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PG&E Letter DCL-06-100

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Docket No. 50-323, OL-DPR-82
Diablo Canyon Unit 2
Special Report 06-02 - Results of Steam Generator (SG) Tube Inspections for Diablo Canyon Power Plant Unit 2 Thirteenth Refueling Outage

Dear Commissioners and Staff:

In accordance with Technical Specifications (TS) 5.6.10.e and TS 5.6.10.f, Enclosure 1 provides the 90-day reporting of results of the Unit 2 steam generator (SG) Wstar (W*) alternate repair criteria (ARC) tubesheet inspections and calculated steam line break leakage from application of all ARC and non-ARC.

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

In accordance with Pacific Gas and Electric Company's (PG&E) commitment to Generic Letter 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking (ODSCC)," Enclosure 3 provides the 90-day reporting of results of Unit 2 SG voltage-based ARC inspections for TSP ODSCC, prepared by Areva for PG&E. As concluded in Section 5.3 of Enclosure 3, reporting to the NRC in accordance with TS 5.6.10.i is not required. There are no new or revised regulatory commitments as defined by the Nuclear Energy Institute 99-04, "Guidelines for Managing NRC Commitment changes," dated July 1999, in this report.

If you have any questions, please contact John Arhar at (805) 545-4629.

Sincerely,

DJacobs

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ddm1/469/R0272302
Enclosures

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ENCLOSURE 1
SPECIAL REPORT 06-02

W* ALTERNATE REPAIR CRITERIA 90-DAY REPORT

DIABLO CANYON POWER PLANT UNIT 2 THIRTEENTH REFUELING OUTAGE

This report implements the Diablo Canyon Power Plant (DCPP) Technical Specification (TS) 5.6.10.e and 5.6.10.f steam generator (SG) tube inspection reporting criteria.

Wstar (W*) Alternate Repair Criteria (ARC) was implemented for the fifth time in DCPP Unit 2 during the Unit 2 Thirteenth Refueling Outage (2R13) SG inspections and repairs that were completed in May 2006. This was the first Unit 2 inspection applying the revised W* ARC approved in NRC letter dated October 28, 2005.

One hundred percent of the SG tubes were inspected by bobbin from tube end to tube end, except for Row 1 and 2 U-bends. 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.

Technical Specification 5.6.10.e Reporting Requirements

DCPP TS 5.6.10.e requires that the results of the inspection of W* tubes be reported to the Commission pursuant to 10 CFR 50.4 within 90 days following return to service of the SGs. This enclosure provides the specific TS reporting requirements, and Pacific Gas and Electric Company's (PG&E) description of compliance.

A comprehensive list of axial primary water stress corrosion cracking (PWSCC) indications detected in the hot leg WEXTEX region during 2R13 Plus Point inspections are provided in Table 1 for SG 2-1 and SG 2-2, Table 2 for SG 2-3, and Table 3 for SG 2-4. The following discussions provide references to columns in these tables where appropriate information is contained.

- *Identification of W* tube indications and indications that do not meet W* requirements and were plugged or repaired.*

  The Table 1 column labeled "W* Cand" identifies 65 tubes (containing 70 single axial PWSCC indications ["SAI"] in the W* length) that are categorized as W* candidates (W* tubes) and left in service under W* ARC. No Table 1 indications were plugged because of failure to meet W* ARC.

  Table 6 of Enclosure 2 lists one small circumferential outside diameter stress corrosion cracking (ODSCC) indication in SG 2-2 R22C24 that was detected at 0.05 inches below the hot leg top of tubesheet. This indication was plugged because it did not meet W* requirements; that is, circumferential indications within the flexible W* distance must be repaired.

Not included in Table 2 are multiple Plus Point confirmed PWSCC repeat indications in W* tube SG 2-3 R32C55 in the plug expansion zone (PEZ) near the tube end. PWSCC indications in the PEZ region of this tube were previously reported in the Unit 2 Twelfth Refueling Outage (2R12) 90-day report, PG&E Letter DCL-05-024. This tube was previously deplugged in the Unit 2 Ninth Refueling Outage (2R9) and returned to service at that time. In 2R13, this tube was inspected with Plus Point the full length of the hot leg tubesheet because of bobbin distorted tubesheet indications (DTS) located near the tube end, even though Plus Point inspection of DTS indications located below the flexible W* length is not required. Plus Point confirmed the presence of multiple SAIs located near the tube end, in the PEZ region. The indications are located below the shop hard roll transition, as in 2R12. Because the indications are located below the flexible W* length, they were returned to service under W* ARC. As discussed in PG&E Letter DCL-05-017, "Reply to Request for Additional Information Regarding: Special Report 04-02 – Results of Steam Generator Inspections for Diablo Canyon Power Plant Unit 1 Twelfth Refueling Outage," primary-to-secondary leakage from PEZ indications is very unlikely. Therefore, no steam line break (SLB) leakage is attributed to these 2R13 indications for condition monitoring (CM). For operational assessment, potential leakage from these indications is accounted for by use of the tube sever model, which is discussed later.

- *Number of indications and location of the indications (relative to below the W* transition [BWT] and top of tubesheet [TTS]).*

  For each of the 70 indications, the lower crack tip ("LCT") and upper crack tip ("UCT") columns provide the elevation (inch) relative to the TTS. The "Dist UCT to TTS" column provides the distance (inch) between the upper crack tip and the TTS, accounting for nondestructive examination (NDE) uncertainty on locating the crack tip relative to the TTS. The "Dist UCT to BWT" column provides the distance (inch) between the upper crack tip and the BWT, accounting for NDE uncertainty on locating the crack tip relative to the BWT.

- *Orientation (axial, circumferential, volumetric, inclined).*

  The "Ind" column provides the orientation of the indication. All indications are SAIs. No indications are circumferential or volumetric. One indication was inclined in SG 2-3 R21C38, as discussed below.

- *Angle of inclination of clearly skewed axial cracks (if applicable).*

  SG 2-3 R21C38 repeat axial PWSCC indication in the W* length was identified to be inclined based on a review of the Plus Point data. Per W* ARC requirements, the inclination angle was measured as 32 degrees based on 0.080 inch pancake coil. The NDE uncertainty on measurement of the crack angle is 6.8 degrees for 0.080 inch pancake coil. Therefore, the total inclination angle is 38.8 degrees, less than the 45-degree plugging limit defined for W* ARC inclined indications. In addition, the total length of the indication was 0.50 inch, and after applying a growth rate of 0.119 inch/effective full power year (EFPY) over the next cycle (1.62 EFPY), the projected end of cycle (EOC) 14 crack length is 0.69 inch. This projected crack length is less than the 2.0 inches plugging limit defined for W* ARC inclined indications. Therefore, based on the shallow inclination angle and projected short length, the indication was left in service under W* ARC.

- *Radial position of the tube within the tubesheet.*

  The "Tube Radial Position" column provides the radial position of the tube within the tubesheet.

- *W* Zone of the tube.*

  The "W*ZONE" column provides the W* zone of each indication.

- *Severity of each indication (estimated depth).*

  The "MD-adj" column provides the estimated maximum depth (MD) (percent through-wall) of each indication. The depth is the adjusted depth using the same techniques as PWSCC ARC depth sizing.

- *Side of the tube in which the indication initiated (inside or outside diameter [ID/OD]).*

  All indications are ID initiated (i.e., PWSCC).

- *W* inspection distance measured with respect to the 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 plus +2/-8 inches. Assuming no degradation in the W* length, 8 inches below the TTS constitutes the W* inspection distance. If degradation is detected in the W* region, the inspection extent must bound the calculated flexible W* length. The "W* Insp Ext wrt BWT" column lists the W* inspection distances measured with respect to BWT for tubes in which axial PWSCC was detected. The distances are with respect to BWT because, in all cases, the BWT elevation was located lower than the TTS elevation. In all cases, the W* inspection distance was greater than or equal to the flexible W* length, as indicated by "Yes" in the "Insp Ext Satisfied" column.

- *Length of axial indications.*

  The "Crack Length" column provides the crack length of each axial indication. For tubes with multiple cracks, the "Total Length" column provides the total (summed) length of individual cracks within the flexible W* length.

- *Updated 95 percent growth rate for use in operational assessment.*

  Of the seventy axial PWSCC indications in the hot leg WEXTEX region that were detected in 2R13, four were new indications and sixty-six were repeat W* indications that had been left in service in the prior inspection (2R12). The four new indications were detectable in the prior inspection based on lookup reviews. One repeat indication (SG 2-4 R5C37) was identified as two SAIs in the prior inspection, and one SAI in the current inspection (the two indications merged in cycle 13), such that the growth data for this indication was excluded. As a result, 69 additional length growth rate data points were available for evaluation. The average growth rate was 0.03 inch per EFPY at T_{hot} of 604 degrees, indicating negligible growth. After addition of these 69 data points, the updated W* growth rate distribution now consists of 350 data points from DCPP Units 1 and 2 over 11 cycles. The updated growth rate at 95 percent cumulative probability is 0.104 inch per EFPY at 604 degrees. The W* methodology requires that, if the new growth data and deletion of the oldest cycle(s) of growth data results in a minimum of 200 data points, then the oldest cycle(s) of data is excluded. There are 210 data points combined from the most recent Unit 2 cycles 11, 12, and 13. Therefore, data from all other cycles is excluded. The 95 percent cumulative probability growth rate of the 210 data points is 0.119 inch per EFPY, and this growth rate value was used for the final operational assessment (OA).

  In support of growth rate evaluations and W* calculations, the actual length of Unit 2 Cycle 13 was 1.31 EFPY, and the projected length of Unit 2 Cycle 14 is 1.62 EFPY.

- *Cumulative number of indications detected in the tubesheet region as a function of elevation within the tubesheet.*

  Table 4 provides the cumulative number of indications detected in the tubesheet region as a function of elevation within the tubesheet. The table includes the distribution of Unit 2 indications before 2R13, the distribution of new 2R13 indications, updated Unit 2 distribution after 2R13, and the Unit 2 cumulative distribution and cumulative frequency after 2R13. In 2R13, four new indications were detected: one at 5.91 inch below the TTS (included in the minus 5 inch bin), one at 3.27 inch below the TTS (included in the minus 3 inch bin), one at 0.48 inch below the TTS (included in the 0 inch bin), and one at 0.28 inch below the TTS (included in the 0 inch bin).

- *Condition monitoring and operational assessment main steamline break leak rate for each indication and each SG in accordance with the leak rate methodology described in PG&E Letter DCL-05-018, dated March 11, 2005, as supplemented by PG&E Letter DCL-05-090 dated August 25, 2005.*

Condition Monitoring SLB Leak Rate for Indications within Flexible W Length*

CM leak rate for axial PWSCC indications detected within the flexible W* length is determined using the DENTFLO leak model in accordance with WCAP-14797-P, Revision 2. (Note: As discussed in DCL-05-090, the constrained crack leak model is not applicable for EOC 13 condition monitoring.) The 95 percent leak rates for each indication, as well as each SG, are provided in column "DENTFLO CM Leak Rate." The total SG leak rates are repeated in Table 5.

For information only, applying the constrained crack leak model, the 95 percent prediction bound leak rates for each indication, as well as each SG, are provided under column "Constrained Crack Model CM Leak Rate."

Operational Assessment SLB Leak Rate for Indications within 12 inches from TTS

The OA leak rate for axial PWSCC indications detected within 12 inches from the TTS is determined by using the constrained crack leak model. The 95 percent prediction bound leak rates for each indication, as well as each SG, are provided under column "Constrained Crack Model OA Leak Rate." The total SG leak rates are repeated in Table 6.

The OA leak rate for undetected indications between 8 and 12 inches below the TTS is determined by multiplying the number of projected undetected indications between 8 and 12 inches below the TTS at the next inspection by a factor of 0.0033 gallons per minute (gpm). The leak rate value of 0.0033 gpm is the 95 percent prediction bound leak rate, applying the constrained crack model with a Zone B1 contact pressure at a depth of 8 inches below the TTS. Twelve undetected indications are projected between 8 and 12 inches below the TTS based on the more conservative of the 2 methods described below. Therefore, the OA leak rate for undetected indications between 8 and 12 inches below the TTS is 0.0396 gpm for each SG. These SG leak rates are repeated in Table 6.

Historical data projection method. The number of undetected PWSCC indications between 8 and 12 inches below the TTS would not be expected to be much greater than the number reported between 4 and 8 inches below the TTS, due to the trend of decreasing number of indications with distance below TTS. Of the 162 cumulative PWSCC indications detected to date in DCPP Unit 2, 5 percent were between 4 to 8 inches below the TTS, and 2 percent were between 8 to 12 inches below the TTS. Two percent of the total historical plus EOC projected indication count will be assumed to be undetected between 8 and 12 inches below the TTS.

Figure 1 illustrates the cumulative number of PWSCC indications versus EFPY in DCPP Unit 2. A linear regression analysis using only data from the last 5 outages shows that about 168 cumulative indications are projected at EOC-14, of which 4 (2 percent of 168) are assumed to be undetected between 8 and 12 inches below the TTS.

Ninety percent probability prediction method. Figure 2 presents a plot of the binned PWSCC elevation data for all DCPP Unit 2 historical indications located greater than 2 inches below the TTS. Excluding the expansion transition indications above 2 inches for Unit 2 would be expected to provide the best dataset for estimating indications at deeper depths. Figure 2 provides a best-fit regression of this data, an upper 90 percent probability prediction bound, and an upper 90 percent probability cumulative prediction bound. The number of indications that could be present in the range of 8 to 12 inches below the top of tubesheet is obtained by summing the upper 90 percent probability prediction bound individual values at 8, 9, 10, and 11 inches (approximately 3 in each bin), for a total of about 12 indications. As a result, twelve indications will be applied for OA because it is greater than four indications from the historical data projection method.

Operational Assessment SLB Leak Rate for Indications Below 12 inches from TTS

The OA leak rate for indications located below 12 inches from the TTS is determined by the severed tube model. This model assumes all in-service tubes contain a 360° tube sever located 12 inches below the TTS and assigns a leak rate of 0.00009 gpm per tube. This value is the 90 percent prediction bound leak rate at 2560 pounds per square inch differential for a contact pressure representative of the 3 inch nominal crevice test specimen from the drilled hole crevice leak rate test data in WCAP-14797-P, Revision 2. The resulting leak rates for each SG are listed in Table 6, and are approximately 0.3 gpm for each SG.

- *Verification that the upper crack tip of W* indications returned to service in the prior cycle remain below the BWT by at least the 95 percent confidence NDE uncertainty on locating the crack tip relative to the BWT.*

As stated in DCL-05-090, for 2R13 90-day reporting, this reporting requirement is not applicable because the new, more conservative, W* repair criteria was not in effect in the prior inspections. Therefore, for 2R13 90-day reporting, PG&E applies the prior cycle requirement, that is, verification that the upper crack tip of W* indications returned to service in the prior cycle remain below the TTS by at least the 95 percent confidence NDE uncertainty on locating the crack tip relative to the TTS.

The "Dist UCT to TTS" column provides the as-found 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 as-found upper crack tip for indications returned to service in the prior cycle 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 13.

- *Assessment of whether the results were consistent with expectations and, if not consistent, a description of the proposed corrective action.*

  The CM leak rates were consistent with expectations. The column "Prior OA Leak Rate" provides the prior cycle predicted operational assessment leak rates for each repeat indication using the DENTFLO model. This leak rate is compared to the as-found condition monitoring leak rate under column "DENTFLO CM Leak Rate." The prior cycle OA leak rates predicted for each SG are greater (more conservative) than the as-found CM leak rates, as reported in the "OA Underprediction" column. The number of new PWSCC indications (four) is consistent with expectations, because it was less than the six new indications expected in 2R13 based on a linear regression analysis using data from the four prior inspections. Also, comparison of the pre-2R13 and post-2R14 cumulative distribution frequencies in Table 4 shows no significant changes; therefore, the elevations of the new indications are consistent with expectations.

Technical Specification 5.6.10.f Reporting Requirements

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

Table 7 (for CM) and Table 8 (for OA) reports the calculated SLB leakage from application of each ARC in each SG, that is, W* ARC, Generic Letter 95-05 voltage-based ARC, and PWSCC ARC. SLB leakage from non-ARC degradation is also provided in these tables. The ARC and non-ARC leak rates are then summed to arrive at an aggregate SLB leakage for each SG.

No in-situ leak testing of indications was performed in 2R13, so there is no SLB leakage contribution from in-situ testing.

In order to meet the accident-induced leakage performance criteria (AILPC), the aggregate calculated steam line break leakage from application of all ARC and non-ARC must 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 in License Amendment (LA) 156/156. The aggregate calculated condition monitoring SLB leakage at EOC 13 is 1.193 gpm for the limiting SG (SG 2-4) as shown in Table 7. The aggregate calculated operational assessment SLB leakage at EOC 14 is 5.695 gpm for the limiting SG (SG 2-4) as shown in Table 8. In both assessments, SLB leakage is less than the allowable limit. Therefore, the AILPC has been satisfied for condition monitoring at EOC 13 and operational assessment at EOC 14.

Table 1
2R13 SG 2-1 and SG 2-2 PWSCC Indications in Hot Leg WEXTEX Tubesheet Region

SG	Count	Row	Col	Tube Radial Position	Ind	Volts	Crack #	CAL	LCT	UCT	Crack Length	Total Length	MD-adj	Dist UCT to TTS	UCT below TTS	W*ZONE	W* Length	BWT	Dist UCT to BWT	UCT Below W* ?	UCT Below BWT?	Dist EOC (N+1) UCT to TTS	Dist EOC (N+1) UCT to BWT	EOC (N+1) UCT Below BWT?	W*Cand
21	1	6	77	38.76	SAI	0.80	1	29	-1.46	-1.29	0.17	0.17	59	1.07	Yes	B4	7.12	-0.40	0.61	No	Yes	0.88	0.42	Yes	Yes
21	2	7	24	31.69	SAI	0.20	1	29	-2.01	-1.89	0.12	0.12	44	1.67	Yes	B3	7.12	-0.37	1.24	No	Yes	1.48	1.05	Yes	Yes
21	3	7	62	21.04	SAI	4.91	1	29	-2.36	-1.44	0.92	0.92	100	1.22	Yes	B2	7.12	-1.06	0.10	No	Yes	1.03	-0.09	No	No
21	4	8	32	22.78	SAI	0.74	1	29	-2.02	-1.88	0.14	0.14	59	1.66	Yes	B2	7.12	-0.39	1.21	No	Yes	1.47	1.02	Yes	Yes
21	5	9	49	12.58	SAI	1.15	1	29	-2.14	-1.81	0.33	0.33	62	1.59	Yes	B1	7.12	-0.36	1.17	No	Yes	1.40	0.98	Yes	Yes
21	6	10	49	13.85	SAI	0.17	1	29	-1.24	-1.09	0.15	0.15	38	0.87	Yes	B1	7.12	-0.30	0.51	No	Yes	0.68	0.32	Yes	Yes
21	7	11	37	20.15	SAI	0.48	1	29	-7.95	-7.84	0.11	0.62	24	7.62	Yes	B2	7.12	-0.41	7.15	Yes	Yes	7.43	6.96	Yes	Yes
21	8	11	37	20.15	SAI	0.68	2	29	-7.06	-6.86	0.20	0.62	47	6.64	Yes	B2	7.12	-0.41	6.17	No	Yes	6.45	5.98	Yes	Yes
21	9	11	37	20.15	SAI	0.60	3	29	-2.16	-1.85	0.31	0.62	53	1.63	Yes	B2	7.12	-0.41	1.16	No	Yes	1.44	0.97	Yes	Yes
21	10	11	39	18.54	SAI	1.43	1	29	-1.82	-1.6	0.22	0.22	77	1.38	Yes	B1	7.12	-0.42	0.90	No	Yes	1.19	0.71	Yes	Yes
21	11	11	40	17.81	SAI	0.33	1	29	-0.97	-0.82	0.15	0.15	41	0.60	Yes	B1	7.12	-0.34	0.20	No	Yes	0.41	0.01	Yes	Yes
21	12	11	48	15.01	SAI	3.20	1	29	-5.25	-4.76	0.49	0.49	84	4.54	Yes	B1	7.12	-0.42	4.06	No	Yes	4.35	3.87	Yes	Yes
21	13	13	49	17.67	SAI	0.39	1	29	-1.82	-1.68	0.14	0.14	62	1.46	Yes	B1	7.12	-0.66	0.74	No	Yes	1.27	0.55	Yes	Yes
21	14	16	79	45.68	SAI	0.28	1	62	-6.06	-5.91	0.15	0.15	40	5.69	Yes	A	5.32	-0.44	5.19	No	Yes	5.50	5.00	Yes	Yes
21	15	23	67	39.33	SAI	0.18	1	64	-3.38	-3.27	0.11	0.11	54	3.05	Yes	A	5.32	-0.34	2.65	No	Yes	2.86	2.46	Yes	Yes
21	16	23	70	41.88	SAI	1.46	1	29	-1.67	-1.22	0.45	0.45	62	1.00	Yes	A	5.32	-0.22	0.72	No	Yes	0.81	0.53	Yes	Yes
21	17	30	59	42.01	SAI	3.73	1	29	-11.36	-10.72	0.64	0.64	80	10.50	Yes	B4	7.12	-0.15	10.29	Yes	Yes	10.31	10.10	Yes	Yes
22	1	5	18	38.50	SAI	1.32	1	22	-1.25	-0.83	0.42	0.42	83	0.61	Yes	B4	7.12	-0.24	0.31	No	Yes	0.42	0.12	Yes	Yes
22	2	10	48	13.73	SAI	0.42	1	22	-3.23	-3.12	0.11	0.11	36	2.90	Yes	B1	7.12	-0.09	2.75	No	Yes	2.71	2.56	Yes	Yes
22	3	10	56	17.52	SAI	0.65	1	22	-1.10	-0.95	0.15	0.15	48	0.73	Yes	B1	7.12	-0.35	0.32	No	Yes	0.54	0.13	Yes	Yes
22	4	13	43	18.48	SAI	0.35	1	22	-1.61	-1.45	0.16	0.16	48	1.23	Yes	B1	7.12	-0.45	0.72	No	Yes	1.04	0.53	Yes	Yes
22	5	31	25	49.81	SAI	4.80	1	22	-2.43	-1.62	0.81	0.81	100	1.40	Yes	A	5.32	-0.55	0.79	No	Yes	1.21	0.60	Yes	Yes

Table 1 (continued)
2R13 SG 2-1 and SG 2-2 PWSCC Indications in Hot Leg WEXTEX Tubesheet Region

SG	Count	Row	Col	Inspect Extent	W* Insp Ext wrt BWT	Flex W* Length	Insp Ext Satisfied ?	DentFlo CM Leak Rate	Prior OA Leak Rate	OA Under Prediction	Constrained Crack Model CM Leak rate	Constrained Crack Model OA Leak Rate	PREVW* Tube	Deplugged?	Tube Plugged
21	1	6	77	-9.03	8.54	7.34	Yes	0.024	0.027	No	0.043	0.047	Yes	Yes	
21	2	7	24	-9.23	8.77	7.29	Yes	0.015	0.016	No	0.058	0.064	Yes	Yes	
21	3	7	62	-12.70	11.55	8.09	Yes	0.042	0.045	No	0.152	0.000	Yes	Yes	Yes
21	4	8	32	-9.06	8.58	7.31	Yes	0.016	0.017	No	0.104	0.118	Yes		
21	5	9	49	-9.11	8.66	7.50	Yes	0.017	0.016	Yes	0.174	0.198	Yes		
21	6	10	49	-8.97	8.58	7.32	Yes	0.027	0.031	No	0.271	0.310	Yes		
21	7	11	37	-12.82	12.32	7.12	Yes	0.000	0.001	No	0.004	0.004	Yes		
21	8	11	37	-12.82	12.32	7.85	Yes	0.001	0.001	No	0.006	0.007	Yes		
21	9	11	37	-12.82	12.32	7.90	Yes	0.017	0.018	No	0.123	0.139	Yes		
21	10	11	39	-9.30	8.79	7.39	Yes	0.020	0.022	No	0.156	0.177	Yes	Yes	
21	11	11	40	-9.10	8.67	7.32	Yes	0.038	0.043	No	0.271	0.308	Yes		
21	12	11	48	-10.17	9.66	7.66	Yes	0.005	0.005	No	0.024	0.027	Yes		
21	13	13	49	-8.89	8.14	7.31	Yes	0.022	0.024	No	0.154	0.175	Yes		
21	14	16	79	-9.01	8.48	5.52	Yes	0.000	NA	NA	0.004	0.004	No		
21	15	23	67	-8.60	8.17	5.48	Yes	0.003	NA	NA	0.017	0.018	No		
21	16	23	70	-9.42	9.11	5.82	Yes	0.020	0.021	No	0.033	0.036	Yes	Yes	
21	17	30	59	-12.74	12.50	7.12	Yes	0.000	0.000	No	0.001	0.001	Yes		
								0.265	0.286		1.593	1.632			
22	1	5	18	-9.77	9.44	7.59	Yes	0.033	0.037	No	0.055	0.060	Yes		
22	2	10	48	-9.75	9.57	7.28	Yes	0.008	0.008	No	0.070	0.079	Yes		
22	3	10	56	-9.56	9.12	7.32	Yes	0.033	0.040	No	0.252	0.287	Yes	Yes	
22	4	13	43	-9.43	8.89	7.33	Yes	0.023	0.028	No	0.172	0.196	Yes	Yes	
22	5	31	25	-9.76	9.12	6.18	Yes	0.017	0.022	No	0.012	0.013	Yes	Yes	
								0.113	0.135		0.561	0.635			

Table 2
2R13 SG 2-3 PWSCC Indications in Hot Leg WEXTEX Tubesheet Region

SG	Count	Row	Col	Tube Radial Position	Ind	Volts	ID/OD	Crack #	CAL	LCT	UCT	Crack Length	Total Length	MD-adj	Dist UCT to TTS	UCT below TTS	W*ZONE	W* Length	BWT	Dist UCT to BWT	UCT Below W* ?	UCT Below BWT?	Dist EOC (N+1) UCT to TTS	Dist EOC (N+1) UCT to BWT	EOC (N+1) UCT Below BWT?	W*Cand
23	1	2	91	55.84	SAI	0.99	ID	1	26	-1.04	-0.60	0.44	0.44	63	0.38	Yes	A	5.32	-0.12	0.20	No	Yes	0.19	0.01	Yes	Yes
23	2	3	69	27.95	SAI	2.13	ID	1	26	-1.30	-0.82	0.48	0.48	79	0.60	Yes	B2	7.12	-0.34	0.20	No	Yes	0.41	0.01	Yes	Yes
23	3	4	90	54.78	SAI	0.90	ID	1	26	-1.20	-0.93	0.27	0.27	50	0.71	Yes	A	5.32	-0.19	0.46	No	Yes	0.52	0.27	Yes	Yes
23	4	5	51	8.58	SAI	0.53	ID	1	26	-2.27	-2.13	0.14	0.14	63	1.91	Yes	B1	7.12	-0.24	1.61	No	Yes	1.72	1.42	Yes	Yes
23	5	5	55	12.07	SAI	1.99	ID	1	26	-2.40	-1.99	0.41	0.41	86	1.77	Yes	B1	7.12	-0.19	1.52	No	Yes	1.58	1.33	Yes	Yes
23	6	6	77	38.76	SAI	0.22	ID	1	26	-1.93	-1.84	0.09	0.09	20	1.62	Yes	B4	7.12	-0.42	1.14	No	Yes	1.43	0.95	Yes	Yes
23	7	7	52	11.43	SAI	4.97	ID	1	26	-1.56	-0.76	0.80	0.80	100	0.54	Yes	B1	7.12	-0.28	0.20	No	Yes	0.35	0.01	Yes	Yes
23	8	7	59	17.74	SAI	1.81	ID	1	26	-1.91	-1.43	0.48	0.48	89	1.21	Yes	B1	7.12	-0.31	0.84	No	Yes	1.02	0.65	Yes	Yes
23	9	7	92	57.86	SAI	1.24	ID	1	26	-1.17	-0.75	0.42	0.42	53	0.53	Yes	A	5.32	-0.24	0.23	No	Yes	0.34	0.04	Yes	Yes
23	10	8	93	59.35	SAI	1.31	ID	1	26	-0.93	-0.60	0.33	0.33	44	0.38	Yes	A	5.32	-0.12	0.20	No	Yes	0.19	0.01	Yes	Yes
23	11	9	63	23.43	SAI	0.44	ID	1	26	-1.34	-1.19	0.15	0.15	39	0.97	Yes	B2	7.12	-0.38	0.53	No	Yes	0.78	0.34	Yes	Yes
23	12	12	48	16.29	SAI	0.21	ID	1	26	-2.28	-2.20	0.08	0.08	44	1.98	Yes	B1	7.12	-0.29	1.63	No	Yes	1.79	1.44	Yes	Yes
23	13	14	24	35.52	SAI	0.40	ID	1	26	-2.02	-1.84	0.18	0.18	28	1.62	Yes	B4	7.12	-0.16	1.40	No	Yes	1.43	1.21	Yes	Yes
23	14	16	24	36.94	SAI	0.34	ID	1	26	-1.43	-1.32	0.11	0.11	53	1.10	Yes	B4	7.12	-0.16	0.88	No	Yes	0.91	0.69	Yes	Yes
23	15	19	71	39.29	SAI	1.01	ID	1	26	-2.19	-1.87	0.32	0.32	53	1.65	Yes	A	5.32	-0.38	1.21	No	Yes	1.46	1.02	Yes	Yes
23	16	21	38	30.36	SAI	0.93	ID	1	26	-1.66	-1.16	0.50	0.50	93	0.94	Yes	B3	7.12	-0.33	0.55	No	Yes	0.75	0.36	Yes	Yes
23	17	21	83	53.31	SAI	0.72	ID	1	26	-1.16	-0.90	0.26	0.26	47	0.68	Yes	A	5.32	-0.31	0.31	No	Yes	0.49	0.12	Yes	Yes
23	18	25	37	35.58	SAI	1.29	ID	1	26	-1.41	-1.06	0.35	0.35	72	0.84	Yes	B4	7.12	-0.31	0.47	No	Yes	0.65	0.28	Yes	Yes
23	19	32	55	42.99	SAI	1.80	ID	1	26	-1.30	-0.86	0.44	0.44	72	0.64	Yes	A	5.32	-0.37	0.21	No	Yes	0.45	0.02	Yes	Yes
23	20	45	37	60.09	SAI	1.47	ID	1	26	-1.68	-1.32	0.36	0.36	60	1.10	Yes	A	5.32	-0.28	0.76	No	Yes	0.91	0.57	Yes	Yes

Table 2 (continued)
2R13 SG 2-3 PWSCC Indications in Hot Leg WEXTEX Tubesheet Region

SG	Count	Row	Col	Inspect Extent	W* Insp Ext wrt BWT	Flex W* Length	Insp Ext Satisfied ?	DentFlo CM Leak Rate	Prior OA Leak Rate	OA Under Prediction	Constrained Crack Model CM Leak rate	Constrained Crack Model OA Leak Rate	PREVW* Tube	Deplugged?	Tube Plugged
23	1	2	91	-10.04	9.83	5.81	Yes	0.038	0.045	No	0.008	0.008	Yes	Yes	
23	2	3	69	-9.93	9.50	7.65	Yes	0.038	0.045	No	0.140	0.157	Yes		
23	3	4	90	-10.06	9.78	5.64	Yes	0.029	0.034	No	0.008	0.009	Yes		
23	4	5	51	-10.04	9.71	7.31	Yes	0.012	0.015	No	0.157	0.179	Yes	Yes	
23	5	5	55	-9.76	9.48	7.58	Yes	0.013	0.015	No	0.156	0.178	Yes		
23	6	6	77	-9.87	9.36	7.26	Yes	0.012	0.017	No	0.033	0.036	Yes	Yes	
23	7	7	52	-10.09	9.72	7.97	Yes	0.038	0.045	No	0.375	0.430	Yes	Yes	
23	8	7	59	-9.98	9.58	7.65	Yes	0.021	0.025	No	0.181	0.206	Yes	Yes	
23	9	7	92	-9.93	9.60	5.79	Yes	0.036	0.042	No	0.006	0.006	Yes	Yes	
23	10	8	93	-10.42	10.21	5.70	Yes	0.038	0.045	No	0.005	0.005	Yes	Yes	
23	11	9	63	-10.00	9.53	7.32	Yes	0.027	0.033	No	0.154	0.173	Yes		
23	12	12	48	-10.40	10.02	7.25	Yes	0.012	0.015	No	0.117	0.132	Yes	Yes	
23	13	14	24	-10.11	9.86	7.35	Yes	0.009	0.013	No	0.044	0.048	Yes	Yes	
23	14	16	24	-10.29	10.04	7.28	Yes	0.017	0.027	No	0.050	0.055	Yes	Yes	
23	15	19	71	-9.79	9.32	5.69	Yes	0.008	0.009	No	0.031	0.034	Yes	Yes	
23	16	21	38	-10.06	9.64	7.67	Yes	0.026	0.037	No	0.096	0.106	Yes	Yes	
23	17	21	83	-9.80	9.40	5.63	Yes	0.033	0.040	No	0.010	0.011	Yes	Yes	
23	18	25	37	-9.84	9.44	7.52	Yes	0.028	0.034	No	0.065	0.071	Yes	Yes	
23	19	32	55	-10.07	9.61	5.81	Yes	0.037	0.042	No	0.034	0.037	Yes	Yes	
23	20	45	37	-10.07	9.70	5.73	Yes	0.018	0.027	No	0.004	0.004	Yes	Yes	
								0.489	0.604		1.674	1.888			

Table 3
2R13 SG 2-4 PWSCC Indications in Hot Leg WEXTEX Tubesheet Region

SG	Count	Row	Col	Tube Radial Position	Ind	Volts	ID/OD	Crack #	CAL	LCT	UCT	Crack Length	Total Length	MD-adj	Dist UCT to TTS	UCT below TTS	W*ZONE	W* Length	BWT	Dist UCT to BWT	UCT Below W* ?	UCT Below BWT?	Dist EOC (N+1) UCT to TTS	Dist EOC (N+1) UCT to BWT	EOC (N+1) UCT Below BWT?	W*Cand
24	1	2	10	48.17	SAI	0.36	ID	1	18	-1.67	-1.52	0.15	0.15	43	1.30	Yes	A	5.32	-0.20	1.04	No	Yes	1.11	0.85	Yes	Yes
24	2	3	5	54.66	SAI	2.81	ID	1	18	-2.05	-0.77	1.28	1.28	100	0.55	Yes	A	5.32	-0.29	0.20	No	Yes	0.36	0.01	Yes	Yes
24	3	3	12	45.73	SAI	0.45	ID	1	18	-3.08	-2.90	0.18	0.45	66	2.68	Yes	A	5.32	-0.28	2.34	No	Yes	2.49	2.15	Yes	Yes
24	4	3	12	45.73	SAI	0.90	ID	2	18	-2.72	-2.45	0.27	0.45	81	2.23	Yes	A	5.32	-0.28	1.89	No	Yes	2.04	1.70	Yes	Yes
24	5	3	17	39.36	SAI	0.68	ID	1	18	-4.22	-3.98	0.24	0.24	69	3.76	Yes	B4	7.12	-0.06	3.64	No	Yes	3.57	3.45	Yes	Yes
24	6	4	6	53.51	SAI	0.53	ID	1	30	-0.52	-0.28	0.24	0.24	84	0.06	Yes	A	5.32	-0.29	-0.29	No	No	0.13	-0.48	No	No
24	7	4	24	30.71	SAI	0.45	ID	1	22	-0.63	-0.48	0.15	0.15	64	0.26	Yes	B3	7.12	-0.19	0.01	No	No	0.07	-0.37	No	No
24	8	4	35	17.11	SAI	1.28	ID	1	18	-1.82	-1.53	0.29	0.29	75	1.31	Yes	B1	7.12	-0.25	1.00	No	Yes	1.12	0.81	Yes	Yes
24	9	5	31	22.37	SAI	0.96	ID	1	18	-1.38	-0.99	0.39	0.39	72	0.77	Yes	B2	7.12	-0.33	0.38	No	Yes	0.58	0.19	Yes	Yes
24	10	5	36	16.45	SAI	0.62	ID	1	18	-2.08	-1.89	0.19	0.19	81	1.67	Yes	B1	7.12	-0.14	1.47	No	Yes	1.48	1.28	Yes	Yes
24	11	5	37	15.31	SAI	2.46	ID	1	18	-4.61	-3.93	0.68	0.68	99	3.71	Yes	B1	7.12	-0.28	3.37	No	Yes	3.52	3.18	Yes	Yes
24	12	5	53	10.16	SAI	1.94	ID	1	18	-2.00	-1.73	0.27	0.27	78	1.51	Yes	B1	7.12	-0.26	1.19	No	Yes	1.32	1.00	Yes	Yes
24	13	5	61	18.78	SAI	0.44	ID	1	18	-10.41	-10.24	0.17	0.17	69	10.02	Yes	B1	7.12	-0.22	9.74	Yes	Yes	9.83	9.55	Yes	Yes
24	14	6	33	20.47	SAI	1.55	ID	1	18	-3.13	-2.77	0.36	0.36	84	2.55	Yes	B2	7.12	-0.16	2.33	No	Yes	2.36	2.14	Yes	Yes
24	15	7	4	56.60	SAI	0.75	ID	1	18	-1.32	-1.14	0.18	0.18	63	0.92	Yes	A	5.32	-0.21	0.65	No	Yes	0.73	0.46	Yes	Yes
24	16	7	38	15.67	SAI	2.05	ID	1	18	-7.26	-6.95	0.31	1.02	84	6.73	Yes	B1	7.12	-0.25	6.42	No	Yes	6.54	6.23	Yes	Yes
24	17	7	38	15.67	SAI	2.74	ID	2	18	-4.84	-4.13	0.71	1.02	87	3.91	Yes	B1	7.12	-0.25	3.60	No	Yes	3.72	3.41	Yes	Yes
24	18	7	53	12.13	SAI	0.30	ID	1	18	-2.87	-2.73	0.14	0.14	66	2.51	Yes	B1	7.12	-0.34	2.11	No	Yes	2.32	1.92	Yes	Yes
24	19	13	4	58.43	SAI	0.38	ID	1	18	-1.46	-1.32	0.14	0.14	66	1.10	Yes	A	5.32	-0.23	0.81	No	Yes	0.91	0.62	Yes	Yes
24	20	13	40	20.02	SAI	3.54	ID	1	18	-2.17	-1.58	0.59	0.59	100	1.36	Yes	B2	7.12	-0.21	1.09	No	Yes	1.17	0.90	Yes	Yes
24	21	15	10	52.09	SAI	0.40	ID	1	18	-1.18	-0.82	0.36	0.36	45	0.60	Yes	A	5.32	-0.21	0.33	No	Yes	0.41	0.14	Yes	Yes
24	22	16	10	52.60	SAI	2.95	ID	1	18	-2.53	-2.08	0.45	0.45	81	1.86	Yes	A	5.32	-0.29	1.51	No	Yes	1.67	1.32	Yes	Yes
24	23	20	47	26.54	SAI	2.71	ID	1	18	-2.02	-1.49	0.53	0.53	81	1.27	Yes	B2	7.12	-0.25	0.96	No	Yes	1.08	0.77	Yes	Yes
24	24	24	26	41.96	SAI	3.44	ID	1	18	-2.25	-1.73	0.52	0.68	99	1.51	Yes	A	5.32	-0.32	1.13	No	Yes	1.32	0.94	Yes	Yes
24	25	24	26	41.96	SAI	0.75	ID	2	18	-1.64	-1.48	0.16	0.68	63	1.26	Yes	A	5.32	-0.32	0.88	No	Yes	1.07	0.69	Yes	Yes
24	26	25	64	39.14	SAI	1.90	ID	1	18	-1.52	-1.17	0.35	0.35	72	0.95	Yes	B4	7.12	-0.35	0.54	No	Yes	0.76	0.35	Yes	Yes
24	27	26	45	34.37	SAI	2.10	ID	1	18	-4.14	-3.77	0.37	0.37	75	3.55	Yes	B4	7.12	-0.23	3.26	No	Yes	3.36	3.07	Yes	Yes
24	28	26	64	40.22	SAI	0.75	ID	1	18	-1.14	-0.84	0.30	0.30	54	0.62	Yes	B4	7.12	-0.36	0.20	No	Yes	0.43	0.01	Yes	Yes

Table 3 (continued)
2R13 SG 2-4 PWSCC Indications in Hot Leg WEXTEX Tubesheet Region

SG	Count	Row	Col	Inspect Extent	W* Insp Ext wrt BWT	Flex W* Length	Insp Ext Satisfied ?	DentFlo CM Leak Rate	Prior OA Leak Rate	OA Under Prediction	Constrained Crack Model CM Leak rate	Constrained Crack Model OA Leak Rate	PREVW* Tube	Deplugged?	Tube Plugged
24	1	2	10	-9.43	9.14	5.52	Yes	0.009	0.018	No	0.015	0.016	Yes	Yes	
24	2	3	5	-10.26	9.88	6.65	Yes	0.038	0.042	No	0.009	0.009	Yes	Yes	
24	3	3	12	-9.99	9.62	5.82	Yes	0.003	0.004	No	0.012	0.012	Yes	Yes	
24	4	3	12	-9.99	9.62	5.88	Yes	0.005	0.006	No	0.014	0.015	Yes	Yes	
24	5	3	17	-9.71	9.56	7.41	Yes	0.002	0.003	No	0.012	0.013	Yes		
24	6	4	6	-9.14	8.76	5.61	Yes	NA	NA	NA	0.012	0.000	No		Yes
24	7	4	24	-9.99	9.52	7.32	Yes	0.045	NA	NA	0.136	0.000	No		Yes
24	8	4	35	-9.47	9.13	7.46	Yes	0.018	0.020	No	0.175	0.199	Yes	Yes	
24	9	5	31	-9.64	9.22	7.56	Yes	0.031	0.039	No	0.186	0.211	Yes		
24	10	5	36	-9.88	9.65	7.36	Yes	0.014	0.015	No	0.142	0.161	Yes		
24	11	5	37	-9.61	9.24	7.85	Yes	0.006	0.006	No	0.040	0.045	Yes	Yes	
24	12	5	53	-9.93	9.58	7.44	Yes	0.016	0.020	No	0.199	0.227	Yes	Yes	
24	13	5	61	-13.10	12.79	7.12	Yes	0.000	0.000	No	0.001	0.001	Yes		
24	14	6	33	-9.33	9.08	7.53	Yes	0.008	0.008	No	0.068	0.076	Yes		
24	15	7	4	-10.05	9.75	5.55	Yes	0.023	0.030	No	0.006	0.007	Yes	Yes	
24	16	7	38	-10.28	9.94	8.19	Yes	0.001	0.001	No	0.006	0.007	Yes	Yes	
24	17	7	38	-10.28	9.94	8.25	Yes	0.006	0.006	No	0.035	0.039	Yes	Yes	
24	18	7	53	-10.08	9.65	7.31	Yes	0.009	0.011	No	0.095	0.108	Yes		
24	19	13	4	-9.65	9.33	5.51	Yes	0.016	0.027	No	0.005	0.005	Yes		
24	20	13	40	-9.91	9.61	7.76	Yes	0.017	0.023	No	0.147	0.166	Yes	Yes	
24	21	15	10	-10.21	9.91	5.73	Yes	0.032	0.039	No	0.012	0.013	Yes	Yes	
24	22	16	10	-10.38	10.00	5.82	Yes	0.006	0.009	No	0.008	0.008	Yes	Yes	
24	23	20	47	-9.83	9.49	7.70	Yes	0.019	0.023	No	0.105	0.117	Yes	Yes	
24	24	24	26	-10.89	10.48	6.05	Yes	0.008	0.020	No	0.026	0.028	Yes		
24	25	24	26	-10.89	10.48	6.11	Yes	0.014	0.027	No	0.029	0.031	Yes		
24	26	25	64	-9.60	9.16	7.52	Yes	0.026	0.033	No	0.044	0.048	Yes	Yes	
24	27	26	45	-10.22	9.90	7.54	Yes	0.002	0.003	No	0.018	0.020	Yes		
24	28	26	64	-9.55	9.10	7.47	Yes	0.038	0.045	No	0.046	0.050	Yes		
								0.413	0.479		1.600	1.633			

Column – Tables 1, 2, 3	Legend and Notes for Tables 1, 2 and 3
SG	Steam generator
Count	Indication count per SG
Row	Tube Row
Col	Tube Column
Tube Radial Position	Tube radial position, inch.
Ind	Orientation of indication of degradation. SAI means single axial indication.
Volts	Peak voltage from Plus Point coil, as adjusted using the same techniques as PWSCC ARC sizing.
Crack #	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)
Total Length	Total length of all cracks (inch).
MD-adj	Maximum depth (% through-wall) from Plus Point coil. The depth is the adjusted depth using the same techniques as PWSCC ARC depth sizing.
Dist UCT to TTS	Distance (inch) between the UCT and TTS, including ΔNDE_{CT-TTS} (Plus Point NDE uncertainty on locating the crack tip relative to the TTS).
UCT below TTS?	If the UCT (including NDE uncertainty) is located below TTS (i.e., a positive number in the "Dist UCT to TTS" column), then PC is satisfied for repeat indications.
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.
Dist UCT to BWT	Distance (inch) between the UCT and BWT, including ΔNDE_{CT-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.
Dist EOC (N+1) UCT to TTS	Distance (inch) between the UCT and TTS at the end of the next cycle including ΔNDE_{CT-TTS}, based on growing the UCT at 0.119 inch/EFPY.
Dist EOC (N+1) UCT to BWT	Distance (inch) between the UCT and BWT at the end of the next cycle including ΔNDE_{CT-BWT}, based on growing the UCT at 0.119 inch/EFPY.
EOC (N+1) UCT below BWT?	If the UCT (including NDE uncertainty) is located below BWT at the end of the next cycle (i.e., a positive number in the "Dist UCT (n+1) UCT to BWT" column), the tube is a W* candidate.
W* Cand?	W* candidate, also referred to as W* tube. A tube is a W* candidate (or W* tube) if the UCT is below BWT and the EOC (n+1) UCT is below BWT.
Inspect Extent	Elevation of Plus Point inspection relative to TTS (inch).
W* Insp Ext wrt BWT	W* inspection extent with respect to BWT, also referred to as the 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.
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)
Insp Ext Satisfied?	If the W* inspection distance is greater than or equal to the flexible W* length, then the inspection extent is satisfied.
DENTFLO CM Leak Rate	Condition monitoring (CM) SLB leak rate, gpm at room temperature, using DENTFLO leak model, based on distance of UCT to BWT, using Figure 6.4-3 of WCAP-14797-P Rev 2. No SLB leak rate is assigned to indications with UCT below W* length.
Prior OA Leak Rate	Prior cycle projected operational assessment (OA) leak rate, gpm at room temperature, using DENTFLO leak model.
OA Underprediction?	If the DENTFLO CM leak rate is greater than the prior cycle DENTFLO OA projected leak rate, then the OA would be underpredicted.
Constrained Crack Model CM Leak Rate	Condition monitoring (CM) SLB leak rate, gpm at room temperature, using Constrained Crack leak model, based on distance of UCT to TTS. No SLB leak rate is assigned to indications with UCT located below TTS minus 12 inches. Note: For 1R13, this leak rate is for information only and is not the CM leak rate of record.
Constrained Crack Model OA Leak Rate	Operational assessment (OA) SLB leak rate, gpm at room temperature, using Constrained Crack leak model, based on distance of EOC (n+1) UCT to TTS. No SLB leak rate is assigned to indications with EOC (n+1) UCT located below TTS minus 12 inches.
PREVW* Tube?	Previous W* Tube. If the indication was left in service in the prior cycle, it is classified as a previous W* tube (i.e., a repeat indication). Otherwise, the indication is new.
Deplugged?	If tube was de-plugged during a previous outage, then "yes" is indicated.
Tube Plugged?	If tube was plugged during the current outage, then "yes" is indicated.

Table 4

Cumulative Number of Unit 2 PWSCC Indications Detected in the Tubesheet Region as a Function of Tubesheet Elevation

Distance (inch) relative to TTS	Distribution Pre-2R13	Cumulative Frequency Pre-2R13	Distribution of New Indications in 2R13	Distribution Post-2R13	Cumulative Distribution Post-2R13	Cumulative Frequency Post-2R13
-12	0	0.00		0	0	0.00
-11	2	0.01		2	2	0.01
-10	2	0.03		2	4	0.02
-9	0	0.03		0	4	0.02
-8	0	0.03		0	4	0.02
-7	1	0.03		1	5	0.03
-6	2	0.04		2	7	0.04
-5	0	0.04	1	1	8	0.05
-4	4	0.07		4	12	0.07
-3	5	0.10	1	6	18	0.11
-2	19	0.22		19	37	0.23
-1	53	0.56		53	90	0.56
0	68	0.99	2	70	160	0.99
1	2	1.00		2	162	1.00
Total	158		4	162	162	

Table 5
DCPP Unit 2 Condition Monitoring Steam Line Break Leak Rates for W* Alternate Repair Criteria

EOC 13 Condition Monitoring Leak Rate (gpm at room temperature)	SG 2-1	SG 2-2	SG 2-3	SG 2-4
Axial PWSCC within flexible W* length (DENTFLO model)	0.265	0.113	0.489	0.413

Table 6
DCPP Unit 2 Operational Assessment Steam Line Break Leak Rates for W* Alternate Repair Criteria

EOC 14 Operational Assessment Leak Rate (gpm at room temperature)	SG 2-1	SG 2-2	SG 2-3	SG 2-4
Detected indications within TTS minus 12 inches	1.632	0.635	1.888	1.633
Undetected indications within 8 to 12 inches below TTS	0.0396	0.0396	0.0396	0.0396
Undetected indications below TTS minus 12 inches (Note 1)	0.294	0.281	0.293	0.272
Total	1.966	0.956	2.221	1.945

Note 1: Leak rates are based on 0.00009 gpm multiplied by the number of inservice tubes in Cycle 14 (3263, 3120, 3258, and 3021 tubes for SGs 2-1, 2-2, 2-3, and 2-4, respectively.)

Table 7
DCPP Unit 2 Aggregate Condition Monitoring Steam Line Break Leak Rates

EOC 13 Condition Monitoring Leak Rate (gpm at room temperature)	SG 2-1	SG 2-2	SG 2-3	SG 2-4
W* ARC	0.265	0.113	0.489	0.413
Voltage-Based ARC (Note 1)	0.11	0.07	0.09	0.78
PWSCC ARC (Note 2)	0	0	0	0
Non-ARC degradation	0	0	0	0
Aggregate	0.375	0.183	0.579	1.193

Note 1: Voltage-based ARC leak rates are described in Enclosure 3.
Note 2: PWSCC ARC leak rates are described in Enclosure 2.

Table 8
DCPP Unit 2 Aggregate Operational Assessment Steam Line Break Leak Rates

EOC 14 Operational Assessment Leak Rate (gpm at room temperature)	SG 2-1	SG 2-2	SG 2-3	SG 2-4
W* ARC	1.966	0.956	2.221	1.945
Voltage-Based ARC (Note 1)	1.16	0.61	0.53	3.75
PWSCC ARC (Note 2)	0	0	0	0
Non-ARC degradation	0	0	0	0
Aggregate	3.126	1.566	2.751	5.695

Note 1: Voltage-based ARC leak rates are described in Enclosure 3.
Note 2: PWSCC ARC leak rates are described in Enclosure 2.

Figure 1

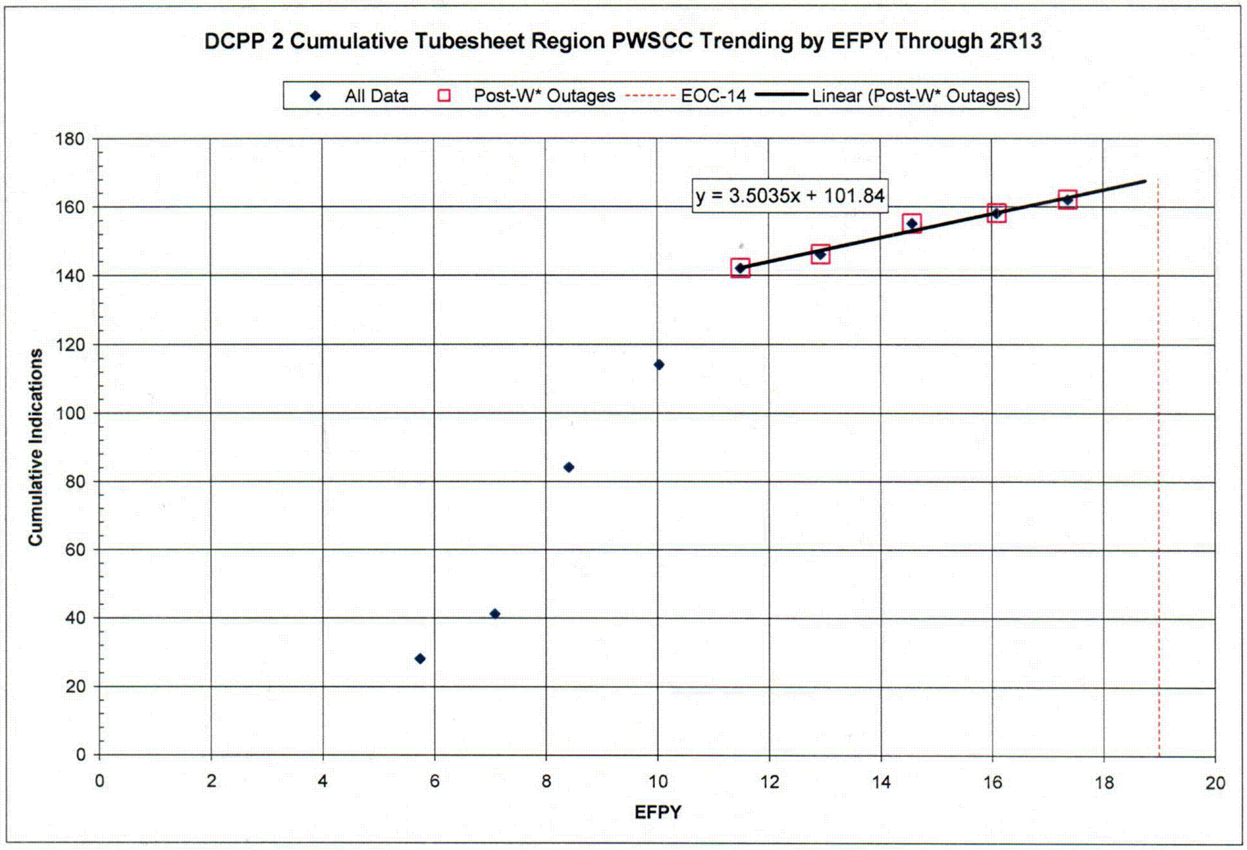
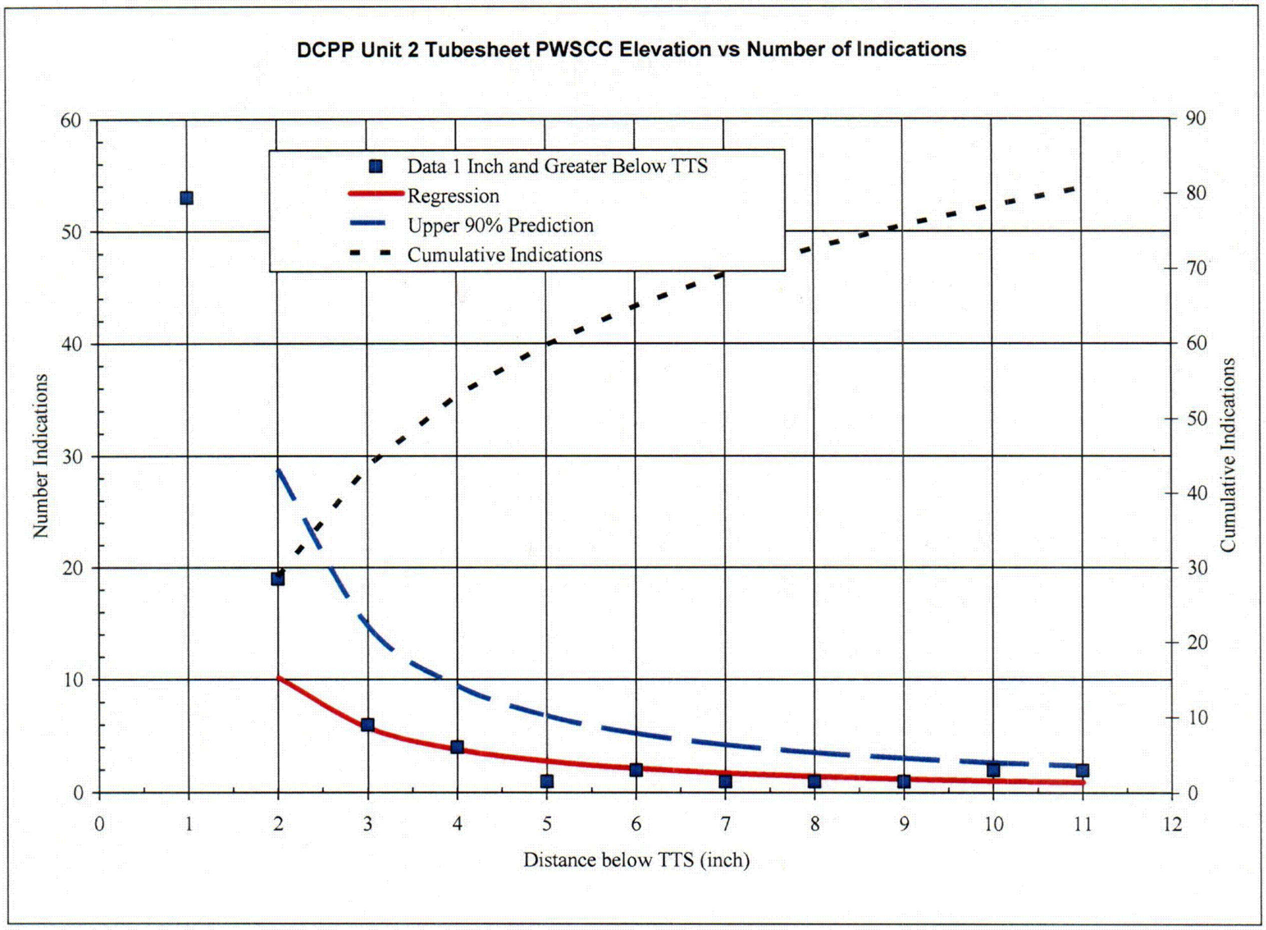

DCPP 2 Cumulative Tubesheet Region PWSCC Trending by EFPY Through 2R13
All Data
Post-W* Outages
EOC-14
Linear (Post-W* Outages)
y = 3.5035x + 101.84
Cumulative Indications
180
160
140
120
100
80
60
40
20
0
0
2
4
6
8
10
12
14
16
18
20
EFPY

Figure 2


DCPP Unit 2 Tubesheet PWSCC Elevation vs Number of Indications
Data 1 Inch and Greater Below TTS
Regression
Upper 90% Prediction
Cumulative Indications
Number Indications
Cumulative Indications
Distance below TTS (inch)
0
10
20
30
40
50
60
70
80
90
0
1
2
3
4
5
6
7
8
9
10
11
12

ENCLOSURE 2
SPECIAL REPORT 06-02

TSP PWSCC ALTERNATE REPAIR CRITERIA 120-DAY REPORT

DIABLO CANYON POWER PLANT UNIT 1 THIRTEENTH REFUELING OUTAGE

NRC Reporting Requirements

Primary water stress corrosion cracking (PWSCC) alternate repair criteria (ARC) for axial PWSCC at dented tube support plates (TSP) was implemented for the third time in Diablo Canyon Power Plant (DCPP) Unit 2 during Unit 2 Thirteenth Refueling Outage (2R13). 2R13 steam generator (SG) inspections and repairs were completed in May 2006.

For implementation of ARC for axial PWSCC at dented TSPs, DCPP Technical Specification (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 through-wall (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 Pacific Gas and Electric Company (PG&E) Letter DCL-02-045, "Response to Final NRC Request for Additional Information Regarding Supplement 3 to License Amendment Request 00-06, 'Alternate Repair Criteria for Axial PWSCC at Dented Intersections in Steam Generator Tubing'," 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.

Background: Dented TSP Plus Point Inspection Scope

The 2R13 Plus Point dent inspection scope for greater than 2 volt dents was based on greater than 2 volt dents called in the prior Unit 2 Twelfth Refueling Outage (2R12). The minimum scope for greater than 2 volt dents inspected by Plus Point in 2R13 is provided in Table 1.

The dented TSP inspection criteria and expansion plan criteria described below are based on PG&E Letter DCL-01-036, "Revision of Dent Inspection Program Requirements," 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."

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 2 Cycle 13. Fifty three axial PWSCC indications had been left in service in Cycle 13 under PWSCC ARC.

Plus Point inspection criteria for greater than or equal to (≥) 5 volt dented intersections

For Unit 2, in each SG, Plus Point inspections shall be conducted on 100 percent of ≥ 5 volt dented intersections, both hot leg and cold leg.

Plus Point inspection criteria for greater than 2 and less than 5 volt dented intersections

On a SG-specific basis, Plus Point inspections shall be conducted on 100 percent of greater than (>) 2 and less than (<) 5 volt dented intersections up to and including the coldest TSP elevation where PWSCC (at any size dent), circumferential indications (at any size dent), or ≥ 2 inferred volt axial ODSCC not detected by bobbin (AONDB) (at > 2 and < 5 volt dent) have been previously detected in that SG in the prior two outages, or current outage (implies expansion requirement), plus 20 percent of > 2 and < 5 volt dent at the next colder 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 coldest TSP where PWSCC, AONDB with ≥ 5 volt dent, or circumferential indications have been found in the prior two outages (Unit 2 Eleventh Refueling Outage [2R11] and 2R12) was 5H for SG 2-2, 3H for SG 2-3, and 3H for SG 2-4. In SG 2-1, no PWSCC, AONDB with ≥ 5 volt dent, or circumferential indications have been detected. In addition, all inferred bobbin voltages for AONDB indications have been less than 2 volts, so AONDB indications do not factor into the inspection scope.

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 (implies expansion requirement), 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.

The smallest dent in which a circumferential crack has been detected in the prior two outages (2R11 and 2R12) was 6.74 volts (in SG 2-2). Thus, the affected population for potential circumferential cracking is dents greater than greater than 6.44 volts (i.e., 6.74 – 0.3 = 6.44). The existing 2 volt dent cutoff for 2R13 Plus Point inspections is much less than the 6.44 volt threshold for circumferential cracking, and was therefore sufficient. Therefore, less than 2 volt dent Plus Point inspections were not required in the inspection plans. In addition, all inferred bobbin voltages for AONDB indications have been less than 2 volts, so AONDB indications do not factor into the inspection scope for detection of circumferential indications.

Summary of Plus Point inspection plan of dented TSPs

Based on the Plus Point inspection criteria listed above, the following Plus Point dent inspection criteria were implemented. The numbers of dent inspections is summarized in Table 1.

≥ 5 volt dents

- 100 percent in all SGs, both hot leg and cold leg

>2 and < 5 volt dents

- SG 2-1: 20 percent at 1H
- SG 2-2: 100 percent from 1H to 5H, 20 percent at 6H
- SG 2-3: 100 percent from 1H to 3H, 20 percent at 4H
- SG 2-4: 100 percent from 1H to 3H, 20 percent at 4H

- All 20 percent samples shall contain a minimum of 50 dents. If the population of dents at the TSP elevation is less than 50, then inspect 100 percent of the dents at the TSP.

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

One hundred percent of the tubes were inspected full length by bobbin coil (except for Rows 1 and 2 U-bends), and the bobbin coil was relied upon for detection of axial PWSCC in $\leq$ 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.

Summary of Inspection Results

Table 5 provides a list of all TSP axial PWSCC indications detected in 2R13. Table 6 provides a list of all TSP circumferential indications detected in 2R13.

No expansion of the Plus Point dent inspection program was required in 2R13, based on the following inspection results:

- No axial PWSCC or circumferential indications were detected in SG 2-1.
- No axial PWSCC or circumferential indications were detected above 5H in SG 2-2.
- No axial PWSCC or circumferential indications were detected above 3H in SG 2-3.
- No axial PWSCC or circumferential indications were detected above 3H in SG 2-4.
- All inferred bobbin voltages for AONDB indications were less than 2 volts.
- The dent voltages associated with TSP circumferential indications were greater than 0.3 volts above the 2.0 volt dent threshold for potential expansion. The smallest 2R13 dent voltage coincident with a circumferential indication was 4.03 volts.

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

Fifty nine axial PWSCC indications at dented TSP intersections were detected in 2R13. 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 2R13, the reason for plugging
- Adjusted nondestructive examination (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 operational assessment, the pressures are calculated using the ANL/TW burst model. For the condition monitoring assessment, the pressures are calculated using the Westinghouse burst model. A burst pressure of 6100 pounds per square inch (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.
- Steam line break (SLB) leak rates (free span and total length) using the ANL ligament tearing model, for condition monitoring and operational assessment.

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:

- Operational Assessment (OA) free span burst pressure (based on the ANL/TW model) exceeds 3 times the normal operating differential pressure (3dPNO). The 3dPNO burst pressure is equal to 4419 psi.
- OA total length burst pressure (based on the ANL/TW model) exceeds 1.4 times the SLB differential pressures (1.4dPSLB). The 1.4dPSLB burst pressure is equal to 3367 psi, based on a dPSLB of 2405 psi (pressurizer power operated relief valve (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 gallons per minute (gpm) (room temperature) in a faulted SG.
- The indication is less than 40 percent 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 a different degradation mechanism.
- The indication is not located in a tube that contains another repairable indication.

Fifty three axial PWSCC indications at dented TSPs had been left in service following 2R12 under PWSCC ARC. Following 2R13 Plus Point inspection, sizing, and application of PWSCC ARC requirements, 6 of the repeat axial PWSCC indications were plugged, as described below:

- Two due to the axial PWSCC indication being greater than or equal to 40 percent depth outside the tube support plate (SG 2-2 R11C30 crack 2, SG 2-2 R23C14 crack 1). In addition, SG 2-2 R11C30 cracks 1 and 3 were plugged because crack 2 was plugged.
- Two due to the axial PWSCC indication being located at a TSP where

circumferential cracking was also detected (SG 2-2 R2C40 crack 1, SG 2-2 R10C30 crack 1). This combined degradation is termed PWSCC mixed mode.

In 2R13, six new axial PWSCC indications at dented TSPs were detected, sized by Plus Point, and applied to PWSCC ARC requirements. Two of these were plugged due to combined axial ID/OD degradation (SG 2-4 R22C21 crack 1, SG 2-4 R23C52 crack 1), and all others 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 3dPNO, 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.

Fifty one axial PWSCC indications at dented TSPs were returned to service in 2R13: forty seven repeat indications and four new indications.

<u>Growth rate distributions for indications used to establish the tube repair limits and for indications found in the inspection</u>

The growth rate distribution used to establish the tube repair limits was based on prior outage growth data. The methodology for establishing the growth rate was established in WCAP-15573, Revision 1, as further explained in PG&E Letters DCL-02-023, "Response to NRC Request for Additional Information Regarding Supplement 3 to License Amendment Request 00-06, 'Alternate Repair Criteria for Axial PWSCC at Dented Intersections in Steam Generator Tubing'," and DCL-02-045. The methodology is summarized below:

- If there are at least two hundred 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 two hundred 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 two hundred 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.

In preparation for 2R13, the third bullet applied. As shown in Table 3, over the prior two Unit 2 inspections (2R11 and 2R12), there are only 107 data points, less than the

200 points required for a Unit 2 specific growth rate distribution. Therefore, the 2R11 and 2R12 data were supplemented by data from 1R12 and 1R13, resulting in a total of 548 data points over the last two cycles from each unit: 2R11 (49), 2R12 (58), 1R12 (215), and 1R13 (226). The oldest growth data from 1R8, 2R8, 1R9, 2R9, 1R10, 2R10, and 1R11, does not require evaluation and is excluded per the above methodology because over 200 data points are already available from the more recent inspections.

Per the ARC methodology, the four data sets to be included for evaluation are to be examined for potential exclusion of data points. To bound the ARC method, for the preliminary Cycle 14 operational assessment, PG&E chose to conservatively use the lower bound Cumulative Probability Distribution (CPD) growth rates between each of the four data sets. The lower bound growth rate CPD is provided in Table 2 and was used in the Monte Carlo preliminary cycle 14 OA calculations for determining the need for tube repair.

In accordance with WCAP-15573, Revision 1, Unit 1 Cycle 13 growth rates that could impact the upper tail of the preliminary OA growth distribution were evaluated during 2R13. The methodology requires that if new growth data causes 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.

57 additional growth rate data points from Cycle 13 were established, 53 from repeat indications and 4 from new indications. The CPD of the growth data is provided in Table 2.

During 2R13, the Cycle 13 growth rates were compared to the 90 percentile growth rates established from the preliminary Cycle 14 OA growth distribution in Table 2 (0.069 inch, 9.65 percent maximum depth [MD], 7.10 percent average depth [AD]). Several Cycle 13 growth rates exceeded these values, and the WCAP methodology required that these Cycle 13 data points be added to the growth distribution for the final OA. To bound the WCAP methodology, PG&E developed a conservative growth distribution based on the lower bound of the CPD from the combined Cycle 13 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. The lower bound growth rate CPD is provided in Table 2 and was used in the Monte Carlo final Cycle 14 OA calculations for determining the need for tube repair in 2R13. When comparing the final OA and preliminary OA growth distributions, the final OA was more conservative for maximum depth and length, and unchanged for average depth. For information, Table 3 compares the 90 percentile growth values per EFPY at 604 degrees for the recent inspections that were evaluated.

<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 2R13, 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 193 DIS indications detected *by bobbin at less than or equal to* 2 volt dented TSP *intersections* with *non-repeat* PWSCC indications. Tracking of Plus Point confirmation rates for repeat PWSCC indications 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. None of the DIS indications were confirmed as PWSCC by Plus Point, for a Plus Point confirmation rate of 0 percent, or a 100 percent bobbin overcall rate. The high bobbin overcall rate is greater than the approximately 90 percent overall 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.

<u>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 through-wall burst pressure model.</u>

This item is not applicable. All indications satisfied condition monitoring (CM) burst margin requirements based on the combined ANL ligament tearing and EPRI through-wall (ANL/TW) burst pressure model, as well as the Westinghouse (WEC) burst pressure model. The CM Westinghouse model burst pressures are shown in Table 5 for both free span and total length. The ANL/TW model burst pressures for total length are shown in Table 6. The total length CM burst requirement was 3367 psi at 1.4dPSLB. The free span length CM burst requirement was 4419 psi at 3dPNO.

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

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.

Performance Evaluation of Single Indication SLB Leak Rates

Regarding CM single indication total length SLB leak rates, no 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 single indication OA leak rate methodology using the ANL ligament tearing model is determined to be adequately conservative, and no corrective actions are required.

Performance Evaluation of Single Indication Burst Pressures

A benchmarking assessment (CM versus prior cycle OA projections) was performed for the repeat indications that had been left in service in Unit 2 Cycle 13 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.

With one exception, all prior cycle projected EOC 13 burst pressures exceeded the default free span and total length burst pressures of 6100 psi, using the ANL/TW model (the exception was 2R12 indication in SG 2-2 R8C36 with a projected total length burst pressure of 5784 psi using the ANL/TW model). The as-found free span and total length burst pressures for all indications exceeded the default value of 6100 psi for the CM assessment, using both burst models.

Based on this performance evaluation via benchmarking, the OA burst pressure methodology is determined to be adequately conservative.

Performance Evaluation of Total SG Monte Carlo SLB Leakage

Page 7-12 of WCAP-15573, Revision 1, requires the following: "If the results of the single indication analyses show leakage for condition monitoring or operational assessment for either free span or total length, then a total SG leak rate Monte Carlo operational assessment is required for each SG that shows leakage. A conservative probability of detection (POD) of 0.6 is used in the SG analysis."

The results of the 2R13 single indication analysis did not show CMOA leakage for free span and total length analyses and, as such, a total SG leak rate Monte Carlo OA was not required for any SG per the WCAP requirements. However, as committed in DCL-06-029 dated February 24, 2006, PG&E requires that total SG Monte Carlo analyses be performed in each SG with axial PWSCC indications for CM and OA, regardless of the result of the single indication analyses. Therefore, total SG leak rate analyses were performed for CM (using a POD of 1.0) and OA (using a POD of 0.6) for SGs 2-2, 2-3, and 2-4. The results of the total SG leak rate analyses show that no SG had any CMOA leakage.

<u>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.</u>

As discussed above, there were 59 axial PWSCC indications detected in 2R13: 6 new indications and 53 repeat indications. The number of new indications continues to be a small fraction of the total number of indications. Of the 5 new indications with prior Plus Point inspection (1 had no prior Plus Point inspection), 4 were detectable in 2R12 based on a lookup review, indicating a small growth rate progression. All of the new indications had CM and OA burst pressures in excess of 6100 psi using both the Westinghouse model and the ANL/TW model. Therefore, because the numbers of new flaws are relatively small, exhibited slow growth rates, and have CMOA burst pressures well in excess of burst margin requirements, there is no need to account for new indications in the OA burst evaluation.

<u>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.</u>

For PWSCC ARC, a mixed mode indication is defined as an axial PWSCC indication and a circumferential indication (either outside diameter stress corrosion cracking (ODSCC) or PWSCC) occurring at the same dented TSP intersection. The indications are termed PWSCC mixed mode. Per the WCAP-15573 Revision 1 methodology, a separation distance of 0.25 inch is adequate to reduce mixed mode effects on axial burst pressures to acceptable levels, except for the case when both the axial and circumferential indications are throughwall (in which case a separate mixed mode evaluation is required for any separation distance). Per WCAP-15573 Revision 1, the required 0.25 inch separation distance can also be confirmed by the presence of at least 0.075 inch and 0.050 inch null point spacing for circumferential ODSCC indications and circumferential PWSCC indications, respectively. The WCAP methodology recommends that the return to null separation be determined using the 600 kHz 0.080 inch pancake coil instead of the Plus Point coil, due to the potential that the Plus Point coil could provide a false null for closely spaced axial PWSCC indications (which rotate up) and circumferential PWSCC indications (which rotate down) of significant depth.

There were two TSP intersections that contained PWSCC mixed mode indications in 2R13, as described below. Detailed NDE measurements are provided in Table 5 for axial indications and Table 6 for circumferential indications.

SG 2-2 R10C30 1H, with dent of 11.84 volts, had one circumferential ODSCC indication, one circumferential PWSCC indication, and one axial PWSCC indication. The axial indication was a repeat indication from the prior cycle. Figure 4 provides a simplified sketch of the 3 indications, the axial and circumferential separation distances between the axial and circumferential indications, and the lengths and depths of the indications. The separation distance between the axial indication and circumferential PWSCC indication is 0.31 inch. The separation distance between the axial indication and circumferential ODSCC indication is 0.37 inch applying the square root of the sum of the squares (SRSS) of the axial and circumferential separation distances. Because these separation distances are greater than the 0.25 inch threshold value for potential interaction, and because none of the indications are 100 percent throughwall at any point, with allowances for NDE uncertainty, the indications are treated as noninteracting for PWSCC ARC. Therefore, a detailed mixed mode evaluation is not required because there is no potential impact on the axial indication burst pressure or leakage based on PWSCC ARC WCAP-15573 Revision 1 methodology. The required 0.25 inch separation distance between the axial indication and the circumferential PWSCC indication was confirmed by the presence of 8 null points (about 0.264 inch null point spacing) using both the 600 kHz 0.080 inch pancake coil and the 300 kHz Plus Point coil. The required 0.25 inch separation distance between the axial indication and the circumferential ODSCC indication was confirmed by the presence of 4 null points (about 0.132 inch null point spacing) using the 300 kHz Plus Point coil. The ODSCC indication could not be detected using the 600 kHz 0.080 inch pancake coil because the depth was very shallow, so null points observed using this coil cannot be applied. The rotating probe coil spacing is 0.033 inch.

SG 2-2 R2C40 1H, with dent of 22.92 volts, had two circumferential ODSCC indications and one axial PWSCC indication. The axial indication was a repeat indication from the prior cycle. Figure 5 provides a simplified sketch of the 3 indications, the axial and circumferential separation distances between the axial and circumferential indications, and the lengths and depths of the indications. The resultant separation distances between the axial indication and circumferential ODSCC indications number 1 and number 2 are 0.81 inch and 0.89 inch respectively, applying the SRSS of the axial and circumferential separation distances. Because these separation distances are greater than the 0.25 inch threshold value for potential interaction, and because none of the indications are 100 percent throughwall at any point, with allowances for NDE uncertainty, the indications are treated as noninteracting for PWSCC ARC. The required 0.25 inch separation distance between the axial indication and circumferential ODSCC indication number 1 and number 2 was confirmed by the presence of 4 null points (about 0.132 inch null point spacing) and 6 null points (about 0.198 inch null point spacing), respectively, using the 300 Khz Plus Point coil. The ODSCC indications could not be detected using the 600 Khz 0.080 inch pancake coil because the depths were very shallow, so null points observed using this coil cannot be applied. The rotating probe coil spacing is 0.033 inch.

Based on the above mixed mode evaluations, a detailed mixed mode evaluation is not required because there is no potential impact on the axial indication burst pressure or leakage based on PWSCC ARC WCAP-15573 Revision 1 methodology. Even if the indications are assumed to be interacting, there is no potential impact on the axial indication burst pressure or leakage because (1) the axial and circumferential indications are not throughwall, (2) the axial indications are short and shallow such that their burst pressures exceed 6100 psi, and (3) the average depths of the circumferential indications are less than the 80 percent threshold value after accounting for 95 percent NDE uncertainty for mixed mode affects.

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 1, 2, and 3.

Figure 1 provides all DCPP Unit 2 TSP PWSCC and ODSCC circumferential indication measured adjusted average depths versus year detected. The adjustments do not include NDE uncertainty. The mean trend line shows a slight increase in average depths, attributed to the three short indications noted above with larger average depths but low amplitudes (i.e., less than or equal to 0.21 volt). The frequency of larger depths tends to show an oscillating up and down pattern between outages, which may be a result of conservative sizing of low amplitude flaws.

Figure 2 data is a subset of Figure 1, showing the PWSCC mixed mode circumferential indication average depths versus year detected. A total of nine Unit 2 circumferential indications have been associated with PWSCC mixed mode indications, including the four circumferential indications detected in 2R13. The mean trend line shows a slight increase in average depths of these nine circumferential indications, attributed to the two largest depth indications detected in 2R13.

Figure 3 provides the number of DCPP Unit 2 TSP PWSCC and ODSCC circumferential indications detected over time. Even though there was an increase in the number of circumferential indications in 2R13 compared to recent outages, the overall mean trend line shows a slight decrease due to the large number of indications detected in 1996.

Even though Unit 2 shows increasing recent trends in the number of circumferential indications, circumferential average depths, and mixed mode indications, there is not a significant potential for increasing mixed mode affects over time based on the small Plus Point voltages associated with these circumferential indications (indicating shallow depths), and low probability of interacting mixed mode indications. Of the nine Unit 2 TSP intersections with mixed mode indications, none were determined to be interacting based on the WCAP-15573 Revision 1 methodology.

Conditions Requiring Evaluation to Determine Need for Corrective Actions

There are several conditions related to mixed mode indications and circumferential indications that require evaluation to determine the need for corrective actions. These are discussed below:

- *If an interacting PWSCC 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 earlier, there are no interacting mixed mode indications, so no corrective actions are necessary.

- *If an interacting PWSCC 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 earlier, there are no interacting mixed mode indications, so no corrective actions are necessary.

- *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.*

  There were 16 TSP circumferential indications detected in 2R13. All of the TSPs with circumferential indications detected in 2R13 were previously Plus Point inspected in 2R12. The deepest 2R13 circumferential indications had average depths of 75 percent, 71.5 percent and 71.3 percent, including 95 percent NDE uncertainty, less than the 80 percent average depth threshold. The maximum Plus Point amplitude for these flaws were very small (0.21, 0.15, 0.16 volts, respectively), and it is expected that the flaws were very conservatively sized. Therefore, no corrective actions are needed to adjust the OA SLB leak rates.

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 no total length leakage was calculated. In addition, total SG leak rate Monte Carlo analyses were performed for each SG with indications, and no free span or total length leakage was calculated at 95/50 confidence levels using a POD of 1.0.

Table 1
2R13 Minimum Scope for Plus Point Inspection of Dented TSP Intersections

2-5 Volt Dents

TSP	SG 2-1	SG 2-2	SG 2-3	SG 2-4	TOTAL
1H	2	85	6	1	94
2H		23	4	4	31
3H		2	8	23	33
4H		38	2	3	43
5H		2			2
6H					
7H					
TOTAL	2	150	20	31	203

≥ 5 Volt Dents

TSP	SG 2-1	SG 2-2	SG 2-3	SG 2-4	TOTAL
1H	0	303	1	0	304
2H	0	6	0	0	6
3H	0	1	1	26	28
4H	0	84	0	1	85
5H	2	0	0	0	2
6H	0	0	0	0	0
7H	0	0	1	4	5
7C	0	0	1	0	1
6C	0	0	0	0	0
5C	0	0	0	0	0
4C	0	0	3	0	3
3C	0	0	0	0	0
2C	0	0	0	0	0
1C	0	0	0	1	1
TOTAL	2	394	7	32	435

2R13 Plus Point dent inspection criteria:

- 100% of ≥ 5 volt dents
- SG 2-1: 20% of > 2 and <5 volt dents at 1H
- SG 2-2: 100% of > 2 and <5 volt dents from 1H to 5H (critical area), 20% at 6H
- SG 2-3: 100% of > 2 and <5 volt dents from 1H to 3H (critical area), 20% at 4H
- SG 2-4: 100% of > 2 and <5 volt dents from 1H to 3H (critical area), 20% at 4H
- All 20% samples shall contain a minimum of 50 dents. If the population of >2 and <5 volt dents at the TSP elevation is less than 50, then inspect 100% of >2 and <5 volt dents at the TSP.

Table 2 - Axial PWSCC Cumulative Probability Distribution (CPD) Growth Rates per EFPY at 604F												
	2R11 data		1R12 data		2R12 data		1R13 data		Prelim OA	2R13 data		Final OA
Length Bin (inch)	Freq	CPD	Freq	CPD	Freq	CPD	Freq	CPD	Lower Bound CPD from 4 prior cycles	Freq	CPD	Lower Bound CPD from 5 prior cycles
0	19	0.388	78	0.363	22	0.379	58	0.257	0.257	11	0.193	0.193
0.01	4	0.469	24	0.474	7	0.500	27	0.376	0.376	4	0.263	0.263
0.02	13	0.735	45	0.684	13	0.724	24	0.482	0.482	8	0.404	0.404
0.03	3	0.796	17	0.763	7	0.845	34	0.633	0.633	6	0.509	0.509
0.04	2	0.837	19	0.851	3	0.897	19	0.717	0.717	8	0.649	0.649
0.05	2	0.878	14	0.916	1	0.914	14	0.779	0.779	5	0.737	0.737
0.06	4	0.959	7	0.949	1	0.931	21	0.872	0.872	5	0.825	0.825
0.07	0	0.959	5	0.972	1	0.948	7	0.903	0.903	4	0.895	0.895
0.08	0	0.959	1	0.977	2	0.983	3	0.916	0.916	0	0.895	0.895
0.09	2	1.000	4	0.995	1	1.000	4	0.934	0.934	0	0.895	0.895
0.1	0	1.000	1	1.000	0	1.000	4	0.951	0.951	1	0.912	0.912
0.11	0	1.000	0	1.000	0	1.000	1	0.956	0.956	2	0.947	0.947
0.12	0	1.000	0	1.000	0	1.000	2	0.965	0.965	0	0.947	0.947
0.13	0	1.000	0	1.000	0	1.000	1	0.969	0.969	3	1.000	0.969
0.14	0	1.000	0	1.000	0	1.000	0	0.969	0.969	0	1.000	0.969
0.15	0	1.000	0	1.000	0	1.000	6	0.996	0.996	0	1.000	0.996
0.16	0	1.000	0	1.000	0	1.000	0	0.996	0.996	0	1.000	0.996
0.17	0	1.000	0	1.000	0	1.000	0	0.996	0.996	0	1.000	0.996
0.18	0	1.000	0	1.000	0	1.000	1	1.000	1.000	0	1.000	1.000
Total	49		215		58		226			57		

Table 2 - Axial PWSCC Cumulative Probability Distribution (CPD) Growth Rates per EFPY at 604F												
	2R11 data		1R12 data		2R12 data		1R13 data		Prelim OA	2R13 data		Final OA
MD Bin (%TW fraction)	Freq	CPD	Freq	CPD	Freq	CPD	Freq	CPD	Lower Bound CPD from 4 prior cycles	Freq	CPD	Lower Bound CPD from 5 prior cycles
0	30	0.612	63	0.293	20	0.345	141	0.624	0.293	35	0.614	0.293
0.01	1	0.633	8	0.330	0	0.345	14	0.686	0.330	0	0.614	0.330
0.02	2	0.673	20	0.423	6	0.448	9	0.726	0.423	4	0.684	0.423
0.03	0	0.673	16	0.498	2	0.483	17	0.801	0.483	1	0.702	0.483
0.04	2	0.714	19	0.586	8	0.621	5	0.823	0.586	3	0.754	0.586
0.05	3	0.776	28	0.716	1	0.638	13	0.881	0.638	1	0.772	0.638
0.06	3	0.837	7	0.749	7	0.759	7	0.912	0.749	4	0.842	0.749
0.07	3	0.898	11	0.800	3	0.810	4	0.929	0.800	2	0.877	0.800
0.08	1	0.918	7	0.833	2	0.845	1	0.934	0.833	2	0.912	0.833
0.09	2	0.959	9	0.874	4	0.914	5	0.956	0.874	2	0.947	0.874
0.1	0	0.959	10	0.921	0	0.914	3	0.969	0.914	0	0.947	0.914
0.11	2	1.000	2	0.930	1	0.931	0	0.969	0.930	1	0.965	0.930
0.12	0	1.000	7	0.963	2	0.966	2	0.978	0.963	0	0.965	0.963
0.13	0	1.000	1	0.967	1	0.983	0	0.978	0.967	1	0.982	0.967
0.14	0	1.000	1	0.972	0	0.983	1	0.982	0.972	0	0.982	0.972
0.15	0	1.000	2	0.981	0	0.983	1	0.987	0.981	0	0.982	0.981
0.16	0	1.000	2	0.991	1	1.000	0	0.987	0.987	1	1.000	0.987
0.17	0	1.000	0	0.991	0	1.000	0	0.987	0.987	0	1.000	0.987
0.18	0	1.000	0	0.991	0	1.000	1	0.991	0.991	0	1.000	0.991
0.19	0	1.000	0	0.991	0	1.000	0	0.991	0.991	0	1.000	0.991
0.2	0	1.000	2	1.000	0	1.000	0	0.991	0.991	0	1.000	0.991
0.21	0	1.000	0	1.000	0	1.000	1	0.996	0.996	0	1.000	0.996
0.22	0	1.000	0	1.000	0	1.000	0	0.996	0.996	0	1.000	0.996
0.23	0	1.000	0	1.000	0	1.000	1	1.000	1.000	0	1.000	1.000
Total	49		215		58		226			57		

Table 2 - Axial PWSCC Cumulative Probability Distribution (CPD) Growth Rates per EFPY at 604F												
	2R11 data		1R12 data		2R12 data		1R13 data		Prelim OA	2R13 data		Final OA
AD Bin (%TW fraction)	Freq	CPD	Freq	CPD	Freq	CPD	Freq	CPD	Lower Bound CPD from 4 prior cycles	Freq	CPD	Lower Bound CPD from 5 prior cycles
0	27	0.551	53	0.247	14	0.241	112	0.496	0.241	28	0.491	0.241
0.01	5	0.653	25	0.363	6	0.345	33	0.642	0.345	7	0.614	0.345
0.02	6	0.776	24	0.474	6	0.448	19	0.726	0.448	4	0.684	0.448
0.03	2	0.816	17	0.553	4	0.517	23	0.827	0.517	4	0.754	0.517
0.04	0	0.816	23	0.660	3	0.569	12	0.881	0.569	2	0.789	0.569
0.05	4	0.898	23	0.767	7	0.690	10	0.925	0.690	4	0.860	0.690
0.06	0	0.898	18	0.851	7	0.810	7	0.956	0.810	2	0.895	0.810
0.07	0	0.898	12	0.907	5	0.897	3	0.969	0.897	0	0.895	0.895
0.08	2	0.939	6	0.935	2	0.931	2	0.978	0.931	3	0.947	0.931
0.09	1	0.959	2	0.944	1	0.948	0	0.978	0.944	0	0.947	0.944
0.1	1	0.980	4	0.963	0	0.948	1	0.982	0.948	2	0.982	0.948
0.11	1	1.000	1	0.967	0	0.948	1	0.987	0.948	1	1.000	0.948
0.12	0	1.000	2	0.977	2	0.983	1	0.991	0.977	0	1.000	0.977
0.13	0	1.000	2	0.986	0	0.983	0	0.991	0.983	0	1.000	0.983
0.14	0	1.000	3	1.000	0	0.983	2	1.000	0.983	0	1.000	0.983
0.15	0	1.000	0	1.000	0	0.983	0	1.000	0.983	0	1.000	0.983
0.16	0	1.000	0	1.000	0	0.983	0	1.000	0.983	0	1.000	0.983
0.17	0	1.000	0	1.000	1	1.000	0	1.000	1.000	0	1.000	1.000
0.18	0	1.000	0	1.000	0	1.000	0	1.000	1.000	0	1.000	1.000
0.19	0	1.000	0	1.000	0	1.000	0	1.000	1.000	0	1.000	1.000
0.2	0	1.000	0	1.000	0	1.000	0	1.000	1.000	0	1.000	1.000
Total	49		215		58		226			57		

Table 3
Recent Inspection Growth Rates per EFPY at 604F

		90 Percentile Growth per EFPY		
Cycle	Data Points	Length inch	Max Depth %	Average Depth %
2R11	49	0.051	7.01	5.37
1R12	215	0.050	9.69	6.88
2R12	58	0.041	8.55	6.92
1R13	226	0.067	5.78	4.40
2R13	57	0.076	7.63	6.30

Table 4
DIS Confirmation Rates

	SG 2-1	SG 2-2	SG 2-3	SG 2-4	Total
Number of bobbin DIS in less than or equal to 2 volt dented TSP intersections (excludes repeat PWSCC indications)	39	53	72	29	193
Number of new PWSCC indications confirmed by Plus Point	0	0	0	0	0
Plus Point confirmation rate	0%	0%	0%	0%	0%
Bobbin DIS overcall rate	100%	100%	100%	100%	100%

Table 5 – 2R13 PWSCC ARC Summary of Results

								2R13 Adjusted NDE						2R13 CM (WEC Model)				2R13 OA (ANL/TW Model)			
SG	R	C	TSP	Crack	Cal	Plug Reason	Ind Cat	Length (in.)	MD (%)	AD (%)	Max Volt	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
2	2	40	01H	1	22	Mix Mode	Repeat	0.10	25.0	15.4	0.38	-0.63	-0.53	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	2	41	01H	1	22		Repeat	0.34	36.0	25.7	0.84	0.39	0.73	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	2	41	01H	2	22		New	0.10	20.0	12.4	0.34	-0.72	-0.62	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	4	28	01H	1	22		Repeat	0.24	30.5	20.1	0.85	0.03	0.27	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	4	34	04H	1	22		Repeat	0.17	20.0	9.5	0.31	0.02	0.19	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	5	3	01H	1	22		Repeat	0.28	25.0	15.3	0.57	-0.19	0.09	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	5	26	01H	1	22		Repeat	0.20	36.0	19.5	0.76	-0.33	-0.13	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	6	24	01H	1	22		Repeat	0.26	33.0	16.8	0.73	-0.36	-0.10	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	6	31	01H	1	22		Repeat	0.25	60.0	42.4	1.36	-0.40	-0.15	6100	0.000	6100	0.000	6100	0.000	5428	0.000
2	6	31	01H	2	22		Repeat	0.15	28.0	18.8	0.44	-0.15	0.00	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	6	36	01H	1	22		Repeat	0.24	30.0	18.6	0.58	-0.29	-0.05	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	6	49	01H	1	22		Repeat	0.12	48.0	34.5	0.42	-0.32	-0.20	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	7	5	01H	1	22		Repeat	0.15	39.0	26.8	0.39	-0.06	0.09	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	7	27	01H	1	22		Repeat	0.17	30.0	15.7	0.61	0.13	0.30	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	7	32	01H	1	22		Repeat	0.22	33.0	23.8	0.94	-0.37	-0.15	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	8	36	01H	1	22		Repeat	0.49	36.0	28.5	0.94	-0.26	0.23	6100	0.000	6100	0.000	6100	0.000	5758	0.000
2	8	43	04H	1	22		Repeat	0.23	39.0	28.1	0.92	-0.12	0.11	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	9	32	01H	1	22		Repeat	0.30	28.0	13.3	0.71	-0.22	0.08	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	10	14	01H	1	25		New	0.12	39.0	25.0	0.30	0.48	0.60	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	10	14	01H	2	25		New	0.07	33.0	16.5	0.49	0.66	0.73	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	10	21	04H	1	22		Repeat	0.23	22.0	7.8	0.45	-0.03	0.20	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	10	30	01H	1	22	Mix Mode	Repeat	0.13	48.0	28.7	0.47	-0.30	-0.17	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	10	32	01H	1	22		Repeat	0.09	20.0	12.3	0.23	0.44	0.53	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	11	17	01H	1	22		Repeat	0.15	36.0	21.8	0.47	-0.50	-0.35	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	11	30	01H	1	22	due to crack 2	Repeat	0.19	39.0	22.7	0.72	-0.28	-0.09	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	11	30	01H	2	22	>40% DOP	Repeat	0.24	54.0	34.3	1.30	-0.52	-0.28	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	11	30	01H	3	22	due to crack 2	Repeat	0.12	39.0	26.8	0.60	0.51	0.63	6100	0.000	6100	0.000	6100	0.000	6100	0.000

Table 5 – 2R13 PWSCC ARC Summary of Results

								2R13 Adjusted NDE						2R13 CM (WEC Model)				2R13 OA (ANL/TW Model)			
SG	R	C	TSP	Crack	Cal	Plug Reason	Ind Cat	Length (in.)	MD (%)	AD (%)	Max Volt	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
2	12	39	01H	1	22		Repeat	0.11	28.0	18.3	0.76	-0.18	-0.07	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	13	25	03H	1	22		Repeat	0.30	42.0	34.4	0.82	-0.19	0.11	6100	0.000	6100	0.000	6100	0.000	5834	0.000
2	13	41	01H	1	22		Repeat	0.27	36.0	26.6	0.74	-0.23	0.04	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	14	45	01H	1	22		Repeat	0.15	20.0	11.4	0.43	-0.08	0.07	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	15	22	01H	1	22		Repeat	0.20	33.0	20.9	0.58	-0.11	0.09	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	15	42	01H	1	22		Repeat	0.27	30.0	13.2	0.49	-0.12	0.15	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	15	51	01H	1	22		Repeat	0.18	22.5	15.6	0.41	-0.27	-0.09	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	16	49	01H	1	22		Repeat	0.22	30.0	23.3	0.97	-0.18	0.04	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	17	12	01H	1	22		Repeat	0.23	28.0	18.7	0.69	0.08	0.31	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	17	12	01H	2	22		Repeat	0.24	36.0	24.6	0.48	-0.19	0.05	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	17	12	01H	3	22		Repeat	0.09	20.0	10.4	0.31	-0.46	-0.37	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	18	10	01H	1	22		Repeat	0.14	28.0	13.6	0.48	-0.35	-0.21	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	19	15	01H	1	22		Repeat	0.14	20.0	10.6	0.48	-0.06	0.08	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	21	35	02H	1	22		Repeat	0.37	28.0	14.1	0.47	-0.22	0.15	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	21	40	01H	1	22		Repeat	0.20	33.0	19.3	0.62	-0.31	-0.11	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	21	41	01H	1	22		Repeat	0.23	30.0	20.3	0.70	0.14	0.37	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	22	44	04H	1	22		Repeat	0.18	22.0	13.4	0.40	-0.36	-0.18	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	22	55	01H	1	22		Repeat	0.18	30.0	21.5	0.50	0.08	0.26	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	23	14	01H	1	22	>40% DOP	Repeat	0.11	45.0	32.0	0.55	0.50	0.61	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	25	44	05H	1	22		Repeat	0.40	20.0	10.5	0.50	-0.25	0.15	6100	0.000	6100	0.000	6100	0.000	6100	0.000
2	29	39	01H	1	37		New	0.14	20.0	15.2	0.53	-0.21	-0.07	6100	0.000	6100	0.000	6100	0.000	6100	0.000
3	15	47	02H	1	26		Repeat	0.09	25.0	15.7	0.18	-0.15	-0.06	6100	0.000	6100	0.000	6100	0.000	6100	0.000
3	21	78	03H	1	26		Repeat	0.33	47.0	36.3	1.15	-0.29	0.04	6100	0.000	6100	0.000	6100	0.000	5580	0.000
3	29	41	03H	1	26		Repeat	0.09	33.0	22.0	0.47	-0.11	-0.02	6100	0.000	6100	0.000	6100	0.000	6100	0.000
3	45	56	01H	1	26		Repeat	0.12	28.0	20.5	0.57	0.22	0.34	6100	0.000	6100	0.000	6100	0.000	6100	0.000
4	3	12	03H	1	25		Repeat	0.24	47.0	33.6	0.98	-0.21	0.03	6100	0.000	6100	0.000	6100	0.000	6100	0.000
4	5	15	01H	1	18		Repeat	0.12	26.0	18.5	0.30	-0.07	0.05	6100	0.000	6100	0.000	6100	0.000	6100	0.000
4	8	20	01H	1	18		Repeat	0.24	51.0	40.0	1.07	-0.30	-0.06	6100	0.000	6100	0.000	6100	0.000	5705	0.000

Table 5 – 2R13 PWSCC ARC Summary of Results

								2R13 Adjusted NDE						2R13 CM (WEC Model)				2R13 OA (ANL/TW Model)			
SG	R	C	TSP	Crack	Cal	Plug Reason	Ind Cat	Length (in.)	MD (%)	AD (%)	Max Volt	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
4	12	17	03H	1	18		Repeat	0.20	51.0	34.1	1.09	0.10	0.30	6100	0.000	6100	0.000	6100	0.000	6100	0.000
4	14	53	03H	1	18		Repeat	0.16	31.0	18.2	0.50	-0.03	0.13	6100	0.000	6100	0.000	6100	0.000	6100	0.000
4	22	21	03H	1	51	ID/OD	New	0.24	45.0	34.9	0.90	-0.23	0.01	6100	0.000	6100	0.000	6100	0.000	6100	0.000
4	23	52	02H	1	48	ID/OD	New	0.11	33.0	23.4	0.52	-0.09	0.02	6100	0.000	6100	0.000	6100	0.000	6100	0.000

Table 6 – 2R13 Circumferential Indications and Growth Rates

											Unadjusted NDE			Adjusted NDE			Adjusted for Upper 95% NDE Uncertainty			ODSCC Adjusted for Upper 95% NDE Uncertainty Mix Mode Only			Growth Rate per EFPY			
SG	R	C	TSP	Crk No.	Axial Elev	Max Volt	Dent Volt	Orient	Stab	Mix Mode	Angle deg	MD %	AD %	Angle deg	MD %	AD %	Angle deg	MD %	AD %	Angle deg	MD %	AD %	Angle deg	MD %	AD %	Volt
22	2	40	1H	1	-0.29	0.15	22.92	OD	Yes	Yes	28.2	86	68.7	28.2	77.0	64.2	172.1	91.4	71.5	131.5	91.4	73.4	-6.0	-9.9	-8.4	-0.02
22	2	40	1H	2	-0.24	0.21		OD		Yes	21.2	94	73.9	21.2	86.0	69.8	169.2	98.0	75.0	127.9	98.0	76.9	-2.1	1.3	0.6	-0.01
22	5	30	1H	1	0.25	0.18	50.10	OD			25.2	1	0.9	25.2	40.0	31.3	170.9	64.3	51.0				0.5	0.0	2.9	0.02
22	10	30	1H	1	0.05	0.16	11.84	OD	Yes	Yes	24.9	1	0.9	24.9	40.0	31.5	170.8	64.3	51.2	129.8	64.3	52.7	0.7	0.0	1.0	0.02
22	10	30	1H	2	0.14	0.30		ID		Yes	25.0	42	27.6	25.0	40.0	27.2	78.9	64.2	44.3				-2.3	0.0	0.0	-0.01
22	11	31	1H	1	-0.17	0.32	31.90	OD			29.1	35	15.9	29.1	40.0	28.7	172.5	64.3	49.4				-3.1	0.0	-0.2	0.12
22	13	24	1H	1	-0.28	0.16	37.29	OD			31.2	94	69.6	31.2	82.0	63.8	173.4	95.0	71.3				NDD			
22	14	39	1H	1	-0.33	0.13	29.96	OD			18.2	82	60.0	18.2	68.5	52.1	168.0	85.2	63.9				NDD			
22	15	53	1H	1	0.06	0.23	13.95	OD			52.6	12	3.3	52.6	40.0	33.0	182.2	64.3	52.1				4.7	0.0	0.8	0.02
22	17	29	4H	1	-0.08	0.57	18.28	OD			25.4	39	26.4	25.4	40.0	26.3	171.0	64.3	47.9				3.4	0.0	-1.8	-0.06
22	19	26	1H	1	-0.18	0.22	20.08	OD			32.7	34	20.1	32.7	40.0	30.1	174.0	64.3	50.3				NDD			
22	19	27	1H	1	-0.32	0.11	41.38	OD	Yes		18.2	37	20.6	18.2	40.0	27.9	168.0	64.3	48.9				NDD			
22	19	27	1H	2	0.32	0.17		OD			25.4	1	0.9	25.4	40.0	29.7	171.0	64.3	50.1				6.8	0.0	1.6	0.00
22	19	32	1H	1	0.02	0.14	4.03	OD			32.7	21	4.9	32.7	40.0	29.0	174.0	64.3	49.6				0.8	0.0	-0.9	0.02
22	24	30	1H	1	0.06	0.22	5.35	OD			21	26	14.1	21	40.0	28.6	169.2	64.3	49.3				-4.8	0.0	0.8	0.06
24	11	16	3H	1	-0.18	0.44	39.06	ID			25.9	99	77.7	25.9	79.0	57.9	79.8	92.5	65.0				1.7	-3.8	-3.9	0.16
22	22	24	TSH	1	-0.05	0.16	NA	OD			73												NDD			

Note 1: Growth rate based on adjusted NDE, not the uncertainty adjusted NDE.
Note 2: Location (inch) is relative to the centerline of the tube support plate, or top of tubesheet.
Note 3: Tube stabilization determined per evaluation by Westinghouse.
Note 4: NDD means prior outage lookup did not detect any degradation, so no growth rate can be assigned for indication.
Note 5: SG 2-2 R22C24 TSH indication was too small to be sized using line by line technique.

Figure 1

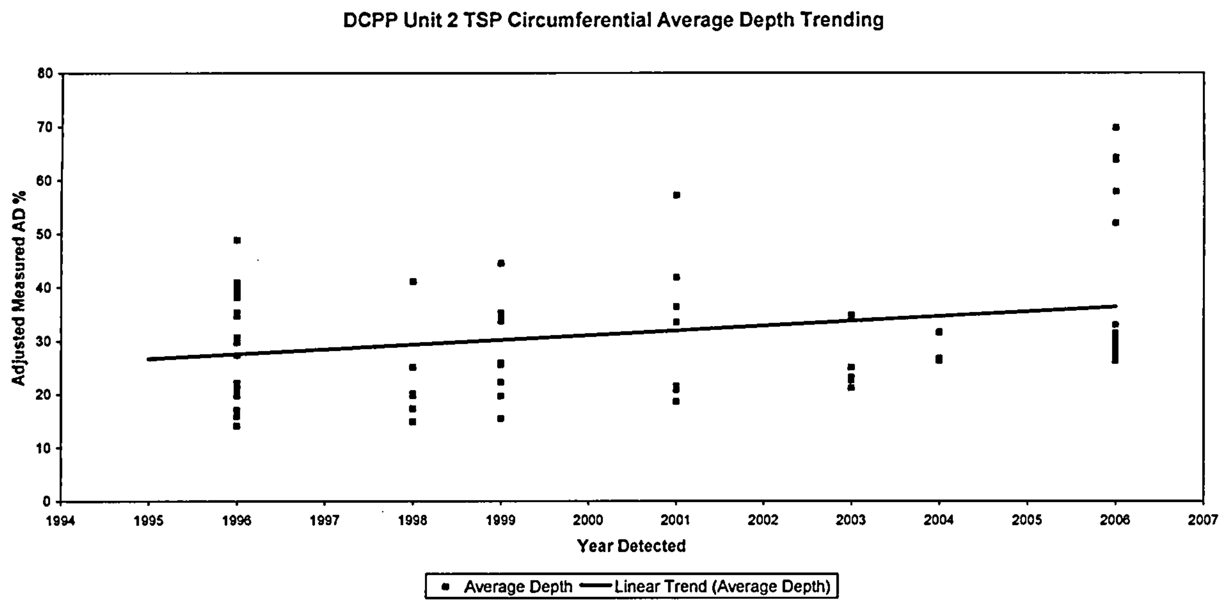


Figure 2

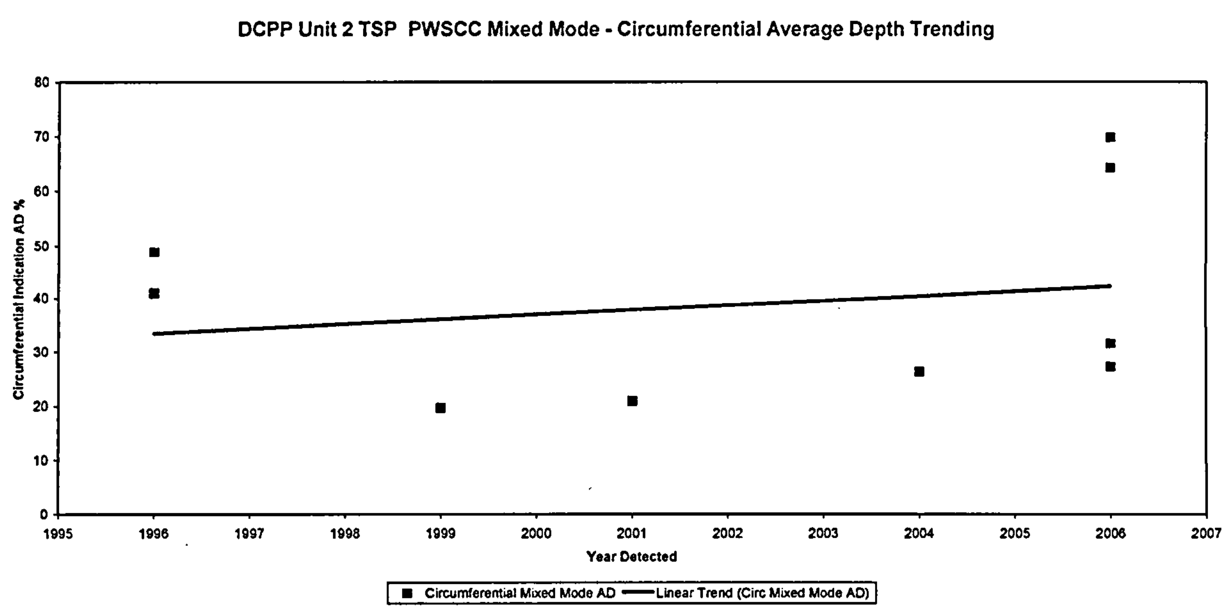


Figure 3

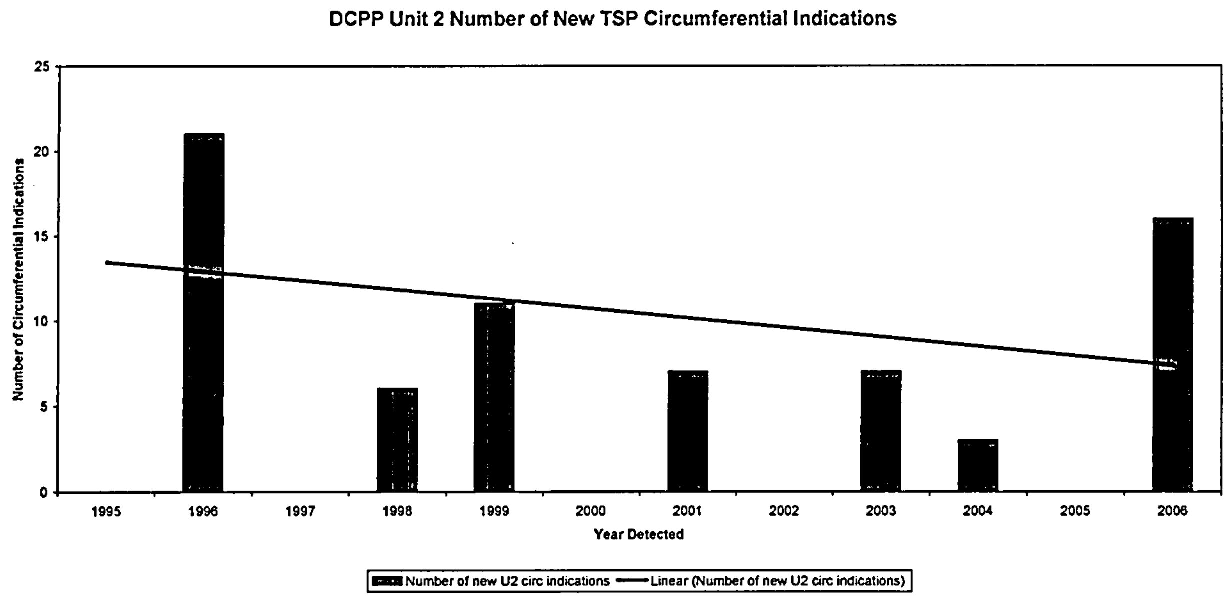

DCPP Unit 2 Number of New TSP Circumferential Indications
Number of Circumferential Indications
0
5
10
15
20
25
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Year Detected
Number of new U2 circ indications
Linear (Number of new U2 circ indications)

Figure 4
SG 2-2 R10 C30 1H Mixed Mode
Axial PWSCC and Circumferential Indications

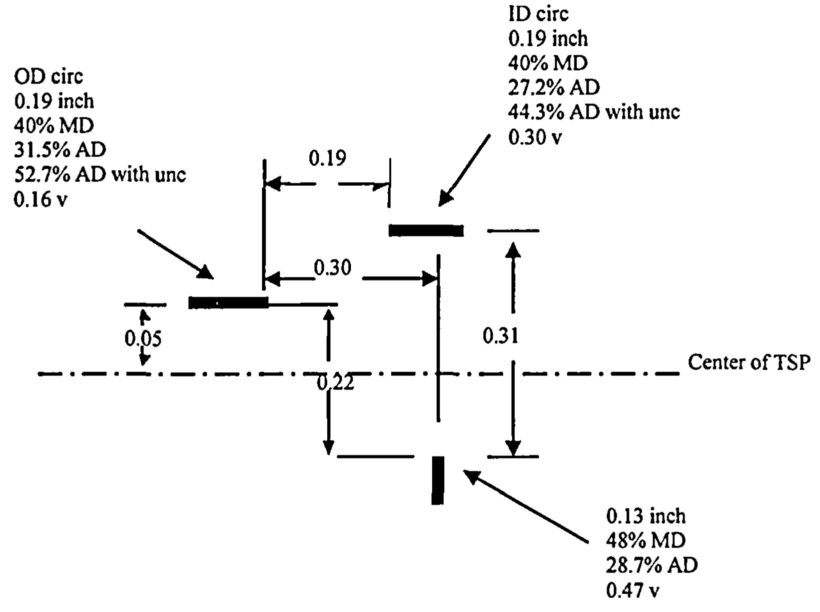
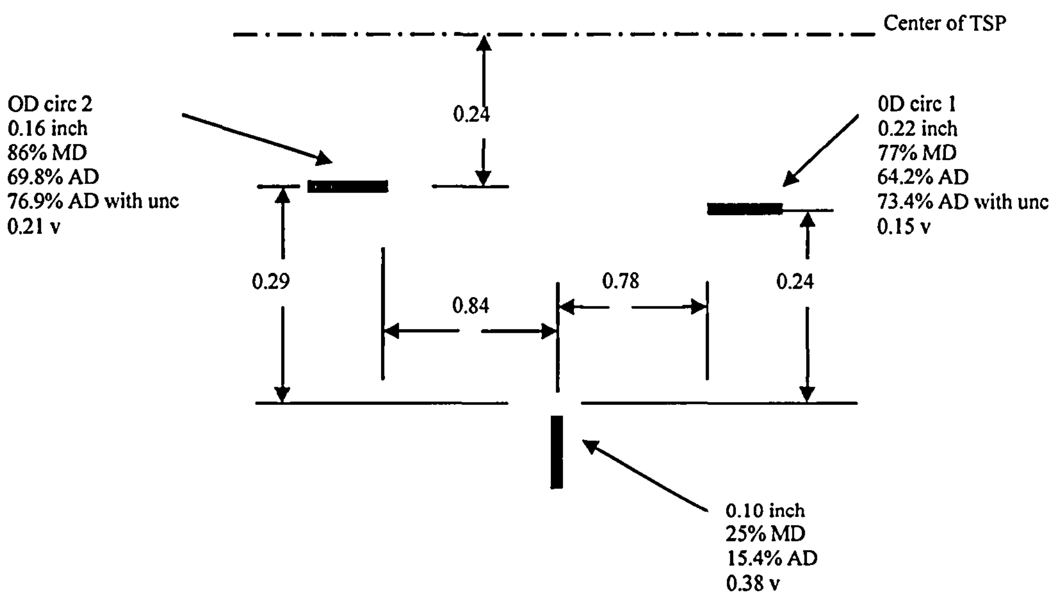


Figure 5
SG 2-2 R2 C40 1H Mixed Mode
Axial PWSCC and Circumferential Indications



ENCLOSURE 3
SPECIAL REPORT 06-02

AREVA REPORT 86-9024635-000
"DCPP UNIT 2 R13 VOLTAGE-BASED ARC 90-DAY SUMMARY REPORT"

AREVA

CALCULATION SUMMARY SHEET (CSS)

Document Identifier 86-9024635-000

Title DCPP Unit 2 R13 Voltage-Based ARC 90-Day Report

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PURPOSE AND SUMMARY OF RESULTS:

This report summarizes the Diablo Canyon Unit 2 – 2R13 inspection of the steam generator tubing with respect to the implementation of the voltage-based repair criteria as specified in NRC Generic Letter 95-05. This document provides the projected probability of burst and leak rate calculations needed for submittal to the NRC. This report provides a non-proprietary summary of the results. The supporting proprietary calculations and necessary code verifications required for safety-related calculations are contained in Reference 23.

THE FOLLOWING COMPUTER CODES HAVE BEEN USED IN THIS DOCUMENT:

CODE/VERSION/REV	CODE/VERSION/REV
lkr97v30.exe / Version 3.0	pob97v20.exe / Version 2.0

THE DOCUMENT CONTAINS ASSUMPTIONS THAT MUST BE VERIFIED PRIOR TO USE ON SAFETY-RELATED WORK

☐ YES
☒ NO

RECORD OF REVISIONS

Revision Number	Affected Page(s)	Description of Change(s)
000	All	Original Release

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Glossary of Acronyms

Term	Definition
AONDB	Axial ODSCC Not Detected by Bobbin
ARC	Alternate Repair Criteria
BOC	Beginning of Cycle
CDS	Computer Data Screening
CPDF	Cumulative Probability Distribution Function
CFR	Code of Federal Regulations
CLT	Cold-Leg Thinning
DCPP	Diablo Canyon Power Plant
DIS	Distorted ID Support Signal with possible Indication
DOS	Distorted OD Support Signal with possible Indication
DNF	Degradation Not Found
EFPD	Effective Full Power Day
EFPY	Effective Full Power Year
ECT	Eddy Current Test
EOC	End of Cycle
FS	Free Span
AREVA	Framatome Advanced Nuclear Power
GL	NRC Generic Letter 95-05
GPM	Gallons per Minute
INR	Indication Not Reportable
ISI	In-service Inspection
LRL	Lower Repair Limit
LU	Lookup
MSLB	Main Steam Line Break
NDE	Non Destructive Examination
NDD	No Degradation Detected
NRC	Nuclear Regulatory Commission
ODSCC	Outside Diameter Stress Corrosion Cracking
PG&E	Pacific Gas and Electric Company
POB	Probability of Burst
POD	Probability of Detection
POPCD	Probability of Prior Cycle Detection
POL	Probability of Leak
PWSCC	Primary Water Stress Corrosion Cracking
RPC	Rotating Pancake Coil
RSS	Retest Support Plate Signal
RTS	Return to Service
SG	Steam Generator
SER	Safety Evaluation Report
TS	Technical Specification
TSP	Tube Support Plate
VDG	Voltage Dependent Growth

1.0 Introduction

The Diablo Canyon Power Plant (DCPP) Unit 2 completed the thirteenth cycle of operation and subsequent steam generator ISI in May 2006. The unit employs four Westinghouse-designed Model 51 SGs with ⅞-inch OD mill annealed alloy 600 tubing and ¾-inch carbon steel drilled-hole tube support plates. It should be noted that 2R13 was the last planned inspection of these SGs, as they are to be replaced at EOC-14.

In accordance with the Generic Letter 95-05, ARC implementation requires a pre-startup assessment (Ref. 1) and a 90-day post-startup tube integrity assessment. The NRC Generic Letter 95-05, Reference 2, outlines an alternate repair criterion (ARC) for allowing tubes containing ODSCC indications to remain in service if the indications are contained within the TSP structure and the measured Bobbin voltage is ≤2.0 volts. A complete list of criteria for excluding TSP intersections from ARC application is provided in section 1.b of Reference 2 and in Reference 3. The NRC has approved implementation of the voltage-based repair criteria at both DCPP units per Reference 3. The steam generator TSP inspection results and the postulated MSLB leak rate and tube burst probabilities are summarized in this report. AREVA uses Monte Carlo codes, as described in References 4 and 5, to provide the burst and leak rate analysis simulations. These evaluations are based on the methods in Reference 6 (for burst) and the slope sampling method for calculating the leak rate as defined in Section 9.5 of Reference 8. These evaluations also use the voltage-dependent POPCD (Probability of Prior Cycle Detection) and the new growth methods as defined in References 16, 25, and 28, and approved by the NRC in Reference 29.

2.0 Executive Summary

During the 2R13 inspection, a total of 2457 DOS indications were detected with the bobbin coil. There were an additional 56 support plate intersections that were identified as containing AONDB (axial ODSCC not detected by bobbin). Since there were no DOS indications at these intersections, a bobbin voltage was inferred from the +Point™ results per the methodology provided in Reference 8.

There were 32 DOS indications greater than the lower repair limit of 2.0 volts. All of these indications were confirmed as axial ODSCC with +Point™ and were subsequently plugged. An additional 33 DOS and AONDB indications less than or equal to 2 volts were also plugged for other reasons, located in the wedge region, same TSP as ligament indication, ID/OD at same TSP, AONDB at dent >5 volts, or pluggable indications at another location in the same tube. Only one DOS was preventively repaired for high +Point™ volts.

A review of the growth rates over the previous cycle shows that axial ODSCC at support plates is most active in SG 2-4. SG 2-4 had the highest average growth rate, the highest percentage growth rate and the highest individual growth points of the entire population, consistent with past inspections. Voltage dependent growth was only evident in SGs 2-3 and 2-4. SGs 2-1 and 2-2 showed no effects of voltage dependent growth. Following the DCPP Unit 2 2R11 inspection in 2003, a significant amount of analysis and evaluation was performed on voltage growth for ODSCC at TSPs (Reference 14). The evaluations primarily involved statistical breakpoint analyses to determine where the data suggests a change in the slope of the regression curve that defines the growth data. These efforts led to the development of guidelines for determining the breakpoints and growth distributions. These guidelines were provided to the NRC via Reference 24, and were used to determine the breakpoints and growth distributions for the current OA.

The POB and leak rate projections for EOC-14 provided in this report use the DCPP-specific POPCD. The use of the voltage-dependent POPCD was approved in Reference 29. The updated POPCD correlation is provided in Section 6. Using the DCPP-specific POPCD, a conservatively estimated cycle length, and the conservative growth rate analyses discussed in Section 3.2, the projected POB at EOC-14 for the limiting steam generator (SG 2-4) was determined to be 5.94×10^{-3}. The projected leak rate for the limiting generator (SG 2-4) was 3.75 gpm. Both of these results are below the acceptance criteria of 1×10^{-2} and 10.5 gpm, respectively.

Section 5 provides the as-found EOC-13 condition monitoring results and results of a benchmarking study that compares the projected EOC-13 conditions to the as-found conditions. The as-found leak rate and POB at EOC-13 for the limiting steam generator (SG 2-4) were determined to be 0.78 gpm and 5.57×10^{-4}, respectively, and are both below the acceptance criteria of 10.5 gpm and 1×10^{-2}. The prior cycle operation assessment was recalculated using the actual cycle length and as shown in Section 6, the recalculated EOC-13 POB, leak rate, and number of indications were conservative in all cases compared to EOC-13 actual conditions.

3.0 EOC-13 Inspection Results and Voltage Growth Rates

3.1 EOC-13 Inspection Results

The DCPP 2R13 bobbin coil inspection consisted of a 100% full-length bobbin coil examination of in-service tubes in all four steam generators except for Rows 1 and 2 U-bends which were inspected with +Point™. All in-service TSP intersections in the hot and cold legs were inspected with 0.720" replaceable feet bobbin probes.

Special interest +Point™ examinations were conducted as follows in support of the voltage-based ARC, and in accordance with the Degradation Assessment (Ref. 9) and Surveillance Test Procedure STP M-SGTI (Ref. 12).

- 100% of DOS ≥ 1.7 volts
- 100% of DOS in dented intersections
- 100% of DIS (distorted ID support signal at dented intersection)
- 100% of hot leg SPR (Support Plate Residual) ≥ 2.3 volts; minimum of five largest hot leg SPRs in each steam generator
- 100% of prior cycle AONDB indications
- 100% of new DOS in cold leg thinning region
- Dented TSP examinations
- Other Special Interest or test programs that may test TSP intersections

Based upon the bobbin inspection of all steam generators, a total of 2457 indications were identified. The results of the inspections are summarized as follows:

1) Voltage Dependent Growth was evident in SGs 2-3 and 2-4, but was not occurring in SGs 2-1 and 2-2.
2) 32 DOS indications were greater than the lower repair limit (2.0 volts). Each of the indications confirmed as ODSCC, required repair by plugging, and were distributed as follows: 2 in SG 2-1, 1 in SG 2-2, 3 in 2-3, and 26 in SG 2-4. Table 3-1 lists the DOS indications that were above the LRL.
3) No indications were identified that exceeded the upper repair limit of 5.57 volts.
4) One less than or equal to 2.0 volt bobbin indication exceeded the 1.9 volt +Point™ threshold for preventive plugging, per industry guidance in Reference 8. R33C55 in SG 2-4 had a 1.94 volt DOS and a 2.07 volt +Point™ axial indication that was preventively plugged.
5) 64 indications at 56 TSP intersections were identified as AONDB (axial ODSCC not detected by bobbin). Table 3-2 lists the indications that were identified as AONDB. These are +Point™ indications of axial ODSCC that have no signal present in the bobbin coil data (no DOS signal). These locations are typically smaller voltage ODSCC, by +Point™, and can be accompanied by a dent that masks any bobbin signal. Per Reference 8, a methodology has been developed to assign a bobbin voltage based on a correlation to the +Point™ voltage. Once the calculated voltages are obtained per Reference 17, the locations are subjected to exclusion criteria defined in Reference 12. All inferred voltages were small, less than about 0.96 equivalent bobbin volts.

6) Overall, 65 DOS/AONDB indications were in tubes that were repaired during 2R13. The breakdown is: 3 in SG 2-1, 6 in SG 2-2, 3 in SG 2-3, and 53 in SG 2-4. This population was used in computing the BOC-14 distributions for the OA calculations.

The average voltage was 0.64 volts, including AONDB indications. The 2R12 average was 0.61 volts. The average voltage for new DOS indications was 0.37v, excluding prior AONDB. The majority of the largest voltages were detected in SG 2-4, with the highest overall average voltage of 0.73 volts. Table 3-3 summarizes the voltage distributions for the as-found condition of the indications, the repaired indications, indications returned to service that were either confirmed by +Point™ or not inspected with +Point™ and the total indications returned to service. 32 confirmed DOS had to be repaired because they exceeded the 2-volt repair limit. The main reasons for repair of the other 33 DOS/AONDB included DOS < 2.0 volts (preventively, as discussed below), wedge exclusion criterion, AONDB at >5 volt dent, combined ID/OD degradation at the same intersection, or other pluggable tube degradation.

Reference 8 provides guidelines for preventive tube repair of less than or equal to 2.0 volt bobbin indications to reduce the potential for finding large voltage growth rates for indications left in service. PG&E committed to implement the guideline by performing +Point™ inspection of 100% of greater than 1.7 volt bobbin indications, and to repair any +Point™ confirmed ODSCC with +Point™ amplitude greater than 1.9 volts, as this could be near throughwall and potentially result in a large voltage growth rate in the next cycle. 27 less than 2.0 volt bobbin indications were therefore +Point™ inspected in 2R13 (that would not have been inspected otherwise) to meet this commitment. All of the indications were confirmed as ODSCC and the +Point™ and bobbin voltages were reviewed. Figures 3-38 to 3-41 plot all of the ODSCC +Point™ voltages versus bobbin voltages. For bobbin amplitudes less than 2.0 volts, only one +Point™ amplitude was greater than 1.9 volts (see Figure 3-41 for SG 2-4), therefore the tube was required to be preventively plugged per the guideline. This tube (R33C55 in SG 2-4) had a bobbin indication of 1.94 volts and a +Point™ indication of 2.07 volts. No other tubes were repaired less than this criterion. Therefore, it is concluded that the preventive plugging program used at 2R13 meets PG&E's commitment to the NRC.

The largest +Point™ amplitude found in 2R13 was 2.89 volts with a DOS voltage of 4.16, and the largest bobbin voltage growth rate was 1.92 v/EFPY.

The +Point™ inspections required for DOS indications were accomplished as a part of the special interest exams. 306 +Point™ inspections were performed where DOS indications were called by bobbin, excluding the AONDB intersections. Of these inspections, 244 were confirmed yielding an overall confirmation rate of about 80%. However, when excluding the cold leg DOS signals from this count (none of which have ever confirmed as crack-like at DCPP), the confirmation rate is 89%, which is typical at DCPP.

The 2R13 +Point™ TSP inspection scope also included intersections with signals that could potentially mask or cause a flaw to be missed or misread. These inspections included dented intersections based on the criteria in the degradation assessment (Ref. 9) and hot leg intersections with support plate residuals (SPR) ≥ 2.3 volts. Per GL 95-05, a large mixed residual is one that could cause a 1.0 volt bobbin signal to be missed or misread. In Reference 9, DCPP determined that a 2.3 volt SPR is the upper 95th value that could potentially mask bobbin indications ≥ 1.0 volt. Per the inspection requirements specified in References 9 and

12, all hot leg intersections with SPRs with voltages ≥ 2.3 volts were inspected with +Point™. In addition, References 9 and 12 require that, if there are less than five hot leg SPRs ≥ 2.3 volts in a given steam generator, the five largest hot leg SPRs in that steam generator should be inspected with +Point™. A total of 3 hot leg SPRs ≥ 2.3 volts were identified and inspected, with no indications detected. Since none of the steam generators contained five SPRs ≥ 2.3 volts, the five largest hot leg SPRs were inspected in each steam generator resulting in a total of 20 inspected with +Point™. No confirmed ODSCC indications were detected from these +Point™ inspections.

Figures 3-1 and 3-2 show the as-found voltage distribution (including AONDB) for all indications detected during the 2R13 inspection. Figures 3-3 and 3-4 show the indications removed from service at 2R13. Figures 3-5 and 3-6 illustrate the indications returned to service that were confirmed as axial ODSCC or were not inspected with RPC. Figures 3-7 and 3-8 illustrate all of the indications returned to service following the 2R13 ECT inspection. Table 3-1 lists all of the indications greater than the 2.0-volt lower repair limit. As previously stated, all of these indications were confirmed as axial ODSCC and were removed from service by plugging.

Of all the DOS indications returned to service, the largest bobbin voltage was 2.00 volts. This indication confirmed as two axial ODSCC indications with +Point™ voltages of 0.99 and 0.98 v. The single largest +Point™ voltage indication returned to service was 1.79 v, with a corresponding DOS bobbin voltage of 1.79 volts.

There were 223 intersections returned to service that contained confirmed axial ODSCC at dented TSP intersections. 53 were AONDB intersections and 170 were confirmed bobbin DOS indications. 207 of these intersections contained dents ≤2.0 v and 16 of these intersections contained dents between 2 and 5 volts, and there were no intersections containing >5 volt dent since it is an exclusion criteria. The largest bobbin voltage indication returned to service with a dent at the same TSP was 1.93 volts and confirmed as a 1.38v SAI. The largest +Point™ indication with a dent at the same TSP returned to service is 1.55 v, and has a corresponding DOS of 1.49 volts.

The DOS voltage distribution as a function of TSP elevation is provided in Table 3-5. Table 3-5 and Figure 3-9 show that the ODSCC mechanism is most active at the lower hot leg TSPs and the number of indications tends to decrease as a function of higher TSP elevations. This distribution shows the typical temperature dependence of ODSCC.

Table 3-5 and Figure 3-9 include a small number of cold leg DOS indications that were NDD by +Point™ based on the +Point™ inspection of new cold leg DOS (with no prior Plus Point inspections) located in the cold leg thinning region. 100% of cold leg DOS had been +Point™ inspected in the prior inspection (2R12) to define and validate the cold leg thinning region. No cold leg ODSCC has been confirmed by +Point™ to date at DCPP. Non-confirmed bobbin DOS indications in the cold leg are conservatively retained in the ODSCC ARC calculations.

3.2 *Voltage Growth Rates*

For projection of leak rates and tube burst probabilities at EOC-14, voltage growth rates were developed from the 2R12 and 2R13 inspection data. Cycle 13 was 1.31 EFPY in length per Reference 12. For repeat indications reported as DOS in both inspections, growth rates were determined based on comparison of the voltages called in 2R12 and 2R13. For indications not reported during the 2R12 inspection (i.e. new at 2R13), the indications were sized using the 2R12 ECT signals based on a lookup review. Lookups were also performed for all of the 2R13 DOS locations that were previously reported as DIS. In both of these cases, an OD component could not be always found in the bobbin lookup results, and these intersections were excluded from the growth distributions.

Table 3-4 provides a summary of indications with the largest growth during Cycle 13. Table 3-5 provides the maximum and average voltage growth distribution by TSP. Table 3-6 provides the average BOC voltage, average growth rate data and average percent growth for the last six cycles at DCPP-2. Figure 3-13 depicts this information graphically.

Table 3-7 shows the voltage independent growth distributions for each SG, the composite distribution for all four SGs, and the cumulative probability distribution function for each distribution. Figures 3-10 and 3-11 show the voltage growth distributions depicted in bar charts. Figure 3-12 provides the CPDF curves of the voltage growth distributions. Reviewing the Table 3-5 average and maximum voltage growth for all indications for each SG as well as the number of new indications in each SG shows that the ODSCC mechanism is most active in SG 2-4. This phenomenon of a leading SG in plants affected by ODSCC is common in the industry. Reviewing Table 3-6 and Figures 3-10 and 3-11 also supports this conclusion.

As discussed in Section 3.2.1 below, the Cycle 13 growth rates for each SG were less than Cycle 12 growth rates. There were 412 newly reported DOS indications in 2R13, the largest of which was 1.40 volts. 368 of these new indications were detected during the 2R12 lookup, sized appropriately, and subsequently included in the growth distributions. There were 42 new DOS indications that were not detected during the lookup and were, therefore, not included in the growth rate analyses. The largest of these new indications not present in the look up was 1.0v in SG 2-4 R35C65 2H. This particular location was AONDB in the previous inspection (See Section 3.7 and Table 3-22) and had an assigned voltage of 0.78 volts in 2R12. The upper 95% growth rates of all new and repeat indications were 0.18 and 0.31 v/EFPY, respectively. The average growth rates for new and repeat indications were 0.04 and 0.07 v/EFPY, respectively. These data confirm that the new indications continue to grow at a slower rate than the previously detected indications, consistent with prior inspection results at DCPP.

3.2.1 *Selection of Limiting Growth Distribution for Each Steam Generator*

In June 2004, PG&E received a set of RAIs from the NRC on their submittal for a permanent POPCD approval. The responses to these RAIs were provided in Reference 25. In response to one of the questions, PG&E prepared a guideline for determining the appropriate growth distribution to use for the operational assessments. This guideline was used for the determination of the growth rates used for the EOC-14 projections provided in this document. This guideline either meets, or is more conservative than the guidance provided in References 2 and 6 and Enclosure 3 of Reference 24.

The first step in determining the most conservative growth distribution for each steam generator is to compare the SG-specific and the composite growth distributions for each of the last two cycles. These comparisons are initially done without considering the impact of voltage dependent growth. In order to determine which growth distribution to use for each steam generator in the next operational assessment, four different growth curves must be compared (SG-specific for Cycle 12, SG-specific for Cycle 13, composite for Cycle 12, and composite for Cycle 13). Worth noting is the fact that Cycle 12 had no BOC indications >1.2 volts returned to service for Cycle 12, due to the preventive repairs conducted at 2R11. Therefore, the Cycle 12 growth data is supplemented with Cycle 11 growth for BOC indications >1.2 volts at BOC-11. This approach is consistent with the 2R12 90 day report.

Figures 3-14 through 3-17 provide graphical comparisons of growth for each steam generator. All of the figures consistently show that the bounding curve comes from the supplemented Cycle 12 growth data (either SG-specific or composite), except in the case for SG 2-1. For SG 2-1, it was not apparent from the curves themselves which was bounding. Therefore, leak rate and probability of burst analyses were performed using both the SG 2-1 specific supplemented Cycle 12 growth and the composite supplemented Cycle 12 growth. These analyses showed that the SG 2-1 specific growth bounds the composite growth. For SG 2-4, the supplemented Cycle 12 SG-specific curve is bounding over the composite curve for supplemented Cycle 12, and all curves from Cycle 13. For SGs 2-2 and 2-3, the supplemented Cycle 12 composite curve is clearly bounding. In summary, for EOC-14 projections, supplemented Cycle 12 growth data was used for all SGs. SGs 2-1 and 2-4 used SG-specific curves, and SGs 2-2 and 2-3 used SG-composite curves.

3.2.2 Voltage-Dependent Growth Analyses for Cycle 13

Even though the Cycle 12 growth rates were determined to be bounding, the voltage-dependent growth analyses for the Cycle 13 data are documented in this report for possible future reference. For Cycle 13, growth rates were plotted against the BOC voltage for all steam generators, including a composite curve. Their data are shown in Figures 3-18 through 3-22. As demonstrated by the figures, a positive slope exists only in SGs 2-1, 2-3, 2-4 and for the composite data. The slope is negative in SG 2-2. A threshold slope of 0.1 was defined in Reference 25 as the point at which voltage-dependent growth should be considered in the operational assessment. Therefore SGs 2-1 and 2-2 are considered not to be experiencing VDG. The slope of the curve for SG 2-3 is slightly above this value at 0.113, with VDG apparent in SG 2-4 with a slope of 0.194.

Voltage-dependent growth is not a new concept, and has been documented by the operators of European steam generators affected by ODSCC. Because of their higher repair limits, their data encompass a much broader and higher range of data than at DCPP and the US plants and provides significant basis for the VDG approach.

A significant amount of analysis and evaluation was performed following the 2R11 inspection on voltage growth for ODSCC at TSPs. The evaluations primarily involved statistical breakpoint analysis to determine where the data suggests a change in the slope of the regression curve that defines the growth data. These efforts led to the development of a guidelines document for determining the breakpoints. This document was transmitted to the NRC via Enclosure 3 of Reference 24 and currently resides in Reference 8. These methods were used to determine breakpoints for the Cycle 13 growth data.

Cycle 13 VDG breakpoint analyses were performed for SGs 2-3 and 2-4 and for a composite growth distribution (including all steam generators). Figures 3-23 through 3-25 show the scatter charts and the resulting breakpoints for all of these analyses. The analysis for SG 2-3 yielded a single breakpoint at 0.89 volts, and SG 2-4 yielded two breakpoints at 1.06v and 1.53v. The composite analysis also yielded two breakpoints at 0.88v and 1.50v. Tables 3-8 through 3-10 and Figures 3-26 through 3-28 provide the growth distributions and cumulative probability distribution function (CPDF) curves, respectively, for the Cycle 13 VDG analysis, for information only. These tables and figures reflect the results after application of the delta volts adjustments as discussed in Section 3.2.4 of this report. As shown in Figures 3-26 through 3-28, the growth rates for the higher VDG bins bound the lower bins, indicating it would be conservative to apply voltage dependent growth in EOC-14 projections if Cycle 13 growth was to be used.

3.2.3 Voltage-Dependent Growth Analyses for Cycle 12

As discussed in Section 3.2.1, the supplemented Cycle 12 growth rates were determined to bound the Cycle 13 growth rates. This section provides the VDG breakpoint analyses for the growth curves used in the EOC-14 Monte Carlo analyses. In the case of SGs 2-1 and 2-4, SG-specific growth was bounding and in the case of SGs 2-2 and 2-3, the composite growth was bounding.

Tables 3-11 through 3-13 and Figures 3-29 through 3-31 provide the results of the breakpoint analyses for the 2R12 inspection. These tables are similar to those provided in the 2R12 90 day report (Reference 27) except that the delta volts adjustments from Section 3.2.4 of this report were applied in lieu of the delta volts adjustments from Reference 27. SG-specific VDG curves for SG 2-1 and SG 2-4 are provided, as well as a composite VDG analysis curve. As shown in the figures, SG 2-1 had a single breakpoint at 1.12v, SG 2-4 had two breakpoints at 0.47 and 1.03v, and the composite analysis had breakpoints at 1.10 and 1.71 volts. These are the breakpoints that will be utilized in the EOC-14 projections, since the Cycle 12 supplemented growth is bounding. The CPDF curves of the Cycle 12 supplemented growth resulting from these breakpoints are included in Figures 3-32 through 3-34. These figures are similar to those provided in Reference 27 except for the application of the delta volts adjustments.

3.2.4 Delta Volts Adjustment

Another part of the growth guideline provided in Reference 25 involves implementation of a "delta volts adjustment" when implementing POPCD in operational assessment calculations. The purpose of this adjustment is to account for the possibility that the growth rates may increase over the next operating cycle. The intent of the adjustment procedure is to increase growth in a specific VDG bin when a comparison between cycle N and cycle N-1 indicates such. The growth rate guidelines that PG&E committed to utilize in combination with POPCD do not specifically address the case where growth rates decrease over subsequent cycles. The guidelines were written on the premise that once VDG is experienced, increasing growth would likely continue to occur. This is not the case in comparing Cycles 12 and 13. However, PG&E conservatively interprets the adjustment procedure applicable to this analysis, even though Cycle 12 is bounding.

The amount of the adjustment is determined by comparing the average growth from Cycle 13 to the average growth from Cycle 12 for each VDG bin. Tables 3-14 and 3-15 provide the details for the Cycle 13 and Cycle 12 breakpoints, respectively. Per the Reference 25 guideline, if the Cycle 13 data has a higher average growth rate than the Cycle 12 data, then the difference between the average growth rates would be added to each growth rate value in the distribution being used prior to binning the data. Per Table 3-14, if Cycle 13 growth rates were being used in the Cycle 14 operational assessment, a small growth adjustment would be required in SG 2-3 Bin 2. Table 3-15 shows a slight increase in the average growth rate for Bin 2 in SG 2-3 when using the Cycle 12 supplemented growth breakpoints. However, the SG-specific curve is not being used for SG 2-3 operational assessment; therefore, no adjustment is required for any of the EOC-14 projections documented in this report.

3.2.5 Growth Summary

As discussed in Section 3.2.1, supplemented Cycle 12 growth bounds Cycle 13 growth in all cases. Based on the Cycle 12 SG-specific versus composite growth evaluations, a composite curve should be used for SGs 2-2 and 2-3 and a SG-specific curve should be used for SGs 2-1 and 2-4 for EOC-14 projections.

Tables 3-11 through 3-13 show the supplemented Cycle 12 growth distributions that were used in the Monte Carlo analyses for EOC-14. These curves are shown graphically in Figures 3-32 through 3-34. As mentioned in Section 3.2.3, these tables and figures are similar to those found in the 2R12 90 day report (Reference 27) except for the application of the delta volts adjustments. As required by Generic Letter 95-05, the negative growth values were included as zero growth rates in the ARC calculations.

3.3 *Voltage Distributions Used for Monte Carlo Analyses*

Now that the breakpoints for the growth bins have been established (from supplemented Cycle 12 data), the BOC-14 voltage distributions to be used in the Monte Carlo simulations can be defined. Table 3-3 shows the voltage distributions for the as-found and repaired indications. Additional voltage bins must be inserted at the value of the VDG breakpoints, as shown in Table 3-16: an additional voltage bin at 1.12v was inserted into the SG 2-1 voltage distribution, an additional voltage bin at 1.71v was inserted into the voltage distributions for SGs 2-2 and 2-3, and two additional bins at 0.47 and 1.03 volts were inserted into the SG 2-4 voltage distribution. Adding these additional voltage bins forces the Monte Carlo simulation codes to apply each VDG growth distribution to the correct number of indications.

3.4 *Probe Wear Criteria*

In order to maintain consistent detection and sizing capabilities throughout the inspection, probe wear is monitored by following the requirements of Reference 15, which is documented in Reference 13. The first NRC requirement regarding probe wear is to minimize the potential for tubes to be inspected with a probe that had failed the probe wear check. This was accomplished by implementing the bobbin Examination Technique Specification Sheet (ETSS) #1 (Ref. 11), which required the probe have its feet replaced when failing the probe wear check, or in the case of non-changeable feet probes, the probe discarded. Review of the probe wear log sheets and the eddy current test results indicate that no tubes were inspected with a probe known to have failed the probe wear check.

If the DOS voltage is at or above the retest threshold (1.5 volts or higher) and the cal is designated as "ARC Out" on the cal board, the indication code is changed from a DOS to a RSS (retest support plate signal) indicating that a retest is required with a new probe. No new indications were detected in the tubes when retested with the new probe.

The 2R13 eddy current inspection resulted in 21 bobbin indications in excess of 1.5 volts that were inspected with a worn probe, termed as RSS (retest support signal) indications. Table 3-17 shows these RSS indications, including any less than 1.5 volt DOS indications in the same tube inspected with a worn probe, along with the retested DOS indications in a subsequent calibration group with a good probe. Figure 3-35 shows a comparison of the worn probe and good probe voltages. The final acceptable DOS voltage values compare reasonably well with the RSS voltages. In the majority of cases, the voltage of the DOS was lower than the corresponding RSS. The average change between the initial voltages (both DOS and RSS) relative to the final DOS call was 4.18%. There was only one instance (R21C79 in SG 2-4) where the final DOS indication (2.05 volts) exceeded the RSS indication (1.76 volts) by more than 15% (16.5%).

The next requirement involves monitoring tubes that contain new DOS indications that were inspected with probes that failed the wear check in the previous outage. This evaluation is intended to look for "new" large indications or a non-proportionately large percentage of "new" indications in tubes that failed the check in the previous outage. Table 3-18 shows the new 2R13 DOS indications that were ≥0.5 volts and were inspected on cal groups that failed the probe wear check in 2R12. As shown in Table 3-18, with the exception of R45C57 in SG 2-3, there are no newly reported DOS indications greater than 1 volt in tubes that were inspected with worn probes in 2R12. The lookup voltage for R45C57 for 2R12 was 1.37 volts and the 2R13 DOS voltage was 1.4 volts showing that the voltage change was not due to a probe wear condition, but a matter of POD. Additionally, about 75% of the new indications were < 0.5 volts in 2R12 based on the historical lookups performed. This also indicates that new indications are more a result of probability of detection rather than whether the tube was inspected with a worn probe in 2R12. The percentages do not indicate that a disproportionate number of new DOS >0.5 are present in tubes that were inspected with a worn probe in the previous outage.

Table 3-19 summarizes new DOS indications for probe wear comparisons. Overall there were 2457 DOS indications detected in the 2R13 inspection. 387 (about 16%) of the DOS indications were truly new indications (not reported as DIS in 2R12). Of the 387 total new indications, 108 (about 28%) were in tubes inspected with a worn probe in 2R12 and 279 were in tubes inspected with a good probe in 2R12. Additionally, the number of new indications ≥ 0.5 volts was determined to be 81. Out of these, 25 (about 31%) were in tubes that were inspected with a worn probe in 2R12. This confirms that a tube tested with a worn probe in 2R12 is no more likely to contain a large DOS in 2R13 than a tube tested with a good probe in 2R12.

Additionally, the 2R12 results were reviewed to determine the number of inspections performed with probes that passed and failed the probe wear check. These results are shown in Table 3-20. This review showed that the number of inspections performed with "ARC OUT" probes was 3661, compared to 9825 inspections that were performed with "ARC IN" probes. This total number of examinations is greater than the number of tubes in service because several tubes have multiple examinations. The ratio of ARC OUT tube inspections to the total number of bobbin inspections is about 0.27 (or 27%). This percentage is nearly equivalent to the percentage of new DOSs that was previously inspected with worn probes (about 28%). This demonstrates that the number of new indications is not biased towards the tubes that were inspected with worn probes in 2R12.

In summary, the NRC analysis requirements regarding probe wear monitoring were met during the 2R13 bobbin coil inspection and a more stringent wear tolerance is not required at DCPP.

3.5 Upper Voltage Repair Limit

Per Generic Letter 95-05, the upper repair limit must be calculated prior to each outage. The more conservative of the plant-specific average growth rate per EFPY or 30 percent per EFPY should be used as the anticipated growth rate input for this calculation. Since the average growth rate for Cycle 12 was 23.8% (Ref. 27 and Table 3-6), the required 30%/EFPY was used for the upper repair limit calculation. The structural limit used for this calculation is based on the Addendum 6 database. Based on the following formula, the upper repair limit was calculated to be 5.57v.

$$V_{URL} = \frac{V_{SL}}{1 + \frac{\%V_{NDE}}{100} + \frac{\%V_{CG}}{100}}$$

where:
V_{URL} = upper voltage repair limit,
V_{NDE} = NDE voltage measurement uncertainty = 20%,
V_{CG} = voltage growth anticipated between inspections = 30%/EFPY x 1.62 EFPY = 48.6%,
V_{SL} = voltage structural limit from the burst pressure – Bobbin voltage correlation, where the limit of 9.40 volts was used based on Reference 8.

3.6 NDE Uncertainty Distributions

NDE uncertainties must be taken into account when projecting the end-of-cycle voltages for the next operating cycle. The NDE uncertainties used in the calculations of the EOC-13 voltages are described in Reference 6. The acquisition uncertainty was sampled from a normal distribution with a mean of zero, a standard deviation of 7%, and a cutoff limit of 15% based on the use of the probe wear standard. The analyst uncertainty was sampled from a normal distribution with a mean of zero, a standard deviation of 10.3%, and no cutoff limit. These uncertainty distributions are shown in Table 3-21 and Figure 3-36.

3.7 +Point™ to Bobbin Voltage Correlation

In Reference 28, PG&E committed to providing an assessment in each 90-day report to ensure that the bobbin voltages assigned to AONDB indications continue to be conservative. That is, for those prior cycle AONDB indications that become detectable by bobbin (DOS), this assessment was to include a review of the current cycle bobbin voltages against the expected bobbin voltages assuming that all of these indications grew at the average growth rate for the DOS population.

In 2R12, 58 AONDB were returned to service for Cycle 13. 21 of these AONDB indications were reported with bobbin as DOS in 2R13 and the remaining 37 remained AONDB. Table 3-22 provides the growth rate (volt/EFPY) comparison of inferred to DOS (apparent growth), inferred to inferred, and +Point™ to +Point™. Comparing the 2R12 inferred voltage to the 2R13 DOS voltage (apparent growth), results in an average increase of 0.016 v/EFPY, which is about one-fourth of the average growth rate for DOS indications detectable in both inspections, 0.063 v/EFPY. Growth rates using inferred to inferred and +Point™ to +Point™ both indicate an average growth of 0.025v/EFPY, which is also less than the average of the DOS population.

As a prudent measure, the bobbin to +Point™ voltage correlation continues to be assessed by comparing the inferred bobbin voltages against the measured bobbin voltages for all of the intersections that had both bobbin DOS indications and +Point™ indications of axial ODSCC. The 2R13 +Point™ indications were assigned bobbin voltages based on the following equation from Reference 17.

$$V_{Bobbin-95UCL} = V_{+PT} * 1.0161 + 0.2835 + \sqrt{0.00024 + 0.0011(V_{+PT} - 0.45)^2}$$

For cases where more than one +Point™ indication was reported at the same intersection, each indication was assigned an inferred voltage. These multiple voltages were then combined via the square root of the sum of the squares method (SRSS) to obtain a single inferred bobbin voltage for those intersections.

These inferred bobbin voltages were then compared to the measured bobbin voltages to ensure that the inferred voltages are generally conservative relative to the measured bobbin voltages. There were a total of 245 intersections with DOS indications that were confirmed as containing axial ODSCC with +Point™. In 152 of these 245 cases (about 62%), the inferred voltage was over predicted relative to the measured bobbin voltage. The average difference between the inferred voltages and the measured voltages was a 0.03v over-prediction, indicating conservatism in the voltage correlation across the entire data set.

In 2R13, the largest inferred voltage for an AONDB indication was 0.96v. Since the +Point™ to bobbin voltage correlation was only used for intersections with inferred voltages less than 0.96v, this is the voltage range of interest for this comparison. When only the inferred voltages less than 0.96v are considered, 108 of 146 (about 74%) inferred voltages were over predicted relative to the measured voltage. The average difference between the inferred voltages and the measured bobbin voltages for this population was a 0.10v over-prediction.

Figure 3-37 shows these comparisons graphically. This figure shows the inferred voltages plotted against the measured bobbin voltages. The linear regression fit shows that, in the region of interest (<0.96 inferred volts), the inferred bobbin voltage is comparable to the measured bobbin voltage. Based on the facts that about 74% of the voltages are over predicted and the average difference in voltages is a 0.10v over-prediction in the range of voltages where it is utilized, the +Point™ to bobbin voltage correlation is shown to provide reasonable and conservative results at 2R13.

Table 3-1: 2R13 DOS >2 Volts

SG	Row	Col	Ind	Elev	Volts
21	5	45	DOS	1H	2.23
21	13	39	DOS	1H	2.39
22	19	85	DOS	2H	2.07
23	12	8	DOS	2H	2.13
23	20	32	DOS	1H	2.1
23	22	52	DOS	2H	3.19
24	1	60	DOS	2H	3.75
24	6	56	DOS	1H	2.05
24	6	64	DOS	2H	3.82
24	7	10	DOS	2H	2.81
24	7	78	DOS	3H	4.16
24	8	69	DOS	2H	2.19
24	8	76	DOS	2H	3.09
24	11	73	DOS	2H	2.23
24	11	79	DOS	3H	2.63
24	12	90	DOS	2H	2.67
24	13	88	DOS	2H	3.32
24	14	36	DOS	2H	2.58
24	14	69	DOS	2H	2.05
24	16	84	DOS	2H	2.99
24	18	70	DOS	2H	2.06
24	18	71	DOS	2H	2.91
24	19	79	DOS	2H	2.05
24	20	43	DOS	2H	2.35
24	21	42	DOS	1H	2.18
24	21	79	DOS	2H	2.05
24	30	16	DOS	2H	2.25
24	36	34	DOS	3H	3.99
24	38	25	DOS	2H	2.26
24	38	61	DOS	2H	3.24
24	40	30	DOS	1H	2.14
24	40	47	DOS	2H	2.01

Table 3-2: 2R13 AONDB Indications

SG	Row	Col	Elev	+Pt Ind	+Pt Volts	Reason for Repair	Dent Voltage	Inferred Bobbin Volts	
								Indication	Intersection
21	2	47	2H	SAI	0.19		0.89	0.494	0.494
21	17	9	3H	SAI	0.14		0.41	0.444	0.444
21	44	55	1H	SAI	0.13		0.85	0.434	0.434
21	44	57	2H	SAI	0.12		0.51	0.424	0.424
22	4	29	1H	SAI	0.25	AONDB @ >5V DENT @ 1H	23.65	0.554	0.554
22	8	13	1H	SAI	0.20		2.47	0.504	0.504
22	8	30	1H	SAI	0.25		2.22	0.554	0.554
22	13	22	1H	SAI	0.17		3.88	0.474	0.474
22	14	42	1H	SAI	0.25		2.81	0.554	0.554
22	14	50	1H	SAI	0.16		2.64	0.464	0.464
22	15	41	1H	SAI	0.32	AONDB @ >5V DENT @ 1H	9.01	0.625	0.625
22	17	42	1H	SAI	0.30		3.73	0.605	0.605
22	19	45	1H	SAI	0.34		0.65	0.645	0.645
22	19	75	1H	SAI	0.27		0.86	0.574	0.574
22	22	28	2H	SAI	0.17		1.87	0.474	0.474
22	22	62	1H	SAI	0.14		0.96	0.444	0.444
22	24	40	2H	SAI	0.18		1.12	0.484	0.484
22	25	8	1H	SAI	0.23		2.03	0.534	0.534
22	25	46	2H	SAI	0.40		1.26	0.706	0.706
22	26	17	3H	SAI	0.12		0.39	0.424	0.659
22	26	17	3H	SAI	0.20			0.504	
22	27	50	3H	SAI	0.18		0.36	0.484	0.484
22	29	36	2H	SAI	0.12		0.52	0.424	0.424
22	31	22	2H	SAI	0.32		1.47	0.625	0.625
22	33	22	1H	SAI	0.17		0.42	0.474	0.474
22	35	67	2H	SAI	0.11		0.42	0.414	0.414
22	37	46	2H	SAI	0.28		1.4	0.584	0.584
22	45	39	2H	SAI	0.46		1.3	0.766	0.766
23	5	66	3H	SAI	0.19		1.84	0.494	0.494
23	13	58	1H	SAI	0.26		0.71	0.564	0.564
23	17	80	1H	SAI	0.49		1.4	0.797	0.959
23	17	80	1H	SAI	0.23			0.534	
23	19	77	2H	SAI	0.11		0.84	0.414	0.579
23	19	77	2H	SAI	0.10			0.404	
23	22	10	1H	SAI	0.15		0.44	0.454	0.454
23	26	80	2H	SAI	0.11		0.9	0.414	0.414
23	29	61	1H	SAI	0.11		0.72	0.414	0.891
23	29	61	1H	SAI	0.31			0.615	
23	29	61	1H	SAI	0.19			0.494	
23	29	66	2H	SAI	0.15		0.43	0.454	0.454
23	30	15	1H	SAI	0.24		0.65	0.544	0.544
23	33	35	2H	SAI	0.08		0.69	0.385	0.385
23	33	57	2H	SAI	0.15		0.43	0.454	0.650
23	33	57	2H	SAI	0.16			0.464	
23	35	71	1H	SAI	0.07		0.2	0.375	0.375

Table 3-2: 2R13 AONDB Indications									
SG	Row	Col	Elev	+Pt Ind	+Pt Volts	Reason for Repair	Dent Voltage	Inferred Bobbin Volts	
								Indication	Intersection
23	37	61	1H	SAI	0.13		1.39	0.434	0.434
24	2	21	3H	SAI	0.28		2.88	0.584	0.584
24	2	36	2H	SAI	0.18		0.72	0.484	0.484
24	5	27	1H	SAI	0.10		0.83	0.404	0.404
24	7	40	3H	SAI	0.10		3.85	0.404	0.404
24	8	41	1H	SAI	0.27		0.52	0.574	0.574
24	10	29	3H	SAI	0.17		1.52	0.474	0.474
24	11	37	4H	SAI	0.27		0.3	0.574	0.703
24	11	37	4H	SAI	0.10		0.3	0.404	0.703
24	16	36	1H	SAI	0.14		0.32	0.444	0.703
24	16	36	1H	SAI	0.24		0.32	0.544	0.703
24	22	16	1H	SAI	0.29		0.71	0.595	0.595
24	22	21	3H	SAI	0.11	SAI-ID/OD @ 3H	2.8	0.414	0.414
24	22	22	3H	SAI	0.15		0.88	0.454	0.454
24	24	10	1H	SAI	0.21		0.85	0.514	0.514
24	25	27	1H	SAI	0.13		1.05	0.434	0.434
24	27	19	3H	SAI	0.11		0.35	0.414	0.414
24	30	36	3H	SAI	0.27		3.37	0.574	0.574
24	42	61	1H	SAI	0.15		0.8	0.454	0.454

Table 3-3: Summary of Inspection and Repair for Tubes Affected by ODSCC at TSPs

	SG 2-1				SG 2-2				SG 2-3			
Voltage Bin	As-Found EOC-13	Repaired Tubes	DOSs Returned to Service		As-Found EOC-13	Repaired Tubes	DOSs Returned to Service		As-Found EOC-13	Repaired Tubes	DOSs Returned to Service	
			Conf. ODSCC or Not Insp w/ +Pt	Total			Conf. ODSCC or Not Insp w/ +Pt	Total			Conf. ODSCC or Not Insp w/ +Pt	Total
0.1	0	0	0	0	0	0	0	0	2	0	2	2
0.2	47	0	47	47	37	0	35	37	30	0	28	30
0.3	83	1	81	82	66	0	61	66	46	0	42	46
0.4	106	0	101	106	85	0	81	85	66	0	64	66
0.5	62	0	60	62	71	2	67	69	50	0	46	50
0.6	57	0	54	57	53	1	49	52	35	0	34	35
0.7	44	0	42	44	44	1	40	43	27	0	27	27
0.8	30	0	30	30	31	0	30	31	25	0	23	25
0.9	27	0	26	27	15	0	15	15	12	0	12	12
1	17	0	17	17	14	0	14	14	9	0	9	9
1.1	17	0	17	17	8	0	8	8	5	0	5	5
1.2	9	0	9	9	7	1	6	6	4	0	4	4
1.3	4	0	4	4	7	0	7	7	2	0	2	2
1.4	11	0	11	11	8	0	8	8	4	0	4	4
1.5	3	0	3	3	3	0	3	3	5	0	5	5
1.6	6	0	6	6	3	0	3	3	2	0	2	2
1.7	2	0	2	2	2	0	2	2	3	0	3	3
1.8	1	0	1	1	0	0	0	0	1	0	1	1
1.9	1	0	1	1	1	0	1	1	0	0	0	0
2	2	0	2	2	0	0	0	0	1	0	1	1
2.1	0	0	0	0	1	1	0	0	1	1	0	0
2.2	0	0	0	0	0	0	0	0	1	1	0	0
2.3	1	1	0	0	0	0	0	0	0	0	0	0
2.4	1	1	0	0	0	0	0	0	0	0	0	0
2.5	0	0	0	0	0	0	0	0	0	0	0	0
2.6	0	0	0	0	0	0	0	0	0	0	0	0
2.7	0	0	0	0	0	0	0	0	0	0	0	0
2.8	0	0	0	0	0	0	0	0	0	0	0	0
2.9	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
>3	0	0	0	0	0	0	0	0	1	1	0	0
Total	531	3	514	528	456	6	430	450	332	3	314	329
>1V	58	2	56	56	40	2	38	38	30	3	27	27
>2V	2	2	0	0	1	1	0	0	3	3	0	0

Table 3-3 (cont): Summary of Inspection and Repair for Tubes Affected by ODSCC at TSPs

	SG 2-4				Composite of All SGs			
Voltage Bin	As-Found EOC-13	Repaired Tubes	DOSs Returned to Service		As-Found EOC-13	Repaired Tubes	DOSs Returned to Service	
			Conf. ODSCC or Not Insp w/ +Pt	Total			Conf. ODSCC or Not Insp w/ +Pt	Total
0.1	1	0	1	1	3	0	3	3
0.2	43	0	39	43	157	0	149	157
0.3	117	2	112	115	312	3	296	309
0.4	168	4	160	164	425	4	406	421
0.5	144	5	137	139	327	7	310	320
0.6	128	2	126	126	273	3	263	270
0.7	118	4	114	114	233	5	223	228
0.8	69	2	67	67	155	2	150	153
0.9	77	3	74	74	131	3	127	128
1	62	0	62	62	102	0	102	102
1.1	57	1	56	56	87	1	86	86
1.2	43	1	42	42	63	2	61	61
1.3	33	0	33	33	46	0	46	46
1.4	39	2	37	37	62	2	60	60
1.5	24	0	24	24	35	0	35	35
1.6	13	0	13	13	24	0	24	24
1.7	12	0	12	12	19	0	19	19
1.8	4	0	4	4	6	0	6	6
1.9	5	0	5	5	7	0	7	7
2	11	1	10	10	14	1	13	13
2.1	6	6	0	0	8	8	0	0
2.2	3	3	0	0	4	4	0	0
2.3	3	3	0	0	4	4	0	0
2.4	1	1	0	0	2	2	0	0
2.5	0	0	0	0	0	0	0	0
2.6	1	1	0	0	1	1	0	0
2.7	2	2	0	0	2	2	0	0
2.8	0	0	0	0	0	0	0	0
2.9	1	1	0	0	1	1	0	0
3	2	2	0	0	2	2	0	0
>3	7	7	0	0	8	8	0	0
Total	1194	53	1128	1141	2513	65	2386	2448
>1V	267	31	236	236	395	38	357	357
>2V	26	26	0	0	32	32	0	0

Table 3-4: Summary of Largest Voltage Growth Rates per EFPY

SG	Row	Col	Elev	Volts	Prev Volts (2R12)	Growth/EFPY	+Pt	New?
2-4	6	64	2H	3.82	1.3	1.924	SAI	Repeat
2-4	7	78	3H	4.16	1.72	1.863	SAI	Repeat
2-4	1	60	2H	3.75	1.41	1.786	SAI	Repeat
2-4	36	34	3H	3.99	1.92	1.580	SAI	Repeat
2-3	22	52	2H	3.19	1.40	1.366	SAI	Repeat
2-4	12	90	2H	2.67	0.990	1.282	SAI	Repeat
2-4	13	88	2H	3.32	1.67	1.260	SAI	Repeat
2-4	38	61	2H	3.24	1.65	1.214	SAI	Repeat
2-4	11	79	3H	2.63	1.22	1.076	SAI	Repeat
2-4	18	71	2H	2.91	1.63	0.977	SAI	Repeat
2-4	16	84	2H	2.99	1.80	0.908	SAI	Repeat
2-4	7	10	2H	2.81	1.640	0.893	SAI	Repeat
2-4	8	76	2H	3.09	1.94	0.878	SAI	Repeat
2-1	17	20	1H	1.47	0.34	0.863	Not Insp	Repeat
2-1	12	86	1H	1.79	0.74	0.802	SAI	Repeat
2-1	2	28	1H	1.51	0.50	0.771	Not Insp	Repeat
2-4	20	43	2H	2.35	1.410	0.718	SAI	Repeat
2-2	5	61	2H	1.20	0.27	0.710	Not Insp	Repeat
2-4	38	25	2H	2.26	1.38	0.672	SAI	Repeat
2-4	19	79	2H	2.05	1.20	0.649	SAI	Repeat
2-4	23	21	1H	1.18	0.35	0.634	Not Insp	Repeat
2-4	14	22	2H	1.18	0.35	0.634	Not Insp	Repeat
2-4	25	56	2H	1.11	0.30	0.618	Not Insp	Repeat
2-4	7	56	3H	1.97	1.18	0.603	SAI	Repeat
2-1	24	30	1H	1.32	0.54	0.595	Not Insp	Repeat
2-3	17	18	3H	1.63	0.85	0.595	Not Insp	Repeat
2-4	16	59	1H	1.12	0.35	0.588	Not Insp	Repeat
2-3	36	76	2H	1.38	0.62	0.580	Not Insp	Repeat
2-4	11	73	2H	2.23	1.48	0.573	SAI	Repeat
2-1	13	39	1H	2.39	1.68	0.542	SAI	Repeat
2-4	14	36	2H	2.58	1.87	0.542	SAI	Repeat
2-4	16	43	1H	1.07	0.37	0.534	Not Insp	Repeat
2-4	10	79	2H	1.59	0.89	0.534	Not Insp	Repeat
2-3	12	8	2H	2.13	1.43	0.534	SAI	Repeat
2-4	37	64	2H	1.14	0.45	0.527	Not Insp	Repeat
2-4	16	74	2H	1.37	0.69	0.519	Not Insp	Repeat
2-1	5	45	1H	2.23	1.55	0.519	SAI	Repeat
2-4	23	40	3H	1.91	1.23	0.519	SAI	Repeat
2-4	23	64	2H	1.81	1.14	0.511	SAI	Repeat
2-4	40	30	1H	2.14	1.48	0.504	SAI	Repeat
2-2	12	88	3H	1.01	0.35	0.504	Not Insp	Repeat
2-4	17	37	1H	1.25	0.59	0.504	Not Insp	Repeat

Table 3-5: DOS/AONDB Voltage and Growth Distribution by TSP

Tube Support Plate	SG 2-1					Tube Support Plate	SG 2-2				
	No. of Indications	Max Voltage	Average Voltage	Max Growth/ EFPY	Average Growth/ EFPY		No. of Indications	Max Voltage	Average Voltage	Max Growth/ EFPY	Average Growth/ EFPY
1H	323	2.39	0.60	0.86	0.05	1H	155	1.82	0.57	0.19	0.02
2H	114	1.93	0.47	0.24	0.00	2H	179	2.07	0.56	0.71	0.03
3H	38	1.54	0.52	0.13	0.01	3H	67	1.51	0.49	0.50	0.03
4H	7	0.82	0.42	0.13	-0.01	4H	22	1.07	0.50	0.19	0.00
5H	22	1.07	0.53	0.30	0.03	5H	3	0.84	0.62	0.20	0.04
6H	6	1.18	0.68	0.39	0.06	6H	1	0.41	0.41	0.05	0.05
7H						7H	2	0.59	0.43	0.06	-0.06
CL	21	1.03	0.53	0.17	0.05	CL	27	0.63	0.39	0.20	0.01
All Inds	531	2.39	0.56	0.86	0.03	All Inds	456	2.07	0.54	0.71	0.02

Tube Support Plate	SG 2-3					Tube Support Plate	SG 2-4				
	No. of Indications	Max Voltage	Average Voltage	Max Growth/ EFPY	Average Growth/ EFPY		No. of Indications	Max Voltage	Average Voltage	Max Growth/ EFPY	Average Growth/ EFPY
1H	171	2.1	0.58	0.38	0.05	1H	419	2.18	0.69	0.63	0.07
2H	108	3.19	0.54	1.37	0.05	2H	502	3.82	0.84	1.92	0.13
3H	26	1.63	0.51	0.60	0.04	3H	178	4.16	0.64	1.86	0.09
4H	2	0.5	0.40	-0.01	-0.09	4H	66	1.34	0.55	0.32	0.06
5H	6	0.77	0.43	0.05	-0.02	5H	8	0.81	0.50	0.27	0.05
6H	1	0.51	0.51	0.15	0.15	6H	1	0.3	0.30	0.08	0.08
7H	1	0.16	0.16	-0.04	-0.04	7H					
CL	17	0.75	0.39	0.25	0.07	CL	20	0.51	0.33	0.11	-0.01
All Inds	332	3.19	0.55	1.37	0.05	All Inds	1194	4.16	0.73	1.92	0.09

Tube Support Plate	Composite of All Four SGs				
	No. of Indications	Max Voltage	Average Voltage	Max Growth/ EFPY	Average Growth/ EFPY
1H	1068	2.39	0.63	0.86	0.05
2H	903	3.82	0.70	1.92	0.08
3H	309	4.16	0.58	1.86	0.07
4H	97	1.34	0.53	0.32	0.04
5H	39	1.07	0.51	0.30	0.03
6H	9	1.18	0.59	0.39	0.07
7H	3	0.59	0.34	0.06	-0.05
CL	85	1.03	0.41	0.25	0.03
All Inds	2513	4.16	0.63	1.92	0.06

Table 3-6: DCPP-2 Voltage Growth for Cycles 8 through 13

		SG 2-1	SG 2-2	SG 2-3	SG 2-4	All
Cycle 8	Avg BOC Volts	0.34	0.36	0.40	0.42	0.39
	Average Growth Per EFPY	0.05	0.05	-0.01	0.06	0.05
	Average Percent Growth Per EFPY	16.0%	15.2%	-1.9%	14.3%	13.3%
Cycle 9	Avg BOC Volts	0.388	0.362	0.324	0.387	0.377
	Avg Growth Per EFPY	0.04	0.09	0.17	0.17	0.13
	Average Percent Growth Per EFPY	9.2%	24.2%	52.0%	44.7%	35.6%
Cycle 10	Avg BOC Volts	0.42	0.43	0.48	0.53	0.49
	Avg Growth Per EFPY	0.14	0.08	0.12	0.20	0.16
	Average Percent Growth Per EFPY	33.2%	19.0%	25.5%	37.5%	33.4%
Cycle 11	Avg BOC Volts	0.42	0.44	0.38	0.51	0.47
	Avg Growth Per EFPY	0.13	0.10	0.13	0.23	0.18
	Average Percent Growth Per EFPY	30.9%	23.5%	34.7%	45.3%	38.7%
Cycle 12	Avg BOC Volts	0.42	0.43	0.45	0.50	0.46
	Avg Growth Per EFPY	0.11	0.09	0.05	0.14	0.11
	Average Percent Growth Per EFPY	25.3%	19.8%	11.2%	27.4%	23.8%
Cycle 13	Avg BOC Volts	0.52	0.51	0.49	0.61	0.56
	Avg Growth Per EFPY	0.03	0.02	0.05	0.09	0.06
	Average Percent Growth Per EFPY	6.5%	4.9%	10.5%	15.3%	11.3%

Table 3-7: Summary of Independent Cycle 13 Voltage Growth per EFPY

Delta Volts Per EFPY	SG 2-1		SG 2-2		SG 2-3		SG 2-4		Total	
	No. of Obs.	CPDF	No. of Obs.	CPDF	No. of Obs.	CPDF	No. of Obs.	CPDF	No. of Obs.	CPDF
<=0.0	225	0.430	182	0.425	109	0.354	281	0.243	797	0.330
0.1	210	0.832	181	0.848	119	0.740	479	0.657	989	0.740
0.2	62	0.950	53	0.972	45	0.886	225	0.852	385	0.899
0.3	13	0.975	5	0.984	22	0.958	95	0.934	135	0.955
0.4	3	0.981	4	0.993	7	0.981	27	0.958	41	0.972
0.5	4	0.989	1	0.995	2	0.987	19	0.974	26	0.983
0.6	3	0.994	1	0.998	3	0.997	11	0.984	18	0.990
0.7	0	0.994	0	0.998	0	0.997	6	0.989	6	0.993
0.8	1	0.996	1	1.000	0	0.997	1	0.990	3	0.994
0.9	2	1.000	0	1.000	0	0.997	2	0.991	4	0.995
1	0	1.000	0	1.000	0	0.997	2	0.993	2	0.996
1.1	0	1.000	0	1.000	0	0.997	1	0.994	1	0.997
1.2	0	1.000	0	1.000	0	0.997	0	0.994	0	0.997
1.3	0	1.000	0	1.000	0	0.997	3	0.997	3	0.998
1.4	0	1.000	0	1.000	1	1.000	0	0.997	1	0.998
1.5	0	1.000	0	1.000	0	1.000	0	0.997	0	0.998
1.6	0	1.000	0	1.000	0	1.000	1	0.997	1	0.999
1.7	0	1.000	0	1.000	0	1.000	0	0.997	0	0.999
1.8	0	1.000	0	1.000	0	1.000	1	0.998	1	0.999
1.9	0	1.000	0	1.000	0	1.000	1	0.999	1	1.000
2	0	1.000	0	1.000	0	1.000	1	1.000	1	1.000
>2	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
Total	523	NA	428	NA	308	NA	1156	NA	2415	NA
Upper 95% Growth	0.198		0.183		0.280		0.351		0.282	

Table 3-8: Cycle 13 Voltage Dependent Growth for SG 2-3 (Information Only)

Growth (volts/EFPY)	Cycle 13 Data	
	Bin1 (<=0.89v)	Bin2 (>0.89v)
<0	100	8
0.1	116	4
0.2	41	3
0.3	17	6
0.4	3	3
0.5	1	2
0.6	2	1
0.7	0	0
0.8	0	0
0.9	0	0
1	0	0
1.1	0	0
1.2	0	0
1.3	0	0
1.4	0	1
1.5	0	0
1.6	0	0
1.7	0	0
1.8	0	0
1.9	0	0
>2	0	0
Total	280	28

Table 3-9: Cycle 13 Voltage Dependent Growth for SG 2-4 (Information Only)

Growth (volts/EFPY)	Cycle 13 Data		
	Bin1 (<=1.06v)	Bin2 (1.07v-1.53v)	Bin3 (>1.53v)
<0	261	19	1
0.1	447	28	4
0.2	190	34	1
0.3	74	15	6
0.4	17	8	2
0.5	10	8	1
0.6	6	4	1
0.7	3	3	0
0.8	0	1	0
0.9	0	0	2
1	0	0	2
1.1	0	1	0
1.2	0	0	0
1.3	1	0	2
1.4	0	0	0
1.5	0	0	0
1.6	0	0	1
1.7	0	0	0
1.8	0	1	0
1.9	0	0	1
2	0	1	0
>2	0	0	0
Total	1009	123	24

Table 3-10: Cycle 13 Voltage Dependent Growth for All SGs (Information Only)

Growth (volts/EFPY)	Cycle 13 Data		
	Bin1 (<=0.88v)	Bin2 (0.89v-1.5v)	Bin3 (>1.5v)
<0	705	89	3
0.1	887	95	7
0.2	305	76	4
0.3	90	39	6
0.4	20	17	4
0.5	12	13	1
0.6	9	6	3
0.7	3	3	0
0.8	2	1	0
0.9	2	0	2
1	0	0	2
1.1	0	1	0
1.2	0	0	0
1.3	0	1	2
1.4	0	1	0
1.5	0	0	0
1.6	0	0	1
1.7	0	0	0
1.8	0	1	0
1.9	0	0	1
2	0	1	0
>2	0	0	0
Total	2035	344	36

Table 3-11: Cycle 12 Supplemented Voltage Dependent Growth for SG 2-1 (Used for SG 2-1 EOC-14 Projections)

Growth (volts/EFPY)	Cycle 12 Data		Cycle 11 Data		Combined	
	Bin1 (<=1.12v)	Bin2 (>1.12v)	Bin1 (<=1.12v)	Bin2 (>1.12v)	Bin1 (<=1.12v)	Bin2 (>1.12v)
<0	75	0	0	3	75	3
0.1	198	0	0	1	198	1
0.2	86	2	0	1	86	3
0.3	43	0	0	1	43	1
0.4	19	1	0	0	19	1
0.5	6	0	0	0	6	0
0.6	2	0	0	0	2	0
0.7	2	0	0	0	2	0
0.8	2	0	0	0	2	0
0.9	1	0	0	2	1	2
1	2	0	0	0	2	0
1.1	1	0	0	0	1	0
1.2	0	0	0	0	0	0
1.3	0	0	0	0	0	0
1.4	0	0	0	0	0	0
1.5	0	0	0	0	0	0
1.6	0	0	0	1	0	1
1.7	0	0	0	0	0	0
1.8	0	0	0	0	0	0
1.9	0	0	0	0	0	0
2	0	0	0	0	0	0
2.1	0	0	0	0	0	0
2.2	0	0	0	0	0	0
2.3	0	0	0	1	0	1
2.4	0	0	0	0	0	0
2.5	0	0	0	0	0	0
2.6	0	0	0	1	0	1
2.7	0	0	0	0	0	0
2.8	0	0	0	0	0	0
2.9	0	0	0	1	0	1
3	0	0	0	0	0	0
3.1	0	0	0	0	0	0
3.2	0	0	0	0	0	0
>3.2	0	0	0	0	0	0
Total	437	3	0	12	437	15

Table 3-12: Cycle 12 Supplemented Voltage Dependent Growth for All SGs (Used for SGs 2-2, and 2-3 EOC-14 Projections)

Growth (volts/EFPY)	Cycle 12 Data			Cycle 11 Data			Combined		
	Bin1 (<=1.1v)	Bin2 (1.11v-1.71v)	Bin3 (>1.71v)	Bin1 (<=1.1v)	Bin2 (1.11v-1.71v)	Bin3 (>1.71v)	Bin1 (<=1.1v)	Bin2 (1.11v-1.71v)	Bin3 (>1.71v)
<0	293	7	0	0	11	0	293	18	0
0.1	856	4	0	0	7	2	856	11	2
0.2	468	9	0	0	5	0	468	14	0
0.3	192	9	0	0	6	2	192	15	2
0.4	75	2	0	0	1	0	75	3	0
0.5	29	4	0	0	1	0	29	5	0
0.6	18	3	0	0	2	1	18	5	1
0.7	9	0	0	0	3	0	9	3	0
0.8	4	0	0	0	2	0	4	2	0
0.9	3	0	0	0	4	0	3	4	0
1	2	1	0	0	1	0	2	2	0
1.1	1	0	0	0	1	0	1	1	0
1.2	0	0	0	0	2	0	0	2	0
1.3	0	0	0	0	2	0	0	2	0
1.4	0	0	0	0	1	1	0	1	1
1.5	1	0	0	0	1	2	1	1	2
1.6	0	0	0	0	2	1	0	2	1
1.7	0	0	0	0	0	1	0	0	1
1.8	0	0	0	0	1	0	0	1	0
1.9	0	0	0	0	1	1	0	1	1
2	0	0	0	0	1	0	0	1	0
2.1	0	0	0	0	0	0	0	0	0
2.2	0	0	0	0	3	1	0	3	1
2.3	0	0	0	0	2	0	0	2	0
2.4	0	0	0	0	0	0	0	0	0
2.5	0	0	0	0	1	0	0	1	0
2.6	0	0	0	0	1	1	0	1	1
2.7	0	0	0	0	0	2	0	0	2
2.8	0	0	0	0	0	0	0	0	0
2.9	0	0	0	0	0	1	0	0	1
3	0	0	0	0	0	1	0	0	1
3.1	0	0	0	0	0	0	0	0	0
3.2	0	0	0	0	0	0	0	0	0
>3.2	0	0	0	0	0	0	0	0	0
Total	1951	39	0	0	62	17	1951	101	17

Table 3-13 Cycle 12 Supplemented Voltage Dependent Growth for SG 2-4 (Used for SG 2-4 EOC-14 Projections)

Growth (volts/EFPY)	Cycle 12 Data			Cycle 11 Data			Combined		
	Bin1 (<=0.47v)	Bin2 (0.48v-1.038v)	Bin3 (>1.038v)	Bin1 (<=0.47v)	Bin2 (0.48v-1.038v)	Bin3 (>1.038v)	Bin1 (<=0.47v)	Bin2 (0.48v-1.038v)	Bin3 (>1.038v)
<0	47	25	3	0	0	6	47	25	9
0.1	286	98	5	0	0	8	286	98	13
0.2	134	122	10	0	0	4	134	122	14
0.3	47	68	6	0	0	7	47	68	13
0.4	3	38	3	0	0	1	3	38	4
0.5	4	11	6	0	0	1	4	11	7
0.6	1	10	5	0	0	3	1	10	8
0.7	3	3	0	0	0	2	3	3	2
0.8	0	1	0	0	0	2	0	1	2
0.9	0	1	1	0	0	2	0	1	3
1	0	0	1	0	0	1	0	0	2
1.1	0	0	0	0	0	0	0	0	0
1.2	0	0	0	0	0	2	0	0	2
1.3	0	0	0	0	0	2	0	0	2
1.4	0	0	0	0	0	1	0	0	1
1.5	0	1	0	0	0	3	0	1	3
1.6	0	0	0	0	0	2	0	0	2
1.7	0	0	0	0	0	0	0	0	0
1.8	0	0	0	0	0	1	0	0	1
1.9	0	0	0	0	0	2	0	0	2
2	0	0	0	0	0	1	0	0	1
2.1	0	0	0	0	0	0	0	0	0
2.2	0	0	0	0	0	4	0	0	4
2.3	0	0	0	0	0	1	0	0	1
2.4	0	0	0	0	0	0	0	0	0
2.5	0	0	0	0	0	1	0	0	1
2.6	0	0	0	0	0	1	0	0	1
2.7	0	0	0	0	0	1	0	0	1
2.8	0	0	0	0	0	0	0	0	0
2.9	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	1	0	0	1
3.1	0	0	0	0	0	0	0	0	0
3.2	0	0	0	0	0	0	0	0	0
>3.2	0	0	0	0	0	0	0	0	0
Total	525	378	40	0	0	60	525	378	100

Table 3-14: Delta Volts Adjustments Based on Cycle 13 Breakpoints (Information Only)

SG	Cycle	Breakpoint(s)	Average Growth (Volts per EFPY)		
			Bin1	Bin2	Bin3
2-1	Cycle 12	NA	0.126	NA	NA
	Cycle 13		0.033		
	Delta		<0		
2-2	Cycle 12	NA	0.102	NA	NA
	Cycle 13		0.025		
	Delta		<0		
2-3	Cycle 12	0.89	0.046	0.152	NA
	Cycle 13		0.040	0.167	
	Delta		<0	+0.015	
2-4	Cycle 12	1.06/1.53	0.130	0.509	1.051
	Cycle 13		0.071	0.201	0.544
	Delta		<0	<0	<0
Composite	Cycle 12	0.88/1.50	0.101	0.337	1.212
	Cycle 13		0.046	0.126	0.418
	Delta		<0	<0	<0

Table 3-15: Delta Volts Adjustments Based on Cycle 12 Breakpoints

SG	Cycle	Breakpoint(s)	Average Growth (Volts per EFPY)		
			Bin1	Bin2	Bin3
2-1	Cycle 12	1.12	0.105	0.722	NA
	Cycle 13		0.031	0.075	
	Delta		<0	<0	
2-2	Cycle 12	1.00	0.083	0.540	NA
	Cycle 13		0.023	0.046	
	Delta		<0	<0	
2-3	Cycle 12	0.96	0.046	0.171	NA
	Cycle 13		0.041	0.192	
	Delta		<0	+0.021	
2-4	Cycle 12	0.47/1.03	0.095	0.178	0.638
	Cycle 13		0.057	0.084	0.248
	Delta		<0	<0	<0
Composite	Cycle 12	1.10 / 1.71	0.108	0.514	1.542
	Cycle 13		0.050	0.188	0.552
	Delta		<0	<0	<0

Table 3-16: BOC-14 Voltage Distributions

	SG 2-1			SG 2-2		SG 2-3	
Bin	As-Found	Repaired	Bin	As-Found	Repaired	As-Found	Repaired
0.1	0	0	0.1	0	0	2	0
0.2	47	0	0.2	37	0	30	0
0.3	83	1	0.3	66	0	46	0
0.4	106	0	0.4	85	0	66	0
0.5	62	0	0.5	71	2	50	0
0.6	57	0	0.6	53	1	35	0
0.7	44	0	0.7	44	1	27	0
0.8	30	0	0.8	31	0	25	0
0.9	27	0	0.9	15	0	12	0
1	17	0	1	14	0	9	0
1.1	17	0	1.1	8	0	5	0
1.12	2	0	1.2	7	1	4	0
1.2	7	0	1.3	7	0	2	0
1.3	4	0	1.4	8	0	4	0
1.4	11	0	1.5	3	0	5	0
1.5	3	0	1.6	3	0	2	0
1.6	6	0	1.7	2	0	3	0
1.7	2	0	1.71	0	0	0	0
1.8	1	0	1.8	0	0	1	0
1.9	1	0	1.9	1	0	0	0
2	2	0	2	0	0	1	0
2.1	0	0	2.1	1	1	1	1
2.2	0	0	2.2	0	0	1	1
2.3	1	1	2.3	0	0	0	0
2.4	1	1	2.4	0	0	0	0
2.5	0	0	2.5	0	0	0	0
2.6	0	0	2.6	0	0	0	0
2.7	0	0	2.7	0	0	0	0
2.8	0	0	2.8	0	0	0	0
2.9	0	0	2.9	0	0	0	0
3	0	0	3	0	0	0	0
3.1	0	0	3.1	0	0	0	0
3.2	0	0	3.2	0	0	1	1
Total	531	3		456	6	332	3

Table 3-16 (cont): BOC-14 Voltage Distributions

Bin	SG 2-4	
	As-Found	Repaired
0.1	1	0
0.2	43	0
0.3	117	2
0.4	168	4
0.47	96	4
0.5	48	1
0.6	128	2
0.7	118	4
0.8	69	2
0.9	77	3
1	62	0
1.03	17	1
1.1	40	0
1.2	43	1
1.3	33	0
1.4	39	2
1.5	24	0
1.6	13	0
1.7	12	0
1.8	4	0
1.9	5	0
2	11	1
2.1	6	6
2.2	3	3
2.3	3	3
2.4	1	1
2.5	0	0
2.6	1	1
2.7	2	2
2.8	0	0
2.9	1	1
3	2	2
3.1	1	1
3.2	0	0
3.3	1	1
3.4	1	1
3.5	0	0
3.6	0	0
3.7	0	0
3.8	1	1
3.9	1	1
4	1	1
4.1	0	0
4.2	1	1
Total	**1194**	**53**

Table 3-17: Re-tested DOSs that Failed the Probe Wear Check

SG	Row	Col	Ind	Elev	Volts	Probe	Cal No.	ARC Out 2R13	% Difference
2-2	6	46	RSS	2H	1.71	720RF	CL - 32	Yes	
	6	46	DOS	2H	1.58	720RF	CL - 39		-7.6%
	16	64	RSS	1H	1.65	720RF	HL - 8	Yes	
	16	64	DOS	1H	1.82	720RF	CL - 37		10.3%
	16	64	DOS	2H	0.27	720RF	HL - 8		
	16	64	DOS	2H	0.21	720RF	CL - 37		-22.2%
	22	28	RSS	1H	1.66	720RF	CL - 19	Yes	
	22	28	DOS	1H	1.36	720RF	CL - 37		-18.1%
2-3	16	61	RSS	1H	1.63	720RF	CL - 26	Yes	
	16	61	DOS	1H	1.47	720RF	CL - 40		-9.8%
	18	48	RSS	1H	1.85	720RF	CL - 27	Yes	
	18	48	DOS	1H	1.78	720RF	CL - 32		-3.8%
	21	42	RSS	2H	1.56	720RF	CL - 26	Yes	
	21	42	DOS	2H	1.48	720RF	CL - 32		-5.1%
	27	51	RSS	1H	1.57	720RF	HL - 11	Yes	
	27	51	DOS	1H	1.35	720RF	CL - 41		-14.0%
	15	39	RSS	2H	1.62	720RF	CL - 26	Yes	
	15	39	DOS	2H	1.55	720RF	CL - 48		-4.3%
2-4	15	23	RSS	1H	1.57	720RF	CL - 22	Yes	
	15	23	DOS	1H	1.5	720RF	CL - 30		-4.5%
	18	70	RSS	2H	2.23	720RF	HL - 9	Yes	
	18	70	DOS	2H	2.06	720RF	CL - 28		-7.6%
	18	70	DOS	4H	0.52	720RF	HL - 9	Yes	
	18	70	DOS	4H	0.45	720RF	CL - 28		-13.5%
	19	77	RSS	2H	1.91	720RF	HL - 9	Yes	
	19	77	DOS	2H	1.78	720RF	CL - 28		-6.8%
	19	79	RSS	2H	1.87	720RF	HL - 12	Yes	
	19	79	DOS	2H	2.05	720RF	CL - 28		9.6%
	19	79	DOS	3H	0.45	720RF	HL - 12	Yes	
	19	79	DOS	3H	0.35	720RF	CL - 28		-22.2%
	21	79	DOS	1H	0.22	720RF	HL - 12	Yes	
	21	79	DOS	1H	0.31	720RF	CL - 28		40.9%
	21	79	RSS	2H	1.76	720RF	HL - 12	Yes	
	21	79	DOS	2H	2.05	720RF	CL - 28		16.5%
	21	79	DOS	4H	0.61	720RF	HL - 12	Yes	
	21	79	DOS	4H	0.81	720RF	CL - 28		32.8%
	24	75	RSS	2H	2.1	720RF	HL - 9	Yes	
	24	75	DOS	2H	1.92	720RF	CL - 28		-8.6%
	26	28	RSS	3H	1.5	720RF	CL - 16	Yes	
	26	28	DOS	3H	1.39	720RF	CL - 28		-7.3%
	31	31	RSS	1H	1.78	720RF	CL - 16	Yes	
	31	31	DOS	1H	1.93	720RF	CL - 28		8.4%

Table 3-17: Re-tested DOSs that Failed the Probe Wear Check

SG	Row	Col	Ind	Elev	Volts	Probe	Cal No.	ARC Out 2R13	% Difference
2-4	31	31	DOS	2H	1.47	720RF	CL - 16	Yes	
	31	31	DOS	2H	1.42	720RF	CL - 28		-3.4%
	36	32	RSS	2H	1.52	720RF	CL - 16	Yes	
	36	32	DOS	2H	1.36	720RF	CL - 28		-10.5%
	36	32	DOS	3H	0.67	720RF	CL - 16	Yes	
	36	32	DOS	3H	0.6	720RF	CL - 28		-10.4%
	36	34	DOS	1H	0.41	720RF	CL - 17	Yes	
	36	34	DOS	1H	0.41	720RF	CL - 28		0.0%
	36	34	RSS	3H	4.61	720RF	CL - 17	Yes	
	36	34	DOS	3H	3.99	720RF	CL - 28		-13.4%
	36	34	DOS	4H	0.88	720RF	CL - 17	Yes	
	36	34	DOS	4H	0.78	720RF	CL - 28		-11.4%
	38	28	DOS	1H	1	720RF	CL - 17	Yes	
	38	28	DOS	1H	0.95	720RF	CL - 28		-5.0%
	38	28	DOS	2H	0.62	720RF	CL - 17	Yes	
	38	28	DOS	2H	0.44	720RF	CL - 28		-29.0%
	38	28	RSS	3H	2.22	720RF	CL - 17	Yes	
	38	28	DOS	3H	1.97	720RF	CL - 28		-11.3%
	40	30	RSS	1H	2.03	720RF	CL - 16	Yes	
	40	30	DOS	1H	2.14	720RF	CL - 28		5.4%
	40	46	RSS	2H	1.89	720RF	CL - 11	Yes	
	40	46	DOS	2H	1.79	720RF	CL - 28		-5.3%

Table 3-18: New 2R13 DOSs >=0.5 Volts In Tubes Inspected With A Worn Probe In 2R12

SG	Row	Col	Ind	Elev	Volts	Probe	Cal No.	ARC Out 2R13	ARC Out 2R12
SG 2-1	36	47	DOS	2H	0.63	720RF	HL - 13	Yes	Yes
SG 2-2	29	58	DOS	2H	0.87	720RF	HL - 18		Yes
	41	54	DOS	3H	0.58	720RF	HL - 18		Yes
	23	34	DOS	2H	0.56	720RF	CL - 25	Yes	Yes
	38	70	DOS	2H	0.55	720RF	HL - 14		Yes
	12	87	DOS	4C	0.52	720RF	CL - 36		Yes
	38	52	DOS	2H	0.5	720RF	HL - 16		Yes
SG 2-3	45	57	DOS	1H	1.4	720RF	HL - 14		Yes
	11	39	DOS	1H	0.85	720RF	CL - 48		Yes
	7	29	DOS	2H	0.67	720RF	CL - 46		Yes
	11	48	DOS	2H	0.58	720RF	CL - 38		Yes
	43	59	DOS	1H	0.56	720RF	HL - 14		Yes
SG 2-4	14	48	DOS	2H	0.99	720RF	CL - 25		Yes
	23	32	DOS	2H	0.83	720RF	CL - 24		Yes
	27	42	DOS	2H	0.79	720RF	CL - 12		Yes
	24	83	DOS	1H	0.77	720RF	HL - 11		Yes
	14	22	DOS	1H	0.76	720RF	CL - 23		Yes
	22	39	DOS	1H	0.69	720RF	CL - 24		Yes
	24	78	DOS	2H	0.66	720RF	HL - 10		Yes
	21	42	DOS	2H	0.64	720RF	CL - 24		Yes
	25	39	DOS	2H	0.58	720RF	CL - 25		Yes
	16	71	DOS	1H	0.56	720RF	HL - 9	Yes	Yes
	27	84	DOS	1H	0.52	720RF	HL - 11		Yes
	23	40	DOS	1H	0.52	720RF	CL - 25		Yes
	18	70	DOS	4H	0.52	720RF	HL - 9	Yes	Yes
	13	49	DOS	2H	0.51	720RF	CL - 20		Yes

Table 3-19: Summary of New DOS Indications for Probe Wear Comparison

SG	2R13 DOSs in Active Tubes (Total)	New 2R13 Not Detected in 2R12	New 2R13 Ind. In Tubes Insp. w/ Worn Probe in 2R12	New 2R13 Ind. In Tubes Insp. w/ Good Probe in 2R12	New 2R13 Ind. >=0.5 Volts	New 2R13 Ind. >=0.5 Volts in Tubes Insp. w/ Worn Probe in 2R12
2-1	527	70	9	61	8	1
2-2	433	65	17	48	12	6
2-3	319	61	21	40	11	5
2-4	1178	191	61	130	50	13
Total	2457	387	108	279	81	25

Table 3-20: Summary of ARC In and Out Tube Inspections in 2R12

SG	# ARC Out Tubes (2R12)	# ARC In Tubes (2R12)	Total # of Inspections
2-1	908	2519	3427
2-2	797	2459	3256
2-3	912	2631	3543
2-4	1044	2216	3260
Total	**3661**	**9825**	**13486**

Table 3-21: NDE Uncertainty Distributions

Analyst Uncertainty

Percent Variation	Cumulative Probability
-40.0%	0.00005
-38.0%	0.00011
-36.0%	0.00024
-34.0%	0.00048
-32.0%	0.00095
-30.0%	0.00179
-28.0%	0.00328
-26.0%	0.00580
-24.0%	0.00990
-22.0%	0.01634
-20.0%	0.02608
-18.0%	0.04027
-16.0%	0.06016
-14.0%	0.08704
-12.0%	0.12200
-10.0%	0.16581
-8.0%	0.21867
-6.0%	0.28011
-4.0%	0.34888
-2.0%	0.42302
0.0%	0.50000
2.0%	0.57698
4.0%	0.65112
6.0%	0.71989
8.0%	0.78133
10.0%	0.83419
12.0%	0.87800
14.0%	0.91296
16.0%	0.93984
18.0%	0.95973
20.0%	0.97392
22.0%	0.98366
24.0%	0.99010
26.0%	0.99420
28.0%	0.99672
30.0%	0.99821
32.0%	0.99905
34.0%	0.99952
36.0%	0.99976
38.0%	0.99989
40.0%	0.99995
Std Deviation = 10.3% Mean = 0.0% No Cutoff	

Acquisition Uncertainty

Percent Variation	Cumulative Probability
<-15.0%	0.00000
-15.0%	0.01606
-14.0%	0.02275
-13.0%	0.03165
-12.0%	0.04324
-11.0%	0.05804
-10.0%	0.07656
-9.0%	0.09927
-8.0%	0.12655
-7.0%	0.15866
-6.0%	0.19568
-5.0%	0.23753
-4.0%	0.28385
-3.0%	0.33412
-2.0%	0.38755
-1.0%	0.44320
0.0%	0.50000
1.0%	0.55680
2.0%	0.61245
3.0%	0.66588
4.0%	0.71615
5.0%	0.76247
6.0%	0.80432
7.0%	0.84134
8.0%	0.87345
9.0%	0.90073
10.0%	0.92344
11.0%	0.94196
12.0%	0.95676
13.0%	0.96835
14.0%	0.97725
15.0%	0.98394
>15.0%	1.00000
Std Deviation = 7.0% Mean = 0.0% Cutoff = +/- 15.0%	

Table 3-22: 2R12 RTS AONDB and Results in 2R13 for Each

SG	Row	Col	Elev	2R12 AONDB +Pt Volts	2R12 Inferred Bobbin Volts		2R13 Result	2R13 Bobbin Volts	2R13 +Pt Volts	2R13 Inferred Bobbin Volts	Apparent Growth (v/EFPY) (Inferred to DOS)	Inferred to Inferred Growth (v/EFPY)	+Pt to +Pt Growth (v/EFPY
					Indication	Intersection							
21	2	47	2H	0.21	0.514	0.514	AONDB		0.19	0.494		-0.015	-0.015
	22	58	2H	0.40	0.706	0.706	**DOS**	0.69	0.43	0.740	-0.012	0.026	0.023
	44	55	1H	0.09	0.395	0.395	AONDB		0.13	0.434		0.030	0.031
	44	57	2H	0.11	0.414	0.414	AONDB		0.12	0.424		0.008	0.008
22	8	13	1H	0.22	0.524	0.524	AONDB		0.2	0.504		-0.015	-0.015
	8	30	1H	0.24	0.544	0.544	AONDB		0.25	0.554		0.008	0.008
	13	22	1H	0.16	0.464	0.464	AONDB		0.17	0.474		0.008	0.008
	14	42	1H	0.23	0.534	0.534	AONDB		0.25	0.554		0.015	0.015
	17	42	1H	0.29	0.595	0.595	AONDB		0.3	0.605		0.008	0.008
	19	75	1H	0.19	0.494	0.494	AONDB		0.27	0.574		0.061	0.061
	22	28	2H	0.21	0.514	0.514	AONDB		0.17	0.474		-0.031	-0.031
	22	62	1H	0.14	0.444	0.444	AONDB		0.14	0.444		0.000	0.000
	24	40	2H	0.16	0.464	0.464	AONDB		0.18	0.484		0.015	0.015
	25	8	1H	0.24	0.544	0.544	AONDB		0.23	0.534		-0.008	-0.008
	25	46	2H	0.26	0.564	0.564	AONDB		0.4	0.706		0.108	0.107
	26	17	3H	0.18	0.484	0.484	2 AONDB		0.12, 0.20	0.659		0.133	0.015
	31	22	2H	0.30	0.605	0.605	AONDB		0.32	0.625		0.015	0.015
	37	46	2H	0.30	0.605	0.605	AONDB		0.28	0.584		-0.015	-0.015
	45	39	2H	0.44	0.746	0.746	AONDB		0.46	0.766		0.016	0.015
23	5	66	3H	0.19	0.494	0.494	AONDB		0.19	0.494		0.000	0.000
	6	76	2H	0.08	0.385	0.385	**DOS**	0.08	0.13	0.434	-0.232	0.038	0.038
	13	58	1H	0.20	0.504	0.504	AONDB		0.26	0.564		0.046	0.046
	16	32	1H	0.09	0.395	0.395	**DOS**	0.44	0.17	0.474	0.035	0.061	0.061
	18	53	2H	0.21	0.514	0.514	**DOS**	0.25	0.21	0.514	-0.202	0.000	0.000
	22	10	1H	0.14	0.444	0.444	AONDB		0.15	0.454		0.008	0.008
	24	45	1H	0.09	0.395	0.395	**DOS**	0.31	0.08	0.385	-0.065	-0.007	-0.008
	29	61	1H	0.29	0.595		AONDB		0.11				-0.137
	29	61	1H	0.16	0.464	0.842	AONDB		0.31	0.891		0.037	0.115
	29	61	1H	0.07	0.375		AONDB		0.19				0.092
	29	66	2H	0.13	0.434	0.434	AONDB		0.15	0.454		0.015	0.015

Table 3-22: 2R12 RTS AONDB and Results in 2R13 for Each

SG	Row	Col	Elev	2R12 AONDB +Pt Volts	2R12 Inferred Bobbin Volts		2R13 Result	2R13 Bobbin Volts	2R13 +Pt Volts	2R13 Inferred Bobbin Volts	Apparent Growth (v/EFPY) (Inferred to DOS)	Inferred to Inferred Growth (v/EFPY)	+Pt to +Pt Growth (v/EFPY
					Indication	Intersection							
23	33	35	2H	0.09	0.395	0.395	AONDB		0.08	0.385		-0.008	-0.008
	33	57	2H	0.17	0.474	0.636	AONDB		0.15	0.650		0.010	-0.015
	33	57	2H	0.12	0.424		AONDB		0.16				0.031
	37	19	1H	0.36	0.665	0.665	**DOS**	0.54	0.45	0.756	-0.095	0.069	0.069
	37	61	1H	0.14	0.444	0.444	AONDB		0.13	0.434		-0.008	-0.008
24	2	21	3H	0.20	0.504	0.504	AONDB		0.28	0.584		0.061	0.061
	2	36	2H	0.18	0.484	0.484	AONDB		0.18	0.484		0.000	0.000
	5	27	1H	0.14	0.444	0.444	AONDB		0.10	0.404		-0.030	-0.031
	5	67	2H	0.15	0.454	0.454	**DOS**	0.62	0.26	0.564	0.126	0.084	0.084
	7	65	3H	0.28	0.584	0.584	**DOS**	0.62	0.29	0.595	0.027	0.008	0.008
	8	41	1H	0.22	0.524	0.524	AONDB		0.27	0.574		0.038	0.038
	10	29	3H	0.12	0.424	0.424	AONDB		0.17	0.474		0.038	0.038
	10	77	3H	0.10	0.404	0.601	**DOS**	0.48	0.11	0.660	-0.092	0.045	0.008
	10	77	3H	0.14	0.444				0.20				0.046
	10	84	2H	0.22	0.524	0.687	**DOS**	0.7	0.08	0.385	0.010	-0.231	-0.107
	10	84	2H	0.14	0.444				0.24	0.544			0.076
	13	77	4H	0.14	0.444	0.444	**DOS**	0.5	0.2, 0.09	0.640	0.042	0.150	0.046
	14	7	2H	0.11	0.414	0.700	**DOS**	1.02	0.15	0.740	0.244	0.030	0.031
	14	7	2H	0.26	0.564				0.28				0.015
	16	36	1H	0.13	0.434	0.704	AONDB		0.14	0.703		-0.001	0.008
	16	36	1H	0.25	0.554		AONDB		0.24			0.000	-0.008
	19	82	2H	0.11	0.414	0.600	**DOS**	0.86	0.13	0.434	0.198	-0.127	0.015
	19	82	2H	0.13	0.434				0.18				0.038
	20	78	4H	0.21	0.514	0.514	**DOS**	0.34	0.11, 0.21	0.660	-0.133	0.111	0.000
	22	16	1H	0.27	0.574	0.574	AONDB		0.29	0.595		0.015	0.015
	22	22	3H	0.14	0.444	0.444	AONDB		0.15	0.454		0.008	0.008
	24	10	1H	0.18	0.484	0.484	AONDB		0.21	0.514		0.023	0.023
	25	27	1H	0.12	0.424	0.424	AONDB		0.13	0.434		0.008	0.008
	25	66	2H	0.38	0.685	0.685	**DOS**	0.63	0.55	0.858	-0.042	0.132	0.130
	30	36	3H	0.22	0.524	0.524	AONDB		0.27	0.574		0.038	0.038
	35	65	2H	0.11	0.414	0.777	**DOS**	1.00	0.15	0.788	0.170	0.009	0.031

Table 3-22: 2R12 RTS AONDB and Results in 2R13 for Each

SG	Row	Col	Elev	2R12 AONDB +Pt Volts	2R12 Inferred Bobbin Volts		2R13 Result	2R13 Bobbin Volts	2R13 +Pt Volts	2R13 Inferred Bobbin Volts	Apparent Growth (v/EFPY) (Inferred to DOS)	Inferred to Inferred Growth (v/EFPY)	+Pt to +Pt Growth (v/EFPY
					Indication	Intersection							
24	35	65	2H	0.14	0.444				0.23				0.069
	35	65	2H	0.18	0.484				0.25				0.053
	36	28	2H	0.13	0.434	0.594	**DOS**	0.87	0.11	0.645	0.211	0.039	-0.015
	36	28	2H	0.10	0.404				0.19				0.069
	36	29	1H	0.26	0.564	0.689	**DOS**	0.49	0.14	0.742	-0.152	0.041	-0.092
	36	29	1H	0.09	0.395				0.29				0.153
	36	33	2H	0.09	0.395	0.395	**DOS**	0.59	0.19	0.494	0.149	0.076	0.076
	37	29	2H	0.08	0.385	0.650	**DOS**	0.58	0.14	0.726	-0.054	0.058	0.046
	37	29	2H	0.22	0.524				0.27				0.038
	41	61	4H	0.15	0.454	0.454	**DOS**	0.71	0.42	0.726	0.195	0.207	0.206
							Averages				**0.016**	**0.025**	**0.025**

Figure 3-1: 2R13 As-Found Voltage Distributions SGs 2-1 and 2-2

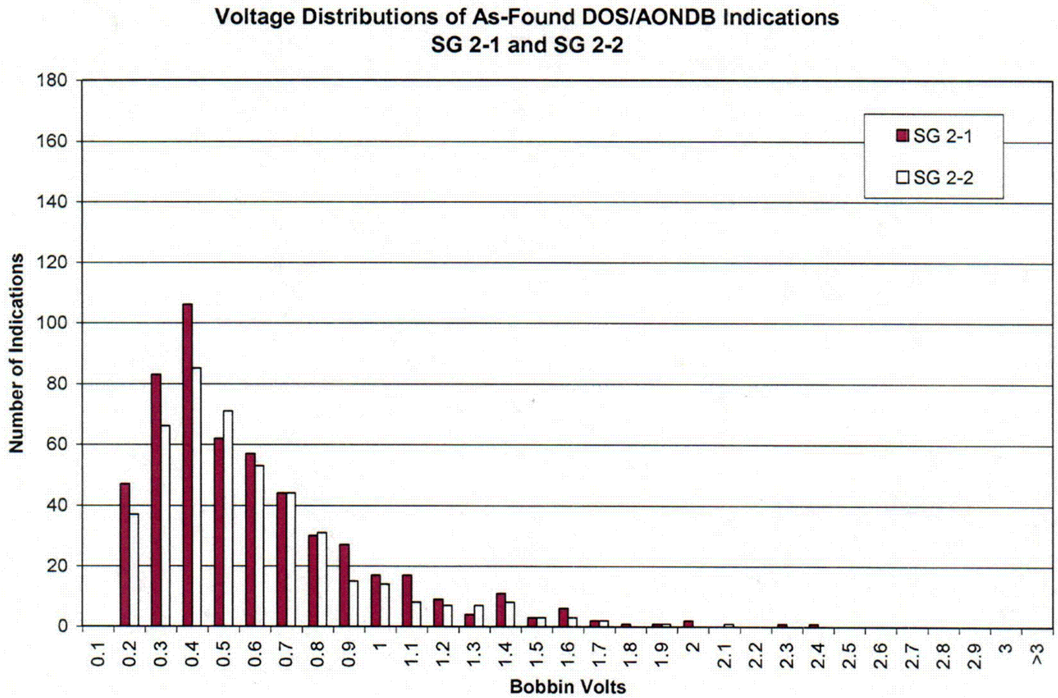


Figure 3-2: 2R13 As-Found Voltage Distributions SGs 2-3 and 2-4

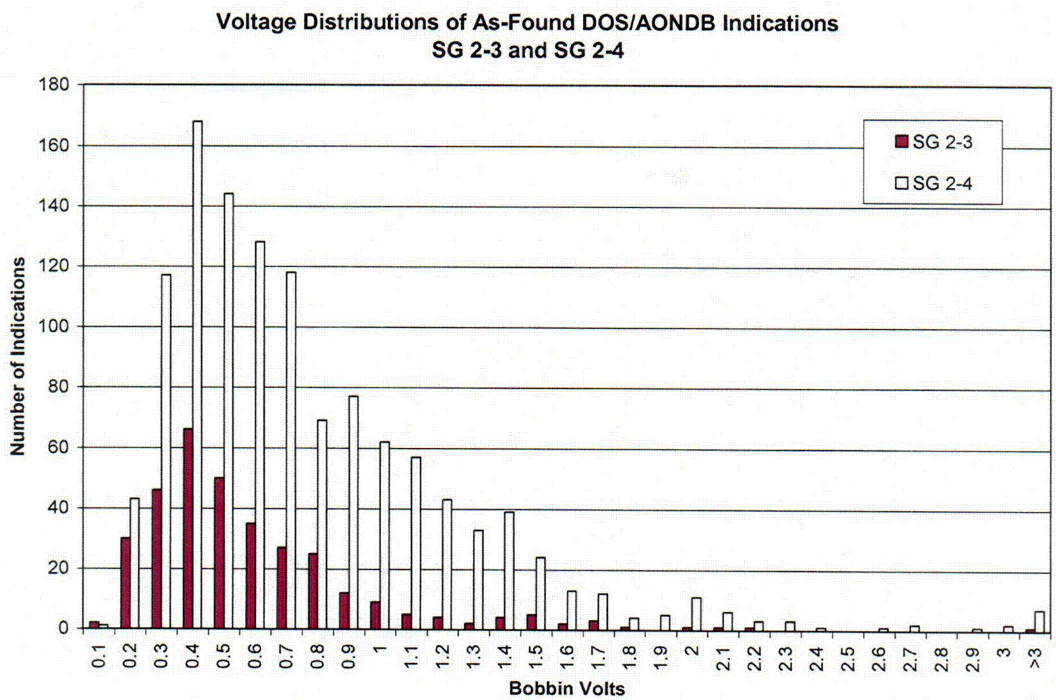


Figure 3-3: 2R13 Repaired Voltage Distributions SGs 2-1 and 2-2

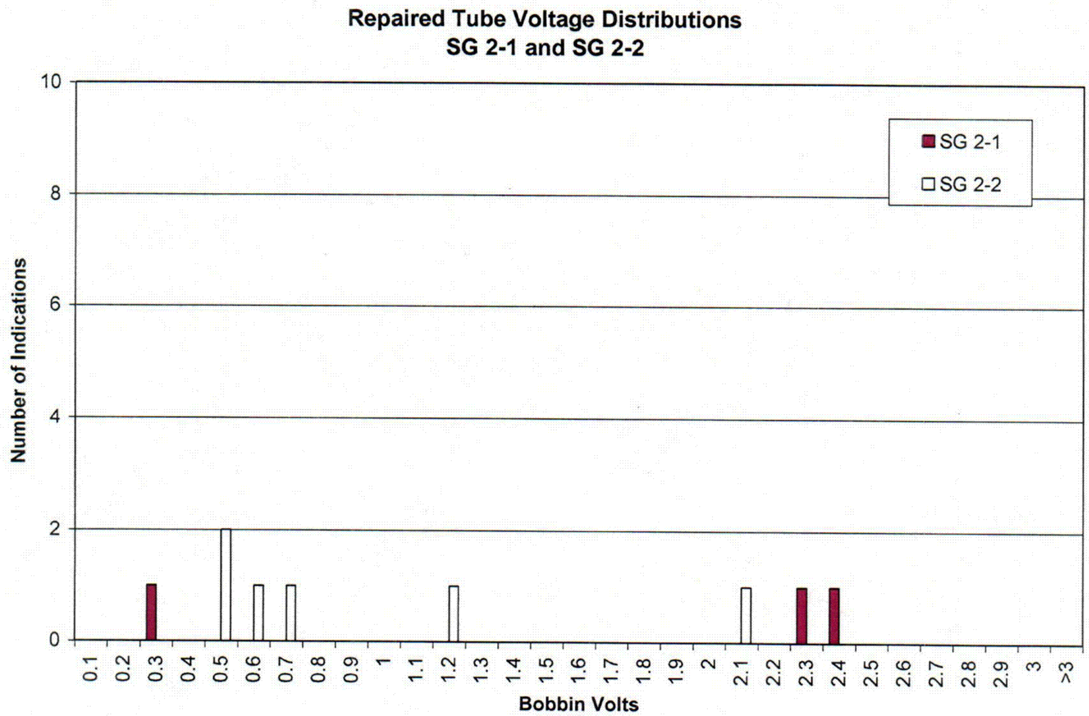


Figure 3-4: 2R13 Repaired Voltage Distributions SGs 2-3 and 2-4

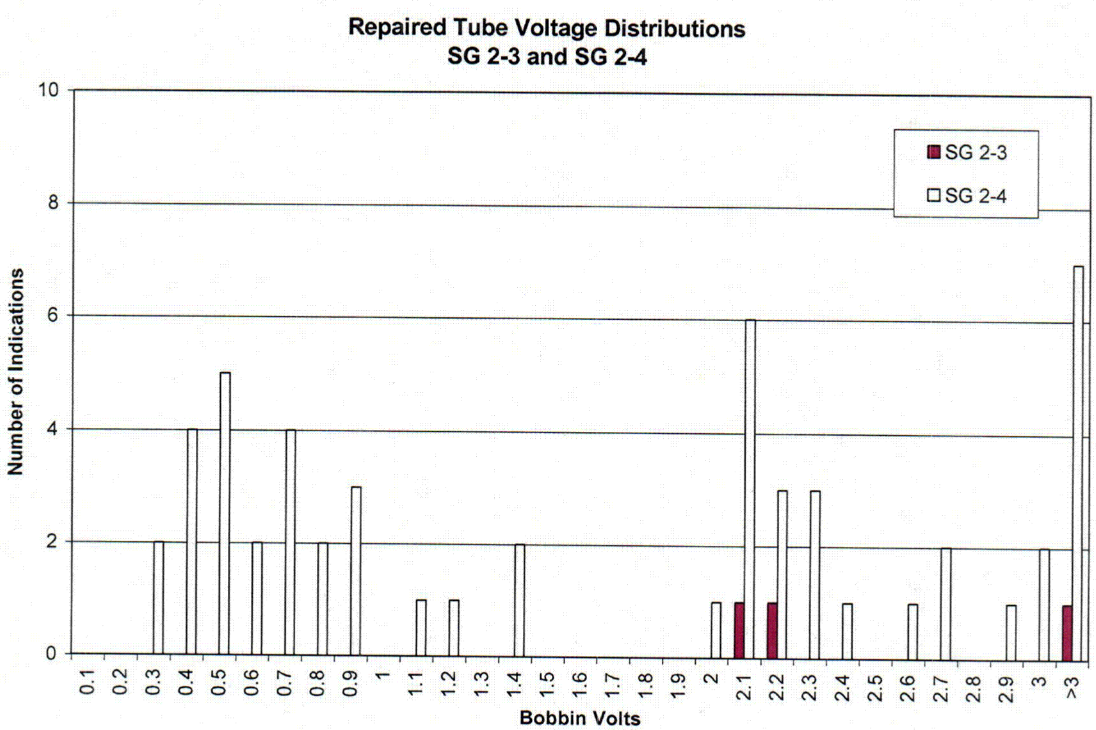


Figure 3-5: 2R13 RTS Voltage Distributions for RPC Confirmed or Not Inspected SGs 2-1 and 2-2

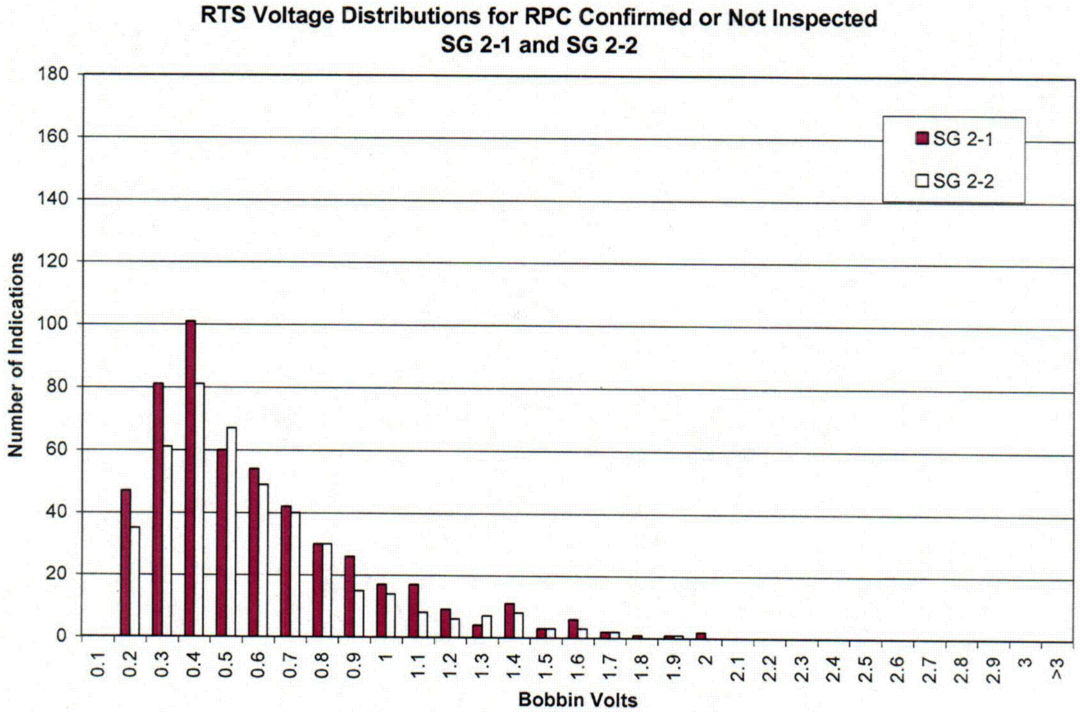


Figure 3-6: 2R13 RTS Voltage Distributions for RPC Confirmed or Not Inspected SGs 2-3 and 2-4

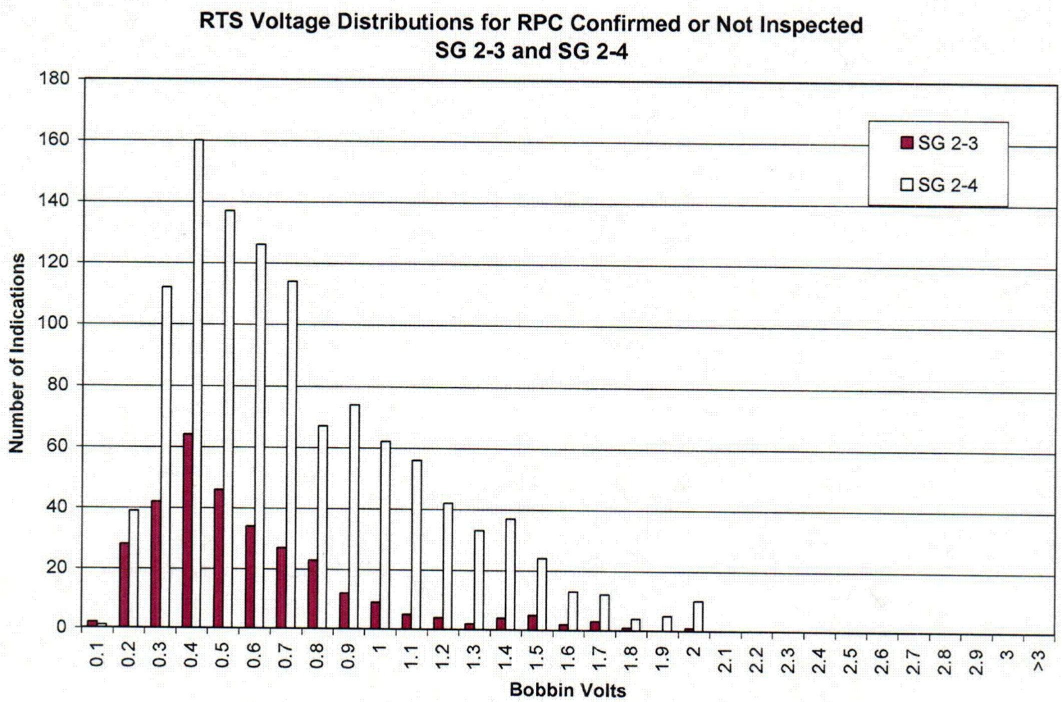


Figure 3-7: 2R13 RTS Voltage Distributions SGs 2-1 and 2-2

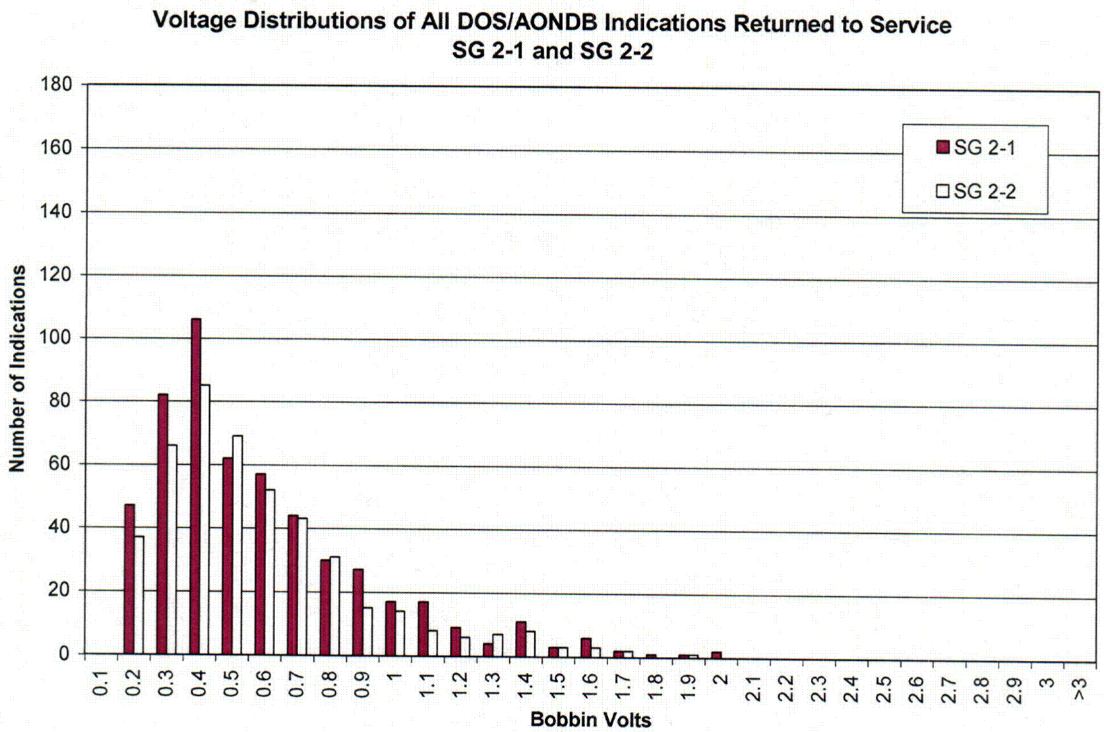


Figure 3-8: 2R13 RTS Voltage Distributions SGs 2-3 and 2-4

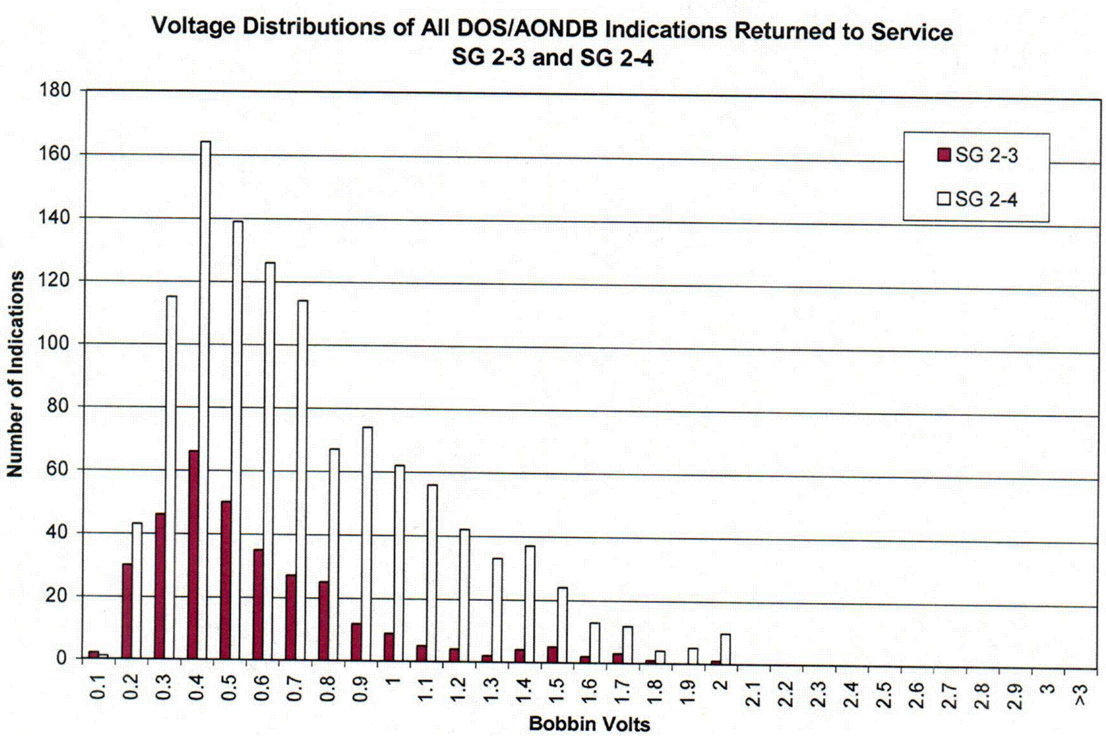
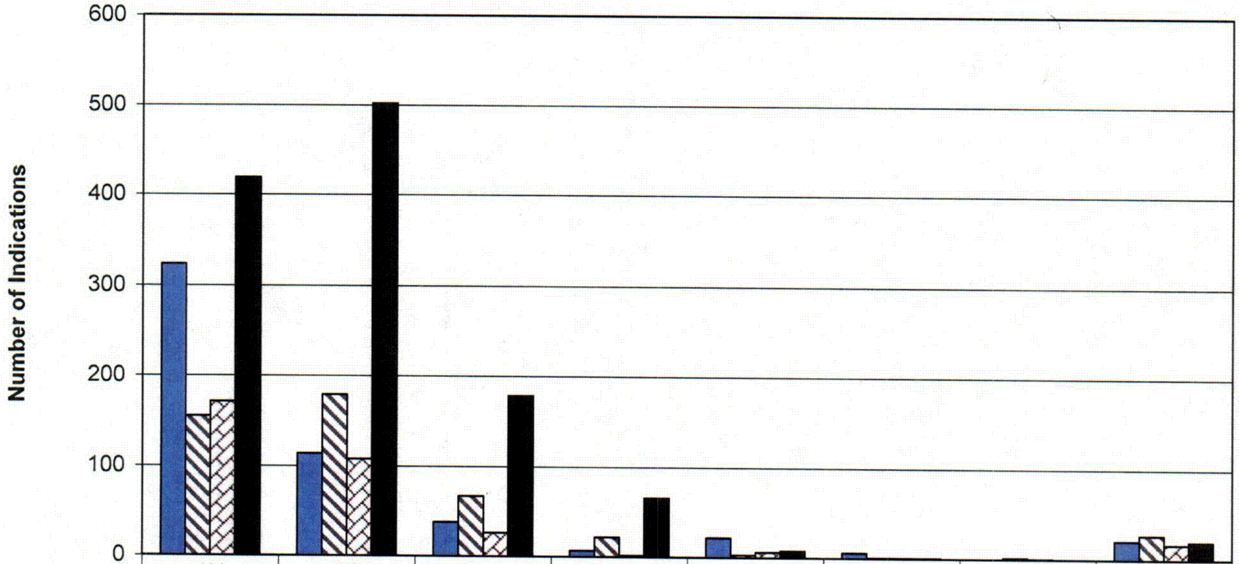


Figure 3-9: 2R13 DOS and AONDB vs. TSP Elevation

Distribution of Indications by TSP Location



	1H	2H	3H	4H	5H	6H	7H	CL
SG 2-1	323	114	38	7	22	6		21
SG 2-2	155	179	67	22	3	1	2	27
SG 2-3	171	108	26	2	6	1	1	17
SG 2-4	419	502	178	66	8	1		20

Tube Support Plate

Figure 3-10: Cycle 13 Growth Distributions SGs 2-1 and 2-2

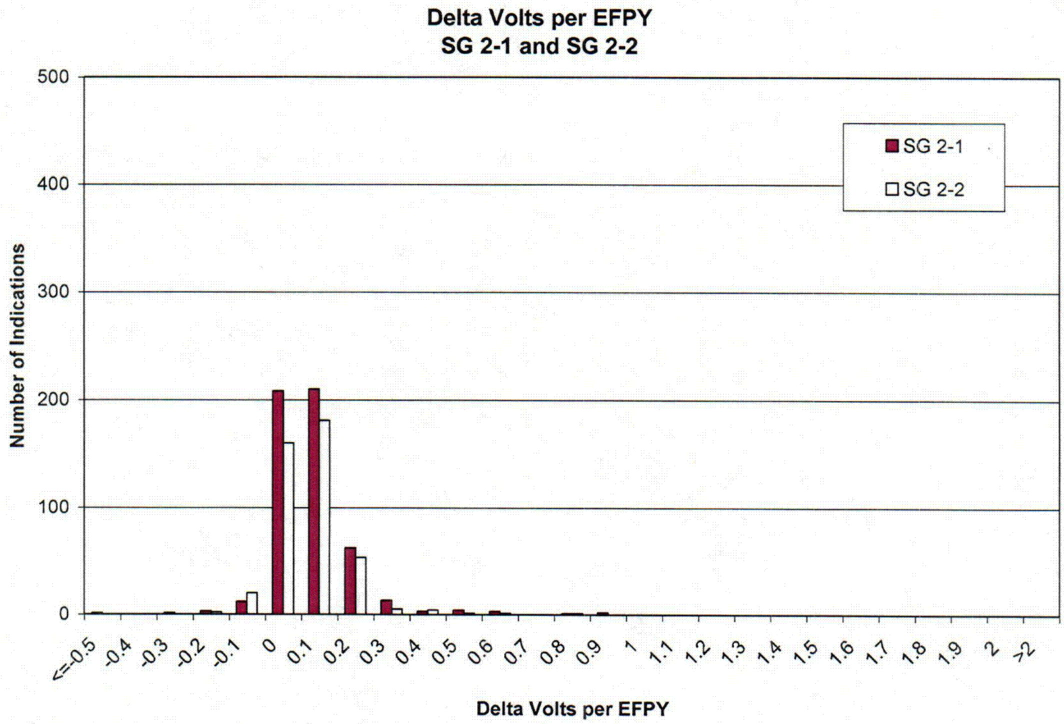


Figure 3-11: Cycle 13 Growth Distributions SGs 2-3 and 2-4

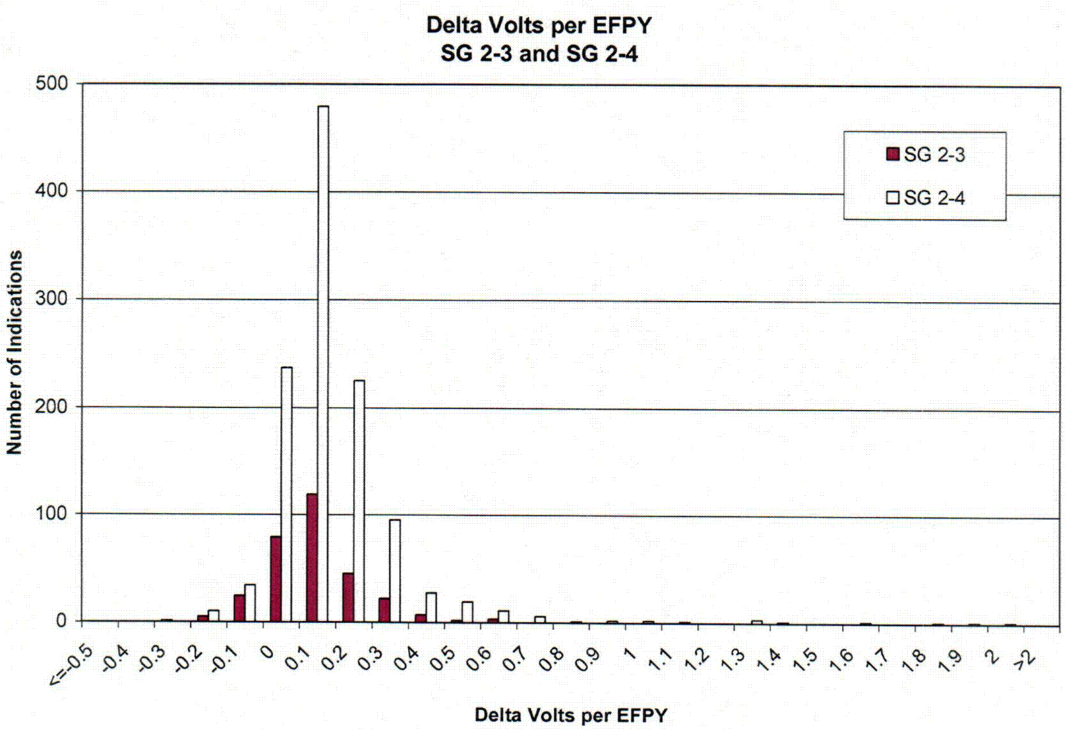


Figure 3-12: Cycle 13 Independent Growth Curves – All SGs

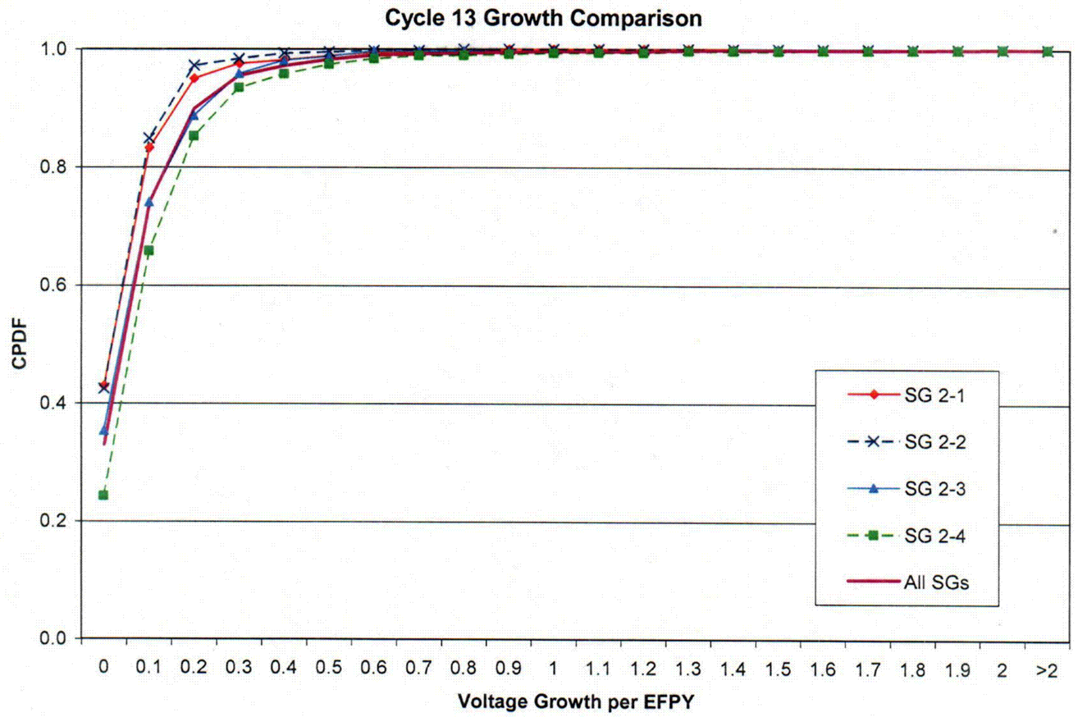


Figure 3-13: Historical Change in Growth and BOC Voltage - All SGs

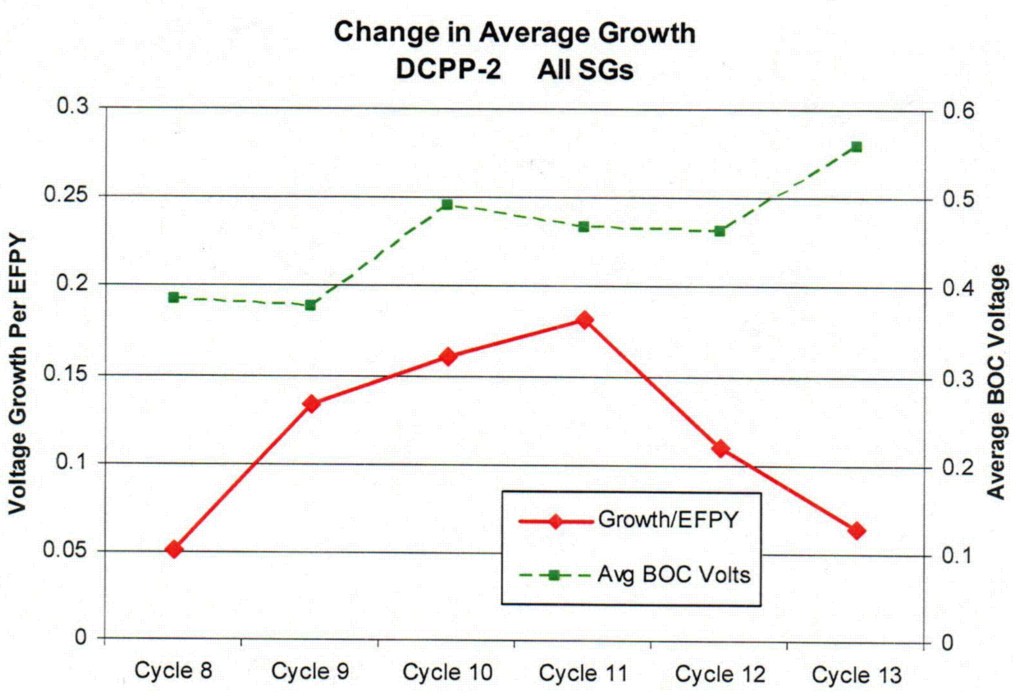


Figure 3-14: Cycle 12 vs. Cycle 13 Growth Comparison for SG 2-1

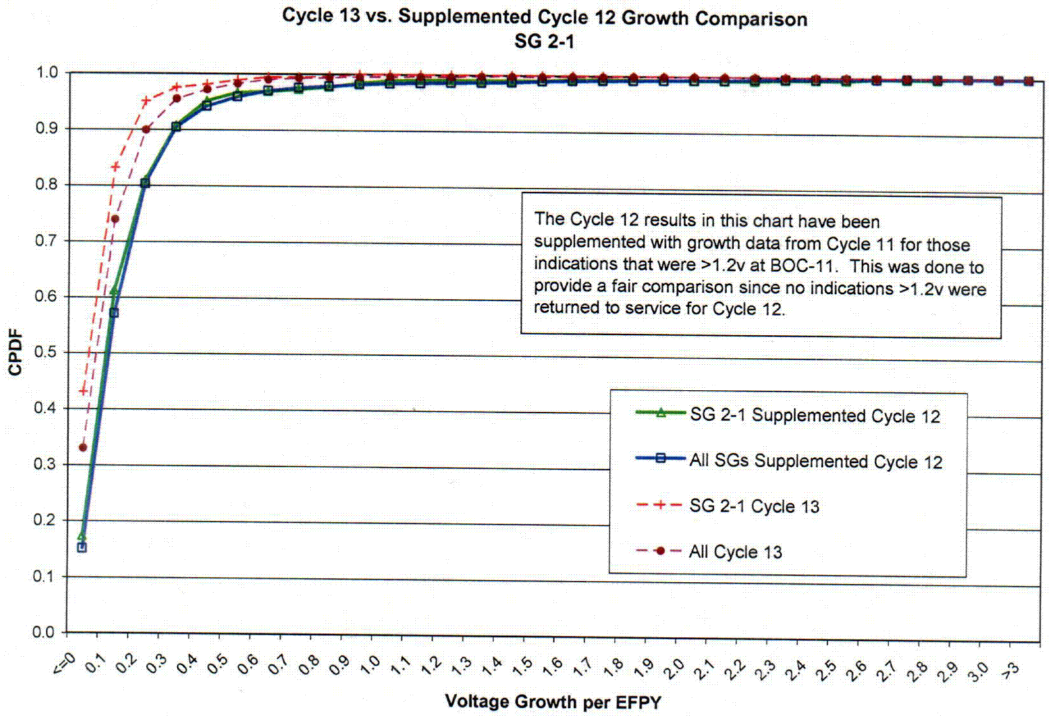


Figure 3-15: Cycle 12 vs. Cycle 13 Growth Comparison for SG 2-2

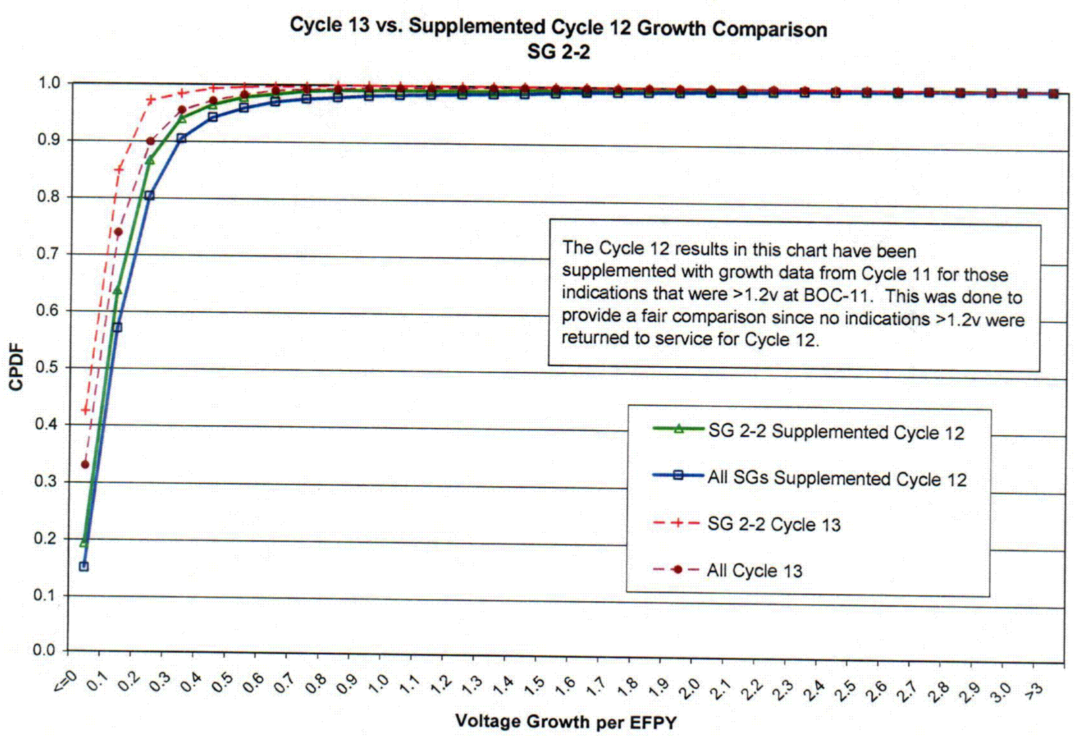


Figure 3-16: Cycle 12 vs. Cycle 13 Growth Comparison for SG 2-3

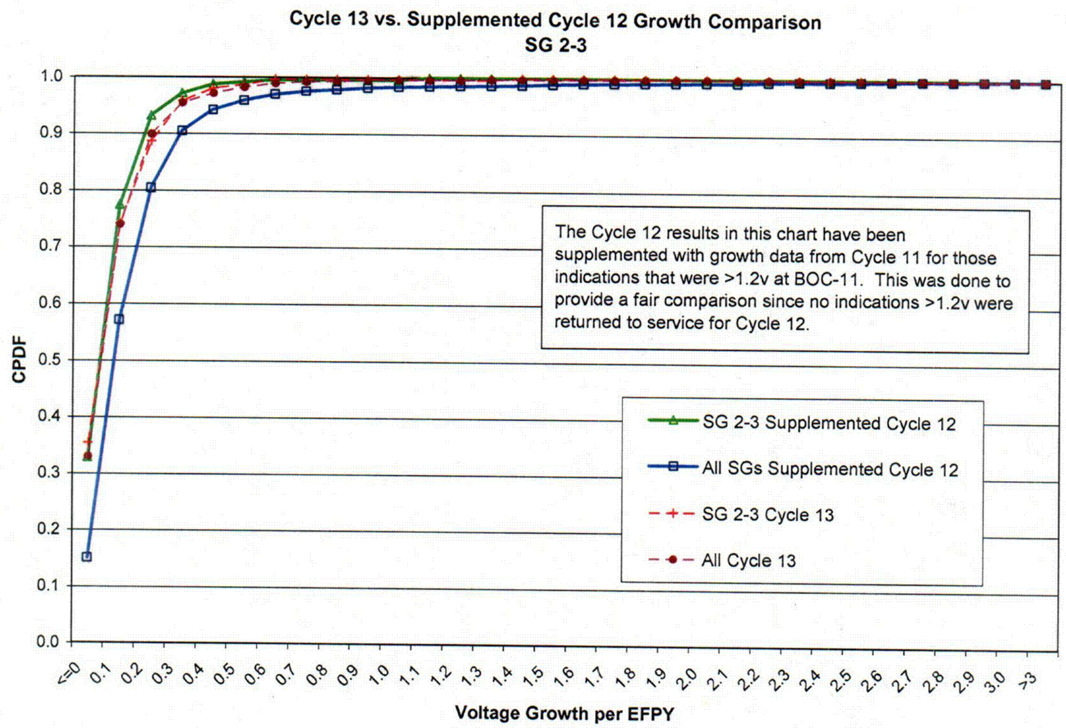


Figure 3-17: Cycle 12 vs. Cycle 13 Growth Comparison for SG 2-4

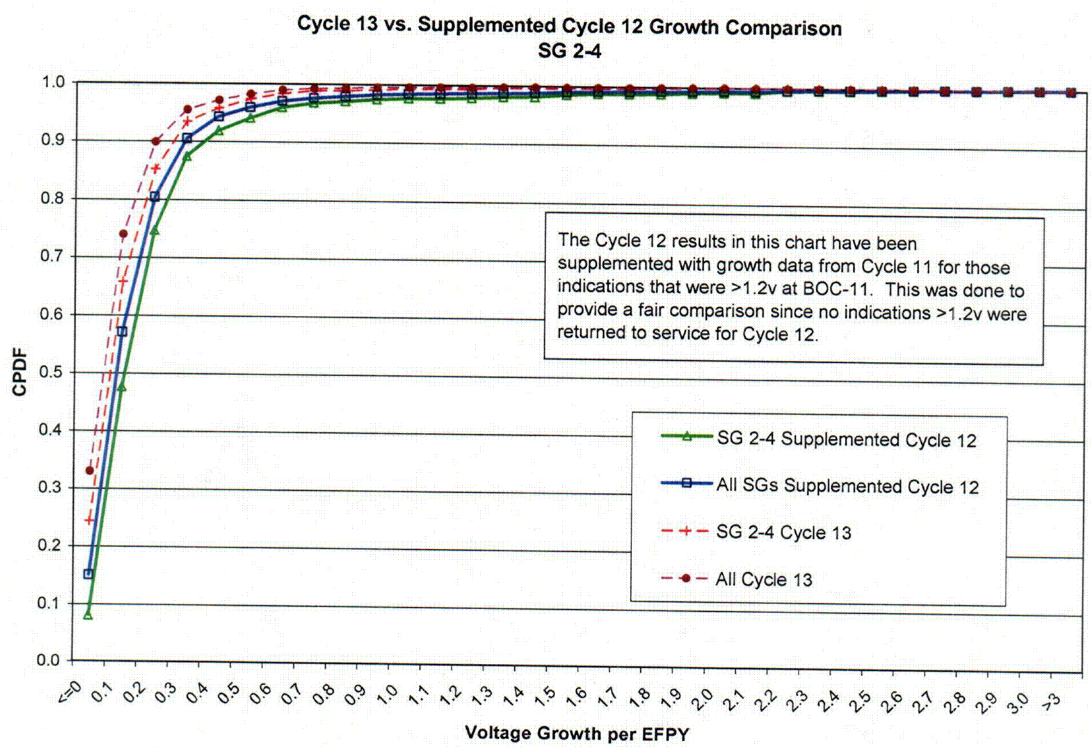


Figure 3-18: SG 2-1 Cycle 13 Growth vs. BOC Voltage

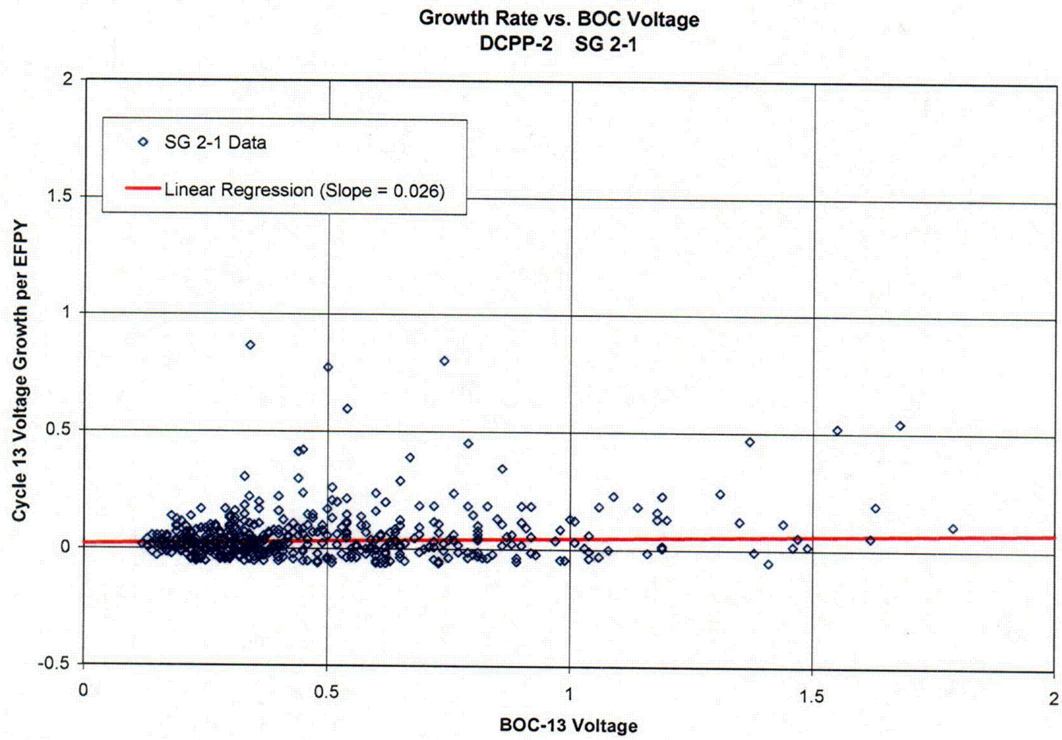


Figure 3-19: SG 2-2 Cycle 13 Growth vs. BOC Voltage

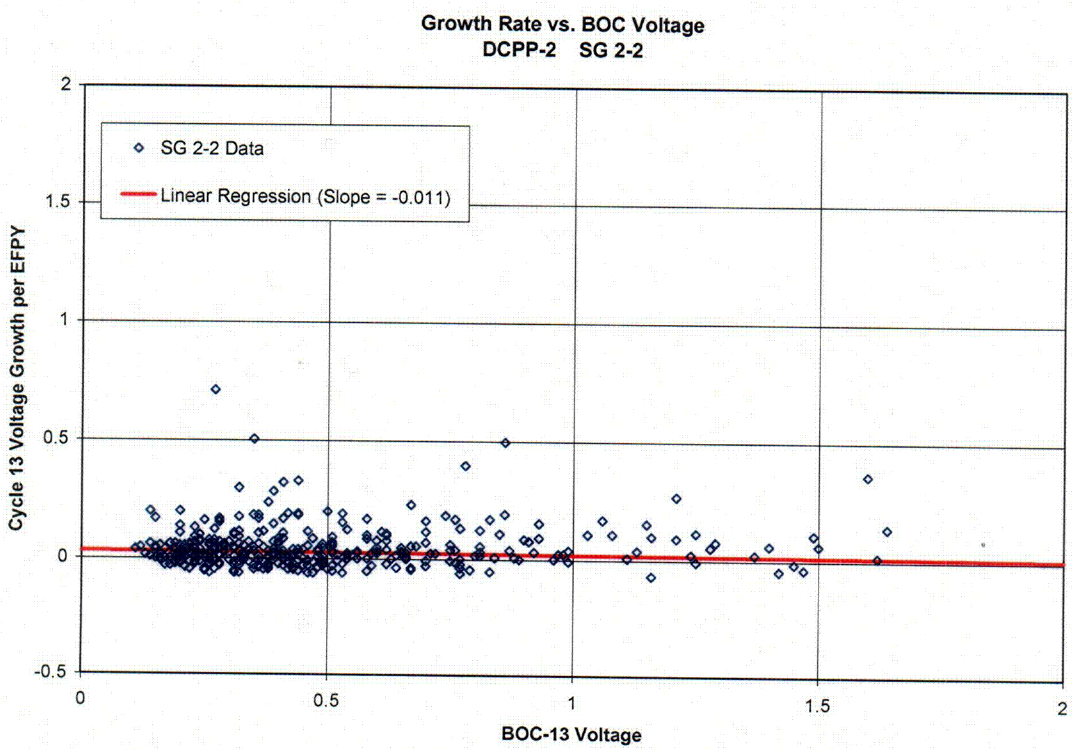


Figure 3-20: SG 2-3 Cycle 13 Growth vs. BOC Voltage

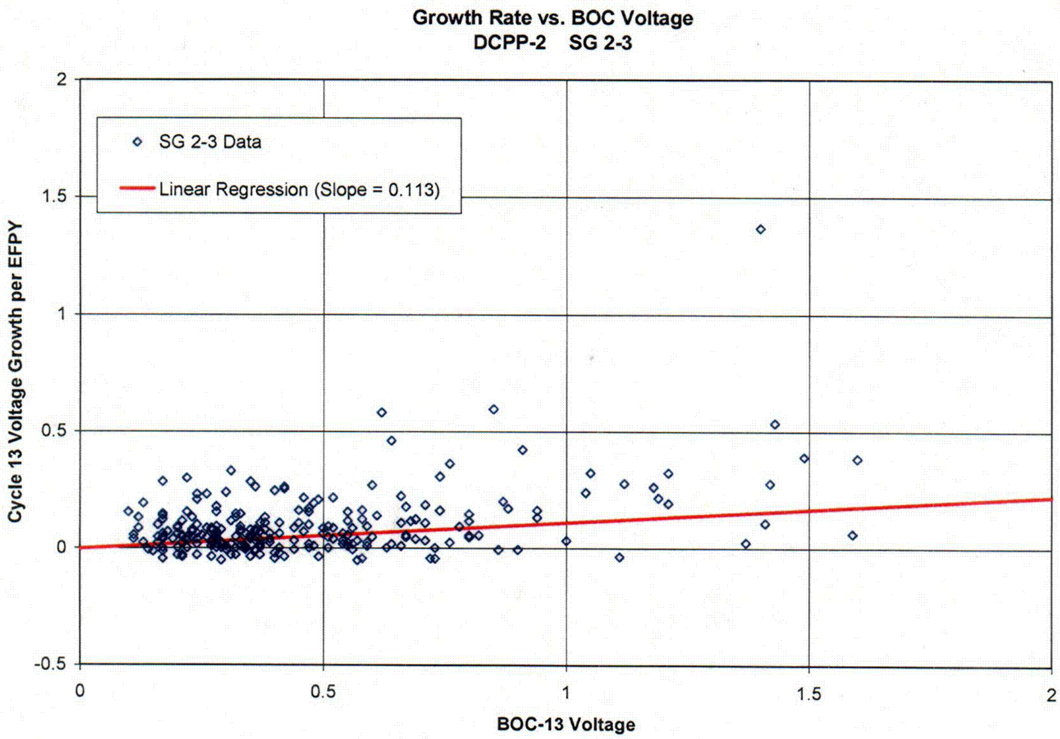


Figure 3-21: SG 2-4 Cycle 13 Growth vs. BOC Voltage

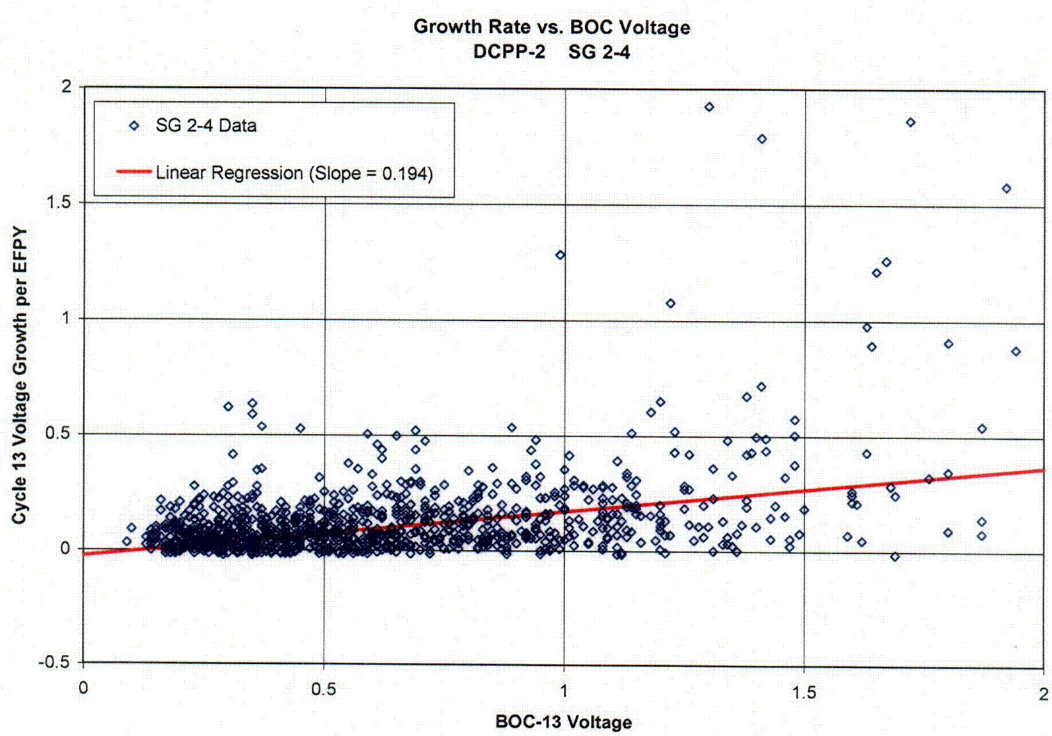


Figure 3-22: Cycle 13 Growth vs. BOC Voltage for All Steam Generators

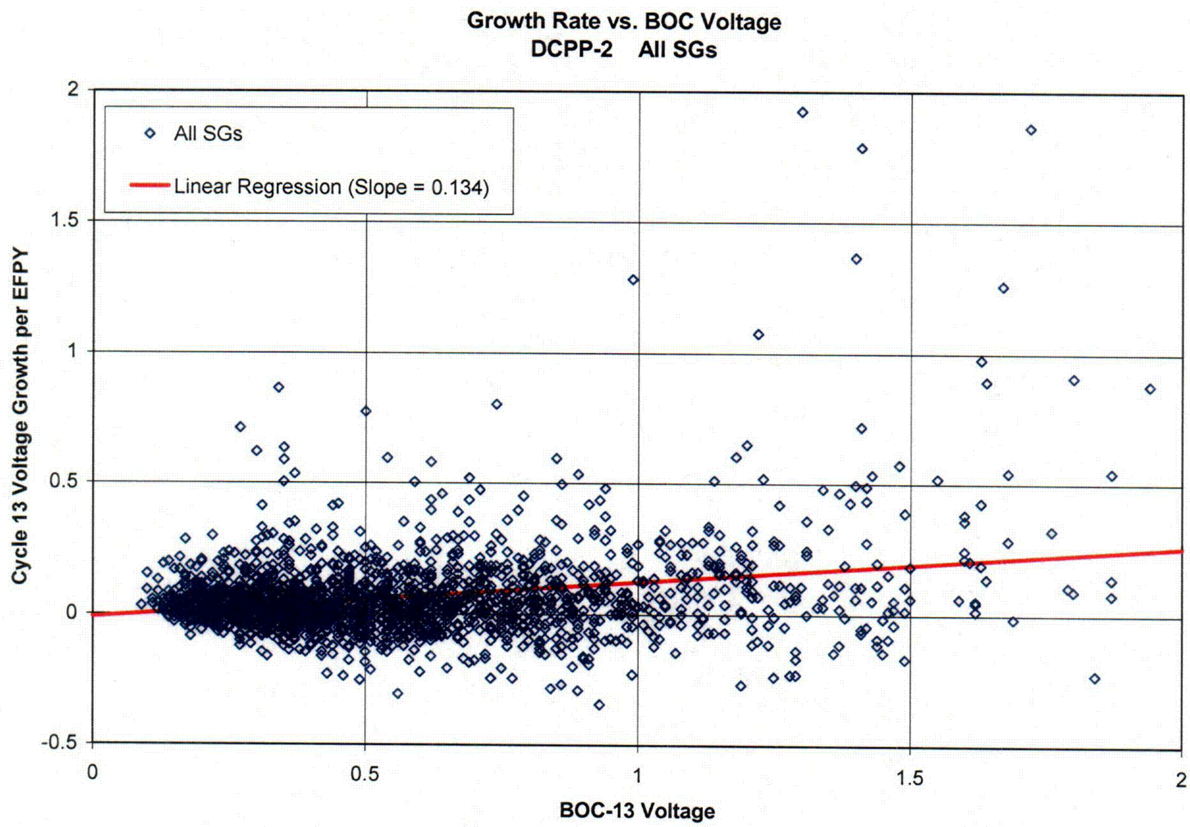


Figure 3-23: SG 2-3 Cycle 13 VDG Breakpoint Analysis Results

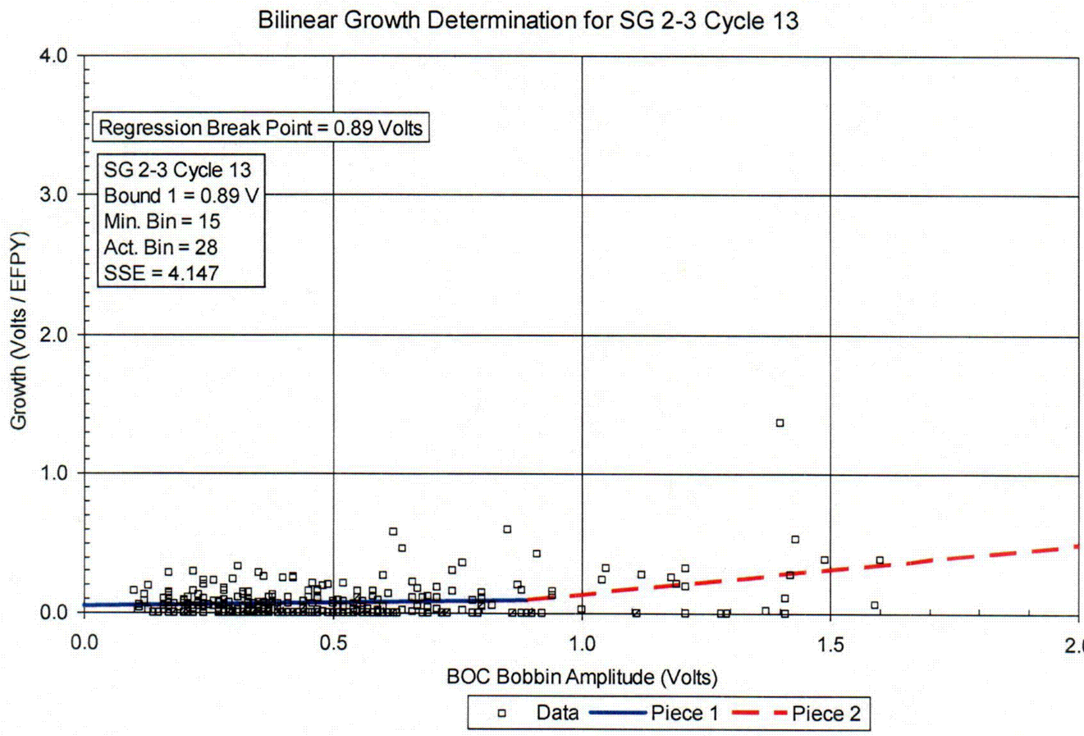


Figure 3-24: SG 2-4 Cycle 13 VDG Breakpoint Analysis Results

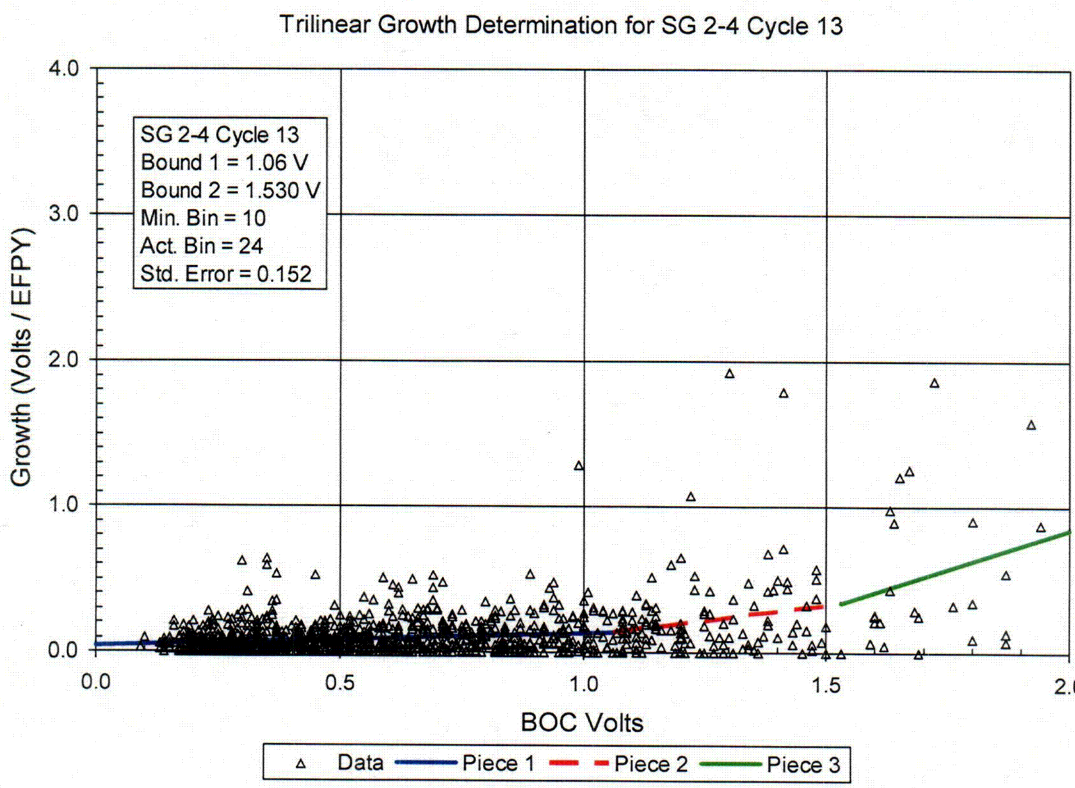


Figure 3-25: Composite Cycle 13 VDG Breakpoint Analysis Results

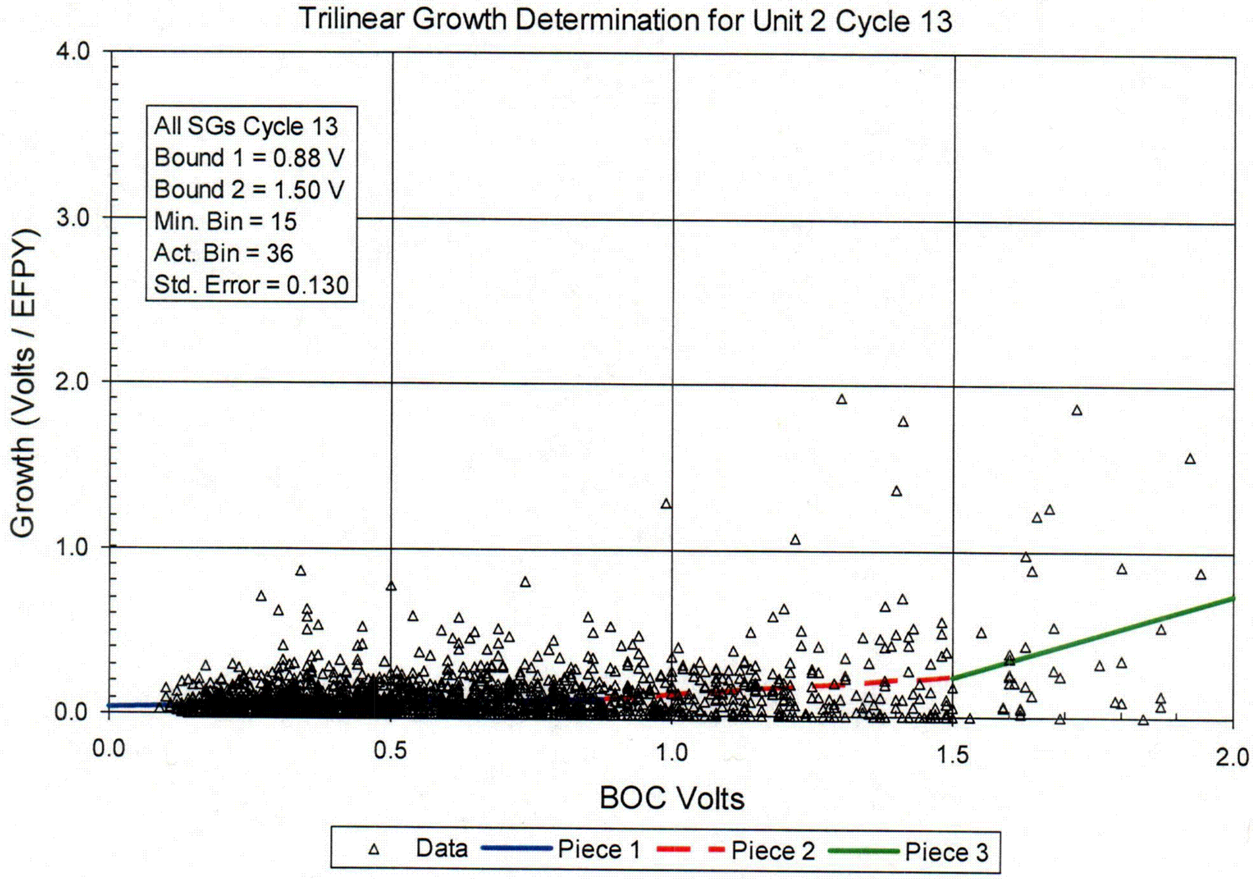


Figure 3-26: Cycle 13 VDG for SG 2-3

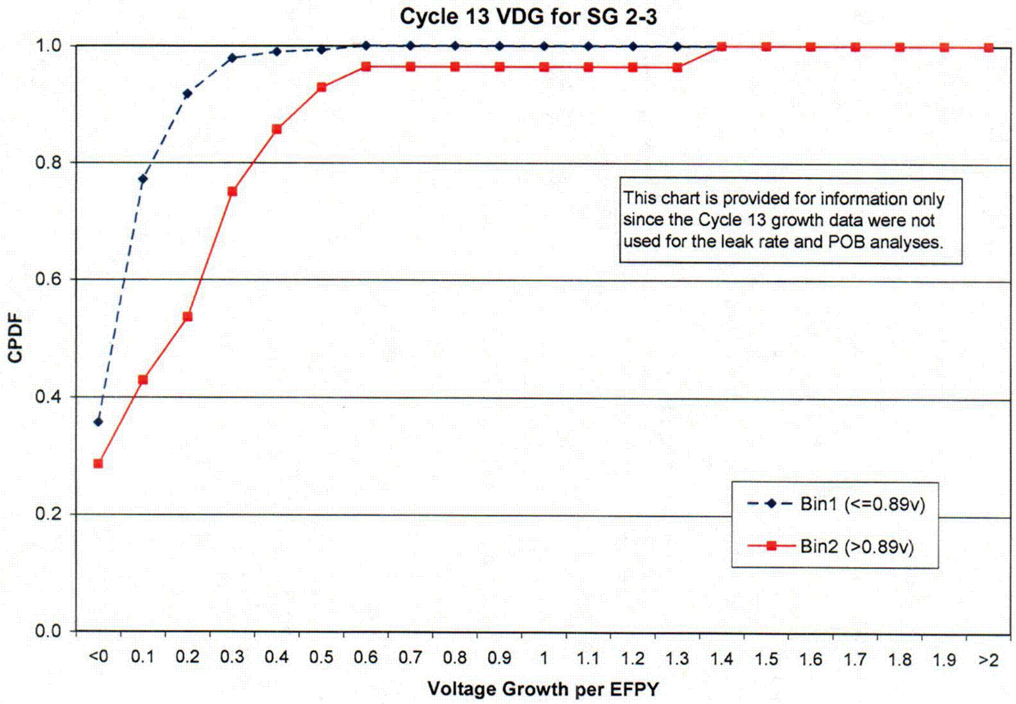


Figure 3-27: Cycle 13 VDG for SG 2-4

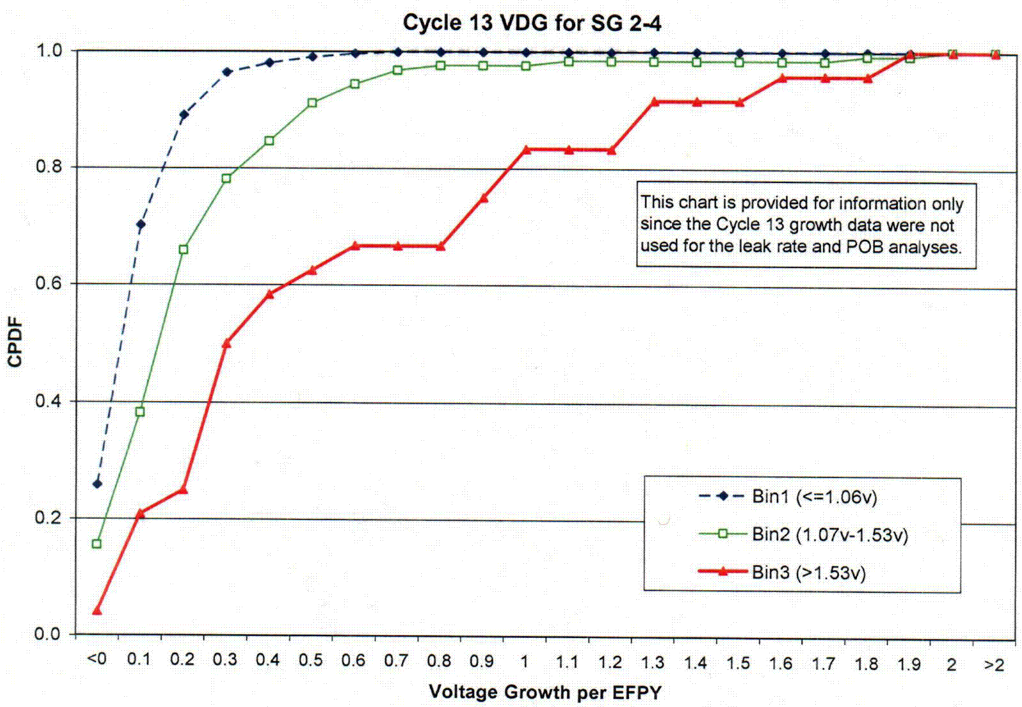


Figure 3-28: Cycle 13 VDG for All SGs

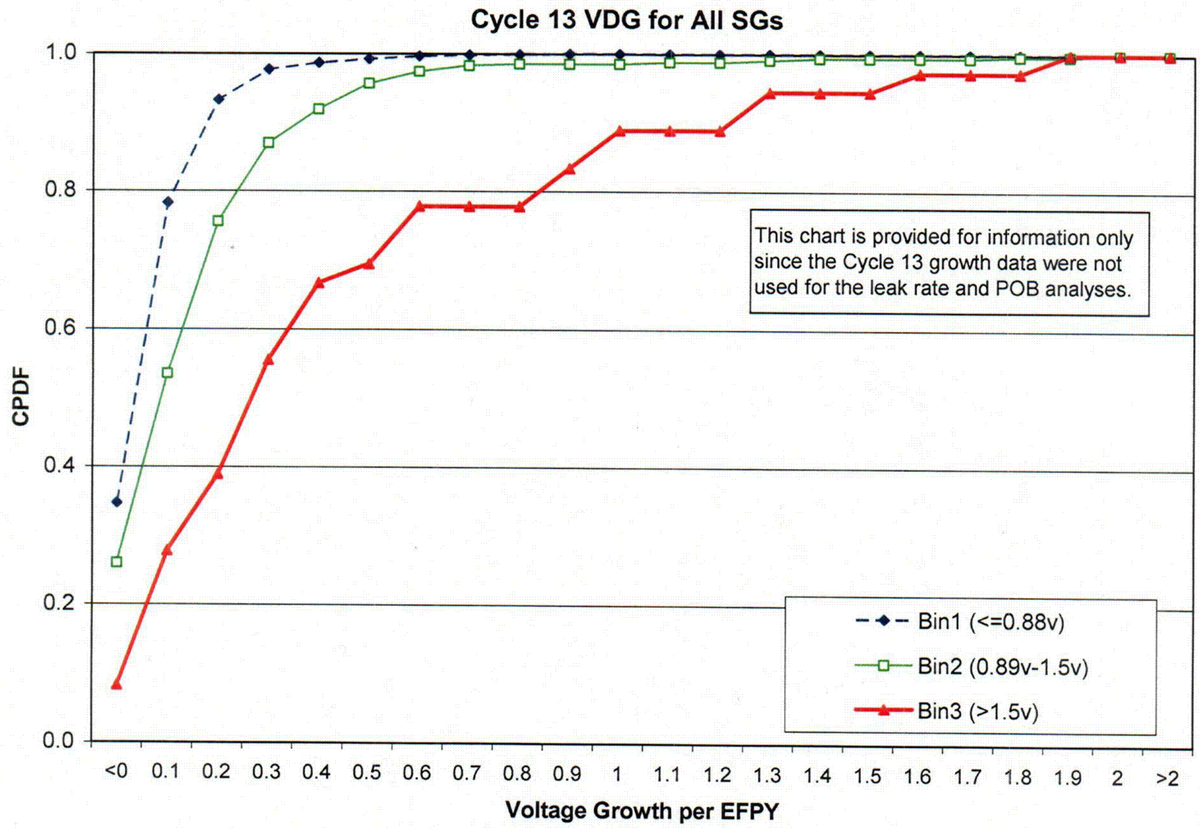


Figure 3-29: SG 2-1 Supplemented Cycle 12 VDG Breakpoint Analysis Results

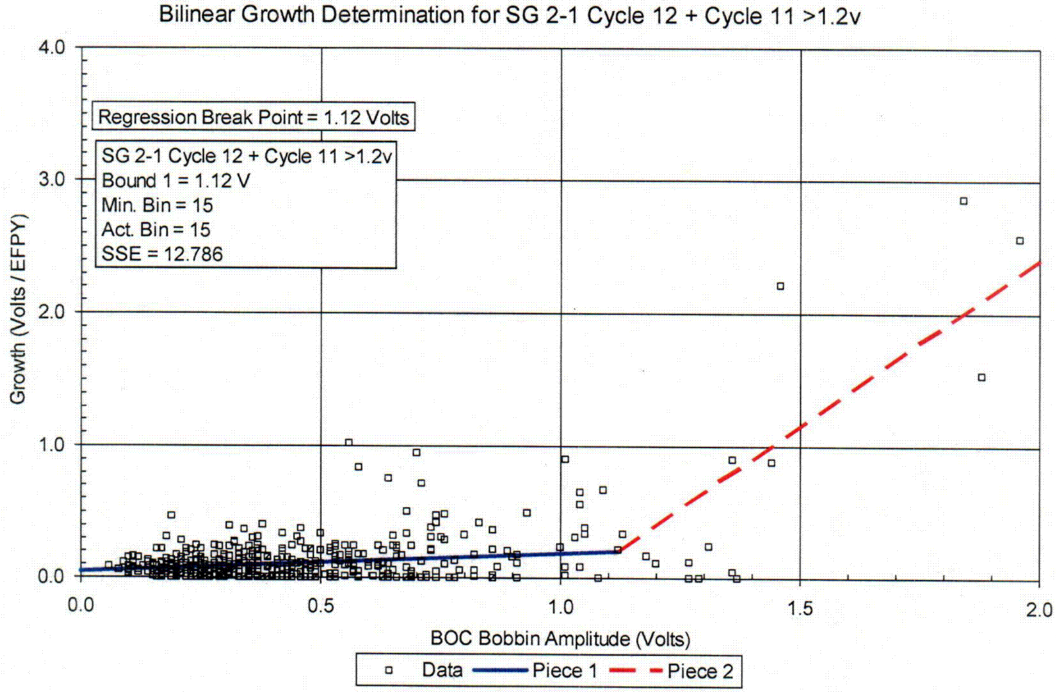


Figure 3-30: SG 2-4 Supplemented Cycle 12 VDG Breakpoint Analysis Results

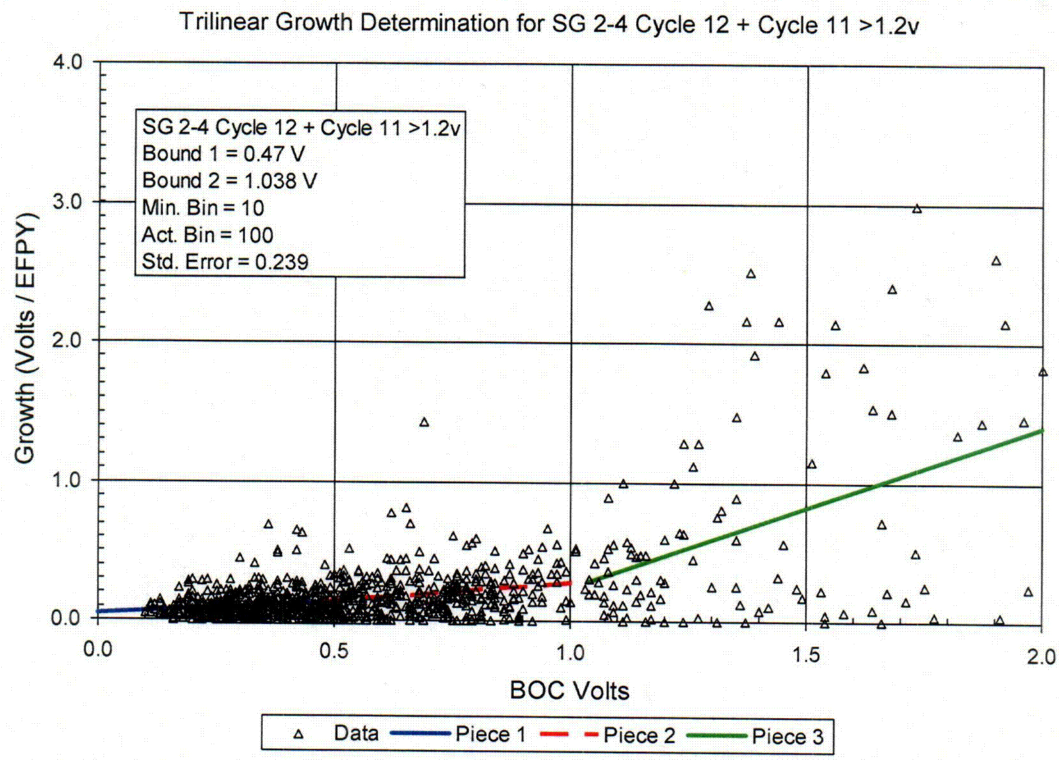


Figure 3-31: Composite SG Supplemented Cycle 12 VDG Breakpoint Analysis Results

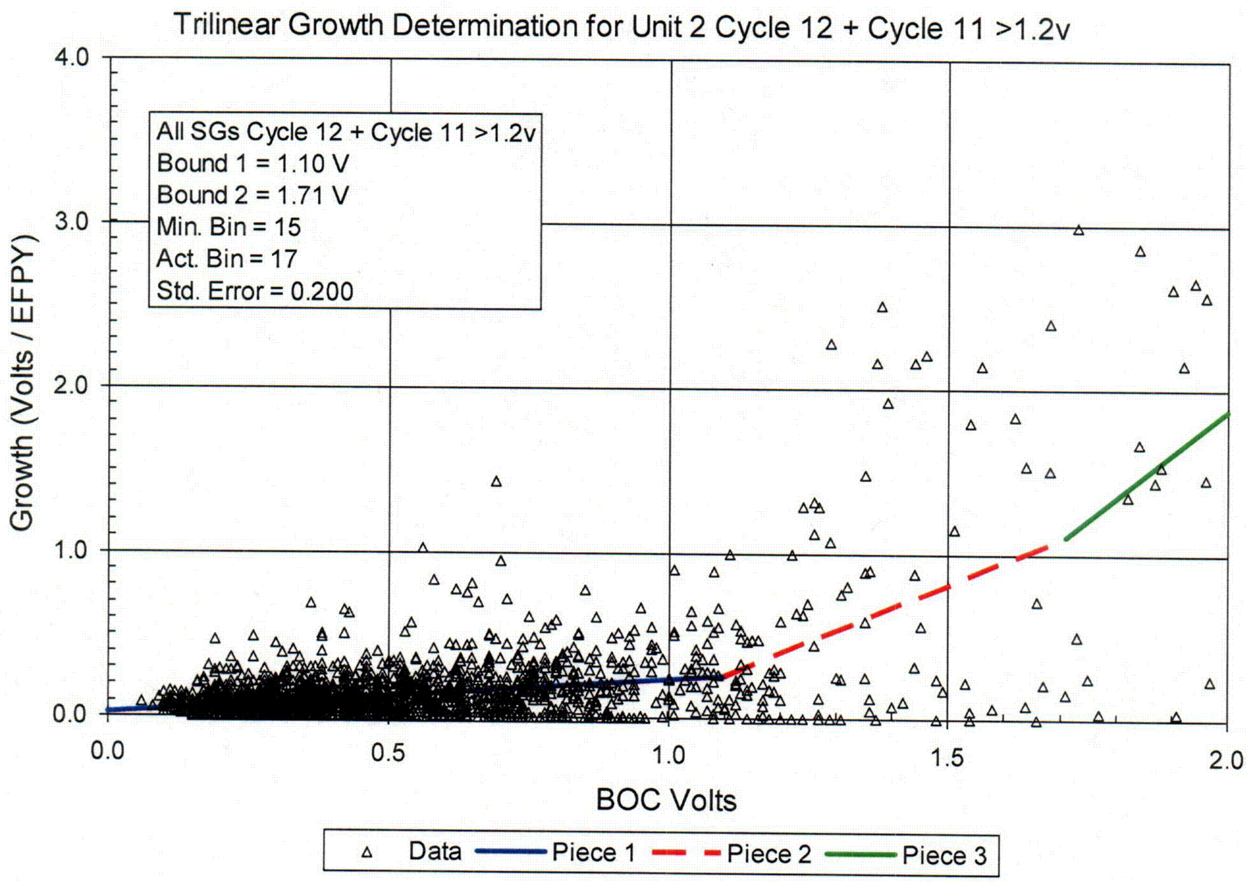


Figure 3-32: Supplemented Cycle 12 VDG for SG 2-1

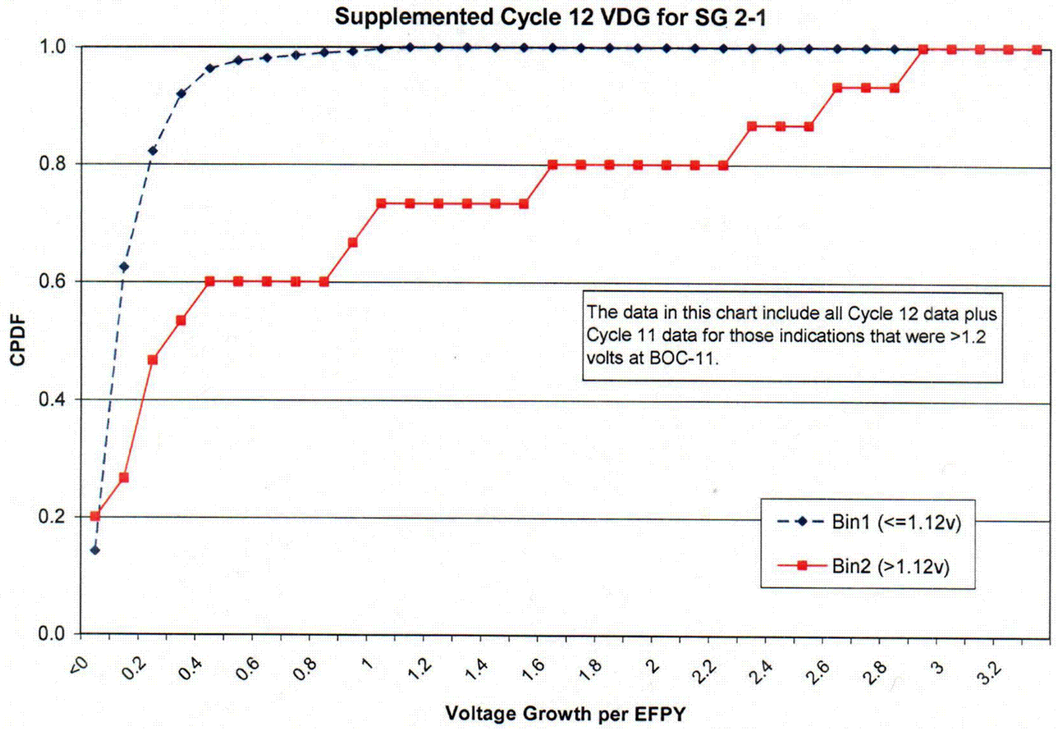


Figure 3-33: Supplemented Cycle 12 VDG for SG 2-4

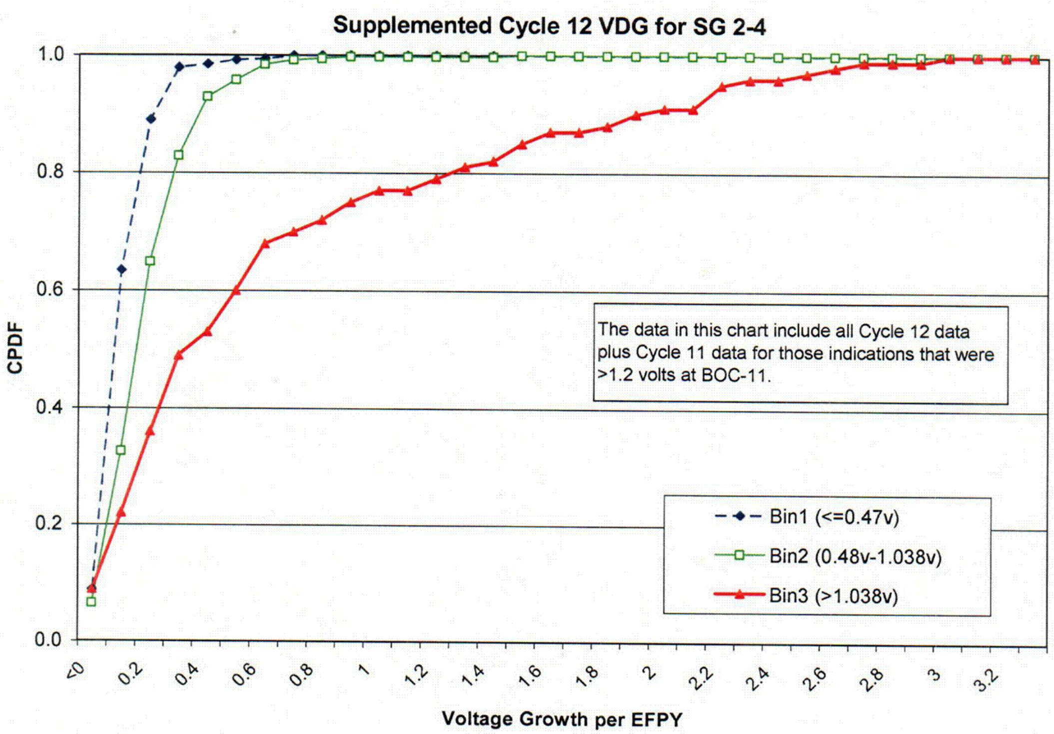


Figure 3-34: Supplemented Cycle 12 VDG for All SGs

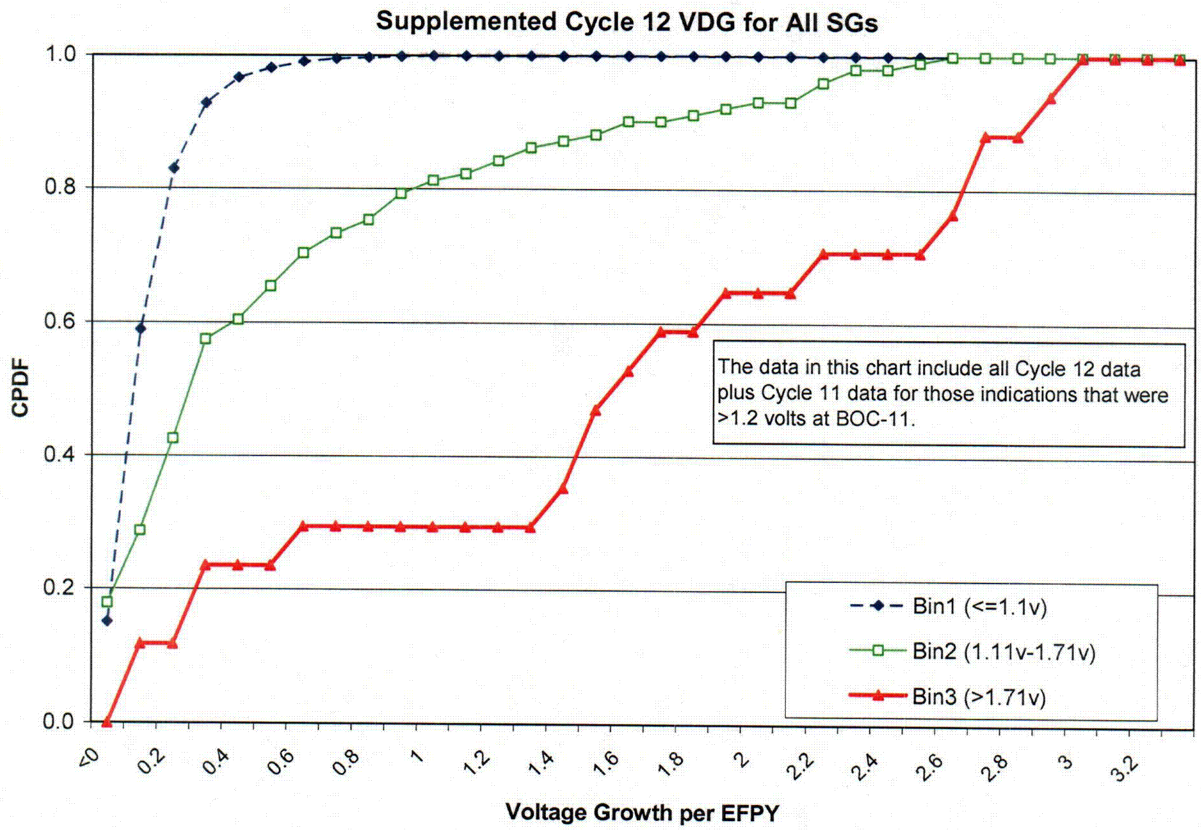


Figure 3-35: 2R13 Probe Wear Voltage Comparison

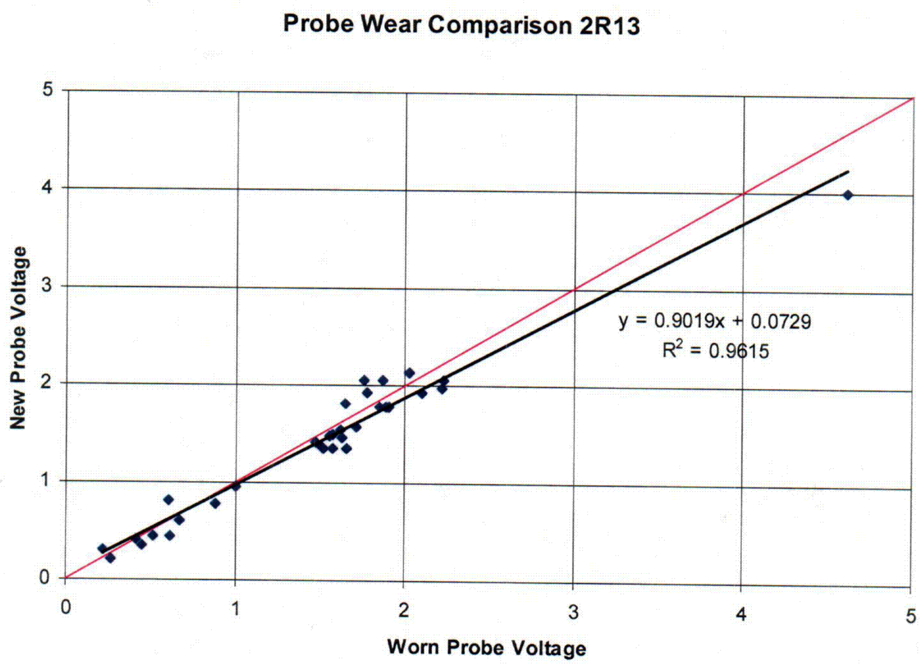


Figure 3-36: Bobbin Voltage Uncertainty Distributions

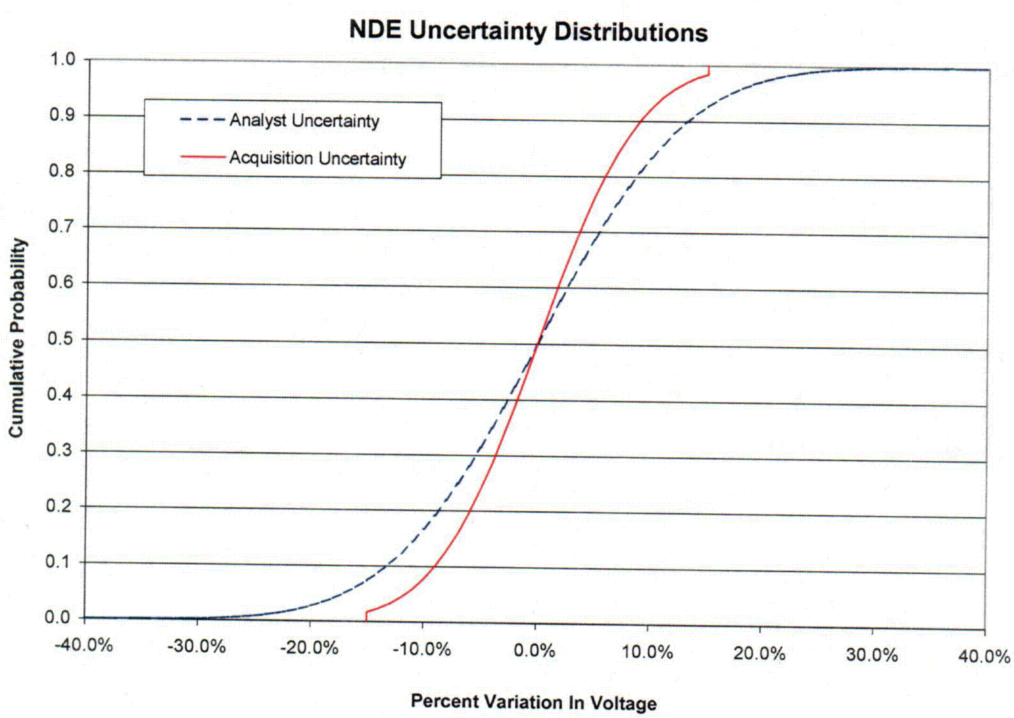


Figure 3-37: Inferred Voltage / Measured Voltage Comparison

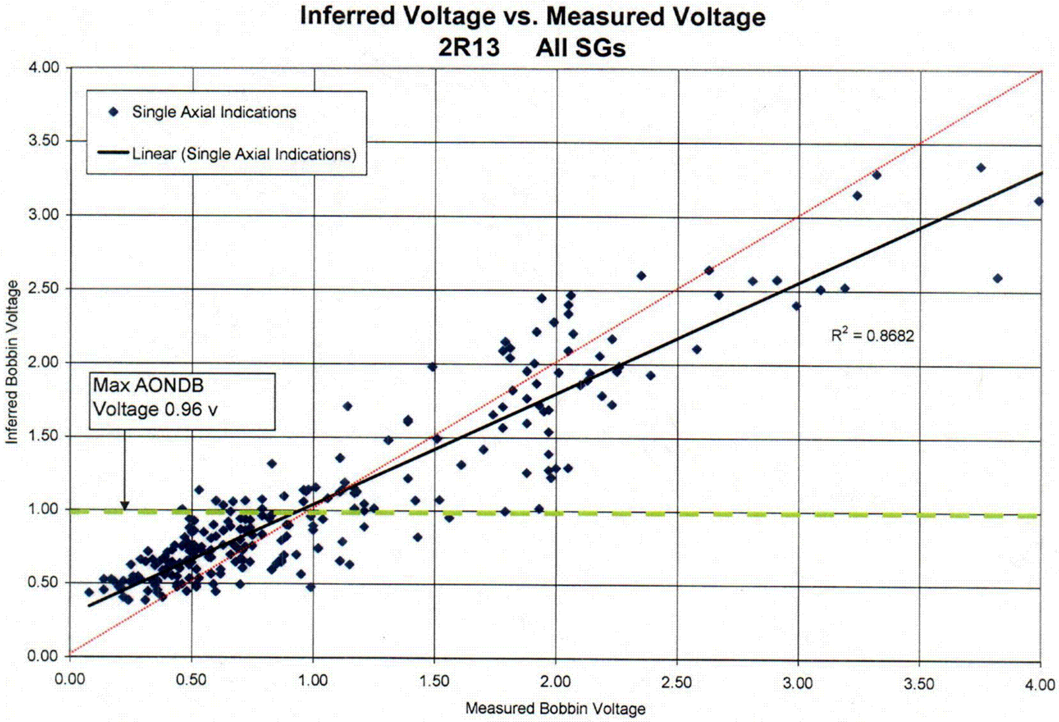


Figure 3-38: +Point™ Indication to Bobbin Voltage Comparison for SG 2-1

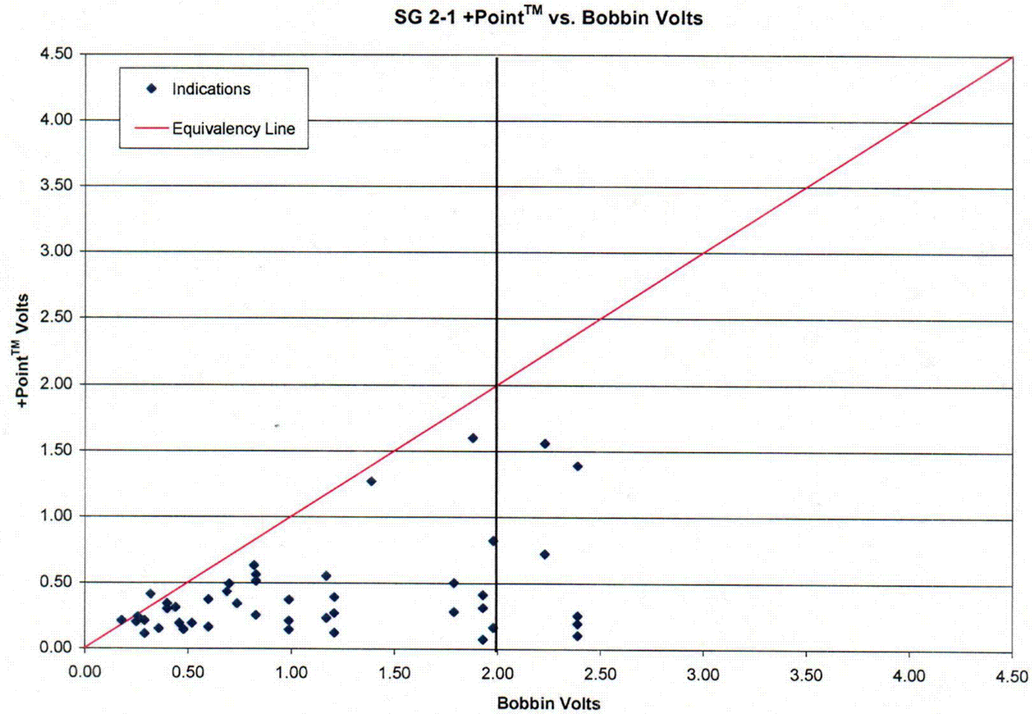


Figure 3-39: +Point™ Indication to Bobbin Voltage Comparison for SG 2-2

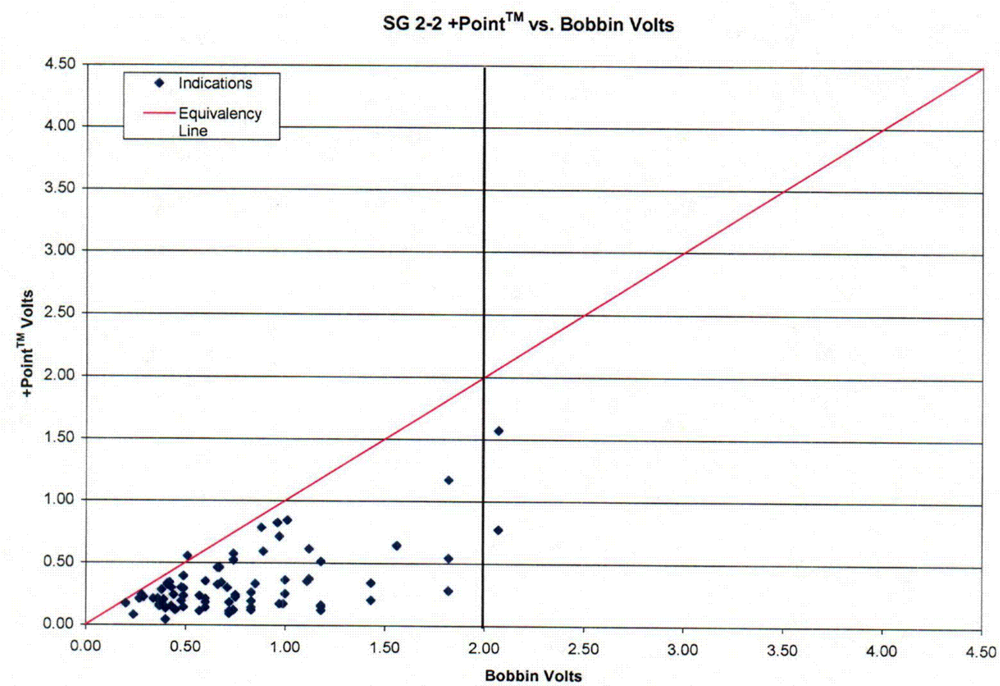


Figure 3-40: +Point™ Indication to Bobbin Voltage Comparison for SG 2-3

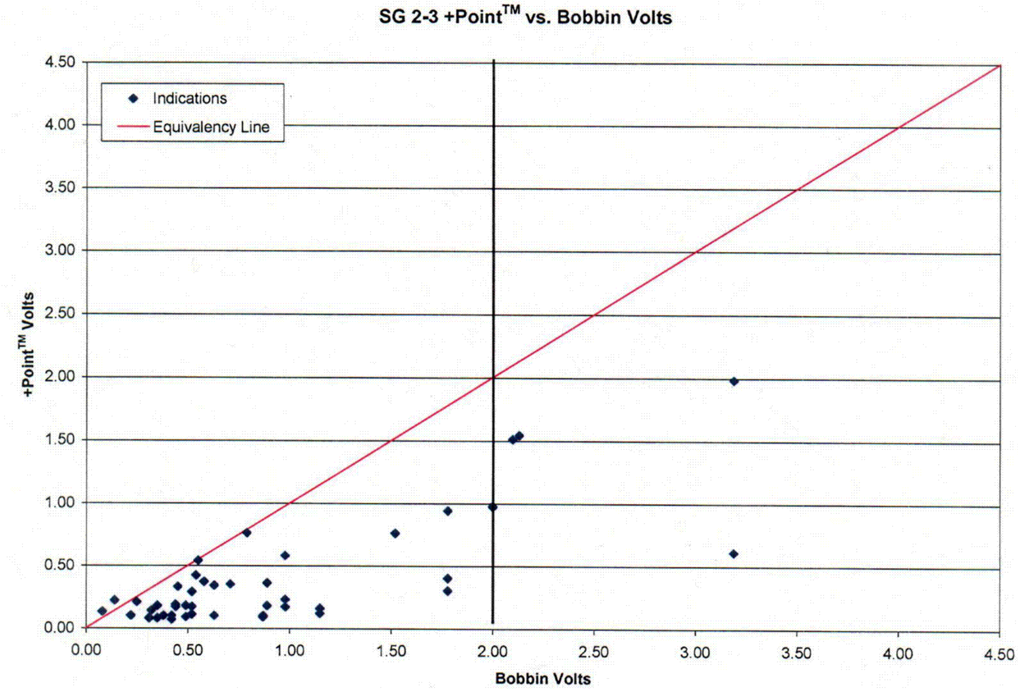
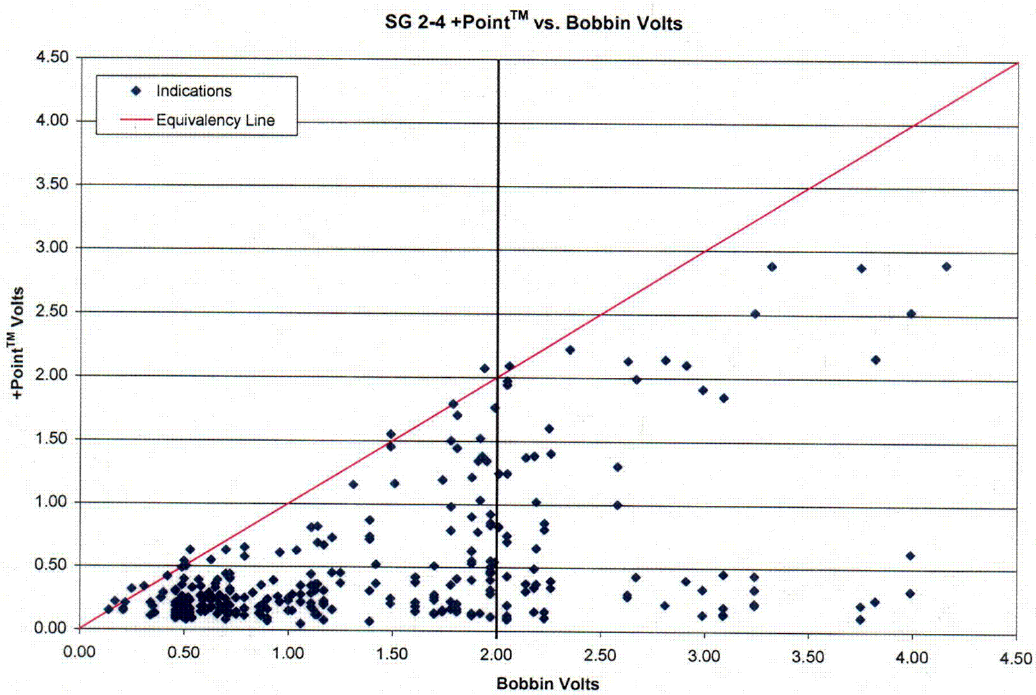


Figure 3-41: +Point™ Indication to Bobbin Voltage Comparison for SG 2-4



4.0 Database Applied for Leak and Burst Correlations

Per GL 95-05, the databases used to perform the tube integrity evaluations should be the latest NRC approved industry database. The updated leak and burst correlations in Reference 8 for the ODSCC database include the 2R11 and 1R12 tube pull results from Diablo Canyon, as well as other recent industry tube pulls.

4.1 Conditional Probability of Burst

For the case of the burst pressure versus voltage correlation, the Addendum 6 database contained in Reference 8, meets all GL 95-05 requirements and was used in the as-found EOC-13 calculations and the EOC-14 projections, as well as the benchmarking of the prior cycle operational assessment. The correlation parameters were taken from Reference 8 and are shown in Table 4-1.

Table 4-1: Burst Pressure vs. Bobbin Amplitude Correlation

$$P_B = a_0 + a_1 \log(Volts)$$

Parameter	Addendum 6
Intercept, a_0	7.4801
Slope, a_1	-2.4002
r^2	79.67%
Std. Dev., σ_{Error}	0.8802
Mean Log(V)	0.3111
SS of Log(V)	51.6595
N (data pairs)	100
Structural Limit (2560 psi) (1)	7.51V
Structural Limit (2405 psi) (1)	9.40V
p Value for a_1 (2)	$5.60 \cdot 10^{-36}$
Reference σ_f	68.78 ksi (3)

Notes: The number of significant figures reported simply corresponds to the output from the calculation code and does not represent true engineering significance.

(1) Values reported correspond to applying a safety factor of 1.4 on the differential pressure associated with a postulated SLB event.

(2) Numerical values are reported only to compare the calculated result to a criterion value of 0.05. For such small values the relative change is statistically meaningless.

(3) This is the flow stress value to which all data was normalized prior to performing the regression analysis.

4.2 Probability of Leak and Conditional Leak Rate

Reference 8 presents the results of the regression analysis for the voltage-dependent leak rate correlation using the Addendum 6 leak rate database for 7/8" tubes. It should be noted that, for the 2405 psi delta pressure, the one-sided p-value for the slope parameter in the voltage dependent leak rate correlation is 0.5%, which meets the 5% threshold for an acceptable correlation specified in Generic Letter 95-05. AREVA computer simulations include the slope sampling method for the leak rate correlation that is presented in Reference 8.

The methodology used in the calculation of these parameters is consistent with NRC criteria in Reference 2. The probability of leak and leak rate correlation parameters used in the CM and OA were taken from Reference 8 and are shown in Tables 4-2 and 4-3.

Table 4-2: Probability of Leak Correlation

$$\Pr(Leak) = \frac{1}{1+e^{-[b_1+b_2\log(Volts)]}}$$

Parameter	Addendum 6
Intercept, b_1	-5.0407
Slope, b_2	7.5434
V_{11} (1)	1.3311
V_{12}	-1.7606
V_{22}	2.7744
DoF (2)	118
Deviance	32.37
Pearson SD	0.611
MSE	0.279

Notes:

1) Parameters V_{ij} are elements of the covariance matrix of the coefficients, b_i of the regression equation.

2) Degrees of freedom.

Table 4-3: Leak Rate vs. Bobbin Amplitude Correlation (2405 psi)

$Q = 10^{[b_3 + b_4 \log(Volts)]}$	
Parameter	Addendum 6
Intercept, b_3	-0.8039
Slope, b_4	1.2077
Index of Deter., r^2	20.0%
Std. Error	0.7774
Mean of Log(Q)	0.5090
Std. Dev. of Log(Q)	22.6667
p Value for b_4	0.5%
Data Pairs, N	32
Mean of Log(V)	1.0871
SS of Log(V)	3.1116
Note: The number of significant figures reported simply corresponds to the output from the calculation code and does not represent true engineering significance.	

5.0 EOC 13 Condition Monitoring, Benchmarking of EOC-13 Conditions and Assessment of Potential Underpredictions

This section provides the EOC-13 condition monitoring, the results of a benchmarking study that compares the projected EOC-13 conditions to the as-found conditions, and an assessment of potential underpredictions as committed to the NRC.

5.1 EOC-13 Condition Monitoring Results

EOC-13 as found conditions were evaluated to ensure that CM burst and leakage requirements were not exceeded. The burst probabilities and leak rates are shown in Table 5-2 and at the bottom of Table 5-7. The requirements for burst probabilities are met for all of the SGs, and for the leak rate, the plant-specific value of 10.5 gpm for the faulted steam generator was not exceeded in any steam generator.

5.2 EOC-13 Benchmark Calculations

EOC-13 projections using the composite DCPP POPCD through 7 inspections have been previously provided to the NRC in Reference 27. Those projections used an estimated Cycle 13 operating interval of 1.33 EFPY and correlations using Addendum 5 plus DCPP pulled tube data from 2R11. The actual Cycle 13 operating interval was 1.31 EFPY and the correlation database has been revised to Addendum 6, so the EOC-13 projections have been recalculated. In addition, the composite DCPP POPCD through 8 inspections was used in the recalculations.

Table 5-1 provides a summary of the inputs required and the corresponding section(s) or table(s) that provide these data. If the input was unchanged relative to the input used in the 2R12 90 day report projections, then "no change" is noted in the comment field. For example, the growth distributions used in the benchmark calculations were the same as used in the 2R12 90 day report, and followed the guidelines provided in References 25 and 28.

Table 5-1: Inputs for EOC-13 Benchmark Projections

Input Description	Section or Table Reference	Comments
BOC Voltage Distribution	Tables 5-3 and 5-4	No change
Repaired Voltage Distribution	Tables 5-3 and 5-4	No change
NDE Uncertainties	Section 3.6 and Table 3-21	No change
POD	DCPP POPCD Table 6-8 from Reference 7.	Composite POPCD through 8 inspections
Growth	Table 5-5 and 5-6	No change
Cycle Length	Section 5.2	1.31 EFPY
Tube Integrity Correlations	Tables 4-1 to 4-3	Addendum 6
Material Properties	Section 7.1	No change

Table 5-7 provides a comparison of the EOC-13 benchmarking projections to the as-found EOC-13 conditions. This table shows the voltage distributions as well as the POB and leak rate results. In all cases, the leak rate, POB, and the number of indications were over-predicted by wide margins. Therefore, the EOC-13 projections using DCPP POPCD correlation and the growth guidelines provided conservative results relative to the as-found conditions, and no adjustments to either of the methodologies are warranted.

5.3 Assessment of Potential Underpredictions

DCPP Tech Specs require that, upon implementation of POPCD, if the EOC conditional MSLB burst probability, the projected MSLB leak rate, or the number of indications are underpredicted by the previous cycle operational assessment, the following guidelines must be applied to assess the need for methods adjustments:

- The assessment of the probable causes for the under predictions, proposed corrective actions, and any recommended changes to probability of detection or growth methodology indicated by potential methods assessments.

- An assessment of the potential need to revise the ARC analysis methods if: the burst probability is underpredicted by more than 0.001 (i.e., 10% of the reporting threshold) or an order of magnitude; or the leak rate is underpredicted by more than 0.5 gpm or an order of magnitude.

- An assessment of the potential need to increase the number of predicted low voltage indications at the BOC if the total number of as found indications in any SG are underestimated by greater than 15 percent or by greater than 150 indications. If future inspection results provide additional information that could alter these guidelines, PG&E would provide recommended changes to the guidelines and basis for the changes in the subsequent 90 day report.

As discussed above, EOC-13 benchmark projections were performed using the actual Cycle 13 operating interval, DCPP POPCD through 8 inspections, and Addendum 6 correlations. As shown in Table 5-7, the POBs, leak rates, and numbers of indications (also shown graphically in Figures 5-1 through 5-4) were overestimated in all cases for EOC-13. Therefore, there is no need to perform a method adjustment assessment.

Table 5-2: Summary of 95-05 ARC Calculations As-found vs. Projected EOC-13					
		SG 2-1	SG 2-2	SG 2-3	SG 2-4
Number of DOS Plus AONDB	As-Found	531	456	332	1194
	Projected (1)	944	797	609	1715
Leak Rate (gpm)	As-Found	0.11	0.07	0.09	0.78
	Projected (1)	0.75	0.49	0.30	2.52
POB	As-Found	4.38×10^{-5}	2.63×10^{-5}	6.52×10^{-5}	5.57×10^{-4}
	Projected (1)	9.63×10^{-4}	3.61×10^{-4}	2.86×10^{-4}	2.76×10^{-3}
Acceptance Criteria		1.0×10^{-2}		10.5 gpm	

Notes:
(1) Used actual cycle length of 1.31 EFPY and DCPP POPCD through 8 inspections.
(2) The 95% Upper Confidence Limit (UCL) is based on the number of trials with one or more failures.
(3) Equivalent volumetric rate at room temperature.
(4) The calculated total leak rate reflects the upper 95% quantile value at an upper 95% confidence bound.
(5) The reference leak limits (10.5 gpm) consider contributions from other ARCs. Therefore other ARC Leak rates should be added to the results in this table to assess total leakage.

Table 5-3: SG 2-1 BOC-13 Voltage Distribution Used for EOC-13 Benchmark Projections

Voltage Bin	SG 2-1	
	As-Found EOC-12	Repaired
0.1	0	0
0.2	29	0
0.3	74	0
0.4	97	0
0.5	55	1
0.6	54	0
0.7	43	0
0.8	33	0
0.9	25	0
1	14	0
1.06	9	0
1.1	2	0
1.2	10	0
1.3	2	0
1.4	4	0
1.5	8	0
1.6	1	0
1.7	3	0
1.8	2	1
1.9	2	1
2	0	0
2.1	2	2
2.2	2	2
2.3	0	0
2.4	1	1
2.5	0	0
2.6	0	0
2.7	0	0
2.8	0	0
2.9	0	0
3	0	0
Total	472	8

Table 5-4: SGs 2-2, 2-3, and 2-4 BOC-13 Voltage Distributions Used for EOC-13 Benchmark Projections

Voltage Bin	SG 2-2		SG 2-3		SG 2-4	
	As-Found EOC-12	Repaired	As-Found EOC-12	Repaired	As-Found EOC-12	Repaired
0.1	0	0	1	0	0	0
0.2	28	1	17	0	31	0
0.3	54	0	42	0	104	0
0.4	70	1	65	0	134	0
0.5	72	2	35	0	141	3
0.59	42	2	35	1	108	1
0.6	5	0	3	0	19	0
0.7	31	0	20	0	100	0
0.8	24	1	18	0	77	2
0.9	23	0	11	0	66	2
1	15	0	5	0	56	0
1.1	5	0	2	0	45	0
1.2	5	0	5	0	38	0
1.3	7	0	5	0	26	0
1.4	4	0	1	0	20	0
1.5	6	0	5	0	18	0
1.6	1	0	2	0	5	0
1.66	2	0	0	0	7	1
1.7	0	0	0	0	4	0
1.8	1	1	0	0	7	2
1.9	0	0	0	0	6	3
2	1	1	0	0	4	2
2.1	1	1	0	0	1	1
2.2	0	0	0	0	0	0
2.3	0	0	0	0	0	0
2.4	0	0	0	0	0	0
2.5	0	0	0	0	1	1
2.6	0	0	0	0	0	0
2.7	0	0	0	0	1	1
2.8	0	0	0	0	0	0
2.9	0	0	0	0	1	1
3.0	0	0	0	0	0	0
Total	**397**	**10**	**272**	**1**	**1020**	**20**

Table 5-5: Cycle 11 Growth Distributions for SG 2-1
(Used for EOC-13 Benchmark Projections for SG 2-1)

Growth (Volts/EFPY)	Bin1 (<=1.06v)	Bin3 (>1.06v)
<=0	38	3
0.1	179	2
0.2	73	1
0.3	19	1
0.4	9	1
0.5	9	1
0.6	0	0
0.7	1	0
0.8	0	0
0.9	0	2
1	0	0
1.1	0	0
1.2	1	0
1.3	1	0
1.4	1	0
1.5	0	0
1.6	0	1
1.7	1	0
1.8	0	0
1.9	0	0
2	0	0
2.1	0	0
2.2	0	0
2.3	0	1
2.4	0	0
2.5	0	0
2.6	0	1
2.7	0	0
2.8	0	0
2.9	0	1
3	0	0
3.1	0	0
3.2	0	0
3.3	0	0
3.4	0	0
3.5	0	0
>3.5	0	0
Total	**332**	**15**

Table 5-6: Cycle 11 Growth Distributions for Remaining SGs
(Used for EOC-13 Benchmark Projections for SGs 2-2, 2-3, and 2-4)

	SGs 2-2 and 2-3			SG 2-4		
Growth (Volts/EFPY)	Bin1 (<=0.59v)	Bin2 (0.59v to 1.66v)	Bin3 (>1.66v)	Bin1 (<=0.59v)	Bin2 (0.59v to 1.66v)	Bin3 (>1.66v)
<=0	152	68	0	48	28	0
0.1	690	84	2	307	50	2
0.2	374	59	1	220	37	1
0.3	124	53	3	79	29	3
0.4	32	37	0	24	24	0
0.5	17	28	0	5	21	0
0.6	10	19	1	8	13	1
0.7	5	10	0	5	6	0
0.8	3	6	0	3	4	0
0.9	0	10	0	0	7	0
1	1	6	0	1	6	0
1.1	0	7	0	0	6	0
1.2	1	3	0	0	3	0
1.3	1	7	0	1	5	0
1.4	0	3	1	0	1	1
1.5	0	3	2	0	3	2
1.6	0	3	2	0	3	1
1.7	1	1	1	1	0	0
1.8	0	2	0	0	2	0
1.9	0	2	1	0	1	1
2	0	1	0	0	1	0
2.1	0	0	0	0	0	0
2.2	0	3	1	0	3	1
2.3	0	2	0	0	1	0
2.4	0	1	0	0	1	0
2.5	0	1	1	0	1	1
2.6	0	1	1	0	1	0
2.7	0	0	2	0	0	1
2.8	0	0	0	0	0	0
2.9	0	0	1	0	0	0
3	0	0	1	0	0	1
>3.0	0	0	0	0	0	0
Total	1411	420	21	702	257	16

Table 5-7: As-found EOC-13 vs. Projected EOC-13 Conditions

Voltage Bin	SG 2-1		SG 2-2		SG 2-3		SG 2-4	
	As-Found	Projected	As-Found	Projected	As-Found	Projected	As-Found	Projected
0.1	0	1.04	0	0.93	2	5.78	1	0.66
0.2	47	20.70	37	18.18	30	28.79	43	13.69
0.3	83	93.81	66	77.47	46	63.08	117	80.39
0.4	106	147.55	85	113.33	66	90.41	168	160.52
0.5	62	161.14	71	128.43	50	102.70	144	213.60
0.6	57	130.52	53	119.97	35	88.74	128	228.81
0.7	44	97.33	44	92.64	27	67.16	118	202.54
0.8	30	74.19	31	61.51	25	43.83	69	151.93
0.9	27	58.09	15	38.57	12	26.84	77	103.92
1	17	43.02	14	25.95	9	17.28	62	74.26
1.1	17	30.42	8	19.61	5	12.46	57	60.16
1.2	9	20.32	7	16.06	4	9.93	43	53.59
1.3	4	13.14	7	13.57	2	8.24	33	49.74
1.4	11	8.22	8	11.37	4	6.93	39	44.76
1.5	3	5.36	3	9.51	5	5.77	24	38.58
1.6	6	3.80	3	7.70	2	4.68	13	31.95
1.7	2	3.05	2	6.16	3	3.80	12	26.01
1.8	1	2.87	0	5.15	1	3.20	4	21.77
1.9	1	2.92	1	4.42	0	2.78	5	19.05
2	2	2.82	0	3.71	1	2.35	11	16.71
2.1	0	2.49	1	3.14	1	1.96	6	14.68
2.2	0	2.09	0	2.56	1	1.57	3	12.57
2.3	1	1.77	0	2.13	0	1.32	3	10.83
2.4	1	1.91	0	1.96	0	1.21	1	9.64
2.5	0	1.88	0	1.72	0	1.06	0	8.19
2.6	0	1.58	0	1.49	0	0.92	1	7.15
2.7	0	1.13	0	1.29	0	0.78	2	6.47
2.8	0	0.79	0	1.09	0	0.66	0	5.60
2.9	0	0.56	0	0.88	0	0.53	1	4.43
3	0	0.39	0	0.75	0	0.45	2	3.78
3.5	0	1.88	0	2.65	1	1.61	3	13.34
4	0	0.96	0	2.20	0	1.33	3	13.22
4.5	0	1.94	0	0.99	0	0.58	1	7.33
5	0	2.83	0	0.20	0	0.12	0	2.44
5.5	0	1.80	0	0.03	0	0.01	0	1.50
6	0	0.31	0	0.01	0	0.00	0	0.92
6.5	0	0.02	0	0.00	0	0.00	0	0.14
7	0	0.00	0	0.00	0	0.00	0	0.01
>7	0	0.00	0	0.00	0	0.00	0	0.00
Total	531	944.62	456	797.31	332	608.86	1194	1714.92
<=1	473	827.37	416	676.98	302	534.60	927	1230.32
>1	58	117.25	40	120.33	30	74.26	267	484.60
>2	2	24.32	1	23.07	3	14.12	26	122.26
>5	0	2.12	0	0.04	0	0.01	0	2.57
POB	4.38E-05	9.63E-04	2.63E-05	3.61E-04	6.52E-05	2.86E-04	5.57E-04	2.76E-03
Leak Rate	0.11	0.75	0.07	0.49	0.09	0.3	0.78	2.52

Figure 5-1: As-found SG 2-1 vs Projected Voltage Distributions (DCPP POPCD)

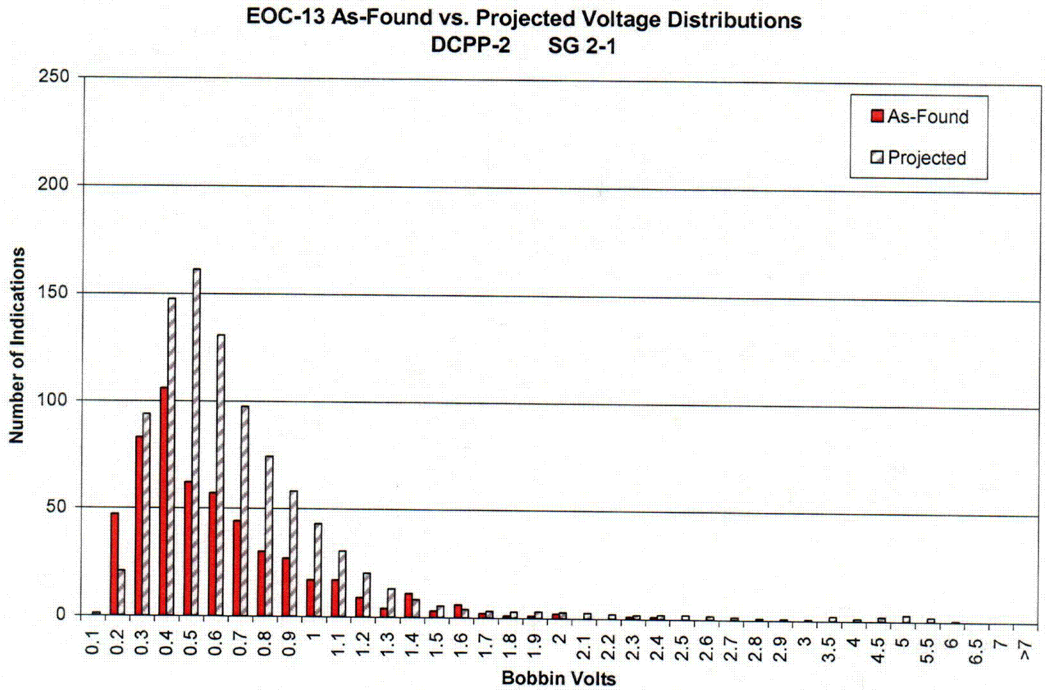


Figure 5-2: As-found SG 2-2 vs Projected Voltage Distributions (DCPP POPCD)

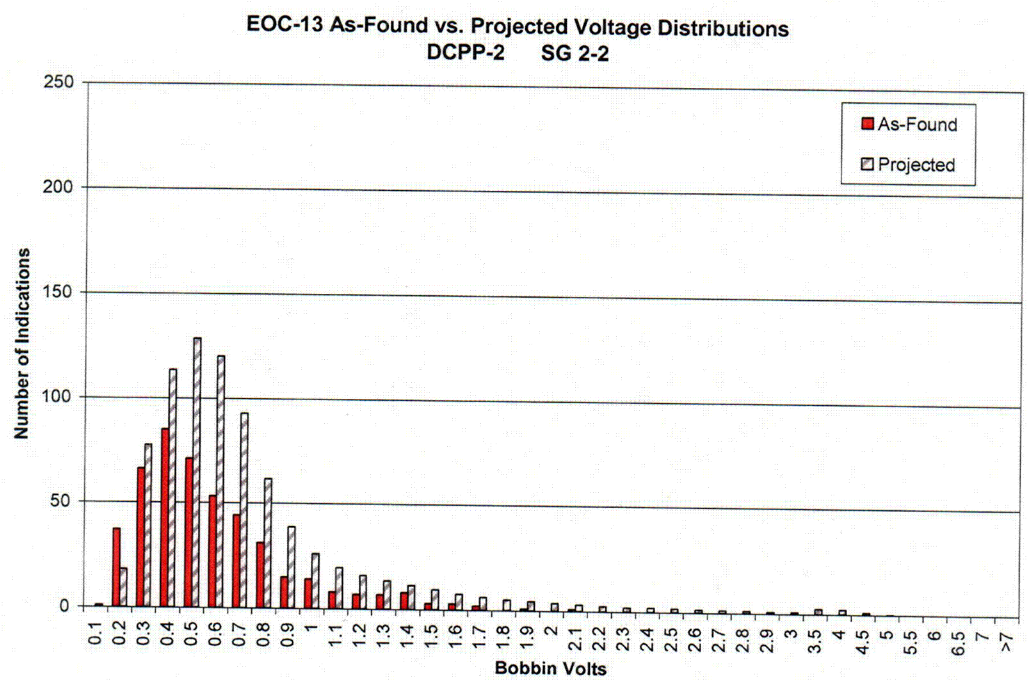


Figure 5-3: As-found SG 2-3 vs Projected Voltage Distributions (DCPP POPCD)

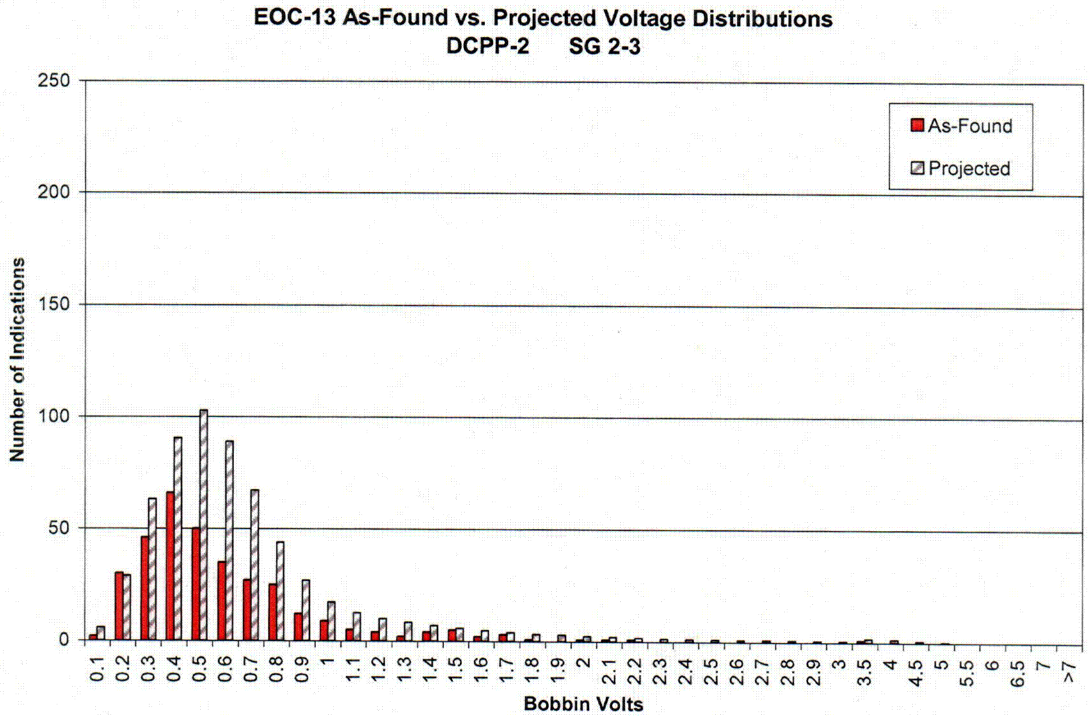
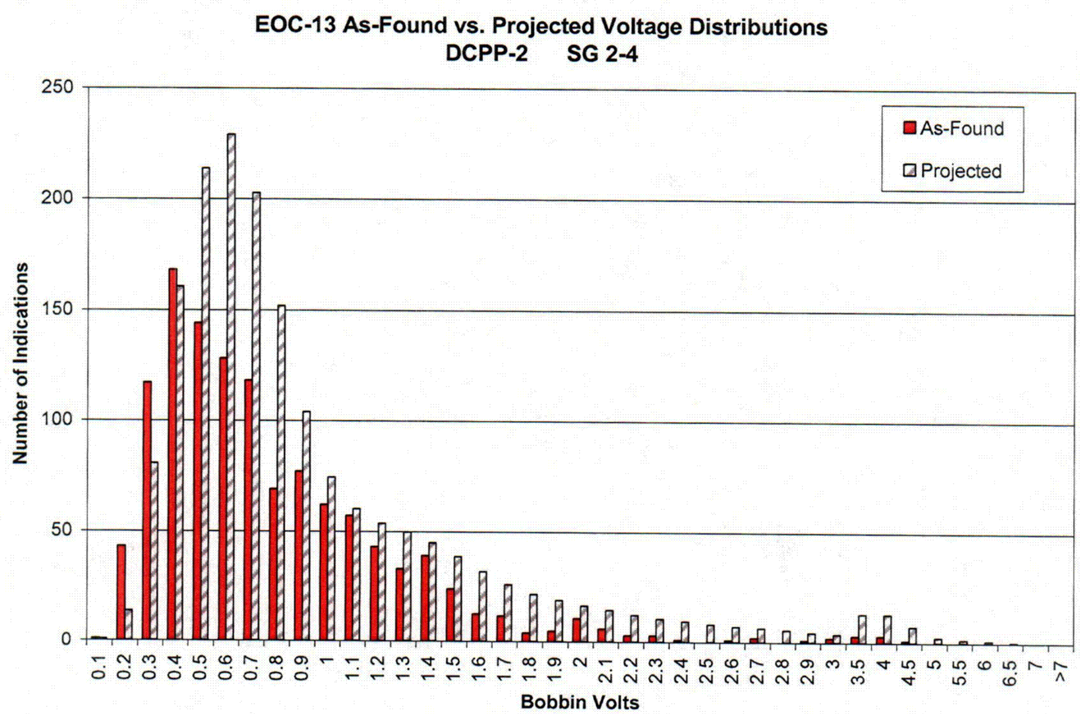


Figure 5-4: As-found SG 2-4 vs Projected Voltage Distributions (DCPP POPCD)



6.0 Probability of Prior Cycle Detection and EOC-14 Projections Using DCPP POPCD

The NRC approved use of the voltage-dependent POPCD at DCPP in Reference 29. This section provides the 2R12 POPCD results, which is based on the results of the 2R12 and 2R13 inspections. This section also provides the updated POPCD correlation that was used in the EOC-14 projections provided in Section 7, as well as NRC reporting requirements for continued application of POPCD.

6.1 Updated DCPP POPCD Correlation

The POPCD method, which is based on results from actual field inspections, reflects the DCPP detection results that approach 1.0 at bobbin voltages above 1.6 volts. The resulting larger POD above about two volts realistically lowers the detection uncertainty, thereby lowering the number of the larger undetected indications in the BOC voltage distribution. Reference 7 provided the DCPP-specific correlation through 1R12 (eight inspections). The data from Reference 7 has since been updated to include the 2R13 results, referred to as the 2R12 POPCD data. Tables 6-1 and 6-2 provide the 2R12 POPCD and composite POPCD data, respectively. The composite POPCD includes results from nine inspections (2R8, 2R9, 2R10, 2R11, 2R12, 1R9, 1R10, 1R11, and 1R12). Table 6-3 provides the POPCD tracking matrix with column letters that correspond to the columns in Tables 6-1 and 6-2. Table 6-4 provides the POPCD matrix table including data from only the just completed cycle segregated into voltage bins of <=1.00v, 1.01-2.00v, and >2.00v based on the beginning-of-cycle (BOC) voltage. Table 6-5 provides the POPCD matrix table for the just completed cycle regardless of the beginning-of-cycle voltage. Table 6-6 provides the composite multi-cycle POPCD matrix table segregated into the three voltage bins. Table 6-7 provides the composite multi-cycle POPCD matrix table regardless of the beginning-of-cycle voltage. Table 6-8 provides the correlation parameters for the composite data set.

The largest "undetected" POPCD indication in 2R12 was 1.37v. SG 2-3 R45C57 1H had a 1.40 volt DOS reported in 2R13 that was not reported in 2R12. The location was not inspected with +Point™ in either inspection (BND w/o RPC to BDD w/o RPC in Table 6-1 Column H) and had a 1.37v DOS look-up in 2R12. POPCD methods conservatively require that new indications at EOC_{n+1} that were not identified by bobbin or +Point™ at EOC_n are counted as no detection at EOC_n.

6.1.1 Assessment of POPCD Changes

NRC requires an assessment of the POPCD method for potential changes over time, that is, the multi-cycle POPCD distribution applied for the last operational assessment must be compared with the POPCD distribution obtained for only the last operating cycle. Differences in the two POPCD distributions must be assessed relative to the potential for significant changes in detection capability. Figure 6-1 shows the POPCD curves for the just completed cycle as well as three prior composite POPCD curves (data through 2R12, 1R13, and 2R13). The curve labeled "through 1R12 (eight inspections)" was used for the benchmarking calculations provided in Section 5 of this document. The composite POPCD through 2R12 was used for the EOC-14 projections provided in Section 7 of this document.

The 2R12 POPCD distribution for the just completed cycle (based on the 2R13 inspection results) is improved over all voltage ranges compared to the previous composite POPCD distributions. As a result, the composite POPCD through 2R12 (9 inspections) is also improved for voltages less than about 2.0 volts compared to previous composite POPCD distributions. The improvements are due to the numbers of indications counted as detection in 2R12 in the lower voltage ranges, as well as no significant missed indications (largest missed indication was 1.37 volts). Large voltage missed indications had a negative affect on the 1R12 POPCD distribution in the upper tail as previously discussed in Reference 30. Table 6-9 provides a direct comparison of the best estimates of the previous and current composite POPCD values up through 10 volts. The improvement in the composite POPCD through 9 inspections may not represent a significant change in actual detection capability and may be more reflective of reduced rates of new crack initiation at detectable levels. The growth rates decreased in Cycle 13 compared to Cycle 12. This growth rate decrease may have contributed to the improvement in the POPCD distribution, assuming that slower growth implies reduced rates of new crack initiation at detectable levels and therefore fewer new indications, which translates into fewer misses for POPCD. The improved POPCD continues to move the DCPP POPCD closer to that found across the industry as reflected in the industry POPCD distribution of the EPRI Addendum 6 Database (Ref. 8).

From Table 6-1 which is the POPCD for the just completed cycle based on 2R13 inspections, the number of non-detected indications was only 473, compared to 2017 detected indications. This is a greater than 4-to-1 ratio. This ratio of detections to non-detections has been increasing over time at DCPP, and was 2.35 for the prior inspection. There were a large number of new small voltage indications detected in 2R12. These new indications were then re-identified in 2R13 and counted as detections at EOCn, which also improved DCPP POPCD based on larger numbers of detected indications.

6.1.2 Assessment of Disappearing Flaws

NRC also requires an assessment of disappearing flaws. For RPC confirmed indications at EOC_n that are RPC NDD at EOC_{n+1}, an assessment is required for the cause of the "disappearing flaws" if the +Point^{TM} voltage is greater than 0.5 volt. If there are a significant number of occurrences of these "disappearing flaws", the cause must be evaluated independent of the +Point^{TM} voltage. (Note: In support of this evaluation, an RPC inspection is required at EOC_{n+1} for RPC confirmed indications at EOC_n (either bobbin detected or bobbin NDD) that are bobbin NDD at EOC_{n+1}. This inspection is necessary to ensure that all known ODSCC indications are included in the condition monitoring and operational assessments as well as properly categorized for the POPCD method evaluation.)

All 2R12 +Point^{TM} indications were also detected by +Point^{TM} during the 2R13 inspection. Therefore an assessment is not required.

6.2 Input to Industry POPCD Database

Tables 6-10 and 6-11 provide the 2R12 and the composite POPCD results in the format of EPRI ODSCC Database Report Addendum 6, Table 7-2, for eventual inclusion in the next addendum of the database report. The EPRI format differs slightly from the DCPP format in that DCPP treats EOC_n RPC NDD indications as no detection as requested by the NRC (listed in Column G of Table 6-1 and Table 6-2), whereas the EPRI table treats these as detection.

Table 6-1: 2R12 POPCD Results

Column	A	B	C	D	E	F	G	H	I	J	K
2R12 POPCD Data Table											
	Detection at EOC_n			No Detection at EOCn (New Indications)							
	EOC_n Bobbin Ind. RPC Confirmed at EOC_{n+1}	EOC_n Bobbin Ind. Not RPC Inspected at EOC_{n+1}	EOC_n Bobbin Ind. Repaired at EOC_n	New EOC_{n+1} Bobbin RPC Confirmed	New EOC_{n+1} Bobbin Not RPC Inspected	Ind. Found Only by RPC at EOC_{n+1} or at EOC_n & Plugged at EOC_n (3)	EOC_n RPC NDD Bobbin Indications (2)	Excluded from POPCD	Totals for POPCD Evaluation		
Voltage Bin	BDD / RDD → BDD / RDD BDD / RDD → BND / RDD BDD w/o RPC → BDD / RDD BDD w/o RPC → BND / RDD	BDD w/o RPC → BDD w/o RPC BDD / RDD → BDD w/o RPC	BDD / RDD → Plugged at EOCn BDD w/o RPC → Plugged at EOCn	BND w/o RPC → BDD / RDD BND / RDD → BDD / RDD BND / RND → BDD / RDD	BND w/o RPC → BDD w/o RPC BND / RDD → BDD w/o RPC BND / RND → BDD w/o RPC	BND w/o RPC → BND / RDD BND / RDD → BND / RDD BND / RND → BND / RDD BND / RDD → Plugged at EOCn	BDD / RND → BDD w/o RPC BDD / RND → BDD / RDD BDD / RND → BND / RDD	All RND AT EOC_{n+1} All BND w/o RPC at EOCn+1 BDD/RND/Plugged at EOCn	Detection at EOCn	No Detection at EOCn	POPCD for Voltage Bin Note (1)
0.01-0.10	0	0	0	0	7	0	0	3	0	7	0.000
0.11-0.20	2	96	1	1	85	0	3	5	99	89	0.527
0.21-0.30	11	236	0	2	121	1	7	19	247	131	0.653
0.31-0.40	21	310	1	2	68	22	14	24	332	106	0.758
0.41-0.50	29	239	6	0	39	17	7	6	274	63	0.813
0.51-0.60	26	214	3	0	23	10	5	5	243	38	0.865
0.61-0.70	19	166	0	2	10	4	3	1	185	19	0.907
0.71-0.80	16	123	3	0	6	0	4	2	142	10	0.934
0.81-0.90	15	105	2	0	3	2	0	4	122	5	0.961
0.91-1.00	11	77	0	1	2	0	1	0	88	4	0.957
1.01-1.10	9	54	0	0	0	0	0	0	63	0	1.000
1.11-1.20	11	47	0	0	0	0	0	0	58	0	1.000
1.21-1.30	10	30	0	0	0	0	0	0	40	0	1.000
1.31-1.40	9	20	0	0	1	0	0	0	29	1	0.967
1.41-1.50	14	23	0	0	0	0	0	0	37	0	1.000
1.51-1.60	6	3	0	0	0	0	0	0	9	0	1.000
1.61-1.70	11	4	1	0	0	0	0	0	16	0	1.000
1.71-1.80	6	0	4	0	0	0	0	0	10	0	1.000
1.81-1.90	3	1	4	0	0	0	0	0	8	0	1.000
1.91-2.00	2	0	3	0	0	0	0	0	5	0	1.000
2.01-2.10	0	0	4	0	0	0	0	0	4	0	1.000
2.11-2.20	0	0	2	0	0	0	0	0	2	0	1.000
2.21-2.30	0	0	0	0	0	0	0	0	0	0	
2.31-2.40	0	0	1	0	0	0	0	0	1	0	1.000
2.41-2.50	0	0	1	0	0	0	0	0	1	0	1.000
2.51-2.60	0	0	0	0	0	0	0	0	0	0	
2.61-2.70	0	0	1	0	0	0	0	0	1	0	1.000
2.71-2.80	0	0	0	0	0	0	0	0	0	0	
2.81-2.90	0	0	1	0	0	0	0	0	1	0	1.000
2.91-3.00	0	0	0	0	0	0	0	0	0	0	
3.01-3.10	0	0	0	0	0	0	0	0	0	0	
3.11-3.20	0	0	0	0	0	0	0	0	0	0	
3.21-3.30	0	0	0	0	0	0	0	0	0	0	
3.31-3.40	0	0	0	0	0	0	0	0	0	0	
3.41-3.50	0	0	0	0	0	0	0	0	0	0	
3.51-3.60	0	0	0	0	0	0	0	0	0	0	
3.61-3.70	0	0	0	0	0	0	0	0	0	0	
3.71-3.80	0	0	0	0	0	0	0	0	0	0	
3.81-3.90	0	0	0	0	0	0	0	0	0	0	
3.91-4.00	0	0	0	0	0	0	0	0	0	0	
4.01-4.10	0	0	0	0	0	0	0	0	0	0	
Total	231	1748	38	8	365	56	44	69	2017	473	

Notes:
1) POPCD for each voltage bin calculated as (Detection at EOCn)/(Detection at EOCn + No Detection at EOCn). By column, POPCD = (A+B+C)/(A+B+C+D+E+F+G).
2) EOCn RPC NDD bobbin indications are treated as new indications per NRC request
3) Includes indications at EOCn plugged at EOCn and new indications at EOCn+1, not reported in the bobbin inspection, and found only by RPC inspection of dents, mixed residuals or other reasons for the RPC inspection.
4) BDD = Bobbin detected indication; BND = Bobbin NDD intersection; RDD = RPC detected indication; RND = RPC NDD intersection

Table 6-2: DCPP Composite POPCD Results (through 9 Inspections)

Column	A	B	C	D	E	F	G	H	I	J	K
DCPP Specific POPCD Data Table											
	Detection at EOC_n			No Detection at EOCn (New Indications)							
	EOC_n Bobbin Ind. RPC Confirmed at EOC_{n+1}	EOC_n Bobbin Ind. Not RPC Inspected at EOC_{n+1}	EOC_n Bobbin Ind. Repaired at EOC_n	New EOC_{n+1} Bobbin RPC Confirmed	New EOC_{n+1} Bobbin Not RPC Inspected	Ind. Found Only by RPC at EOC_{n+1} or at EOC_n & Plugged at EOC_n (3)	EOC_n RPC NDD Bobbin Indications (2)	Excluded from POPCD	Totals for POPCD Evaluation		
Voltage Bin	BDD / RDD → BDD / RDD BDD / RDD → BND / RDD BDD w/o RPC → BDD / RDD BDD w/o RPC → BND / RDD	BDD w/o RPC → BDD w/o RPC BDD / RDD → BDD w/o RPC	BDD / RDD → Plugged at EOCn BDD w/o RPC → Plugged at EOCn	BND w/o RPC → BDD / RDD BND / RDD → BDD / RDD BND / RND → BDD / RDD	BND w/o RPC → BDD w/o RPC BND / RDD → BDD w/o RPC BND / RND → BDD w/o RPC	BND w/o RPC → BND / RDD BND / RDD → BND / RDD BND / RND → BND / RDD BND / RDD → Plugged at EOCn	BDD / RND → BDD w/o RPC BDD / RND → BDD / RDD BDD / RND → BND / RDD	All RND AT EOC_{n+1} All BND w/o RPC at EOCn+1 BDD/RND/Plugged at EOCn	Detection at EOCn	No Detection at EOCn	POPCD for Voltage Bin Note (1)
0.01-0.10	6	2	1	31	139	0	1	13	9	171	0.050
0.11-0.20	30	223	6	123	788	8	40	61	259	959	0.213
0.21-0.30	101	794	32	159	1029	126	52	121	927	1366	0.404
0.31-0.40	167	1065	51	144	710	192	63	118	1283	1109	0.536
0.41-0.50	201	917	45	84	376	126	35	78	1163	621	0.652
0.51-0.60	190	765	40	51	198	79	21	51	995	349	0.740
0.61-0.70	163	579	33	35	97	22	21	39	775	175	0.816
0.71-0.80	130	418	27	23	66	7	12	22	575	108	0.842
0.81-0.90	124	317	14	22	32	4	8	18	455	66	0.873
0.91-1.00	81	225	14	9	16	1	2	4	320	28	0.920
1.01-1.10	89	157	9	7	10	0	1	7	255	18	0.934
1.11-1.20	56	131	7	4	5	0	4	5	194	13	0.937
1.21-1.30	55	80	43	4	4	0	0	2	178	8	0.957
1.31-1.40	56	46	25	2	2	0	0	2	127	4	0.969
1.41-1.50	43	42	22	1	0	0	0	0	107	1	0.991
1.51-1.60	23	10	21	1	0	0	0	0	54	1	0.982
1.61-1.70	32	6	21	0	0	0	0	0	59	0	1.000
1.71-1.80	32	1	21	2	0	0	0	0	54	2	0.964
1.81-1.90	20	1	19	0	0	0	1	0	40	1	0.976
1.91-2.00	19	1	15	0	0	0	0	0	35	0	1.000
2.01-2.10	0	0	18	0	0	0	0	0	18	0	1.000
2.11-2.20	0	0	13	0	0	0	0	0	13	0	1.000
2.21-2.30	0	0	18	0	0	0	0	0	18	0	1.000
2.31-2.40	0	0	22	0	0	0	0	0	22	0	1.000
2.41-2.50	0	0	6	0	0	0	0	0	6	0	1.000
2.51-2.60	0	0	9	0	0	0	0	0	9	0	1.000
2.61-2.70	0	0	6	0	0	0	0	0	6	0	1.000
2.71-2.80	0	0	8	0	0	0	0	0	8	0	1.000
2.81-2.90	0	0	12	0	0	0	0	0	12	0	1.000
2.91-3.00	0	0	3	0	0	0	0	0	3	0	1.000
3.01-3.10	0	0	8	0	0	0	0	0	8	0	1.000
3.11-3.20	0	0	2	0	0	0	0	0	2	0	1.000
3.21-3.30	0	0	4	0	0	0	0	0	4	0	1.000
3.31-3.40	0	0	6	0	0	0	0	0	6	0	1.000
3.41-3.50	0	0	4	0	0	0	0	0	4	0	1.000
3.51-3.60	0	0	2	0	0	0	0	0	2	0	1.000
3.61-3.70	0	0	2	0	0	0	0	0	2	0	1.000
3.71-3.80	0	0	2	0	0	0	0	0	2	0	1.000
3.81-3.90	0	0	2	0	0	0	0	0	2	0	1.000
4.01-4.10	0	0	5	0	0	0	0	0	5	0	1.000
4.11-4.20	0	0	3	0	0	0	0	0	3	0	1.000
4.21-4.30	0	0	1	0	0	0	0	0	1	0	1.000
4.31-4.40	0	0	4	0	0	0	0	0	4	0	1.000
4.41-4.50	0	0	2	0	0	0	0	0	2	0	1.000
4.51-4.60	0	0	2	0	0	0	0	0	2	0	1.000
4.61-4.70	0	0	1	0	0	0	0	0	1	0	1.000
4.81-4.90	0	0	1	0	0	0	0	0	1	0	1.000
4.91-5.00	0	0	3	0	0	0	0	0	3	0	1.000
5.01-5.10	0	0	5	0	0	0	0	0	5	0	1.000
5.21-5.30	0	0	2	0	0	0	0	0	2	0	1.000
5.41-5.50	0	0	3	0	0	0	0	0	3	0	1.000
5.51-5.60	0	0	2	0	0	0	0	0	2	0	1.000
5.61-5.70	0	0	1	0	0	0	0	0	1	0	1.000
6.11-6.20	0	0	3	0	0	0	0	0	3	0	1.000
6.31-6.40	0	0	1	0	0	0	0	0	1	0	1.000
6.51-6.60	0	0	1	0	0	0	0	0	1	0	1.000
6.61-6.70	0	0	1	0	0	0	0	0	1	0	1.000
21.41-21.50	0	0	1	0	0	0	0	0	1	0	1.000
Total	1618	5780	655	702	3472	565	261	541	8053	5000	

Notes:
1) POPCD for each voltage bin calculated as (Detection at EOCn)/(Detection at EOCn + No Detection at EOCn). By column, POPCD = (A+B+C)/(A+B+C+D+E+F+G).
2) EOCn RPC NDD bobbin indications are treated as new indications per NRC request
3) Includes indications at EOCn plugged at EOCn and new indications at EOCn+1, not reported in the bobbin inspection, and found only by RPC inspection of dents, mixed residuals or other reasons for the RPC inspection.
4) BDD = Bobbin detected indication; BND = Bobbin NDD intersection; RDD = RPC detected indication; RND = RPC NDD intersection

Table 6-3: POPCD Matrix Table for Tracking Indications Between EOC_n and EOC_{n+1}

EOC_n				BDD at EOC_{n+1}						BND at EOC_{n+1}					
				BDD w/o RPC		BDD w/RDD		BDD w/RND		BND w/o RPC		BND w/RDD		BND w/RND	
				Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged
BDD at EOC_n	BDD w/o RPC	Plugged	C												
		Not Plugged		B	B	A	A	H	H	H	H	A	A	H	H
	BDD w/ RDD	Plugged	C												
		Not Plugged		B	B	A	A	H (2)	H (2)	H (1)	H (1)	A	A	H (2)	H (2)
	BDD w/ RND	Plugged	H												
		Not Plugged		G (3)	G (3)	G (3)	G (3)	H	H	H	H	G (3)	G (3)	H	H
BND at EOC_n	BND w/o RPC	Plugged													
		Not Plugged		E	E	D	D	H	H	No Count	No Count	F	F	No Count	No Count
	BND w/ RDD	Plugged	F												
		Not Plugged		E	E	D	D	H (2)	H (2)	H (1)	H (1)	F	F	H (2)	H (2)
	BND w/ RND	Plugged													
		Not Plugged		E	E	D	D	H	H	No Count	No Count	F	F	No Count	No Count

General Notes:
The column letters correspond to the column letters in POPCD Tables 6-1 and 6-2.
BDD = Bobbin detected indication
BND = Bobbin no detectable degradation (NDD) intersection
RDD = RPC detected indication
RND = RPC no detectable degradation intersection
No Count = Intersections having no bobbin or RPC indication at either EOC_n or EOC_{n+1}. These are not needed for POPCD.

Specific Notes:
1) For EOC_n bobbin indications that are confirmed by RPC or detected only by RPC, EOC_{n+1} RPC will be performed when bobbin is NDD and the number in this category will be "0" for future inspections.
2) If indications are RPC confirmed at EOC_n but RPC NDD at EOC_{n+1}, and the +Point™ voltage is greater than 0.5 volts the causative factors for this change in RPC detection will be discussed in the ARC 90-day report. If there are a significant number of these occurrences of this category, independent of the +Point™ voltage, the cause will be evaluated in the 90-day report.
3) EOC_n bobbin indications that were RPC NDD at EOC_n, and at EOC_{n+1} are either RPC detected or bobbin detected without RPC inspection, are treated as undetected at EOC_n in accordance with NRC request.

Table 6-4: 2R12 POPCD Voltage-Specific Summary from 2R13 Inspection Results

2R12 POPCD Results

POPCD Matrix for Indications <=1.00v at EOCn															
EOCn				BDD at EOCn+1						BND at EOCn+1					
				BDD w/o RPC		BDD w/RDD		BDD w/RND		BND w/o RPC		BND w/RDD		BND w/RND	
				Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged
BDD at EOCn	BDD w/o RPC	Plugged	8												
		Not Plugged		13	1522	0	2	0	0	0	5	0	0	0	0
	BDD w/ RDD	Plugged	8												
		Not Plugged		1	30	6	141	0	0	0	0	0	1	0	0
	BDD w/ RND	Plugged	0												
		Not Plugged		0	38	0	6	0	48	0	2	0	0	0	0
BND at EOCn	BND w/o RPC	Plugged													
		Not Plugged		5	359	3	4	0	14	No Count	No Count	3	11	No Count	No Count
	BND w/ RDD	Plugged	1												
		Not Plugged		0	0	0	1	0	0	No Count	No Count	0	38	No Count	No Count
	BND w/ RND	Plugged													
		Not Plugged		0	0	0	0	0	0	No Count	No Count	0	3	No Count	No Count

POPCD Matrix for Indications >1.00v and <=2.00v at EOCn															
EOCn				BDD at EOCn+1						BND at EOCn+1					
				BDD w/o RPC		BDD w/RDD		BDD w/RND		BND w/o RPC		BND w/RDD		BND w/RND	
				Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged
BDD at EOCn	BDD w/o RPC	Plugged	1												
		Not Plugged		1	175	20	21	0	0	0	0	0	0	0	0
	BDD w/ RDD	Plugged	11												
		Not Plugged		0	6	13	27	0	0	0	0	0	0	0	0
	BDD w/ RND	Plugged	0												
		Not Plugged		0	0	0	0	0	0	0	0	0	0	0	0
BND at EOCn	BND w/o RPC	Plugged													
		Not Plugged		0	1	0	0	0	0	No Count	No Count	0	0	No Count	No Count
	BND w/ RDD	Plugged	0												
		Not Plugged		0	0	0	0	0	0	No Count	No Count	0	0	No Count	No Count
	BND w/ RND	Plugged													
		Not Plugged		0	0	0	0	0	0	No Count	No Count	0	0	No Count	No Count

POPCD Matrix for Indications >2.00v at EOCn															
EOCn				BDD at EOCn+1						BND at EOCn+1					
				BDD w/o RPC		BDD w/RDD		BDD w/RND		BND w/o RPC		BND w/RDD		BND w/RND	
				Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged
BDD at EOCn	BDD w/o RPC	Plugged	0												
		Not Plugged		0	0	0	0	0	0	0	0	0	0	0	0
	BDD w/ RDD	Plugged	10												
		Not Plugged		0	0	0	0	0	0	0	0	0	0	0	0
	BDD w/ RND	Plugged	0												
		Not Plugged		0	0	0	0	0	0	0	0	0	0	0	0
BND at EOCn	BND w/o RPC	Plugged													
		Not Plugged		0	0	0	0	0	0	No Count	No Count	0	0	No Count	No Count
	BND w/ RDD	Plugged	0												
		Not Plugged		0	0	0	0	0	0	No Count	No Count	0	0	No Count	No Count
	BND w/ RND	Plugged													
		Not Plugged		0	0	0	0	0	0	No Count	No Count	0	0	No Count	No Count

Table 6-5: 2R12 POPCD Summary from 2R13 Inspection Results Regardless of Voltage

POPCD Matrix for All Indications Regardless of Voltage															
EOCn				BDD at EOCn+1						BND at EOCn+1					
				BDD w/o RPC		BDD w/RDD		BDD w/RND		BND w/o RPC		BND w/RDD		BND w/RND	
				Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged
BDD at EOCn	BDD w/o RPC	Plugged	9												
		Not Plugged		14	1697	20	23				5				
	BDD w/ RDD	Plugged	29												
		Not Plugged		1	36	19	168						1		
	BDD w/ RND	Plugged													
		Not Plugged			38		6		48		2				
BND at EOCn	BND w/o RPC	Plugged													
		Not Plugged		5	360	3	4		14	No Count	No Count	3	11	No Count	No Count
	BND w/ RDD	Plugged	1												
		Not Plugged					1			No Count	No Count		38	No Count	No Count
	BND w/ RND	Plugged													
		Not Plugged								No Count	No Count		3	No Count	No Count

Table 6-6: DCPP Composite Voltage-Specific POPCD Summary

Composite of 1R9, 1R10, 1R11, 1R12, 2R8, 2R9, 2R10, 2R11 & 2R12 POPCD Evaluations

POPCD Matrix for Indications <=1.00v at EOCn

EOCn				BDD at EOCn+1						BND at EOCn+1					
				BDD w/o RPC		BDD w/RDD		BDD w/RND		BND w/o RPC		BND w/RDD		BND w/RND	
				Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged
BDD at EOCn	BDD w/o RPC	Plugged	110												
		Not Plugged		95	4685	146	221	2	73	1	67	0	8	0	0
	BDD w/ RDD	Plugged	153												
		Not Plugged		2	523	37	755	0	2	0	0	0	26	0	2
	BDD w/ RND	Plugged	4												
		Not Plugged		5	175	10	62	0	162	0	40	0	3	0	3
BND at EOCn	BND w/o RPC	Plugged													
		Not Plugged		61	3386	115	523	4	159	No Count	No Count	48	217	No Count	No Count
	BND w/ RDD	Plugged	47												
		Not Plugged		0	3	1	34	0	0	No Count	No Count	10	199	No Count	No Count
	BND w/ RND	Plugged													
		Not Plugged		0	1	3	5	0	6	No Count	No Count	19	25	No Count	No Count

POPCD Matrix for Indications >1.00v and <=2.00v at EOCn

EOCn				BDD at EOCn+1						BND at EOCn+1					
				BDD w/o RPC		BDD w/RDD		BDD w/RND		BND w/o RPC		BND w/RDD		BND w/RND	
				Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged
BDD at EOCn	BDD w/o RPC	Plugged	14												
		Not Plugged		6	373	189	58	0	4	0	0	0	0	0	0
	BDD w/ RDD	Plugged	189												
		Not Plugged		2	94	62	115	0	0	0	0	0	1	0	0
	BDD w/ RND	Plugged	2												
		Not Plugged		0	4	0	2	0	5	0	0	0	0	0	0
BND at EOCn	BND w/o RPC	Plugged													
		Not Plugged		0	21	4	15	1	4	No Count	No Count	0	0	No Count	No Count
	BND w/ RDD	Plugged	0												
		Not Plugged		0	0	1	1	0	0	No Count	No Count	0	0	No Count	No Count
	BND w/ RND	Plugged													
		Not Plugged		0	0	0	0	0	0	No Count	No Count	0	0	No Count	No Count

POPCD Matrix for Indications >2.00v at EOCn

EOCn				BDD at EOCn+1						BND at EOCn+1					
				BDD w/o RPC		BDD w/RDD		BDD w/RND		BND w/o RPC		BND w/RDD		BND w/RND	
				Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged
BDD at EOCn	BDD w/o RPC	Plugged	0												
		Not Plugged		0	0	0	0	0	0	0	0	0	0	0	0
	BDD w/ RDD	Plugged	189												
		Not Plugged		0	0	0	0	0	0	0	0	0	0	0	0
	BDD w/ RND	Plugged	0												
		Not Plugged		0	0	0	0	0	0	0	0	0	0	0	0
BND at EOCn	BND w/o RPC	Plugged													
		Not Plugged		0	0	0	0	0	0	No Count	No Count	0	0	No Count	No Count
	BND w/ RDD	Plugged	0												
		Not Plugged		0	0	0	0	0	0	No Count	No Count	0	0	No Count	No Count
	BND w/ RND	Plugged													
		Not Plugged		0	0	0	0	0	0	No Count	No Count	0	0	No Count	No Count

Table 6-7: DCPP Composite POPCD Summary Regardless of Voltage

POPCD Matrix for All Indications Regardless of Voltage															
EOCn				BDD at EOCn+1						BND at EOCn+1					
				BDD w/o RPC		BDD w/RDD		BDD w/RND		BND w/o RPC		BND w/RDD		BND w/RND	
				Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged	Plugged	Not Plugged
BDD at EOCn	BDD w/o RPC	Plugged	124												
		Not Plugged		101	5058	335	279	2	77	1	67		8		
	BDD w/ RDD	Plugged	531												
		Not Plugged		4	617	99	870		2				27		2
	BDD w/ RND	Plugged	6												
		Not Plugged		5	179	10	64		167		40		3		3
BND at EOCn	BND w/o RPC	Plugged													
		Not Plugged		61	3407	119	538	5	163	No Count	No Count	48	217	No Count	No Count
	BND w/ RDD	Plugged	47												
		Not Plugged			3	2	35			No Count	No Count	10	199	No Count	No Count
	BND w/ RND	Plugged													
		Not Plugged			1	3	5		6	No Count	No Count	19	25	No Count	No Count

Table 6-8: DCPP POPCD Log Logistic Parameters

Parameter	POPCD Through 2R11 (7 Inspections)	POPCD Through 1R12 (8 Inspections)	Updated POPCD Through 2R12 (9 Inspections)
Number of Data Points	8647	10566	13053
a.0 (intercept)	2.147	2.125	2.258
a.1 (slope)	4.846	4.634	4.466
V_{11}	0.00317	0.00245	0.00203
V_{12}	0.00607	0.00471	0.00383
V_{22}	0.01454	0.01146	0.00909

Table 6-9: New DCPP POPCD Correlation Comparison to Previous POPCD Correlations (Best Estimates)

Volts	POPCD Through 1R11 (Six Inspections)	POPCD Through 2R11 (Seven Inspections)	POPCD Through 1R12 (Eight Inspections)	POPCD Through 2R12 (Nine Inspections)
0.1	0.050	0.063	0.075	0.099
0.12	0.072	0.090	0.105	0.135
0.14	0.096	0.120	0.138	0.174
0.16	0.123	0.153	0.173	0.215
0.18	0.152	0.188	0.210	0.256
0.2	0.183	0.224	0.247	0.297
0.22	0.214	0.261	0.285	0.337
0.25	0.262	0.316	0.340	0.394
0.3	0.342	0.404	0.426	0.481
0.35	0.417	0.484	0.503	0.555
0.4	0.485	0.554	0.570	0.618
0.45	0.546	0.615	0.627	0.670
0.5	0.600	0.666	0.675	0.714
0.6	0.686	0.745	0.750	0.780
0.7	0.751	0.802	0.803	0.827
0.8	0.799	0.843	0.842	0.861
0.9	0.836	0.873	0.871	0.886
1	0.863	0.895	0.893	0.905
1.1	0.885	0.913	0.910	0.920
1.2	0.902	0.926	0.924	0.932
1.4	0.927	0.946	0.943	0.948
1.6	0.944	0.958	0.956	0.960
1.8	0.955	0.967	0.965	0.968
2	0.964	0.974	0.971	0.973
2.2	0.970	0.978	0.976	0.978
2.4	0.975	0.982	0.980	0.981
2.6	0.979	0.985	0.983	0.984
2.8	0.982	0.987	0.985	0.986
3	0.984	0.989	0.987	0.988
3.5	0.988	0.992	0.990	0.991
4	0.991	0.994	0.993	0.993
4.5	0.993	0.995	0.994	0.994
5	0.9944	0.9961	0.9953	0.9954
6	0.9962	0.9973	0.9968	0.9968
7	0.9972	0.9981	0.9976	0.9976
8	0.9979	0.9985	0.9982	0.9982
9	0.9984	0.9989	0.9986	0.9985
10	0.9987	0.9991	0.9988	0.9988

Table 6-10: 2R12 POPCD Results In Industry Format

Column	A	B	C	D	E	F	G	H	I	J
DCPP 2R12 Input to Generic POPCD Data Table										
	Detection at EOC_n			No Detection at EOCn (New Indications)						
	EOC_n Bobbin Ind. RPC Confirmed at EOC_{n+1}	EOC_n Bobbin Ind. Not RPC Inspected at EOC_{n+1}	EOC_n Bobbin Ind. Repaired at EOC_n	New EOC_{n+1} Bobbin RPC Confirmed	New EOC_{n+1} Bobbin Not RPC Inspected	Ind. Found Only by RPC at EOC_{n+1} or at EOC_n & Plugged at EOC_n[3]	Excluded from POPCD	Totals for POPCD Evaluation		
Voltage Bin	BDD / RDD → BDD / RDD BDD / RDD → BND / RDD BDD / RND → BDD / RDD BDD / RND → BND / RDD BDD w/o RPC → BDD / RDD BDD w/o RPC → BND / RDD	BDD w/o RPC → BDD w/o RPC BDD / RDD → BDD w/o RPC BDD / RND → BDD w/o RPC	BDD / RDD → Plugged at EOCn BDD w/o RPC → Plugged at EOCn	BND w/o RPC → BDD / RDD BND / RDD → BDD / RDD BND / RND → BDD / RDD	BND w/o RPC → BDD w/o RPC BND / RDD → BDD w/o RPC BND / RND → BDD w/o RPC	BND w/o RPC → BND / RDD BND / RDD → BND / RDD BND / RND → BND / RDD BND / RDD → Plugged at EOCn	All RND AT EOC_{n+1} All BND w/o RPC at EOC_{n+1} BDD/RND/Plugged at EOCn	Detection at EOCn	No Detection at EOCn	POPCD for Voltage Bin (Note 1)
0.01-0.10	0	0	0	0	7	0	3	0	7	0.000
0.11-0.20	2	99	1	1	85	0	5	102	86	0.543
0.21-0.30	12	242	0	2	121	1	19	254	124	0.672
0.31-0.40	24	321	1	2	68	22	24	346	92	0.790
0.41-0.50	30	245	6	0	39	17	6	281	56	0.834
0.51-0.60	26	219	3	0	23	10	5	248	33	0.883
0.61-0.70	19	169	0	2	10	4	1	188	16	0.922
0.71-0.80	17	126	3	0	6	0	2	146	6	0.961
0.81-0.90	15	105	2	0	3	2	4	122	5	0.961
0.91-1.00	11	78	0	1	2	0	0	89	3	0.967
1.01-1.10	9	54	0	0	0	0	0	63	0	1.000
1.11-1.20	11	47	0	0	0	0	0	58	0	1.000
1.21-1.30	10	30	0	0	0	0	0	40	0	1.000
1.31-1.40	9	20	0	0	1	0	0	29	1	0.967
1.41-1.50	14	23	0	0	0	0	0	37	0	1.000
1.51-1.60	6	3	0	0	0	0	0	9	0	1.000
1.61-1.70	11	4	1	0	0	0	0	16	0	1.000
1.71-1.80	6	0	4	0	0	0	0	10	0	1.000
1.81-1.90	3	1	4	0	0	0	0	8	0	1.000
1.91-2.00	2	0	3	0	0	0	0	5	0	1.000
2.01-2.10	0	0	4	0	0	0	0	4	0	1.000
2.11-2.20	0	0	2	0	0	0	0	2	0	1.000
2.21-2.30	0	0	0	0	0	0	0	0	0	
2.31-2.40	0	0	1	0	0	0	0	1	0	1.000
2.41-2.50	0	0	1	0	0	0	0	1	0	1.000
2.51-2.60	0	0	0	0	0	0	0	0	0	
2.61-2.70	0	0	1	0	0	0	0	1	0	1.000
2.71-2.80	0	0	0	0	0	0	0	0	0	
2.81-2.90	0	0	1	0	0	0	0	1	0	1.000
2.91-3.00	0	0	0	0	0	0	0	0	0	
3.01-3.10	0	0	0	0	0	0	0	0	0	
Total	237	1786	38	8	365	56	69	2061	429	

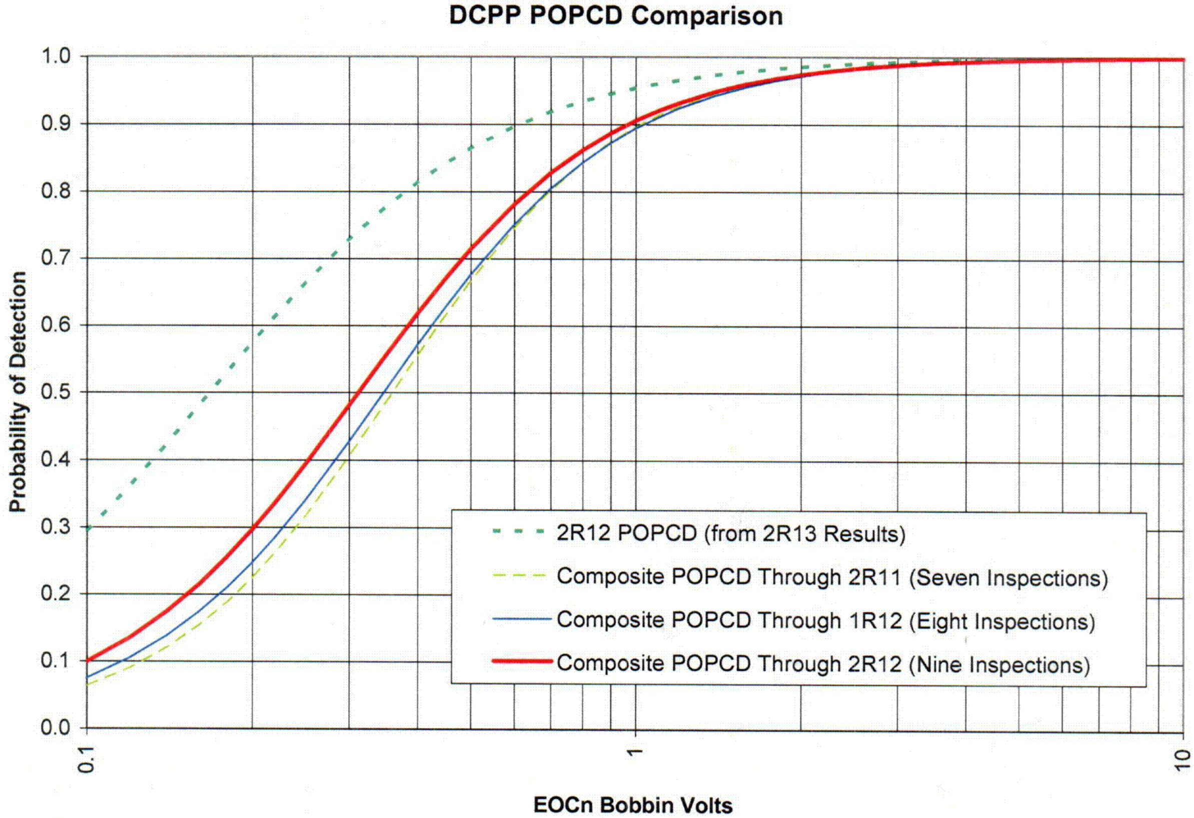
Notes:
1) POPCD for each voltage bin calculated as (Detection at EOCn)/(Detection at EOCn + No Detection at EOCn). By column, POPCD = (A+B+C)/(A+B+C+D+E+F).
2) *Plant specific POPCD to be based upon voltage bins of 0.10 volt. Industry POPCD database may use 0.20 volt bins due to difficulty of adjusting existing database to smaller bins.*
3) Includes indications at EOCn plugged at EOCn and new indications at EOCn+1, not reported in the bobbin inspection, and found only by RPC inspection of dents, mixed residuals or other reasons for the RPC inspection.
4) BDD = Bobbin detected indication; BND = Bobbin NDD intersection; RDD = RPC detected indication; RND = RPC NDD intersection

Table 6-11: DCPP Composite POPCD Results (9 Inspections) In Industry Format

Column	A	B	C	D	E	F	G	H	I	J
	DCPP Total Input to Generic POPCD Data Table									
	Detection at EOC_n			No Detection at EOCn (New Indications)						
	EOC_n Bobbin Ind. RPC Confirmed at EOC_{n+1}	EOC_n Bobbin Ind. Not RPC Inspected at EOC_{n+1}	EOC_n Bobbin Ind. Repaired at EOC_n	New EOC_{n+1} Bobbin RPC Confirmed	New EOC_{n+1} Bobbin Not RPC Inspected	Ind. Found Only by RPC at EOC_{n+1} or at EOC_n & Plugged at EOC_n (3)	Excluded from POPCD	Totals for POPCD Evaluation		
Voltage Bin	BDD / RDD → BDD / RDD BDD / RDD → BND / RDD BDD / RND → BDD / RDD BDD / RND → BND / RDD BDD w/o RPC → BDD / RDD BDD w/o RPC → BND / RDD	BDD w/o RPC → BDD w/o RPC BDD / RDD → BDD w/o RPC BDD / RND → BDD w/o RPC	BDD / RDD → Plugged at EOCn BDD w/o RPC → Plugged at EOCn	BND w/o RPC → BDD / RDD BND / RDD → BDD / RDD BND / RND → BDD / RDD	BND w/o RPC → BDD w/o RPC BND / RDD → BDD w/o RPC BND / RND → BDD w/o RPC	BND w/o RPC → BND / RDD BND / RDD → BND / RDD BND / RND → BND / RDD BND / RDD → Plugged at EOCn	All RND AT EOC_{n+1} All BND w/o RPC at EOC_{n+1} BDD/RND/Plugged at EOCn	Detection at EOCn	No Detection at EOCn	POPCD for Voltage Bin (Note 1)
0.01-0.10	6	3	1	31	139	0	13	10	170	0.056
0.11-0.20	51	242	6	123	788	8	61	299	919	0.245
0.21-0.30	124	823	32	159	1029	126	121	979	1314	0.427
0.31-0.40	185	1110	51	144	710	192	118	1346	1046	0.563
0.41-0.50	205	948	45	84	376	126	78	1198	586	0.672
0.51-0.60	192	784	40	51	198	79	51	1016	328	0.756
0.61-0.70	166	597	33	35	97	22	39	796	154	0.838
0.71-0.80	132	428	27	23	66	7	22	587	96	0.859
0.81-0.90	126	323	14	22	32	4	18	463	58	0.889
0.91-1.00	81	227	14	9	16	1	4	322	26	0.925
1.01-1.10	90	157	9	7	10	0	7	256	17	0.938
1.11-1.20	57	134	7	4	5	0	5	198	9	0.957
1.21-1.30	55	80	43	4	4	0	2	178	8	0.957
1.31-1.40	56	46	25	2	2	0	2	127	4	0.969
1.41-1.50	43	42	22	1	0	0	0	107	1	0.991
1.51-1.60	23	10	21	1	0	0	0	54	1	0.982
1.61-1.70	32	6	21	0	0	0	0	59	0	1.000
1.71-1.80	32	1	21	2	0	0	0	54	2	0.964
1.81-1.90	20	2	19	0	0	0	0	41	0	1.000
1.91-2.00	19	1	15	0	0	0	0	35	0	1.000
2.01-2.10	0	0	18	0	0	0	0	18	0	1.000
2.11-2.20	0	0	13	0	0	0	0	13	0	1.000
2.21-2.30	0	0	18	0	0	0	0	18	0	1.000
2.31-2.40	0	0	22	0	0	0	0	22	0	1.000
2.41-2.50	0	0	6	0	0	0	0	6	0	1.000
2.51-2.60	0	0	9	0	0	0	0	9	0	1.000
2.61-2.70	0	0	6	0	0	0	0	6	0	1.000
2.71-2.80	0	0	8	0	0	0	0	8	0	1.000
2.81-2.90	0	0	12	0	0	0	0	12	0	1.000
2.91-3.00	0	0	3	0	0	0	0	3	0	1.000
3.01-3.10	0	0	8	0	0	0	0	8	0	1.000
3.11-3.20	0	0	2	0	0	0	0	2	0	1.000
3.21-3.30	0	0	4	0	0	0	0	4	0	1.000
3.31-3.40	0	0	6	0	0	0	0	6	0	1.000
3.41-3.50	0	0	4	0	0	0	0	4	0	1.000
3.51-3.60	0	0	2	0	0	0	0	2	0	1.000
3.61-3.70	0	0	2	0	0	0	0	2	0	1.000
3.71-3.80	0	0	2	0	0	0	0	2	0	1.000
3.81-3.90	0	0	2	0	0	0	0	2	0	1.000
3.91-4.00	0	0	0	0	0	0	0	0	0	
4.01-4.10	0	0	5	0	0	0	0	5	0	1.000
4.11-4.20	0	0	3	0	0	0	0	3	0	1.000
4.21-4.30	0	0	1	0	0	0	0	1	0	1.000
4.31-4.40	0	0	4	0	0	0	0	4	0	1.000
4.41-4.50	0	0	2	0	0	0	0	2	0	1.000
4.51-4.60	0	0	2	0	0	0	0	2	0	1.000
4.61-4.70	0	0	1	0	0	0	0	1	0	1.000
4.71-4.80	0	0	0	0	0	0	0	0	0	
4.81-4.90	0	0	1	0	0	0	0	1	0	1.000
4.91-5.00	0	0	3	0	0	0	0	3	0	1.000
5.01-5.10	0	0	5	0	0	0	0	5	0	1.000
5.11-5.20	0	0	0	0	0	0	0	0	0	
5.21-5.30	0	0	2	0	0	0	0	2	0	1.000
5.31-5.40	0	0	0	0	0	0	0	0	0	
5.41-5.50	0	0	3	0	0	0	0	3	0	1.000
5.51-5.60	0	0	2	0	0	0	0	2	0	1.000
5.61-5.70	0	0	1	0	0	0	0	1	0	1.000
5.71-5.80	0	0	0	0	0	0	0	0	0	
5.81-5.90	0	0	0	0	0	0	0	0	0	
5.91-6.00	0	0	0	0	0	0	0	0	0	
>6.00	0	0	7	0	0	0	0	7	0	1.000
Total	1695	5964	655	702	3472	565	541	8314	4739	

Notes:
1) POPCD for each voltage bin calculated as (Detection at EOCn)/(Detection at EOCn + No Detection at EOCn). By column, POPCD = (A+B+C)/(A+B+C+D+E+F).
2) Plant specific POPCD to be based upon voltage bins of 0.10 volt. Industry POPCD database may use 0.20 volt bins due to difficulty of adjusting existing database to smaller bins.
3) Includes indications at EOCn plugged at EOCn and new indications at EOCn+1, not reported in the bobbin inspection, and found only by RPC inspection of dents, mixed residuals or other reasons for the RPC inspection.
4) BDD = Bobbin detected indication; BND = Bobbin NDD intersection; RDD = RPC detected indication; RND = RPC NDD intersection

Figure 6-1: 2R12 POPCD Comparison to Composite POPCDs



7.0 EOC-14 Projections for Probability of Burst and Leak Rate

This section provides the results of the EOC-14 POB and leak rate projections. AREVA uses Monte Carlo codes, as described in References 4 and 5, to provide the burst and leak rate analysis simulations. These evaluations are based on the methods in Reference 6 (for burst) and the slope sampling method for calculating the leak rate as defined in Section 9 of Reference 8. In addition, these evaluations use the POPCD and growth methodologies as described in Reference 16, as updated in References 25 and 28.

7.1 Inputs for Calculations

Most of the inputs required for the POB and leak rate calculations have been described in other sections of this document. Table 7-1 provides a summary of the inputs required and the corresponding section(s) or table(s) that provide these data. The inputs that have not been previously discussed are provided in this section.

Table 7-1: Inputs for EOC-14 POB and Leak Rate Projections

Input Description	Section or Table Reference	Comments
BOC Voltage Distribution	Table 3-16	
Repaired Voltage Distribution	Table 3-16	
NDE Uncertainties	Section 3.6; Table 3-21	
POD	Table 6-8	Composite POPCD through 2R12 (9 inspections)
Growth	Section 3.2; Tables 3-11 and 3-12	Cycle 12 supplemented growth used for EOC-14 projections
Cycle Length	Section 7.1	1.62 EFPY
Tube Integrity Correlations	Tables 4-1 through 4-3	Addendum 6
Material Properties	Section 7.1	

<u>Material Properties</u>

Since the burst pressure for a given flaw varies with the material properties of the tube, the material properties of the tubes must be included as an input into the POB program. This data is obtained from Reference 6. The values used for the EOC-14 projections were taken directly from Reference 6 and were a mean flow stress of 68.78 ksi and a standard deviation of the flow stress of 3.1725 ksi.

<u>Cycle Length</u>

The estimated cycle length for Unit 2 Cycle 14 is 1.62 EFPY (Ref. 12). This value was used in all projections for EOC-14 conditions.

7.2 Projected EOC-14 Voltage Distributions

The EOC-14 voltage distributions are obtained by applying a Monte Carlo sampling process to the BOC-14 voltages. The process starts by selecting a random POPCD correlation based on the POPCD parameters through 2R12 shown in Table 6-8. Based on the POPCD correlation, the BOC-14 population of indications is determined (detected plus assumed undetected). The process then randomly assigns NDE uncertainty values and a growth value to each of the BOC-14 indications. The EOC-14 voltage distributions are then used to calculate a leak rate and probability of tube burst. As discussed in Section 3.2, the Cycle 12 supplemented growth rates were determined to bound the Cycle 13 growth rates. Therefore, the Cycle 12 supplemented growth rates were used for projecting the EOC-14 voltages. SG 2-1 used SG-specific Cycle 12 growth rates divided into two growth bins with a breakpoint at 1.12v. SGs 2-2 and 2-3 utilized a composite growth rate divided into three bins with breakpoints at 1.10 and 1.71 volts, and SG 2-4 used a SG-specific Cycle 12 supplemented growth rate divided into three bins with breakpoints at 0.47v and 1.03v. No "delta volts adjustment" was required. Table 7-2 and Figures 7-1 through 7-4 provide the projected EOC-14 voltage distributions.

Table 7-2: Projected EOC-14 Voltage Distributions (DCPP POPCD + Cycle 12 Supplemented Growth)

Voltage Bin	EOC-14 Projected Distributions			
	SG 2-1	SG 2-2	SG 2-3	SG 2-4
<=0.1	2.01	1.39	11.41	4.04
0.2	38.98	26.87	34.06	27.11
0.3	77.76	56.96	63.49	83.83
0.4	133.81	101.43	90.92	168.19
0.5	145.41	121.05	96.11	223.79
0.6	126.05	112.60	89.28	222.70
0.7	110.09	102.41	76.72	177.56
0.8	86.15	80.90	59.04	138.57
0.9	68.33	62.95	46.04	117.98
1	52.34	47.24	34.20	103.37
1.1	38.99	34.01	24.77	91.47
1.2	28.88	24.75	17.79	83.05
1.3	21.03	17.52	12.32	70.13
1.4	15.07	12.26	8.58	56.25
1.5	11.53	8.80	6.09	45.44
1.6	8.58	6.46	4.47	36.03
1.7	6.64	4.98	3.49	27.55
1.8	5.79	3.91	2.78	21.42
1.9	4.74	3.01	2.25	17.53
2	4.04	2.38	1.82	15.10
2.1	2.93	1.86	1.44	13.05
2.2	2.09	1.48	1.15	11.00
2.3	1.42	1.19	0.92	9.11
2.4	1.01	0.96	0.75	7.56
2.5	0.85	0.80	0.66	6.38
2.6	0.90	0.77	0.61	5.47
2.7	0.98	0.73	0.55	4.70
2.8	0.98	0.65	0.49	3.93
2.9	0.86	0.56	0.43	3.37
3	0.69	0.48	0.37	3.20
3.1	0.51	0.42	0.32	3.01
3.2	0.37	0.38	0.28	2.82
3.3	0.26	0.36	0.26	2.67
3.4	0.18	0.33	0.24	2.63
3.5	0.13	0.30	0.22	2.71
3.6	0.14	0.28	0.20	2.80
3.7	0.23	0.26	0.19	2.74
3.8	0.35	0.25	0.18	2.47
3.9	0.41	0.23	0.18	2.16
4	0.41	0.21	0.18	1.94
4.1	0.35	0.21	0.18	1.89
4.2	0.27	0.21	0.19	1.92
4.3	0.20	0.21	0.20	1.88
4.4	0.15	0.21	0.20	1.74
4.5	0.10	0.20	0.19	1.69
4.6	0.07	0.20	0.19	1.95
4.7	0.08	0.23	0.20	2.25
4.8	0.16	0.28	0.21	2.32
4.9	0.29	0.31	0.22	2.15
5	0.39	0.30	0.22	1.87
5.1	0.42	0.27	0.21	1.65
5.2	0.42	0.23	0.19	1.51
5.3	0.45	0.21	0.18	1.45
5.4	0.52	0.19	0.16	1.42
5.5	0.55	0.16	0.13	1.33
5.6	0.52	0.12	0.11	1.15
5.7	0.49	0.09	0.08	0.93
5.8	0.51	0.06	0.07	0.77
5.9	0.56	0.05	0.06	0.72
6	0.57	0.04	0.06	0.69
7	1.97	0.28	0.53	2.44
>7	0.02	0.01	0.03	0.05
Totals	1011.00	848.48	699.04	1858.63

Figure 7-1: SG 2-1 EOC-14 Projected Voltage Distribution

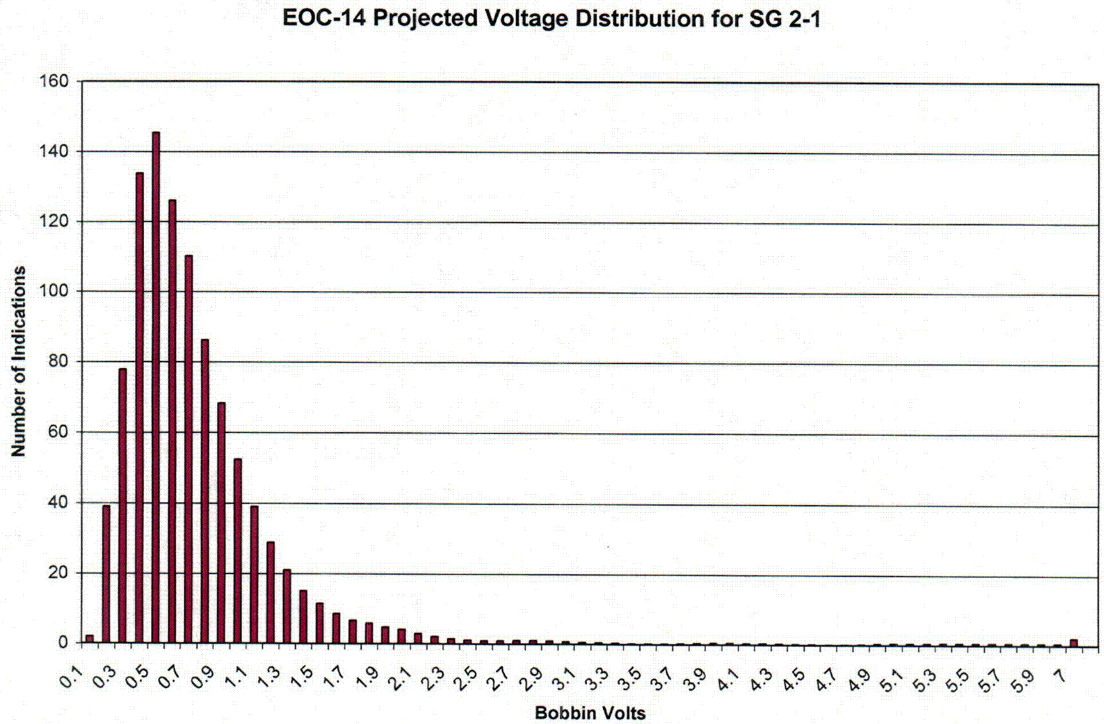


Figure 7-2: SG 2-2 EOC-14 Projected Voltage Distribution

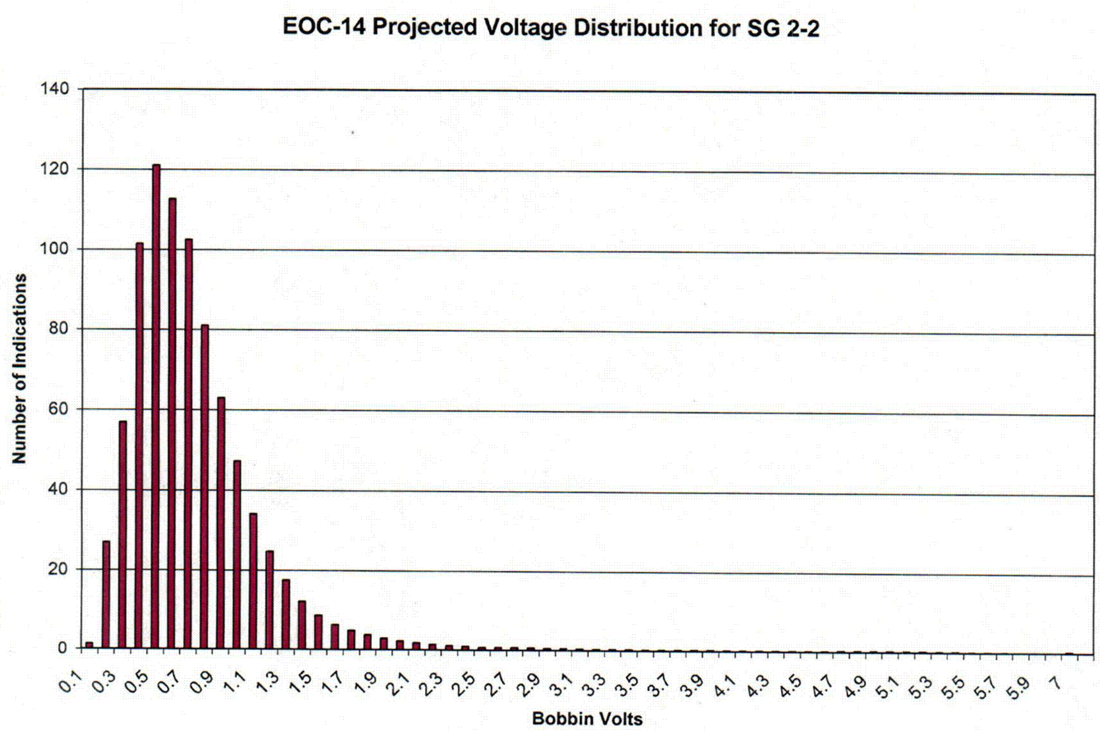


Figure 7-3: SG 2-3 EOC-14 Projected Voltage Distribution

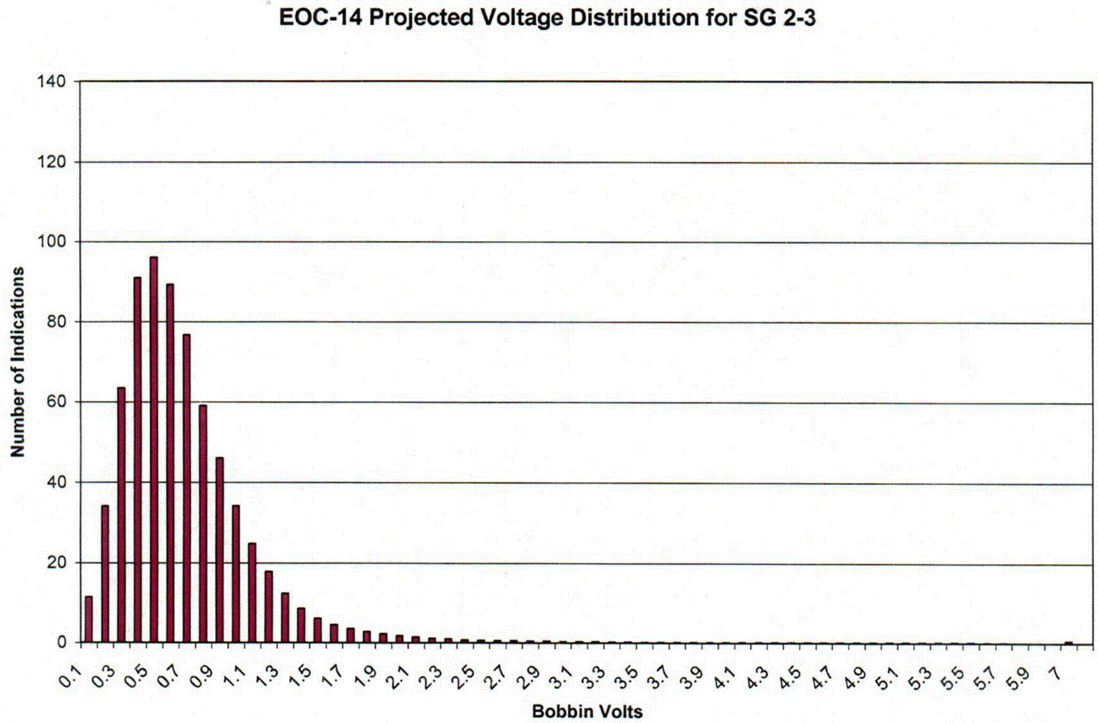
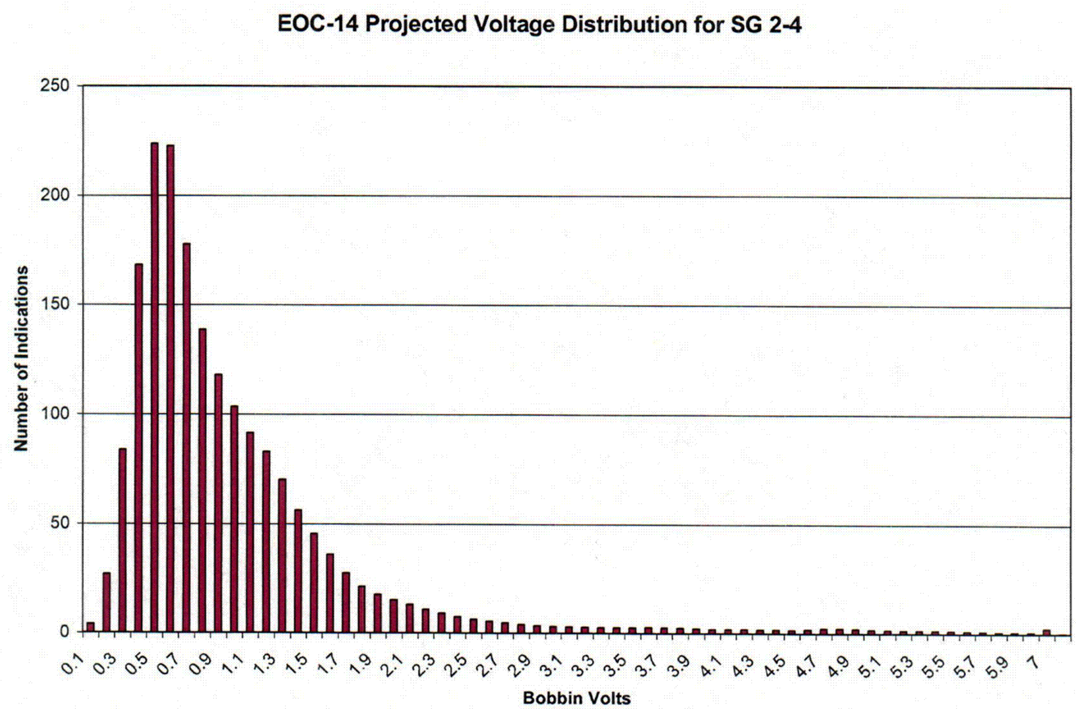


Figure 7-4: SG 2-4 EOC-14 Projected Voltage Distribution



7.3 Projected Tube Burst Probability and Leak Rate for EOC-14

Calculations to predict SLB leak rate and tube burst probability for each steam generator in DCPP Unit 2 at the projected EOC-14 conditions were performed using the burst pressure, leak rate, and probability of leakage correlations provided in Tables 4-1 through 4-3. The results of these calculations are shown in Table 7-3. As shown in Table 7-3, all of the results for projected EOC-14 conditions are below the acceptance criteria of 1.0×10^{-2} for POB and 10.5 gpm for leakage.

Table 7-3: Projected Leak Rate and Burst Probability at EOC-14 Using DCPP POPCD

Steam Generator	Projected Number of Indications at EOC-14	Probability of Burst		SLB Leak Rate
		Best Estimate	95% UCL (1 or More Failures)	(gpm)
SG 2-1	1011.00	1.91×10^{-3}	2.02×10^{-3}	1.16
SG 2-2	848.48	6.46×10^{-4}	7.08×10^{-4}	0.61
SG 2-3	699.04	6.90×10^{-4}	7.54×10^{-4}	0.53
SG 2-4	1858.63	5.76×10^{-3}	5.94×10^{-3}	3.75
Reporting Threshold			$\mathbf{1.0 \times 10^{-2}}$	**10.5**

8.0 References

1. AREVA Document 86-9019535-000, "DCPP Unit 2R13 Voltage-Based ARC and W-star Startup Report", May 2006.

2. NRC Generic Letter 95-05, "Voltage-Based Repair Criteria for the Repair of Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking," USNRC Office of Nuclear Reactor Regulation, August 3, 1995.

3. NRC SER for Diablo Canyon Units 1 and 2 for Voltage-Based Repair Criteria, letter to PG&E dated March 12, 1998.

4. AREVA Document 51-5001160-02, "Steam Generator POB Simulation Code - POB97vb_R20.F90", December 2003.

5. AREVA Document 51-5001151-02, "Steam Generator Leak Rate Simulation Code LKR97VB2_r30.F90", December 2003.

6. WCAP 14277, Revision 1, SLB Leak Rate and Tube Burst Probability Analysis Methods for ODSCC at TSP Intersections, December 1996.

7. AREVA Document 86-9011354-000, "DCPP 1R13 Bobbin Voltage ARC 90-Day Summary Report", February 2006.

8. EPRI Report NP 7480-L, Addendum 6, 2004 Database Update, "Steam Generator Tubing Outside Diameter Stress Corrosion Cracking at Tube Support Plates Database for Alternate Repair Limits", Electric Power Research Institute, January 2005.

9. Pacific Gas and Electric, Diablo Canyon Unit 1 Refueling Outage 2R13, "Steam Generator Tubing Degradation Assessment", Revision 1, May 2, 2006.

10. Not used.

11. Diablo Canyon Power Plant Procedure, NDE ET-7, "Eddy Current Examination of Steam Generator Tubing", Revision 8.

12. Pacific Gas and Electric Company, Diablo Canyon Power Plant, Surveillance Test Procedure, STP M-SGTI, Revision 12, "Steam Generator Tube Inspection", March 7, 2006.

13. AREVA Document 51-9019522-000, "Bobbin Coil Probe Wear Monitoring for DCPP 2R13", May 2006.

14. AREVA Document 86-5029429-00, "DCPP 2R11 Bobbin Voltage ARC 90 Day Summary Report", June 2003.

15. NRC Letter to NEI, dated February 9, 1996, "Probe Wear Criteria."

16. PG&E Letter DCL-04-028, License Amendment Request 04-01, "Revised Steam Generator Voltage-based Repair Criteria Probability of Detection Method for DCPP Units 1 and 2", March 18, 2004.

17. AREVA Document 51-5039454-00, "Bobbin/+Point™ Correlation for AONDB Indications at DCPP", February 2004.

18. Not Used.

19. Not Used.

20. Not Used.

21. Not Used.

22. Not Used.

23. AREVA Document 32-9024634-000, "DCPP Unit 2 R13 Voltage-Based ARC 90-Day Report Supporting Calculation File".

24. NEI Letter to NRC, "Generic Letter 95-05 Alternate Repair Criteria Methodology Updates", June 2, 2004.

25. PG&E Letter DCL-04-104, "Response to NRC Request for Additional Information Regarding License Amendment Request 04-01", August 18, 2004.

26. Not used.

27. AREVA Document 86-5059194-00, "DCPP Unit 2 R12 Voltage-Based ARC 90-Day Report", March 2005.

28. PG&E Letter DCL-04-117, "Response to August 24, 2004, NRC Request for Additional Information Regarding License Amendment Request 04-01", September 17, 2004.

29. NRC Letter to PG&E, "Diablo Canyon Power Plant, Unit Nos. 1 and 2 – Issuance of Amendment Re: Permanently Revised Steam Generator Voltage-Based Repair Criteria Probability of Detection Method (TAC Nos. MC2313 and MC2314)", October 28, 2004.

30. PG&E Letter DCL-06-080, "Reply to Request for Additional Information Regarding: Special Report 04-02 - Results of Steam Generator Inspections for Diablo Canyon Power Plant Unit 1 Thirteenth Refueling Outage", June 23, 2006.