	24	70
14	6	38	7H	13.78	0.86	24	58
14	6	40	7H	4.13	1.48	21	86
14	6	40	7H	14.37	1.24	21	74

Table 12 – Plus Point Data for Circumferential PWSCC in Rows 5 through 8 U-Bend Region							
SG	Row	Col	Elev	Inch	Volts	Arc length degree	Max Depth %
14	6	40	7H	9.64	1.16	24	83
14	6	40	7H	6.51	1.09	21	83
14	6	40	7H	9.02	1.07	21	90
14	6	40	7H	11.44	0.93	21	77
14	6	40	7H	13.52	0.88	24	58
14	6	40	7H	8.25	0.84	18	86
14	6	40	7H	29.67	0.71	21	58
14	6	40	7H	4.67	0.66	18	88
14	6	40	7H	7.78	0.66	16	83
14	6	40	7H	10.74	0.59	18	65
14	6	40	7H	16.84	0.54	21	60
14	6	40	7H	11.11	0.49	18	70
14	6	40	7H	5.51	0.48	21	77
14	6	40	7H	10.49	0.47	18	74
14	6	40	7H	7.13	0.46	18	81
14	6	40	7H	7.46	0.4	18	77
14	6	40	7H	20.9	0.38	21	50
14	6	40	7H	19.86	0.38	21	55
14	6	40	7H	12.02	0.23	16	50
14	6	41	7H	20.35	1.28	24	38
14	6	41	7H	28.49	1.1	29	23
14	6	41	7H	23.06	0.7	26	29
14	6	41	7H	10.48	0.6	18	44
14	6	41	7H	8.97	0.55	21	41
14	6	41	7H	9.8	0.55	21	51
14	6	41	7H	9.45	0.38	16	13
14	6	42	7H	29.16	1.3	24	55
14	6	42	7H	4.5	1.03	18	45
14	6	42	7H	8.67	0.87	18	48
14	6	42	7H	9.84	0.83	24	53
14	6	42	7H	7.47	0.73	24	45
14	6	42	7H	6.94	0.71	21	55
14	6	42	7H	11.6	0.69	21	43
14	6	42	7H	10.55	0.64	21	48
14	6	42	7H	14.14	0.59	21	45
14	6	42	7H	8.12	0.55	21	30
14	6	42	7H	10.14	0.53	18	38
14	6	42	7H	24.44	0.51	21	32
14	6	42	7H	15.02	0.45	21	32
14	6	42	7H	13.14	0.35	18	32
14	6	45	7H	29.58	0.8	26	51
14	6	46	7H	29.25	1.55	29	69
14	6	46	7H	21.15	1.36	23	52
14	6	46	7H	25.18	1.35	23	63
14	6	46	7H	15.17	1.35	26	63
14	6	46	7H	6.82	1.34	29	89
14	6	46	7H	13.19	1.26	21	58
14	6	46	7H	13.91	1.23	26	63
14	6	46	7H	14.33	1.23	26	63
14	6	46	7H	4.23	1.14	26	63
14	6	46	7H	21.42	1.12	23	52
14	6	46	7H	22.07	0.99	26	50
14	6	46	7H	21.75	0.99	26	50

Table 12 – Plus Point Data for Circumferential PWSCC in Rows 5 through 8 U-Bend Region							
SG	Row	Col	Elev	Inch	Volts	Arc length degree	Max Depth %
14	6	46	7H	26.42	0.97	26	50
14	6	46	7H	23.41	0.92	21	58
14	6	46	7H	23.79	0.92	21	58
14	6	46	7H	9.61	0.89	18	98
14	6	46	7H	25.86	0.83	23	50
14	6	46	7H	11.6	0.75	26	55
14	6	46	7H	12.14	0.59	23	52
14	6	46	7H	9.85	0.48	21	95
14	6	46	7H	10.73	0.33	16	66
14	6	46	7H	10.33	0.33	16	66
14	6	48	7H	4.86	1.1	26	44
14	6	49	7H	4.81	0.97	28	31
14	6	50	7H	5	1.37	28	52
14	6	50	7H	5.68	0.67	34	36
14	6	50	7H	6.63	0.35	23	28
14	6	51	7H	5.01	1.41	23	52
14	6	51	7H	29.6	0.72	29	39
14	6	53	7H	5	1.26	21	58
14	6	54	7H	4.88	0.7	18	46
14	6	54	7H	27.31	0.66	26	38
14	6	54	7H	29.76	0.57	24	38
14	6	54	7H	30.24	0.57	24	38
14	6	55	7H	4.91	1.35	23	52
14	6	55	7H	21.58	1.21	26	50
14	6	55	7H	25.21	0.95	31	44
14	6	55	7H	5.66	0.82	21	39
14	6	55	7H	15.09	0.65	18	39
14	6	55	7H	26.05	0.53	23	23
14	6	57	7H	4.82	1.1	21	47
14	6	58	7H	4.72	0.95	21	55
14	6	58	7H	5.21	0.95	21	55
14	6	58	7H	27.51	0.74	26	46
14	6	58	7H	17.02	0.62	24	51
14	6	58	7H	12.14	0.6	18	41
14	6	58	7H	25.14	0.58	29	36
14	6	58	7H	15.08	0.58	24	46
14	6	58	7H	14.32	0.55	21	51
14	6	58	7H	21.96	0.53	29	36
14	6	58	7H	12.67	0.44	18	38
14	6	58	7H	10.72	0.42	13	36
14	6	58	7H	23.01	0.4	18	36
14	6	58	7H	24.28	0.39	34	26
14	6	58	7H	18.62	0.36	21	21
14	6	59	7H	4.71	0.88	26	44
14	6	59	7H	5.88	0.49	18	42
14	6	60	7H	4.66	1.19	21	46
14	6	60	7H	27.6	0.59	29	58
14	6	60	7H	27.9	0.59	29	58
14	6	60	7H	30.11	0.33	26	51
14	6	60	7H	24.9	0.19	34	48
14	6	62	7H	4.86	1.16	33	50
14	6	65	7H	25.48	2.67	37	80
14	6	65	7H	24.78	2.55	37	70

Table 12 – Plus Point Data for Circumferential PWSCC in Rows 5 through 8 U-Bend Region							
SG	Row	Col	Elev	Inch	Volts	Arc length degree	Max Depth %
14	6	65	7H	23.27	2.47	37	68
14	6	65	7H	22.92	2.47	37	68
14	6	65	7H	17.24	2.33	39	70
14	6	65	7H	20.37	2.32	32	68
14	6	65	7H	20.86	2.32	32	68
14	6	65	7H	4.44	2.3	26	68
14	6	65	7H	4.81	2.3	26	68
14	6	65	7H	21.66	2.3	34	73
14	6	65	7H	18.9	2.22	34	75
14	6	65	7H	14.68	2.14	32	68
14	6	65	7H	14.3	2.14	32	68
14	6	65	7H	16.94	2.09	32	68
14	6	65	7H	15.99	2.05	32	68
14	6	65	7H	19.47	2.03	29	63
14	6	65	7H	5.81	1.92	26	68
14	6	65	7H	17.52	1.82	32	73
14	6	65	7H	17.92	1.82	32	73
14	6	65	7H	30.4	1.77	34	75
14	6	65	7H	22.43	1.75	32	51
14	6	65	7H	7.47	1.72	24	65
14	6	65	7H	12.5	1.64	29	63
14	6	65	7H	12.93	1.64	29	63
14	6	65	7H	27.77	1.61	37	99
14	6	65	7H	10.5	1.39	26	60
14	6	65	7H	9.16	0.96	26	51
14	6	65	7H	29.09	0.94	32	77
14	6	65	7H	9.84	0.92	26	48
14	6	66	7H	4.73	1.35	28	55
14	6	66	7H	12.92	0.63	28	55
14	6	66	7H	18.58	0.62	18	50
14	6	66	7H	24.51	0.56	18	58
14	6	66	7H	10.92	0.49	16	44
14	6	66	7H	19.72	0.48	15	44
14	6	66	7H	26.06	0.47	18	42
14	6	66	7H	20.32	0.46	13	42
14	6	66	7H	16.01	0.45	20	44
14	6	66	7H	22.98	0.44	16	42
14	6	66	7H	28.48	0.44	21	36
14	6	66	7H	26.75	0.41	15	39
14	6	66	7H	27.2	0.41	15	39
14	6	66	7H	10.4	0.38	18	28
14	6	66	7H	23.7	0.38	18	61
14	6	66	7H	21.16	0.37	18	39
14	6	67	7H	31.89	0.78	32	56
14	6	67	7H	27.55	0.58	26	46
14	6	67	7H	6.66	0.56	21	36
14	6	67	7H	10.12	0.46	18	39
14	6	67	7H	29.11	0.31	21	33
14	6	69	7H	4.47	1.07	24	52
14	6	69	7H	30.24	1.06	27	69
14	6	69	7H	5.5	0.77	19	38
14	6	69	7H	4.77	0.77	24	38
14	6	69	7H	5.09	0.57	21	38

Table 12 – Plus Point Data for Circumferential PWSCC in Rows 5 through 8 U-Bend Region							
SG	Row	Col	Elev	Inch	Volts	Arc length degree	Max Depth %
14	6	78	7H	4.86	1.17	24	61
14	6	78	7H	11.89	1	21	69
14	6	78	7H	15.56	0.98	21	69
14	6	78	7H	14.22	0.51	21	49
14	6	79	7H	5.86	1.97	29	89
14	6	79	7H	7.68	1.04	24	81
14	6	79	7H	12.72	0.87	21	75
14	6	79	7H	13.13	0.87	21	75
14	6	79	7H	8.75	0.45	18	72
14	6	79	7H	8.48	0.45	18	72
14	6	79	7H	10.26	0.21	21	96
14	6	80	7H	9.41	1.23	26	59
14	6	80	7H	10.82	0.9	24	68
14	6	80	7H	11.53	0.85	24	75
14	6	80	7H	11.94	0.85	24	75
14	6	80	7H	9.94	0.8	24	71
14	6	80	7H	28.07	0.77	29	41
14	6	80	7H	29.76	0.73	29	54
14	6	80	7H	30.13	0.73	29	54
14	6	80	7H	4.17	0.54	16	41
14	6	80	7H	5.39	0.52	18	56
14	6	80	7H	5.75	0.52	18	56
14	6	80	7H	14.2	0.45	18	49
14	6	80	7H	14.63	0.45	18	49
14	6	80	7H	4.89	0.45	18	46
14	6	82	7H	4.6	0.81	26	44
14	6	82	7H	5.27	0.62	26	49
14	7	26	7H	32.22	0.85	29	38
14	7	28	7H	33.28	1.22	37	54
14	7	45	7H	10.67	1.09	21	66
14	7	45	7H	7.19	1.05	21	59
14	7	45	7H	14.76	1.05	21	48
14	7	45	7H	12.42	1.02	21	66
14	7	45	7H	10.26	1	21	62
14	7	45	7H	13.71	0.99	21	44
14	7	45	7H	8.47	0.97	21	59
14	7	45	7H	9.91	0.95	19	41
14	7	45	7H	11.37	0.93	21	41
14	7	45	7H	5.25	0.91	21	48
14	7	45	7H	7.73	0.85	19	55
14	7	45	7H	9.47	0.84	19	44
14	7	45	7H	15.52	0.72	19	48
14	7	45	7H	11.78	0.71	19	38
14	7	45	7H	6.33	0.62	21	23
14	7	45	7H	26.88	0.6	24	32
14	7	45	7H	25.55	0.53	21	35
14	7	45	7H	5.58	0.52	19	35
14	7	45	7H	23.15	0.47	19	38
14	7	45	7H	25	0.46	19	32
14	7	45	7H	27.78	0.39	21	35
14	7	45	7H	31.91	0.3	24	32
14	7	58	7H	4.55	0.78	26	50
14	7	58	7H	4.91	0.78	26	50

Table 12 – Plus Point Data for Circumferential PWSCC in Rows 5 through 8 U-Bend Region							
SG	Row	Col	Elev	Inch	Volts	Arc length degree	Max Depth %
14	7	59	7H	31.65	0.74	29	53
14	7	59	7H	30.84	0.71	26	51
14	7	59	7H	7.5	0.54	24	41
14	7	59	7H	23.27	0.35	21	33
14	7	61	7H	34.17	1.14	37	73
14	7	61	7H	33.54	0.89	29	60
14	7	61	7H	32.79	0.66	32	53
14	7	61	7H	13.62	0.38	24	46
14	7	65	7H	34.1	1.38	32	58
14	7	65	7H	33.49	1.15	26	55
14	7	65	7H	33.23	1.15	26	55
14	7	65	7H	6.37	0.96	29	55
14	7	65	7H	32.84	0.8	24	39
14	7	70	7H	28.15	0.99	34	51
14	7	70	7H	23.1	0.95	29	61
14	7	70	7H	18.38	0.86	37	49
14	7	70	7H	23.92	0.82	42	44
14	7	70	7H	13.79	0.79	29	56
14	7	70	7H	14.31	0.74	26	49
14	7	70	7H	25.62	0.65	29	28
14	7	70	7H	24.66	0.65	34	25
14	7	70	7H	15.52	0.62	21	39
14	7	70	7H	15.05	0.62	21	39
14	7	70	7H	21	0.46	37	46
14	7	70	7H	16.8	0.44	26	59
14	7	70	7H	13.17	0.28	21	64
14	7	73	7H	4.89	0.79	29	41
14	7	73	7H	5.67	0.41	23	36
14	8	33	7H	37.08	1.04	29	20
14	8	56	7H	5.4	0.64	26	28
14	8	59	7H	5.06	0.75	24	31
14	8	60	7H	5.21	0.75	26	31