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"DCPP 1R12 BOBBIN VOLTAGE ARC 90 DAY SUMMARY REPORT"

AREVA

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PURPOSE AND SUMMARY OF RESULTS:

This report summarizes the Diablo Canyon Unit 1 – 1R12 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.

* Appended pages include Pages A-1 to A-2

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TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

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
FANP	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 1 completed the twelfth cycle of operation and subsequent steam generator ISI in April 2004. 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.

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, Ref. 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 $\leq$2.0 volts. A complete list of criteria for excluding TSP intersections from ARC application is provided in section 1.b of Ref. 2 and in Ref. 3. The NRC has approved implementation of the voltage-based repair criteria at both DCPP units per Ref. 3. The steam generator TSP inspection results and the postulated MSLB leak rate and tube burst probabilities are summarized in this report. FANP uses Monte Carlo codes, as described in Refs. 4 and 5, to provide the burst and leak rate analysis simulations. These evaluations are based on the methods in Ref. 6 (for burst) and the new slope sampling method for calculating the leak rate as defined in Section 9.5 of Ref. 8.

2.0 Executive Summary

During the 1R12 inspection, a total of 1367 DOS indications were detected with the bobbin coil. There were an additional 120 support plate intersections that were identified as containing AONDB (axial ODSCC not detected by bobbin). Since there was no DOS indication at these intersections, a bobbin voltage was inferred from the Plus Point results per the methodology provided in Reference 8. All of the inferred bobbin voltages were less than 1 volt.

There were 48 DOS indications greater than the lower repair limit of 2.0 volts. All of these indications were confirmed as axial ODSCC with Plus Point and were subsequently plugged. An additional 74 DOS and AONDB indications less than 2 volts were also plugged for other reasons, such as ODSCC in the wedge region and pluggable indications at another location in the same tube.

A review of the growth rates over the previous cycle shows that axial ODSCC at support plates is once again most active in SG 1-1. SG 1-1 had the six highest growth rates during Cycle 12. Voltage dependent growth was evident in all steam generators, but its effect was minimal in SG 1-3. 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. 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 OA. SG 1-1 showed the most voltage dependent growth and was the only steam generator to yield two breakpoints in the VDG analyses.

The POB and leak rate projections for EOC-13 provided in this report use the constant POD of 0.6 as specified in GL 95-05. DCPP currently has a License Amendment Request (LAR) (Ref. 16) under NRC review to allow implementation of a voltage dependent probability of prior cycle detection (POPCD). Since this LAR has not been approved, the calculation of record for EOC 13 uses 0.6 POD, and the results are in Section 7.

Section 6 provides the results of a benchmarking study that compares the projected EOC-12 conditions to the as-found conditions. Both the constant 0.6 POD and the voltage dependent POPCD were used to predict the conditions. The EOC-12 projections using the 0.6 POD were not taken from the 1R11 90-Day Report (Ref. 7); rather, the SG 1-1 projections were based on results calculated in Case 4 of Table 3-5 of FANP Document 86-5039942-00 (Ref. 19) submitted to NRC in DCL-04-019 dated March 16, 2004. The SG 1-2, 1-3, and 1-4 projections were also recalculated based on the enhanced growth distribution development guidelines provided to the NRC in Reference 25. These results showed that the POBs and leak rates were overpredicted in SGs 1-1, 1-2, and 1-3 compared to the as-found results. But, in SG 1-4, the POB and leak rate were slightly underpredicted by ~5.7×10^{-5} and by 0.01 gpm, respectively. For the POPCD analyses, the POBs for SG 1-1 and SG 1-4 and the leak rate for SG 1-4 were slightly underpredicted. The underpredictions on POB were only 6.0×10^{-5} for SG 1-1 and 4.4×10^{-5} for SG 1-4, while the SLB leak rate underprediction for SG 1-4 was only 0.04 gpm for the steam generator with the smallest leak rate. The predictions using POPCD for SGs 1-2, 1-3, and 1-4 were higher than obtained using the POD of 0.6, while the 0.6 POD results for SLB leakage are slightly higher than obtained with POPCD. None of these underpredictions meet the level of significance as defined in Reference 26.

Using the 0.6 POD and the conservative growth rate analyses discussed in Section 3.2, the projected POB at EOC-13 for the limiting steam generator (SG 1-1) was determined to be 6.65×10^{-3}. The projected leak rate for the limiting generator (SG 1-1) was 4.32 gpm. Both of these results are below the acceptance criteria of 1×10^{-2} and 10.5 gpm, respectively.

3.0 EOC-12 Inspection Results and Voltage Growth Rates

3.1 EOC-12 Inspection Results

The DCPP 1R12 bobbin coil inspection consisted of a 100% complete full-length bobbin coil examination of tubes in all four steam generators. 0.720" replaceable feet bobbin probes were used for the straight length examinations. Two TSP intersections in SG 1-4 (7H in Tube 7-89, and 7C in Tube 9-86) could not be inspected with .720" probes due to restrictions. These intersections were inspected with .700" bobbin probes and Plus Point probes with no degradation detected. Special interest Plus-point examinations were conducted as follows in support of the voltage-based ARC.

- 100% of DOS ≥ 1.7 volts (as identified in Ref. 12)
- 100% of DOS ≥ 1.4 volts in SGs 1-1 and 1-2
- 100% of DOS in dented intersections (as identified in Ref. 12)
- 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
- Dented TSP examinations (as identified in Ref. 12)
- Other Special Interest or test programs that may test TSP intersections (as identified in Ref. 12)

Based upon the 100% bobbin inspection of all steam generators, a total of 1367 DOS indications were identified. The results of the inspections are summarized as follows:

1) Voltage Dependent Growth was evident in all steam generators although the effect was minimal in SG 1-3. SG 1-1 showed the most voltage dependent growth and was the only steam generator to yield two breakpoints in the VDG analyses.
2) 48 DOS indications were greater than the lower repair limit (LRL-2.0 volts). Each of the indications were confirmed as ODSCC, required repair by plugging, and were distributed as follows: 27 in SG 1-1, 9 in SG 1-2, 6 in SG 1-3 and 6 in SG 1-4. Table 3-1 lists the DOS indications that were above the LRL (2.0 volts).
3) One indication was identified that exceeded the upper repair limit of 5.88 volts.
4) 120 indications were identified as AONDB (axial ODSCC not detected by bobbin). Table 3-2 lists the indications that were identified as AONDB. These are Plus-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 Plus Point, and can be accompanied by a dent that masks the bobbin voltage. Per Ref. 8, a methodology has been developed to assign a bobbin voltage based on a correlation to the Plus-Point voltage. Once the calculated voltages are obtained per Reference 17, the locations are subjected to exclusion criteria defined in Ref. 12.
5) Overall, 122 DOS/AONDB indications were repaired during 1R12. The breakdown is: 45 in SG 1-1, 28 in SG 1-2, 32 in SG 1-3, and 17 in SG 1-4. This population was used in computing the BOC-12 distributions for the OA calculations.

The average voltage was 0.71 volts, including AONDB indications. The 1R11 average was 0.64 volts. The average voltage for new DOS indications, excluding prior AONDB indications, was 0.48v. The majority of the largest voltages were detected in SG 1-1, but SG 1-3 had the highest average voltage of 0.74 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 Plus-point or not inspected with Plus-point, and the total indications returned to service. 48 confirmed DOS had to be repaired because they exceeded the 2-volt repair limit. The main reasons for repair of the other 74 DOS included DOS > 2.0v at different intersections in the same tube, the wedge exclusion criterion, combined ID/OD degradation at the same intersection, or other tube degradation (e.g., U-bend PWSCC)

The Plus Point inspections required for DOS indications were accomplished as a part of the special interest exams. 343 Plus-point inspections were performed where DOS indications were called by bobbin, excluding the AONDB intersections. Of these inspections, 319 were confirmed yielding an overall confirmation rate of about 93%.

The 1R12 Plus 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 threshold 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 Plus Point. In addition, if there were less than five hot leg SPRs ≥ 2.3 volts in a given steam generator, the five largest hot leg SPRs in that steam generator were inspected with Plus Point. A total of 12 hot leg SPRs ≥ 2.3 volts were identified using CDS (Computer Data Screening). SGs 1-1, 1-2, and 1-4 had less than five SPRs ≥ 2.3 volts. Therefore, the five largest SPRs were inspected in these steam generators. None of the required SPR inspections resulted in ODSCC being confirmed with Plus Point. One intersection in SG 1-3 (R26C80 – 1H) had a 0.33 volt Plus Point ODSCC indication reported at a 1.93 volt SPR. This location was inspected with Plus Point since it had a DOS (1.55v) and a DNT (0.47v) at the same intersection. Since 1) the SPR did not cause the DOS to be missed, 2) the combination of the DNT and SPR would be expected to increase the DOS voltage, and 3) the DOS voltage was less than 2 volts, this tube was left in service.

Figures 3-1 and 3-2 show the as-found voltage distribution (including AONDB) for all tubes that were in service during Cycle 12. Figures 3-3 and 3-4 show the indications removed from service at 1R12. Figures 3-5 and 3-6 illustrate all of the indications returned to service following the 1R12 ECT inspection. Table 3-1 shows 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 the intersections containing DOS/AONDB indications that were returned to service, 296 contained confirmed axial ODSCC at dented intersections. 95 of these intersections contained dents ≤2.0v and 201 of these intersections contained dents >2.0v. Of these indications, the largest bobbin voltage was 1.78v. This indication had a small corresponding

Plus Point voltage of 0.26v. The largest Plus Point voltage from this population was 0.99v with a corresponding bobbin voltage of 1.28v.

The DOS voltage distribution as a function of TSP elevation is provided in Table 3-5. Table 3-5 and Figure 3-7 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 temperature dependence of ODSCC.

Table 3-5 also includes a small number of cold leg DOS indications that were verified not to be cold leg thinning. At DCPP-1, potential cold leg ODSCC indications are distinguished from cold leg thinning indications by requiring that bobbin indications in the region of occurrence for cold leg thinning per Ref. 12, be Plus Point inspected (and confirmed as volumetric indications by Plus-Point) at the first occurrence of the bobbin indication. No cold leg ODSCC has been confirmed by Plus Point to date at DCPP-1. Non-confirmed bobbin DOS indications in the cold leg are retained in the ODSCC ARC calculations.

NRC letter to PG&E dated November 20, 2003, contained the following observation on volumetric indications at TSPs, and a response is provided below:

> *"In response to an RAI, the licensee indicated that if they had confirmed volumetric degradation in the cold leg thinning region, then they would have depth sized the indication as cold leg thinning (and presumably left it in service if the depth was less than the plugging/repair limit). Assuming the potential for closely spaced axially oriented outside diameter stress corrosion cracking (ODSCC) indications to display a volumetric indication in the eddy current data, the basis for this practice was not evident to the staff. To support their dispositioning criteria for these volumetric indications, the licensee should consider providing a discussion (in the reports submitted in accordance with their technical specifications) of how they distinguish (from the eddy current data) the various mechanisms that could result in a volumetric indication at a tube support plate intersection."*

PG&E Response: The two mechanisms that could result in a volumetric indication at a tube support plate intersection are cold leg thinning and cellular corrosion (IGA). Cold leg thinning is limited to lower cold leg TSPs, where IGA would have a very low probability of occurrence. Plus Point is capable of differentiating these damage mechanisms (bobbin coil cannot differentiate). Since cold leg thinning is caused by wastage at the support, it typically displays a large pancake coil response and larger volumetric Plus Point coil response, and has a bobbin response. Shallow cellular corrosion would produce little or no pancake coil response and a smaller (more complex) volumetric Plus Point coil response, and would have little or no bobbin coil response. For example, shallow cellular corrosion was identified in pulled tube intersection SG 11 R20C54 2H as part of the destructive examination following 1R12. The corrosion was not detectable by bobbin, but was detectable by Plus Point in the post pull platform inspection.

3.2 *Voltage Growth Rates*

For projection of leak rates and tube burst probabilities at the EOC-13 operation, voltage growth rates were developed from the 1R11 and 1R12 inspection data. Cycle 12 was 1.61 EFPY in length per Ref. 18. For repeat indications reported in both 1R11 and 1R12, growth rates were determined based on comparison of the voltages called in 1R11 and 1R12 (i.e., no 1R11 lookups were performed). For indications not reported during the 1R11 inspection (i.e. new at 1R12), the indications were sized using the 1R11 ECT signals based on a lookup review with the exception of the intersections that were AONDB in 1R11 and DOS in 1R12. Since the AONDB intersections are dented, the 1R11 bobbin voltage was not considered to be reliable even if an indication could be detected in a lookup. Therefore, with the exception of the three indications discussed in the next paragraph, the 1R12 DOS indications that were AONDB in 1R11 were not included in the growth rate analyses.

Per the Generic Letter, "voltage growth rates should only be evaluated for those intersections at which bobbin indications can be identified at two successive inspections, except if an indication changes from non-detectable to a relatively high voltage (e.g., 2.0 volts)". During 1R12, there were three newly reported DOS indications that were greater than 2 volts but were not detected as OD (DOS) bobbin indications during the lookup (SG 11 R8C69 1H, SG 12 R19C85 2H, SG 14 R14C34 1H). All three of these intersections are dented and were inspected with Plus Point during 1R11 and were confirmed as having axial ODSCC not detected with bobbin (AONDB). Therefore, the inferred bobbin voltages from the 1R11 Plus Point inspections, and the non-inferred bobbin voltages from the 1R12 bobbin inspections, were used to determine the growth rates for these three indications. R8C69 and R19C85 contained multiple axial indications during both the 1R11 and 1R12 inspections. The largest of these three bobbin indications was a 3.40v DOS indication at 1H in R8C69 in SG 1-1. This intersection contained 3 small (≤0.25v) Plus Point OD axial indications in 1R11 and 4 OD axial indications in 1R12. One of the axial indications in 1R12 was measured at 2.29v with Plus Point. Therefore, this particular intersection did see significant growth during Cycle 12. The measured bobbin voltage for this indication (3.40v) compares relatively well with the voltage that would have been inferred if the bobbin signal had not been detected (2.84v inferred). R19C85 and R14C34 showed more modest growth as measured by the maximum Plus Point voltage (0.32v to 0.49v and 0.31v to 0.72v, respectively). The measured bobbin voltages for both of these intersections are well above the voltage that would be inferred from the Plus Point voltage using the AONDB correlation (2.59 and 2.13 volts measured versus 0.93 and 1.03 volts inferred, respectively). This indicates that the small dents at these intersections may be artificially increasing the bobbin voltage. All three of these indications were conservatively included in the growth distributions (see Table 3-4) because of the GL guidance to include indications that change from bobbin non-detectable to a relatively high voltage (e.g., 2.0 volts), even though they were detectable by Plus Point in the prior outage.

There were 502 newly reported DOS indications in 1R12. Twenty of these new DOSs were reported as AONDB during the 1R11 inspection and, with the exception of the three AONDBs discussed above, were not included in the growth distribution because there is no prior bobbin signal. Of the remaining 482 new indications, 416 were detected during the 1R11 lookup and were assigned a 1R11 voltage and subsequently included in the growth distributions.

There were 66 new DOS indications (excluding previous AONDBs) that were not detected during the 1R11 lookup and were, therefore, not included in the growth rate analyses. The largest of these indications was 1.77v in SG 12 R22C54 1H. Plus Point of R22C54 1H identified 2 small SAIs (0.19 and 0.30 volts Plus Point). The upper 95% growth rates of all new and repeat indications excluding prior AONDB were 0.31 and 0.53 v/EFPY, respectively. The average growth rates for new and repeat indications excluding prior AONDB were 0.10 and 0.14 v/EFPY, respectively. These data indicate that the new indications are growing at a slower rate than the previously detected indications.

Table 3-4 provides a summary of indications with the largest growth during Cycle 12. 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 four cycles at DCPP-1. Figure 3-22 depicts this information graphically and shows the slight increases in the average growth rate and the average BOC voltage.

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 3-8 and 3-9 show the voltage growth distributions depicted in bar charts. The negative growth values in the bar charts were included as zero growth rates in the ARC calculations, as required by Generic Letter 95-05.

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 1-1. This phenomenon of a leading SG in plants affected by ODSCC is common in the industry. Reviewing Table 3-6 and Figures 3-8 and 3-9 also supports this conclusion. As shown in Table 3-4, the largest growth rates occurred in SG 1-1.

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-13 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. Figures 3-23 and 3-24 provide a simple comparison of both cycles and the different steam generators. Figure 3-23 provides a comparison of the Cycle 11 and Cycle 12 composite growth rates. This figure shows that, on a composite basis, the Cycle 12 growth bounds the Cycle 11 growth. Figure 3-24 provides a comparison of the SG-specific growth rates for Cycle 12. This figure shows that SG 1-1 bounds the other steam generators for Cycle 12 growth. This figure also shows that the composite growth curve clearly bounds SGs 1-2 and 1-3, and approximates SG 1-4.

In order to determine which growth distribution to use for each steam generator, four different growth curves must be compared (SG-specific for Cycle 11, SG-specific for Cycle 12, composite for Cycle 11, and composite for Cycle 12). Figures 3-25 through 3-28 provide these comparisons for each steam generator. Figure 3-25 shows that the SG-specific growth for Cycle 12 is clearly bounding for SG 1-1. Figures 3-26 and 3-27 show that the composite Cycle 12 growth curve is bounding for SGs 1-2 and 1-3. For SG 1-4, the bounding growth curve is not evident from examining Figure 3-28. Therefore, additional Monte Carlo sensitivity analysis was required to determine which growth curve was bounding for SG 1-4, as discussed in Section 3.2.4, and it was determined that the composite Cycle 12 growth curve is bounding for SG 1-4.

3.2.2 Dependency of Voltage Growth on BOC Voltage

For Cycle 12, growth rates were plotted against the BOC voltage for all steam generators. Their data are shown in Figures 3-10 and 3-11. As is demonstrated by the figures, a positive slope exists in all SGs (although very slight in SG 1-3) indicating that Cycle 12 voltage growth at DCPP-1 is a function of the BOC voltage. This phenomenon is known as voltage dependent growth (VDG) and the initiation of it was previously observed in the Cycle 11 data for SG 1-1, as documented in the 1R11 90-day report. VDG is not a new concept, and has been documented by the European SGs affected by ODSCC. Because of their higher repair limits, their data encompasses 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. These methods were used to determine breakpoints for the Cycle 12 growth data.

Cycle 12 VDG breakpoint analyses were performed for each steam generator and for a composite growth distribution (including all steam generators). Figures 3-12 through 3-16 show the scatter charts and the resulting breakpoints for all of these analyses. Figures 3-17 to 3-21 show the CPD curves for each SG and composite SG after applying these breakpoints. The SG 1-1 growth yielded two breakpoints at 0.50v and 0.99v. The composite growth distribution also yielded two breakpoints at 0.50v and 1.02v. SGs 1-2, 1-3, and 1-4 yielded one breakpoint at 1.16v, 1.05v, and 0.82v respectively. Because 2 breakpoints generally yield a more conservative result than 1 breakpoint, this VDG analysis helps confirm that SG 1-1 should apply the SG 1-1 Cycle 12 VDG analysis and that SGs 1-2, 1-3, and 1-4 should apply the composite Cycle 12 VDG analysis for determining the OA growth distributions. For SG 1-2, it was noted that the 1.16 volt breakpoint from the SG 1-2 specific growth curve was slightly higher than the 1.02 volt upper bin breakpoint from the SG composite growth curve. Higher breakpoints have the potential to result in more conservative results. Review of Figures 3-18 and 3-21 assists in determining that the composite curve should be limiting, because the composite Bin 3 curve has a much longer tail (out to 3 v/EFPY) than the SG 1-2 Bin 2 growth (out to 1.6 v/EFPY) and, in conjunction with a lower breakpoint, applies a higher growth to more indications. Nonetheless, further Monte Carlo sensitivity analysis was performed (see Section 3.2.4) to confirm that SG 1-2 should use the SG composite growth curve. For the composite data set across all steam generators that resulted in three separate growth bins with breakpoints at 0.50v and 1.02v, Tables 3-8 through 3-10 contain the three different sets of growth rates based on BOC voltages. The composite low bin has 743 indications, the composite middle bin has 418 indications, and the composite high bin has 123 indications. Figure 3-21 shows the growth rate distributions for each of these three bins. As shown in the figure, there is a consistent shift toward higher growth for larger BOC voltages. Similar charts were prepared for each steam generator individually and are shown in Figures 3-17 through 3-20.

3.2.3 Delta Volts Adjustment

Another part of the growth guideline provided in Reference 25 involves implementation of a "delta volts adjustment" when implementing POPCD. Even though POPCD is not being implemented in Unit 1 Cycle 13, because a very conservative constant 0.6 POD is being used, application of the delta volts adjustment for Unit 1 Cycle 13 is being performed as an additional conservatism. The purpose of this adjustment is to account for the possibility that the growth rates may increase over the next operating cycle. The amount of this adjustment is determined by comparing the average growth from Cycle 12 to the average growth from Cycle 11 for each voltage bin. The average growth values from Cycle 11 used in this analysis are based on the same breakpoints determined from the Cycle 12 VDG analyses. Table 3-11 provides the average growth rates and the resulting adjustment for each steam generator as well as for the composite growth curve. Per the Reference 25 guideline, if the Cycle 12 data has a higher growth rate than the Cycle 11 data, then the difference between the average growth rates should be added to each growth rate value in the distribution being used prior to binning the data. As shown in Table 3-11, there were only two cases where the average growth rate decreased from Cycle 11 to Cycle 12. In these cases, no adjustment was made.

3.2.4 Growth Summary

As discussed earlier, SG-specific Cycle 12 growth should be used for SG 1-1. SGs 1-2 and 1-3 should use the composite Cycle 12 growth curves.

For SG 1-4, however, it is not readily apparent from examining Figure 3-28 if the Cycle 12 composite or the Cycle 12 SG-specific growth is bounding. Therefore, a probability of burst calculation was performed using each curve (after the VDG breakpoint analyses and the delta volts adjustment) to determine the more conservative growth rate. These calculations showed that the composite growth curve was more conservative. Therefore, the composite growth curve was also used for SG 1-4.

Likewise, to confirm that SG 1-2 should use the composite Cycle 12 growth curves, a probability of burst calculation was performed using the Cycle 12 composite curve and the SG-specific curve (after the VDG breakpoint analyses and the delta volts adjustment) to determine the more conservative growth rate. These calculations showed that the composite growth curve was more conservative.

Table 3-12 shows the growth distributions that were used in the operational assessment calculations. These growth distributions reflect the delta volts adjustments as discussed earlier.

3.3 Probe Wear Criteria

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.

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 an 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 1R12 eddy current inspection resulted in 37 intersections with bobbin indications greater than or equal to 1.5 volts that were inspected with a worn probe. These indications are shown in Table 3-13. The RSS and DOS voltage variation was tabulated for each worn probe inspection. The retest voltages compare reasonably with the final acceptable DOS voltages. Figure 3-29 shows a comparison of the worn probe and good probe voltages. This figure shows that the voltages do not change significantly between the worn probes and the good probes. Therefore, continued use of the 1.5-volt retest threshold is justified (Ref. 13).

All support plate intersections were inspected in accordance with the Ref. 11 analysis guidelines. 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. These reviews in conjunction with the results in Table 3-13 address the NRC requirements listed in Ref. 15.

Another NRC 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 3-14 shows the new 1R12 ≥0.5v DOS indications that are in tubes that failed the probe wear check in 1R11. The only new indications in Table 3-14 that exceeded two volts are R8C69 in SG 1-1 and R14C34 in SG 1-4. These two indications were AONDB in 1R11 as discussed in Section 3.2 and shown in Table 3-4.

Overall there were 1367 DOS indications detected in the 1R12 inspection. 502 (or ~37%) of the DOS indications were new indications. Table 3-15 is presented to assess the number of new indications against the probe wear requirements. Of the 502 total new indications, 289 (~58%) were in tubes inspected with a worn probe in 1R11 and 213 were in tubes inspected with a good probe in 1R11. Additionally, the number of new indications ≥ 0.5 volts was determined to be 201. Out of these, about 57% (115/201) were in tubes that were inspected with a worn probe in 1R11. This confirms that the number of new indications is approximately equivalent in both data sets.

Table 3-16 shows the ratio of the number of 1R11 examinations performed with worn probes versus good probes. The total number of examinations shown in this table is greater than the number of tubes in service because several tubes have multiple examinations. This table shows that approximately 53% of the tubes were inspected with a worn probe in 1R11. This percentage compares reasonably well with the percentages of new DOSs inspected with worn probes in 1R11 (about 58%) and new ≥ 0.5 volt DOSs inspected with worn probes in 1R11 (about 57%) . This demonstrates that the number of new indications is not biased towards the tubes that were inspected with worn probes in 1R11.

In summary, the NRC analysis requirements regarding probe wear monitoring were met during the 1R12 bobbin coil inspection and a more stringent wear tolerance is not required at DCPP.

3.4 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 11 was 19.8% (Ref. 7 and Table 3-6) and less than the 30% per EFPY criterion, the 30% value was used for the upper repair limit calculation. The structural limit used for this calculation was taken from Reference 27 and is based on the Addendum 5 database supplemented with the tube pull results from 2R11. Based on the following formula, the upper repair limit was calculated to be 5.88v.

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

where:

V_{URL} = upper voltage repair limit,
V_{NDE} = NDE voltage measurement uncertainty = 20%,
V_{CG} = voltage growth anticipated between inspections = 30%/EFPY x 1.36 EFPY = 40.8%,
V_{SL} = voltage structural limit from the burst pressure – Bobbin voltage correlation, where the limit of 9.45 volts was used based on Ref. 27.

3.5 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-12 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 3-17 and Figure 3-30.

Table 3-1: 1R12 DOS Indications > 2.0 Volts

SG	Row	Col	Ind	Elev	Volts
SG11	5	60	DOS	1H	6.15
SG11	6	61	DOS	1H	5.6
SG11	20	54	DOS	1H	5.6
SG11	8	72	DOS	1H	5.06
SG11	24	31	DOS	1H	4.45
SG11	17	73	DOS	1H	4.01
SG11	8	69	DOS	1H	3.4
SG11	36	45	DOS	1H	3.08
SG11	12	71	DOS	1H	3.05
SG11	6	78	DOS	2H	3.04
SG11	29	33	DOS	1H	2.73
SG11	13	67	DOS	1H	2.61
SG11	42	37	DOS	1H	2.37
SG11	4	54	DOS	1H	2.28
SG11	10	71	DOS	1H	2.28
SG11	17	77	DOS	1H	2.27
SG11	19	39	DOS	1H	2.24
SG11	4	52	DOS	1H	2.21
SG11	4	64	DOS	1H	2.09
SG11	8	71	DOS	1H	2.07
SG11	35	43	DOS	2H	2.07
SG11	36	55	DOS	1H	2.07
SG11	26	61	DOS	1H	2.03
SG11	30	37	DOS	1H	2.03
SG11	46	50	DOS	1H	2.02
SG11	26	77	DOS	1H	2.01
SG11	31	38	DOS	1H	2.01
SG12	37	23	DOS	3H	4.08
SG12	23	12	DOS	1H	3.64
SG12	13	56	DOS	1H	3.08
SG12	19	85	DOS	2H	2.59
SG12	24	30	DOS	2H	2.58
SG12	24	46	DOS	1H	2.44
SG12	17	47	DOS	1H	2.35
SG12	20	44	DOS	1H	2.35
SG12	31	51	DOS	1H	2.04
SG13	9	62	DOS	1H	2.88
SG13	9	59	DOS	1H	2.34
SG13	25	87	DOS	1H	2.32
SG13	10	71	DOS	1H	2.31
SG13	9	60	DOS	1H	2.2
SG13	9	56	DOS	6H	2.01
SG14	25	31	DOS	1H	3.64
SG14	25	26	DOS	2H	3.55
SG14	6	12	DOS	2H	2.59
SG14	3	36	DOS	1H	2.56
SG14	14	34	DOS	1H	2.13
SG14	34	53	DOS	1H	2.06

Table 3-2: 1R12 AONDB Indications

SG	Row	Col	Elev	Dent Voltage	Plus Pt Voltage	Inferred Bobbin Voltage	
						Indication	Intersection
SG11	3	62	1H	0.56	0.14	0.444	0.444
SG11	4	20	1H	1.91	0.17	0.474	0.474
SG11	5	34	1H	1.18	0.19	0.494	0.494
SG11	8	32	3H	0.51	0.15	0.454	0.454
SG11	9	3	2H	2.19	0.18	0.484	0.484
SG11	11	15	3H	2	0.23	0.534	0.534
SG11	13	41	2H	1.25	0.15	0.454	0.454
SG11	17	27	3H	1.99	0.28	0.584	0.584
SG11	18	31	2H	2.59	0.25	0.554	0.554
SG11	18	76	1H	0.82	0.13	0.434	0.434
SG11	21	49	1H	1.49	0.18	0.484	0.484
SG11	26	25	1H	1.95	0.22	0.524	0.524
SG11	26	28	1H	4.32	0.29	0.595	0.595
SG11	26	33	1H	1.05	0.14	0.444	0.444
SG11	27	44	2H	4.65	0.26	0.564	0.564
SG11	28	27	1H	2.29	0.30	0.605	0.781
SG11	28	27	1H	2.29	0.19	0.494	
SG11	28	36	1H	0.88	0.14	0.444	0.444
SG11	33	34	1H	1.76	0.31	0.615	0.615
SG11	36	48	2H	1.25	0.17	0.474	0.805
SG11	36	48	2H	1.25	0.17	0.474	
SG11	36	48	2H	1.25	0.14	0.444	
SG11	37	56	2H	1.87	0.22	0.524	0.524
SG11	38	54	2H	3.07	0.27	0.574	0.574
SG11	42	46	1H	1.02	0.15	0.454	0.454
SG11	42	51	1H	0.89	0.19	0.494	0.494
SG12	1	56	2H	0.29	0.15	0.454	0.454
SG12	4	85	3H	0.79	0.15	0.454	0.454
SG12	5	20	6H	2.2	0.18	0.484	0.484
SG12	6	49	1H	2.79	0.22	0.524	0.524
SG12	6	81	1H	3.67	0.20	0.504	0.504
SG12	7	65	2H	1.14	0.26	0.564	0.564
SG12	8	17	1H	3.53	0.16	0.464	0.464
SG12	9	33	1H	2.12	0.15	0.454	0.454
SG12	10	43	1H	1.2	0.32	0.625	0.625
SG12	10	45	2H	1.47	0.17	0.474	0.474
SG12	11	18	2H	3.19	0.23	0.534	0.534
SG12	11	40	1H	4	0.28	0.584	0.584
SG12	11	75	2H	4.78	0.22	0.524	0.524
SG12	12	76	1H	2.98	0.10	0.404	0.404
SG12	12	77	1H	1.5	0.20	0.504	0.679
SG12	12	77	1H	1.5	0.15	0.454	
SG12	13	66	2H	2.95	0.22	0.524	0.524
SG12	14	7	2H	3.61	0.18	0.484	0.484
SG12	14	84	2H	2.5	0.21	0.514	0.514
SG12	15	42	2H	1.4	0.27	0.574	0.574

Table 3-2: 1R12 AONDB Indications

SG	Row	Col	Elev	Dent Voltage	Plus Pt Voltage	Inferred Bobbin Voltage	
						Indication	Intersection
SG12	17	45	1H	4.33	0.24	0.544	0.544
SG12	18	22	1H	3.01	0.16	0.464	0.464
SG12	19	57	2H	1.99	0.29	0.595	0.786
SG12	19	57	2H	1.99	0.21	0.514	
SG12	20	83	1H	3.23	0.26	0.564	0.737
SG12	20	83	1H	3.23	0.17	0.474	
SG12	22	54	2H	2.14	0.24	0.544	0.544
SG12	22	54	6H	2.95	0.14	0.444	0.444
SG12	22	54	7H	2.28	0.28	0.584	0.584
SG12	22	79	2H	1.67	0.14	0.444	0.444
SG12	23	71	2H	2.18	0.17	0.474	0.664
SG12	23	71	2H	2.18	0.16	0.464	
SG12	27	19	1H	4.53	0.22	0.524	0.524
SG12	27	44	1H	1.7	0.20	0.504	0.504
SG12	27	66	2H	2.08	0.16	0.464	0.643
SG12	27	66	2H	2.08	0.14	0.444	
SG12	27	83	2H	1.28	0.19	0.494	0.494
SG12	28	36	2H	1.75	0.22	0.524	0.524
SG12	29	49	3H	2.44	0.13	0.434	0.434
SG12	29	69	1H	4.11	0.14	0.444	0.444
SG12	30	72	2H	0.96	0.18	0.484	0.484
SG12	31	44	4H	2.04	0.18	0.484	0.484
SG12	31	62	1H	2.09	0.26	0.564	0.564
SG12	31	63	1H	2.49	0.30	0.605	0.605
SG12	31	80	4H	4.57	0.17	0.474	0.474
SG12	33	40	1H	0.84	0.26	0.564	0.564
SG12	34	49	1H	0.7	0.41	0.716	0.716
SG12	34	57	4H	3.02	0.22	0.524	0.524
SG12	36	53	1H	3.1	0.27	0.574	0.574
SG12	39	49	2H	1.44	0.22	0.524	0.524
SG12	39	70	1H	2.35	0.26	0.564	0.564
SG12	41	54	3H	2.59	0.11	0.414	0.414
SG13	4	81	1H	5.12	0.13	0.434	0.434
SG13	5	84	1H	7.37	0.14	0.444	0.444
SG13	6	36	1H	2.62	0.22	0.524	0.524
SG13	6	79	1H	2.73	0.31	0.615	0.615
SG13	13	10	1H	2.11	0.14	0.444	0.444
SG13	19	80	1H	2.75	0.32	0.625	0.625
SG13	21	34	1H	1.86	0.29	0.595	0.595
SG13	22	55	1H	2.36	0.31	0.615	0.615
SG13	25	82	1H	3.88	0.11	0.414	0.414
SG13	26	41	1H	1.92	0.12	0.424	0.424
SG13	27	49	1H	1.82	0.16	0.464	0.464
SG13	30	23	1H	2.36	0.20	0.504	0.504
SG14	5	72	2H	3.54	0.16	0.464	0.464
SG14	5	79	1H	2.11	0.19	0.494	0.494

Table 3-2: 1R12 AONDB Indications

SG	Row	Col	Elev	Dent Voltage	Plus Pt Voltage	Inferred Bobbin Voltage	
						Indication	Intersection
SG14	9	37	1H	2.32	0.31	0.615	0.864
SG14	9	37	1H	2.32	0.14	0.444	
SG14	9	37	1H	2.32	0.11	0.414	
SG14	10	35	1H	3.14	0.11	0.414	0.414
SG14	10	93	1H	2.26	0.20	0.504	0.504
SG14	11	46	1H	2.05	0.41	0.716	0.963
SG14	11	46	1H	2.05	0.34	0.645	
SG14	11	87	2H	2.19	0.24	0.544	0.544
SG14	12	32	1H	2.95	0.22	0.524	0.727
SG14	12	32	1H	2.95	0.20	0.504	
SG14	12	43	1H	2.27	0.12	0.424	0.424
SG14	13	10	2H	1.7	0.12	0.424	0.424
SG14	13	31	1H	2.02	0.18	0.484	0.484
SG14	13	51	1H	2.22	0.15	0.454	0.635
SG14	13	51	1H	2.22	0.14	0.444	
SG14	14	7	2H	2.18	0.34	0.645	0.778
SG14	14	7	2H	2.18	0.13	0.434	
SG14	14	19	3H	2.84	0.14	0.444	0.444
SG14	15	7	1H	4.75	0.15	0.454	0.454
SG14	15	29	1H	2.3	0.38	0.685	0.685
SG14	15	36	1H	3.97	0.20	0.504	0.504
SG14	15	47	1H	2.09	0.31	0.615	0.615
SG14	16	65	2H	3.58	0.12	0.424	0.424
SG14	16	69	2H	3.66	0.10	0.404	0.404
SG14	17	32	1H	2.02	0.42	0.726	0.726
SG14	17	75	1H	9.21	0.19	0.494	0.494
SG14	18	27	1H	7.31	0.18	0.484	0.484
SG14	19	32	1H	3.33	0.57	0.879	0.879
SG14	19	40	1H	3.51	0.16	0.464	0.464
SG14	19	45	2H	2.39	0.22	0.524	0.524
SG14	21	51	1H	3.22	0.13	0.434	0.434
SG14	22	43	1H	2.65	0.18	0.484	0.484
SG14	23	73	1H	8.53	0.36	0.665	0.665
SG14	24	62	1H	2.5	0.24	0.544	0.544
SG14	25	36	1H	3.16	0.18	0.484	0.484
SG14	30	59	1H	2.35	0.26	0.564	0.564
SG14	30	61	3H	7.88	0.13	0.434	0.434
SG14	33	58	1H	3.39	0.57	0.879	0.879
SG14	34	41	2H	8.53	0.14	0.444	0.444
SG14	34	54	1H	8.18	0.26	0.564	0.564
SG14	36	47	1H	3.3	0.28	0.584	0.584
SG14	42	54	1H	3.64	0.11	0.414	0.414

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

	SG 1-1				SG 1-2				SG 1-3			
Voltage Bin	As-Found EOC-12	Repaired Tubes	DOSs Returned to Service		As-Found EOC-12	Repaired Tubes	DOSs Returned to Service		As-Found EOC-12	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	2	0	2	2	0	0	0	0	0	0	0	0
0.2	16	0	15	16	10	0	10	10	3	0	3	3
0.3	73	2	70	71	30	3	27	27	23	3	19	20
0.4	115	4	111	111	54	3	50	51	30	4	25	26
0.5	78	2	75	76	71	3	68	68	36	6	29	30
0.6	74	1	73	73	73	6	66	67	24	4	19	20
0.7	64	4	58	60	45	1	43	44	24	0	22	24
0.8	35	2	33	33	48	1	45	47	12	1	11	11
0.9	36	1	34	35	26	0	26	26	10	1	9	9
1	39	1	38	38	12	0	10	12	12	3	9	9
1.1	23	0	23	23	21	0	20	21	11	0	11	11
1.2	18	0	18	18	12	1	11	11	4	1	3	3
1.3	16	0	16	16	8	0	8	8	6	0	6	6
1.4	7	0	7	7	9	0	9	9	4	1	3	3
1.5	16	1	15	15	3	0	3	3	4	0	4	4
1.6	2	0	2	2	2	0	2	2	3	1	2	2
1.7	4	0	4	4	1	0	1	1	3	0	3	3
1.8	3	0	3	3	2	1	1	1	6	1	5	5
1.9	3	0	3	3	3	0	2	3	2	0	2	2
2	2	0	2	2	0	0	0	0	0	0	0	0
2.1	9	9	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	5	5	0	0	0	0	0	0	0	0	0	0
2.4	1	1	0	0	2	2	0	0	3	3	0	0
2.5	0	0	0	0	1	1	0	0	0	0	0	0
2.6	0	0	0	0	2	2	0	0	0	0	0	0
2.7	1	1	0	0	0	0	0	0	0	0	0	0
2.8	1	1	0	0	0	0	0	0	0	0	0	0
2.9	0	0	0	0	0	0	0	0	1	1	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
3.1	3	3	0	0	1	1	0	0	0	0	0	0
3.2	0	0	0	0	0	0	0	0	0	0	0	0
3.3	0	0	0	0	0	0	0	0	0	0	0	0
3.4	1	1	0	0	0	0	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0	0	0	0	0	0
3.6	0	0	0	0	0	0	0	0	0	0	0	0
3.7	0	0	0	0	1	1	0	0	0	0	0	0
3.8	0	0	0	0	0	0	0	0	0	0	0	0
3.9	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	2	2	0	0	1	1	0	0	0	0	0	0
6	3	3	0	0	0	0	0	0	0	0	0	0
7	1	1	0	0	0	0	0	0	0	0	0	0
>7	0	0	0	0	0	0	0	0	0	0	0	0
Total	653	45	602	608	439	28	402	411	223	32	185	191
>1V	121	28	93	93	70	11	57	59	49	10	39	39
>2V	27	27	0	0	9	9	0	0	6	6	0	0
>4V	6	6	0	0	1	1	0	0	0	0	0	0

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

	SG 1-4				Composite of All SGs			
Voltage Bin	As-Found EOC-12	Repaired Tubes	DOSs Returned to Service: Conf. ODSCC or Not Insp w/ +Pt	DOSs Returned to Service: Total	As-Found EOC-12	Repaired Tubes	DOSs Returned to Service: Conf. ODSCC or Not Insp w/ +Pt	DOSs Returned to Service: Total
0.1	0	0	0	0	2	0	2	2
0.2	5	0	5	5	34	0	33	34
0.3	15	0	14	15	141	8	130	133
0.4	23	1	20	22	222	12	206	210
0.5	43	5	38	38	228	16	210	212
0.6	19	2	17	17	190	13	175	177
0.7	15	3	12	12	148	8	135	140
0.8	9	0	9	9	104	4	98	100
0.9	11	0	11	11	83	2	80	81
1	6	0	6	6	69	4	63	65
1.1	6	0	6	6	61	0	60	61
1.2	3	0	3	3	37	2	35	35
1.3	8	0	8	8	38	0	38	38
1.4	2	0	2	2	22	1	21	21
1.5	0	0	0	0	23	1	22	22
1.6	1	0	1	1	8	1	7	7
1.7	0	0	0	0	8	0	8	8
1.8	0	0	0	0	11	2	9	9
1.9	0	0	0	0	8	0	7	8
2	0	0	0	0	2	0	2	2
2.1	1	1	0	0	12	12	0	0
2.2	1	1	0	0	2	2	0	0
2.3	0	0	0	0	5	5	0	0
2.4	0	0	0	0	6	6	0	0
2.5	0	0	0	0	1	1	0	0
2.6	2	2	0	0	4	4	0	0
2.7	0	0	0	0	1	1	0	0
2.8	0	0	0	0	1	1	0	0
2.9	0	0	0	0	1	1	0	0
3	0	0	0	0	0	0	0	0
3.1	0	0	0	0	4	4	0	0
3.2	0	0	0	0	0	0	0	0
3.3	0	0	0	0	0	0	0	0
3.4	0	0	0	0	1	1	0	0
3.5	0	0	0	0	0	0	0	0
3.6	1	1	0	0	1	1	0	0
3.7	1	1	0	0	2	2	0	0
3.8	0	0	0	0	0	0	0	0
3.9	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	3	3	0	0
6	0	0	0	0	3	3	0	0
7	0	0	0	0	1	1	0	0
>7	0	0	0	0	0	0	0	0
Total	172	17	152	155	1487	122	1341	1365
>1V	26	6	20	20	266	55	209	211
>2V	6	6	0	0	48	48	0	0
>4V	0	0	0	0	7	7	0	0

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

SG	Row	Col	Elev	Volts	Prev Volts (1R11)	Growth/ EFPY	Plus Pt Results	New?
SG11	5	60	1H	6.15	1.31	3.006	MAI	Repeat
SG11	8	72	1H	5.06	1.10	2.460	MAI	Repeat
SG11	6	61	1H	5.60	1.67	2.441	MAI	Repeat
SG11	20	54	1H	5.60	1.80	2.360	MAI	Repeat
SG11	24	31	1H	4.45	1.51	1.826	MAI	Repeat
SG11	8	69	1H	3.40	0.823 (1)	1.601	MAI	New
SG12	37	23	3H	4.08	1.59	1.547	SAI	Repeat
SG11	6	78	2H	3.04	0.78	1.404	MAI	Repeat
SG11	17	73	1H	4.01	1.96	1.273	MAI	Repeat
SG12	23	12	1H	3.64	1.60	1.267	MAI	Repeat
SG14	25	31	1H	3.64	1.75	1.174	SAI	Repeat
SG12	19	85	2H	2.59	0.772 (1)	1.129	MAI	New
SG11	12	71	1H	3.05	1.33	1.068	MAI	Repeat
SG11	36	45	1H	3.08	1.38	1.056	MAI	Repeat
SG14	25	26	2H	3.55	1.91	1.019	SAI	Repeat
SG12	13	56	1H	3.08	1.48	0.994	SAI	Repeat
SG14	14	34	1H	2.13	0.615 (1)	0.941	SAI	New
SG11	29	33	1H	2.73	1.23	0.932	MAI	Repeat
SG11	19	39	1H	2.24	0.76	0.919	SAI	Repeat
SG11	4	64	1H	2.09	0.71	0.857	MAI	Repeat
SG11	13	67	1H	2.61	1.25	0.845	MAI	Repeat
SG11	17	77	1H	2.27	0.93	0.832	MAI	Repeat
SG11	26	61	1H	2.03	0.75	0.795	MAI	Repeat
SG11	5	66	1H	1.88	0.60	0.795	SAI	Repeat
SG12	24	30	2H	2.58	1.31	0.789	SAI	Repeat

1) The previous voltages for these three indications are inferred voltages from the 1R11 Plus Point results.

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

Tube Support Plate	SG 1-1					Tube Support Plate	SG 1-2				
	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	439	6.15	0.83	3.01	0.23	1H	208	3.64	0.74	1.27	0.10
2H	144	3.04	0.55	1.40	0.07	2H	132	2.59	0.67	1.13	0.08
3H	43	1.78	0.55	0.63	0.12	3H	52	4.08	0.65	1.55	0.10
4H	17	0.83	0.41	0.17	0.02	4H	21	1.27	0.64	0.19	0.06
5H	1	0.51	0.51	-0.18	-0.18	5H	10	1.39	0.59	0.32	0.04
6H	2	0.61	0.49	0.02	0.02	6H	7	0.59	0.43	0.11	0.03
7H	1	0.30	0.30	0.01	0.01	7H	1	0.58	0.58		
CL	6	0.67	0.46	0.04	0.00	CL	8	0.76	0.50	0.11	0.02
All Inds	653	6.15	0.73	3.01	0.18	All Inds	439	4.08	0.69	1.55	0.09

Tube Support Plate	SG 1-3					Tube Support Plate	SG 1-4				
	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	108	2.88	0.78	0.57	0.08	1H	101	3.64	0.71	1.17	0.16
2H	47	1.75	0.71	0.25	0.05	2H	42	3.55	0.63	1.02	0.13
3H	21	1.75	0.92	0.59	0.13	3H	14	1.35	0.60	0.19	0.08
4H	16	1.71	0.55	0.14	0.03	4H	10	1.26	0.58	0.29	0.07
5H	14	1.71	0.67	0.30	0.07	5H	4	0.51	0.37	0.09	0.03
6H	7	2.01	0.63	0.08	0.03	6H					
7H	1	0.28	0.28	-0.05	-0.05	7H					
CL	9	0.64	0.43	0.08	0.01	CL	1	0.34	0.34	0.04	0.04
All Inds	223	2.88	0.74	0.59	0.07	All Inds	172	3.64	0.67	1.17	0.13

Tube Support Plate	Composite of All Four SGs				
	No. of Indications	Max Voltage	Average Voltage	Max Growth/ EFPY	Average Growth/ EFPY
1H	856	6.15	0.79	3.01	0.17
2H	365	3.55	0.62	1.40	0.08
3H	130	4.08	0.65	1.55	0.11
4H	64	1.71	0.55	0.29	0.04
5H	29	1.71	0.60	0.32	0.05
6H	16	2.01	0.52	0.11	0.03
7H	3	0.58	0.39	0.01	-0.02
CL	24	0.76	0.46	0.11	0.01
All Inds	1487	6.15	0.71	3.01	0.13

Table 3-6: Voltage Growth for Cycles 9 through 12

		SG 1-1	SG 1-2	SG 1-3	SG 1-4	All
Cycle 9	Avg BOC Volts	0.281	0.307	0.457	0.327	0.343
	Average Growth Per EFPY	0.113	0.072	0.127	0.151	0.102
	Average Percent Growth Per EFPY	40.2%	23.3%	27.8%	46.0%	29.6%
Cycle 10	Avg BOC Volts	0.350	0.405	0.602	0.546	0.437
	Avg Growth Per EFPY	0.171	0.135	0.123	0.108	0.143
	Average Percent Growth Per EFPY	49.0%	33.3%	20.4%	19.8%	32.8%
Cycle 11	Avg BOC Volts	0.440	0.548	0.653	0.500	0.515
	Avg Growth Per EFPY	0.127	0.091	0.066	0.085	0.102
	Average Percent Growth Per EFPY	28.8%	16.6%	10.1%	17.0%	19.8%
Cycle 12	Avg BOC Volts	0.488	0.565	0.664	0.484	0.535
	Avg Growth Per EFPY	0.178	0.091	0.068	0.132	0.130
	Average Percent Growth Per EFPY	36.4%	16.0%	10.6%	27.2%	24.3%

Table 3-7: Summary of Independent Cycle 12 Voltage Growth per EFPY

Delta Volts Per EFPY	SG 1-1		SG 1-2		SG 1-3		SG 1-4		Total	
	No. of Obs.	CPDF	No. of Obs.	CPDF	No. of Obs.	CPDF	No. of Obs.	CPDF	No. of Obs.	CPDF
<=0.0	94	0.164	96	0.259	48	0.230	23	0.177	261	0.203
0.1	180	0.477	156	0.679	100	0.708	54	0.592	490	0.585
0.2	128	0.700	72	0.873	42	0.909	31	0.831	273	0.798
0.3	69	0.821	21	0.930	11	0.962	8	0.892	109	0.882
0.4	45	0.899	14	0.968	4	0.981	5	0.931	68	0.935
0.5	19	0.932	4	0.978	1	0.986	4	0.962	28	0.957
0.6	16	0.960	2	0.984	3	1.000	1	0.969	22	0.974
0.7	5	0.969	1	0.987	0	1.000	1	0.977	7	0.980
0.8	3	0.974	1	0.989	0	1.000	0	0.977	4	0.983
0.9	3	0.979	0	0.989	0	1.000	0	0.977	3	0.985
1	2	0.983	1	0.992	0	1.000	1	0.985	4	0.988
1.1	2	0.986	0	0.992	0	1.000	1	0.992	3	0.991
1.2	0	0.986	1	0.995	0	1.000	1	1.000	2	0.992
1.3	1	0.988	1	0.997	0	1.000	0	1.000	2	0.994
1.4	0	0.988	0	0.997	0	1.000	0	1.000	0	0.994
1.5	1	0.990	0	0.997	0	1.000	0	1.000	1	0.995
1.6	0	0.990	1	1.000	0	1.000	0	1.000	1	0.995
1.7	1	0.991	0	1.000	0	1.000	0	1.000	1	0.996
1.8	0	0.991	0	1.000	0	1.000	0	1.000	0	0.996
1.9	1	0.993	0	1.000	0	1.000	0	1.000	1	0.997
2	0	0.993	0	1.000	0	1.000	0	1.000	0	0.997
2.1	0	0.993	0	1.000	0	1.000	0	1.000	0	0.997
2.2	0	0.993	0	1.000	0	1.000	0	1.000	0	0.997
2.3	0	0.993	0	1.000	0	1.000	0	1.000	0	0.997
2.4	1	0.995	0	1.000	0	1.000	0	1.000	1	0.998
2.5	2	0.998	0	1.000	0	1.000	0	1.000	2	0.999
2.6	0	0.998	0	1.000	0	1.000	0	1.000	0	0.999
2.7	0	0.998	0	1.000	0	1.000	0	1.000	0	0.999
2.8	0	0.998	0	1.000	0	1.000	0	1.000	0	0.999
2.9	0	0.998	0	1.000	0	1.000	0	1.000	0	0.999
3	0	0.998	0	1.000	0	1.000	0	1.000	0	0.999
3.1	1	1.000	0	1.000	0	1.000	0	1.000	1	1.000
3.2	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3.3	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3.4	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3.5	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
>3.5	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
Total	574	NA	371	NA	209	NA	130	NA	1284	NA
Upper 95% Growth	0.55		0.35		0.27		0.47		0.47	

Table 3-8: Cycle 12 Voltage Dependent Growth Using Composite Breakpoints (BOC-12 Voltage ≤ 0.50 Volts)

Delta Volts per EFPY	SG 1-1		SG 1-2		SG 1-3		SG 1-4		Total	
	No. of Obs.	CPDF	No. of Obs.	CPDF	No. of Obs.	CPDF	No. of Obs.	CPDF	No. of Obs.	CPDF
0	57	0.155	35	0.192	24	0.226	17	0.193	133	0.179
0.1	139	0.534	91	0.692	66	0.849	44	0.693	340	0.637
0.2	92	0.785	40	0.912	11	0.953	20	0.920	163	0.856
0.3	44	0.905	9	0.962	4	0.991	3	0.955	60	0.937
0.4	24	0.970	5	0.989	1	1.000	2	0.977	32	0.980
0.5	6	0.986	2	1.000	0	1.000	2	1.000	10	0.993
0.6	5	1.000	0	1.000	0	1.000	0	1.000	5	1.000
0.7	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
0.8	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
0.9	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
1	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
1.1	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
1.2	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
1.3	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
1.4	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
1.5	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
1.6	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
1.7	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
1.8	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
1.9	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.1	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.2	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.3	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.4	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.5	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.6	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.7	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.8	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.9	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3.1	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3.2	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3.3	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3.4	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3.5	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
>3.5	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
Total	367	NA	182	NA	106	NA	88	NA	743	NA

Table 3-9: Cycle 12 Voltage Dependent Growth Using Composite Breakpoints (BOC-12 Voltage from 0.51 to 1.02 Volts)

Delta Volts per EFPY	SG 1-1		SG 1-2		SG 1-3		SG 1-4		Total	
	No. of Obs.	CPDF	No. of Obs.	CPDF	No. of Obs.	CPDF	No. of Obs.	CPDF	No. of Obs.	CPDF
0	28	0.168	52	0.338	16	0.246	3	0.094	99	0.237
0.1	40	0.407	55	0.695	28	0.677	9	0.375	132	0.553
0.2	31	0.593	27	0.870	16	0.923	10	0.688	84	0.754
0.3	23	0.731	10	0.935	1	0.938	5	0.844	39	0.847
0.4	20	0.850	7	0.981	1	0.954	3	0.938	31	0.921
0.5	8	0.898	2	0.994	1	0.969	0	0.938	11	0.947
0.6	7	0.940	0	0.994	2	1.000	0	0.938	9	0.969
0.7	3	0.958	0	0.994	0	1.000	1	0.969	4	0.978
0.8	2	0.970	0	0.994	0	1.000	0	0.969	2	0.983
0.9	2	0.982	0	0.994	0	1.000	0	0.969	2	0.988
1	1	0.988	0	0.994	0	1.000	1	1.000	2	0.993
1.1	0	0.988	0	0.994	0	1.000	0	1.000	0	0.993
1.2	0	0.988	1	1.000	0	1.000	0	1.000	1	0.995
1.3	0	0.988	0	1.000	0	1.000	0	1.000	0	0.995
1.4	0	0.988	0	1.000	0	1.000	0	1.000	0	0.995
1.5	1	0.994	0	1.000	0	1.000	0	1.000	1	0.998
1.6	0	0.994	0	1.000	0	1.000	0	1.000	0	0.998
1.7	1	1.000	0	1.000	0	1.000	0	1.000	1	1.000
1.8	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
1.9	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.1	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.2	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.3	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.4	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.5	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.6	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.7	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.8	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
2.9	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3.1	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3.2	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3.3	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3.4	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3.5	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
>3.5	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
Total	167	NA	154	NA	65	NA	32	NA	418	NA

Table 3-10: Cycle 12 Voltage Dependent Growth Using Composite Breakpoints (BOC-12 Voltage >1.02 Volts)

Delta Volts per EFPY	SG 1-1		SG 1-2		SG 1-3		SG 1-4		Total	
	No. of Obs.	CPDF	No. of Obs.	CPDF	No. of Obs.	CPDF	No. of Obs.	CPDF	No. of Obs.	CPDF
0	9	0.225	9	0.257	8	0.211	3	0.300	29	0.236
0.1	1	0.250	10	0.543	6	0.368	1	0.400	18	0.382
0.2	5	0.375	5	0.686	15	0.763	1	0.500	26	0.593
0.3	2	0.425	2	0.743	6	0.921	0	0.500	10	0.675
0.4	1	0.450	2	0.800	2	0.974	0	0.500	5	0.715
0.5	5	0.575	0	0.800	0	0.974	2	0.700	7	0.772
0.6	4	0.675	2	0.857	1	1.000	1	0.800	8	0.837
0.7	2	0.725	1	0.886	0	1.000	0	0.800	3	0.862
0.8	1	0.750	1	0.914	0	1.000	0	0.800	2	0.878
0.9	1	0.775	0	0.914	0	1.000	0	0.800	1	0.886
1	1	0.800	1	0.943	0	1.000	0	0.800	2	0.902
1.1	2	0.850	0	0.943	0	1.000	1	0.900	3	0.927
1.2	0	0.850	0	0.943	0	1.000	1	1.000	1	0.935
1.3	1	0.875	1	0.971	0	1.000	0	1.000	2	0.951
1.4	0	0.875	0	0.971	0	1.000	0	1.000	0	0.951
1.5	0	0.875	0	0.971	0	1.000	0	1.000	0	0.951
1.6	0	0.875	1	1.000	0	1.000	0	1.000	1	0.959
1.7	0	0.875	0	1.000	0	1.000	0	1.000	0	0.959
1.8	0	0.875	0	1.000	0	1.000	0	1.000	0	0.959
1.9	1	0.900	0	1.000	0	1.000	0	1.000	1	0.967
2	0	0.900	0	1.000	0	1.000	0	1.000	0	0.967
2.1	0	0.900	0	1.000	0	1.000	0	1.000	0	0.967
2.2	0	0.900	0	1.000	0	1.000	0	1.000	0	0.967
2.3	0	0.900	0	1.000	0	1.000	0	1.000	0	0.967
2.4	1	0.925	0	1.000	0	1.000	0	1.000	1	0.976
2.5	2	0.975	0	1.000	0	1.000	0	1.000	2	0.992
2.6	0	0.975	0	1.000	0	1.000	0	1.000	0	0.992
2.7	0	0.975	0	1.000	0	1.000	0	1.000	0	0.992
2.8	0	0.975	0	1.000	0	1.000	0	1.000	0	0.992
2.9	0	0.975	0	1.000	0	1.000	0	1.000	0	0.992
3	0	0.975	0	1.000	0	1.000	0	1.000	0	0.992
3.1	1	1.000	0	1.000	0	1.000	0	1.000	1	1.000
3.2	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3.3	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3.4	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
3.5	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
>3.5	0	1.000	0	1.000	0	1.000	0	1.000	0	1.000
Total	40	NA	35	NA	38	NA	10	NA	123	NA

Table 3-11: Delta Volts Adjustments

SG	Cycle	Breakpoint(s)	Average Growth (Volts per EFPY)		
			Bin1	Bin2	Bin3
SG 1-1	Cycle 11	0.50 / 0.99	0.099	0.170	0.359
	Cycle 12		0.119	0.202	0.578
	Delta		0.020	0.032	0.219
SG 1-2	Cycle 11	1.16	0.082	0.241	NA
	Cycle 12		0.076	0.309	NA
	Delta		<0	0.068	NA
SG 1-3	Cycle 11	1.05	0.060	0.091	NA
	Cycle 12		0.056	0.133	NA
	Delta		<0	0.042	NA
SG 1-4	Cycle 11	0.82	0.082	0.102	NA
	Cycle 12		0.110	0.297	NA
	Delta		0.028	0.195	NA
Composite	Cycle 11	0.50 / 1.02	0.088	0.113	0.164
	Cycle 12		0.095	0.133	0.331
	Delta		0.007	0.020	0.167

Table 3-12: VDG Distributions Used for Monte Carlo Simulations

Growth Distributions Used for SGs 1-2, 1-3, and 1-4 (All SGs Combined; Cycle 12)

Growth in Volts/EFPY	BOC Voltage		
	<=0.5V	0.5V to 1.02V	>1.02V
0	93	65	5
0.1	329	127	8
0.2	207	112	22
0.3	64	40	20
0.4	35	36	20
0.5	10	15	13
0.6	5	8	0
0.7	0	6	7
0.8	0	0	9
0.9	0	4	2
1	0	2	2
1.1	0	0	2
1.2	0	1	2
1.3	0	0	2
1.4	0	0	1
1.5	0	1	2
1.6	0	0	0
1.7	0	1	0
1.8	0	0	1
1.9	0	0	0
2	0	0	1
2.1	0	0	0
2.2	0	0	0
2.3	0	0	0
2.4	0	0	0
2.5	0	0	0
2.6	0	0	1
2.7	0	0	2
2.8	0	0	0
2.9	0	0	0
3	0	0	0
3.1	0	0	0
3.2	0	0	1
3.3	0	0	0
3.4	0	0	0
3.5	0	0	0
Total	743	418	123

Growth Distributions Used for SG 1-1 (SG 1-1; Cycle 12)

Growth in Volts/EFPY	BOC Voltage		
	<=0.5V	0.5V to 0.99V	>0.99V
0	29	20	1
0.1	132	32	3
0.2	110	39	5
0.3	54	21	2
0.4	29	23	4
0.5	8	8	5
0.6	5	9	2
0.7	0	3	3
0.8	0	1	5
0.9	0	4	3
1	0	1	1
1.1	0	0	1
1.2	0	0	1
1.3	0	0	2
1.4	0	0	0
1.5	0	1	1
1.6	0	0	0
1.7	0	1	0
1.8	0	0	0
1.9	0	0	0
2	0	0	0
2.1	0	0	1
2.2	0	0	0
2.3	0	0	0
2.4	0	0	0
2.5	0	0	0
2.6	0	0	1
2.7	0	0	2
2.8	0	0	0
2.9	0	0	0
3	0	0	0
3.1	0	0	0
3.2	0	0	0
3.3	0	0	1
3.4	0	0	0
3.5	0	0	0
Total	367	163	44

Table 3-13: Re-tested DOSs ≥1.5 Volts that Failed the Probe Wear Check

SG	Row	Col	Ind	Elev	Volts	Probe	Cal No.	ARC Out 1R12	% Diff
SG 1-1	6	61	RSS	1H	4.68	720RF	CL-24	Yes	
			DOS	1H	5.6	720RF	CL-41		19.7%
	8	69	RSS	1H	3.17	720RF	CL-24	Yes	
			DOS	1H	3.4	720RF	CL-41		7.3%
	8	71	RSS	1H	2.34	720RF	CL-24	Yes	
			RSS	1H	2.02	720RF	CL-42	Yes	
			RSS	1H	2.08	720RF	CL-49	Yes	
			DOS	1H	2.07	720RF	CL-51		-11.5% / 2.5% / -0.5%
	8	72	RSS	1H	5.64	720RF	CL-26	Yes	
			DOS	1H	5.06	720RF	CL-41		-10.3%
	10	71	RSS	1H	2.12	720RF	CL-24	Yes	
			RSS	1H	2.28	720RF	CL-42	Yes	
			RSS	1H	2.28	720RF	CL-49	Yes	
			DOS	1H	2.28	720RF	CL-51		7.5% / 0.0% / 0.0%
	12	70	RSS	1H	1.53	720RF	CL-24	Yes	
			RSS	1H	1.56	720RF	CL-42	Yes	
			RSS	1H	1.54	720RF	CL-49	Yes	
			DOS	1H	1.5	720RF	CL-51		-2.0% / -3.8% / -2.6%
	12	71	RSS	1H	3.31	720RF	CL-24	Yes	
			RSS	1H	3.27	720RF	CL-42	Yes	
			RSS	1H	3.1	720RF	CL-49	Yes	
			DOS	1H	3.05	720RF	CL-51		-7.9% / -6.7% / -1.6%
	14	80	RSS	1H	1.63	720RF	HL-18	Yes	
			DOS	1H	1.7	720RF	CL-31		4.3%
	17	73	RSS	1H	3.41	720RF	HL-17	Yes	
			DOS	1H	4.01	720RF	CL-31		17.6%
	17	74	RSS	1H	1.77	720RF	HL-17	Yes	
			DOS	1H	1.9	720RF	CL-31		7.3%
	17	77	RSS	1H	2.28	720RF	HL-17	Yes	
			DOS	1H	2.27	720RF	CL-31		-0.4%
	20	54	RSS	1H	5.66	720RF	CL-30	Yes	
			DOS	1H	5.6	720RF	CL-41		-1.1%
	22	69	RSS	1H	1.53	720RF	HL-18	Yes	
			DOS	1H	1.63	720RF	CL-31		6.5%
	24	31	RSS	1H	4.97	720RF	HL-14	Yes	
			DOS	1H	4.45	720RF	CL-39		-10.5%

Table 3-13: Re-tested DOSs ≥1.5 Volts that Failed the Probe Wear Check

SG	Row	Col	Ind	Elev	Volts	Probe	Cal No.	ARC Out 1R12	% Diff
SG 1-1	26	32	RSS	1H	1.64	720RF	HL-10	Yes	
			DOS	1H	1.55	720RF	CL-39		-5.5%
	26	63	RSS	1H	1.65	720RF	CL-20	Yes	
			DOS	1H	1.92	720RF	CL-31		16.4%
	26	77	RSS	1H	1.93	720RF	CL-21	Yes	
			DOS	1H	2.01	720RF	CL-41		4.1%
	27	42	RSS	1H	1.94	720RF	HL-12	Yes	
			DOS	1H	1.79	720RF	CL-39		-7.7%
	28	41	RSS	1H	1.63	720RF	CL-42	Yes	
			RSS	1H	1.57	720RF	HL-12	Yes	
			DOS	1H	1.37	720RF	CL-49		-16.0% / -12.7%
	29	41	RSS	1H	1.59	720RF	HL-11	Yes	
			DOS	1H	1.65	720RF	CL-41		3.8%
	29	43	RSS	1H	1.73	720RF	HL-12	Yes	
			DOS	1H	1.72	720RF	CL-39		-0.6%
	29	46	RSS	1H	1.57	720RF	HL-11	Yes	
			DOS	1H	1.44	720RF	CL-39		-8.3%
	30	37	RSS	1H	1.73	720RF	HL-11	Yes	
			DOS	1H	2.03	720RF	CL-41		17.3%
	30	44	RSS	1H	1.84	720RF	HL-11	Yes	
			DOS	1H	1.84	720RF	CL-39		0.0%
	31	38	RSS	1H	2.14	720RF	HL-12	Yes	
			DOS	1H	2.01	720RF	CL-41		-6.1%
	35	43	RSS	2H	2.21	720RF	HL-12	Yes	
			DOS	2H	2.07	720RF	CL-39		-6.3%
	36	45	RSS	1H	3.16	720RF	HL-12	Yes	
			DOS	1H	3.08	720RF	CL-41		-2.5%
	36	55	RSS	1H	2.12	720RF	CL-20	Yes	
			DOS	1H	2.07	720RF	CL-31		-2.4%
	42	45	RSS	3H	2.02	720RF	HL-12	Yes	
			DOS	3H	1.78	720RF	CL-41		-11.9%
SG 1-2	13	56	RSS	1H	3.08	720RF	CL-30	Yes	
			DOS	1H	3.08	720RF	CL-41		0.0%
	19	31	RSS	1H	2.08	720RF	HL-26	Yes	
			DOS	1H	1.86	720RF	HL-56		-10.6%

Table 3-13: Re-tested DOSs ≥1.5 Volts that Failed the Probe Wear Check

SG	Row	Col	Ind	Elev	Volts	Probe	Cal No.	ARC Out 1R12	% Diff
SG 1-2	19	85	RSS	2H	2.25	720RF	CL-24	Yes	
			RSS	2H	2.36	720RF	CL-39	Yes	
			DOS	2H	2.59	720RF	HL-56		15.1% / 9.7%
	24	30	RSS	2H	2.89	720RF	HL-26	Yes	
			DOS	2H	2.58	720RF	CL-33		-10.7%
SG 1-4	6	12	RSS	2H	2.24	720RF	HL-26	Yes	
			DOS	2H	2.59	720RF	CL-49		15.6%
	14	34	RSS	1H	2.01	720RF	HL-15	Yes	
			DOS	1H	2.13	720RF	CL-49		6.0%
	25	26	RSS	2H	3.38	720RF	HL-12	Yes	
			DOS	2H	3.55	720RF	CL-49		5.0%
	25	31	RSS	1H	3.27	720RF	HL-12	Yes	
			DOS	1H	3.64	720RF	CL-49		11.3%

Table 3-14: New 1R12 DOSs ≥0.5 Volts in Tubes Inspected With a Worn Probe in 1R11

SG	Row	Col	Ind	Elev	Volts	Cal	New?	ARC Out 1R12	ARC Out 1R11
SG 1-1	8	69	DOS	1H	3.4	CL-41	New		Yes
	41	41	DOS	3H	1.34	HL-11	New	Yes	Yes
	35	61	DOS	2H	1.18	CL-20	New	Yes	Yes
	36	64	DOS	2H	1.06	CL-20	New	Yes	Yes
	19	59	DOS	1H	1.02	CL-29	New		Yes
	12	86	DOS	1H	1	CL-30	New	Yes	Yes
	18	74	DOS	1H	1	HL-18	New	Yes	Yes
	27	36	DOS	1H	0.99	HL-9	New		Yes
	7	77	DOS	2H	0.98	CL-28	New		Yes
	28	48	DOS	1H	0.95	HL-11	New	Yes	Yes
	22	46	DOS	1H	0.94	HL-15	New		Yes
	31	37	DOS	1H	0.94	HL-12	New	Yes	Yes
	30	39	DOS	1H	0.93	HL-12	New	Yes	Yes
	44	54	DOS	1H	0.88	CL-19	New		Yes
	19	61	DOS	1H	0.85	CL-31	New		Yes
	22	64	DOS	1H	0.85	CL-31	New		Yes
	28	52	DOS	1H	0.84	CL-20	New	Yes	Yes
	11	68	DOS	1H	0.82	CL-23	New		Yes
	32	28	DOS	1H	0.81	HL-8	New	Yes	Yes
	7	62	DOS	1H	0.8	CL-23	New		Yes
	7	31	DOS	1H	0.77	CL-37	New	Yes	Yes
	19	56	DOS	3H	0.77	CL-29	New		Yes
	42	62	DOS	2H	0.76	CL-19	New		Yes
	13	56	DOS	1H	0.75	CL-23	New		Yes
	43	41	DOS	3H	0.71	HL-11	New	Yes	Yes
	29	34	DOS	1H	0.7	HL-9	New		Yes
	6	62	DOS	1H	0.69	CL-24	New	Yes	Yes
	28	26	DOS	1H	0.69	HL-6	New		Yes
	42	50	DOS	4H	0.69	CL-21	New	Yes	Yes
	19	55	DOS	1H	0.68	CL-29	New		Yes
	21	29	DOS	2H	0.68	HL-13	New	Yes	Yes
	29	19	DOS	1H	0.67	HL-8	New	Yes	Yes
	13	61	DOS	1H	0.64	CL-23	New		Yes
	22	69	DOS	2H	0.64	CL-31	New		Yes
	40	68	DOS	1H	0.64	CL-21	New	Yes	Yes
	8	90	DOS	1H	0.63	CL-30	New	Yes	Yes
	27	32	DOS	1H	0.63	HL-9	New		Yes
	6	86	DOS	2H	0.61	CL-30	New	Yes	Yes
	16	79	DOS	2H	0.6	HL-18	New	Yes	Yes
	31	63	DOS	1H	0.6	CL-19	New		Yes
	18	77	DOS	1H	0.59	HL-18	New	Yes	Yes

Table 3-14: New 1R12 DOSs ≥0.5 Volts in Tubes Inspected With a Worn Probe in 1R11

SG	Row	Col	Ind	Elev	Volts	Cal	New?	ARC Out 1R12	ARC Out 1R11
SG 1-1	21	57	DOS	1H	0.59	CL-30	New	Yes	Yes
	13	23	DOS	1H	0.58	CL-35	New		Yes
	13	77	DOS	2H	0.58	CL-28	New		Yes
	29	55	DOS	1H	0.58	CL-19	New		Yes
	11	77	DOS	2H	0.57	CL-28	New		Yes
	13	59	DOS	1H	0.57	CL-23	New		Yes
	17	67	DOS	1H	0.57	HL-17	New	Yes	Yes
	16	80	DOS	2H	0.56	HL-18	New	Yes	Yes
	24	17	DOS	1H	0.56	HL-14	New	Yes	Yes
	6	27	DOS	1H	0.55	CL-38	New	Yes	Yes
	12	73	DOS	1H	0.55	CL-26	New	Yes	Yes
	19	56	DOS	2H	0.55	CL-29	New		Yes
	29	35	DOS	1H	0.55	CL-37	New	Yes	Yes
	6	15	DOS	1H	0.54	CL-36	New		Yes
	7	81	DOS	2H	0.53	CL-28	New		Yes
	21	65	DOS	2H	0.53	HL-17	New	Yes	Yes
	17	53	DOS	1H	0.52	CL-30	New	Yes	Yes
	22	68	DOS	1H	0.52	HL-17	New	Yes	Yes
	29	39	DOS	1H	0.52	HL-11	New	Yes	Yes
	30	22	DOS	4H	0.52	HL-6	New		Yes
	8	64	DOS	1H	0.51	CL-24	New	Yes	Yes
	8	81	DOS	2H	0.51	CL-26	New	Yes	Yes
	24	42	DOS	1H	0.5	HL-16	New	Yes	Yes
	41	68	DOS	3H	0.5	CL-22	New	Yes	Yes
SG 1-2	31	16	DOS	2H	1.07	HL-21	New		Yes
	32	44	DOS	2H	0.9	HL-13	New	Yes	Yes
	29	40	DOS	1H	0.88	HL-14	New	Yes	Yes
	28	84	DOS	1H	0.85	CL-20	New		Yes
	30	53	DOS	2H	0.79	CL-19	New		Yes
	23	34	DOS	2H	0.76	HL-26	New	Yes	Yes
	26	17	DOS	2H	0.76	HL-21	New		Yes
	35	18	DOS	1C	0.76	HL-21	New		Yes
	21	19	DOS	2H	0.75	HL-23	New	Yes	Yes
	14	52	DOS	2H	0.74	CL-27	New		Yes
	21	71	DOS	3H	0.73	CL-23	New		Yes
	25	69	DOS	3H	0.71	CL-22	New	Yes	Yes
	28	53	DOS	1H	0.71	CL-19	New		Yes
	29	33	DOS	1H	0.7	HL-18	New	Yes	Yes
	39	23	DOS	1H	0.68	HL-20	New		Yes
	30	69	DOS	1H	0.67	CL-20	New		Yes
	33	16	DOS	1C	0.66	HL-21	New		Yes

Table 3-14: New 1R12 DOSs ≥0.5 Volts in Tubes Inspected With a Worn Probe in 1R11

SG	Row	Col	Ind	Elev	Volts	Cal	New?	ARC Out 1R12	ARC Out 1R11
SG 1-2	22	62	DOS	2H	0.61	CL-27	New		Yes
	22	83	DOS	1H	0.61	CL-25	New		Yes
	21	32	DOS	1H	0.6	HL-26	New	Yes	Yes
	31	41	DOS	3H	0.56	HL-13	New	Yes	Yes
	32	50	DOS	1H	0.55	CL-19	New		Yes
	10	32	DOS	1H	0.53	CL-38	New	Yes	Yes
	27	78	DOS	1H	0.52	CL-20	New		Yes
	32	44	DOS	3H	0.52	HL-13	New	Yes	Yes
	39	27	DOS	1H	0.52	HL-20	New		Yes
	45	56	DOS	1H	0.51	CL-19	New		Yes
	21	44	DOS	1H	0.5	HL-27	New		Yes
SG 1-3	8	76	DOS	1H	1.38	CL-43	New	Yes	Yes
	31	60	DOS	2H	0.93	CL-24	New	Yes	Yes
	30	32	DOS	2H	0.83	HL-10	New		Yes
	22	87	DOS	1H	0.8	CL-41	New		Yes
	32	31	DOS	1H	0.79	HL-10	New		Yes
	38	47	DOS	1H	0.79	HL-8	New	Yes	Yes
	7	94	DOS	5H	0.67	CL-42	New	Yes	Yes
	29	72	DOS	1H	0.64	CL-30	New	Yes	Yes
	5	74	DOS	1H	0.61	HL-3	New		Yes
	40	56	DOS	1H	0.59	CL-22	New		Yes
	34	40	DOS	1H	0.53	HL-8	New	Yes	Yes
	4	48	DOS	4H	0.5	HL-4	New		Yes
SG 1-4	14	34	DOS	1H	2.13	CL-49	New		Yes
	3	44	DOS	1H	0.95	HL-1	New		Yes
	3	42	DOS	1H	0.85	HL-1	New		Yes
	9	14	DOS	2H	0.68	HL-18	New		Yes
	5	47	DOS	1H	0.62	HL-1	New		Yes
	4	41	DOS	2H	0.61	HL-1	New		Yes
	5	80	DOS	3H	0.56	HL-1	New		Yes
	14	47	DOS	1H	0.56	HL-13	New		Yes
	26	36	DOS	1H	0.51	HL-7	New		Yes
	13	6	DOS	2H	0.5	HL-17	New	Yes	Yes

Table 3-15: Summary of New DOS Indications for Probe Wear Comparison

SG	1R12 DOSs in Active Tubes (Total)	New 1R12 Not Detected in 1R11	New 1R12 Ind. In Tubes Insp. w/ Worn Probe in 1R11	New 1R12 Ind. In Tubes Insp. w/ Good Probe in 1R11	New 1R12 Ind. ≥0.5 Volts	New 1R12 Ind. ≥0.5 Volts in Tubes Insp. w/ Worn Probe in 1R11
SG 1-1	630	253	172	81	93	65
SG 1-2	392	124	67	57	56	28
SG 1-3	211	66	22	44	30	12
SG 1-4	134	59	28	31	22	10
Total	**1367**	**502**	**289**	**213**	**201**	**115**

Table 3-16: Summary of ARC Out Tube Inspections in 1R11

SG	# ARC Out Tubes (1R11)	# ARC In Tubes (1R11)	Total # of Inspections
SG 1-1	2239	1564	3803
SG 1-2	2548	1158	3706
SG 1-3	1450	2397	3847
SG 1-4	1941	1953	3894
Total	8178	7072	15250

Table 3-17: 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%

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

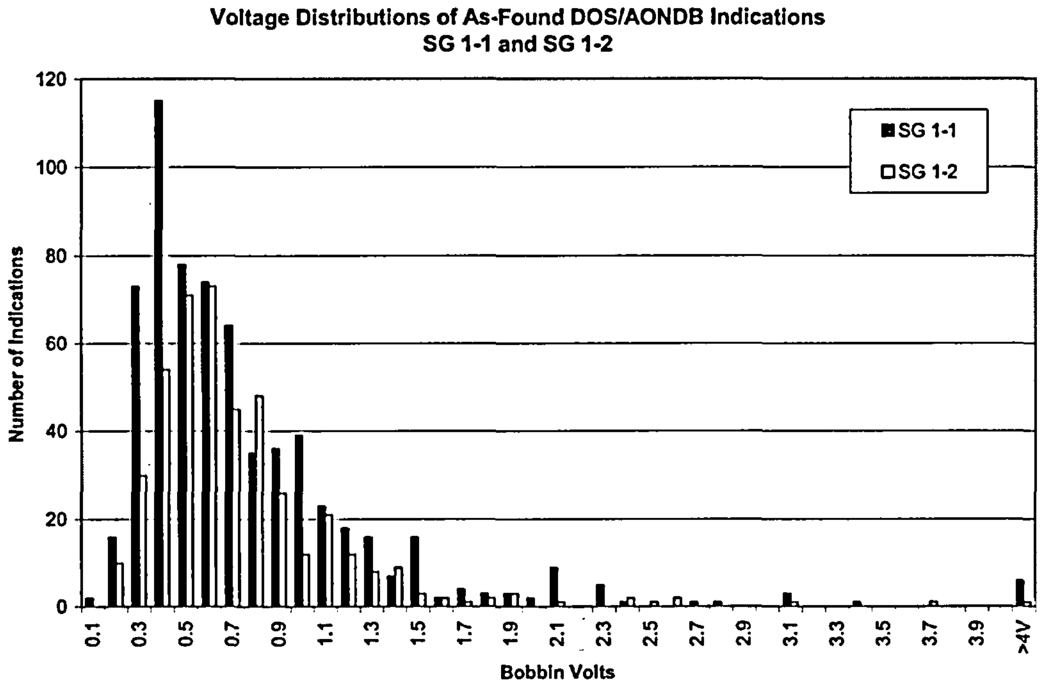


Figure 3-2: As-Found Voltage Distributions SGs 1-3 and 1-4

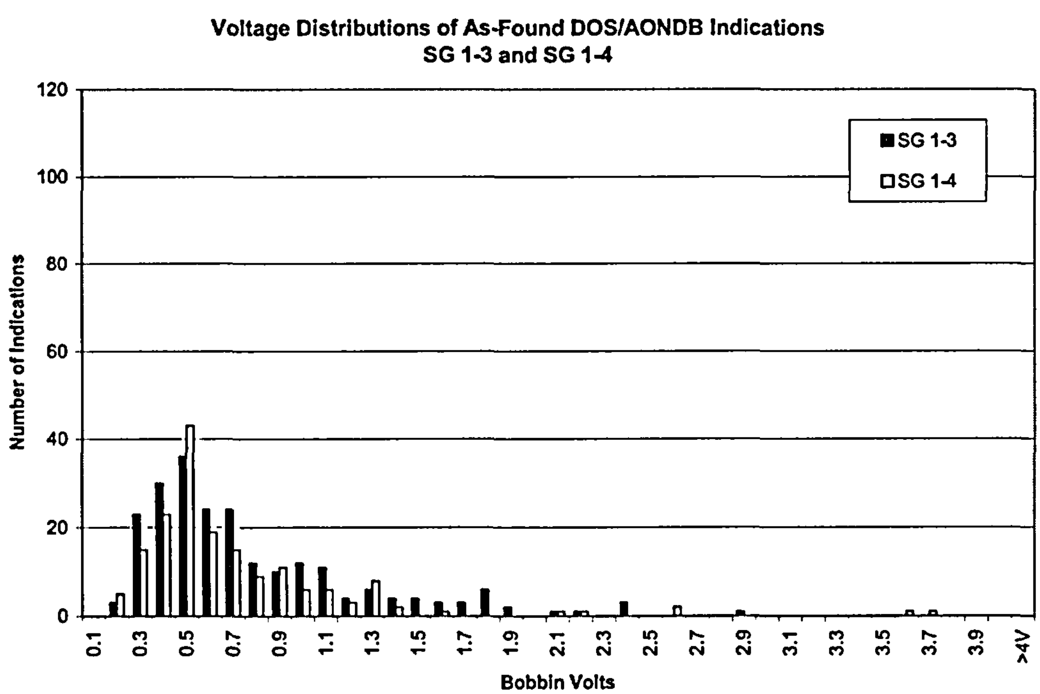


Figure 3-3: 1R12 Repaired Voltage Distributions SGs 1-1 and 1-2

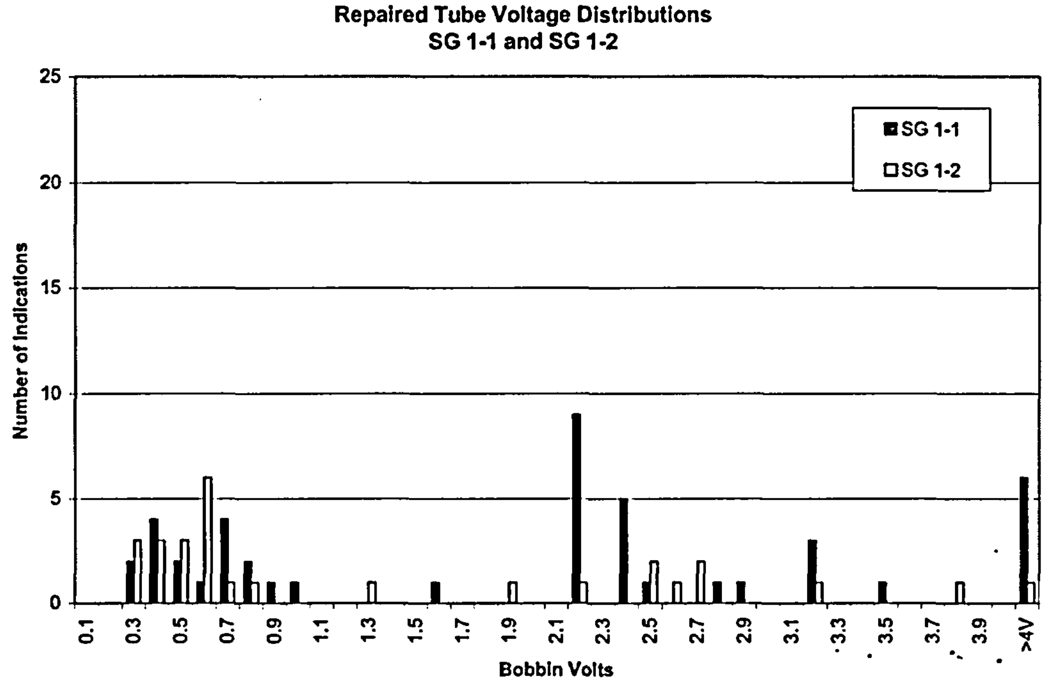


Figure 3-4: 1R12 Repaired Voltage Distributions SGs 1-3 and 1-4

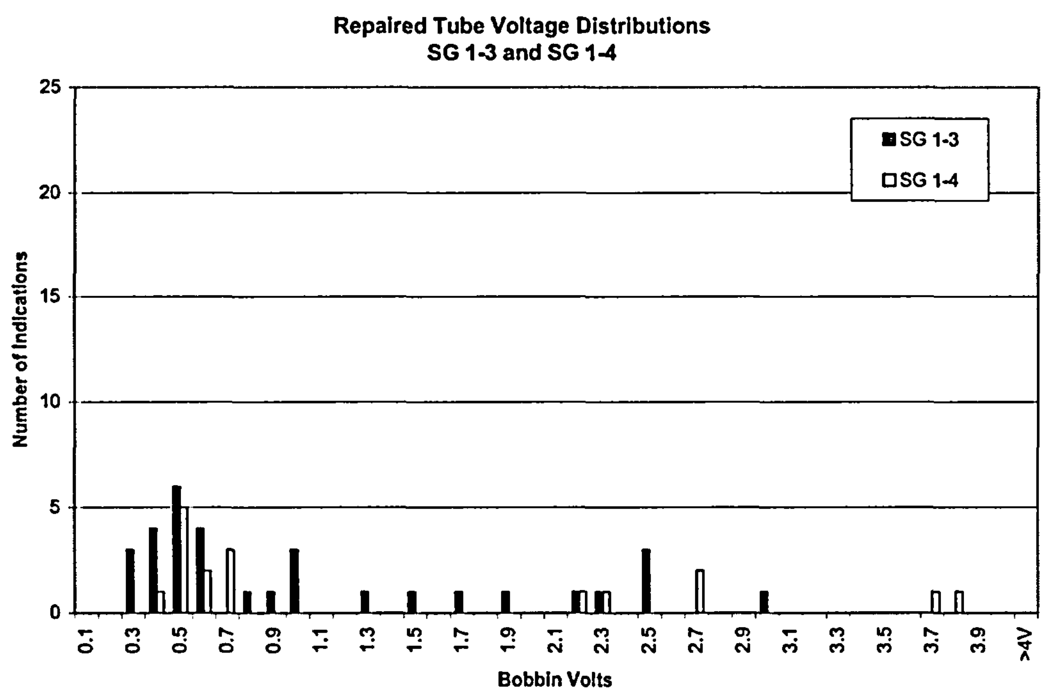


Figure 3-5: Indications RTS Voltage Distributions SGs 1-1 and 1-2

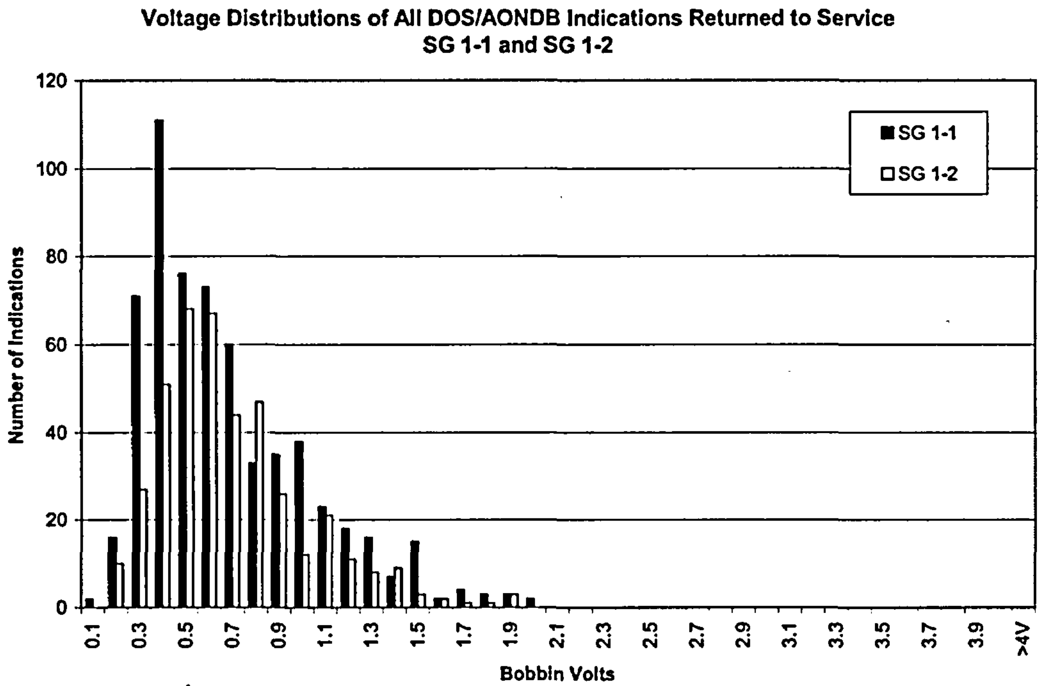


Figure 3-6: Indications RTS Voltage Distributions SGs 1-3 and 1-4

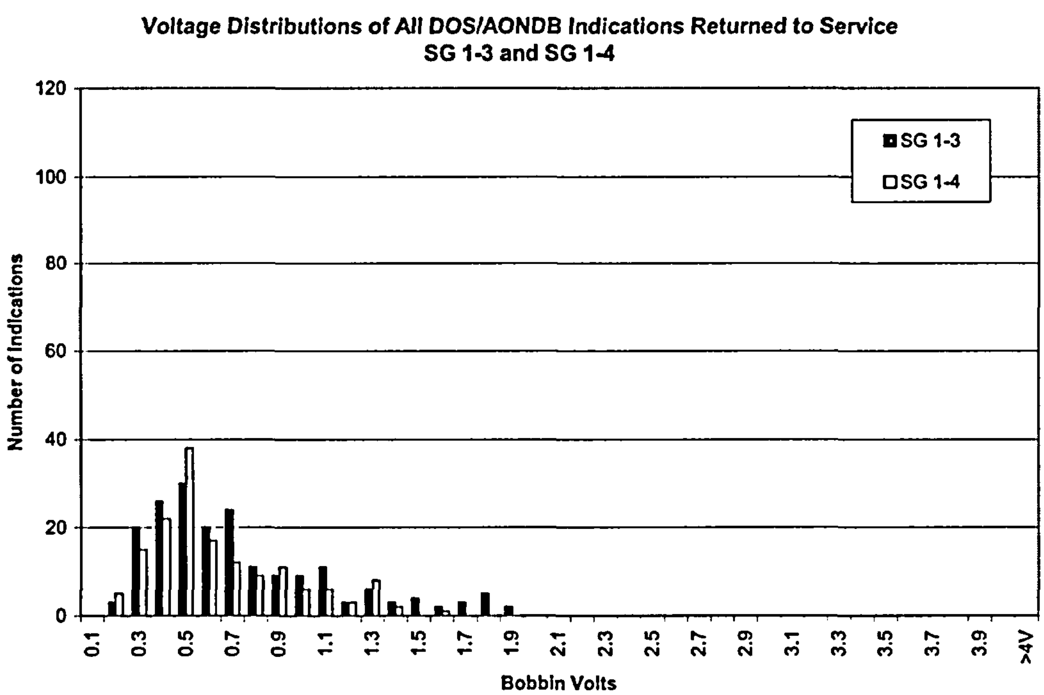
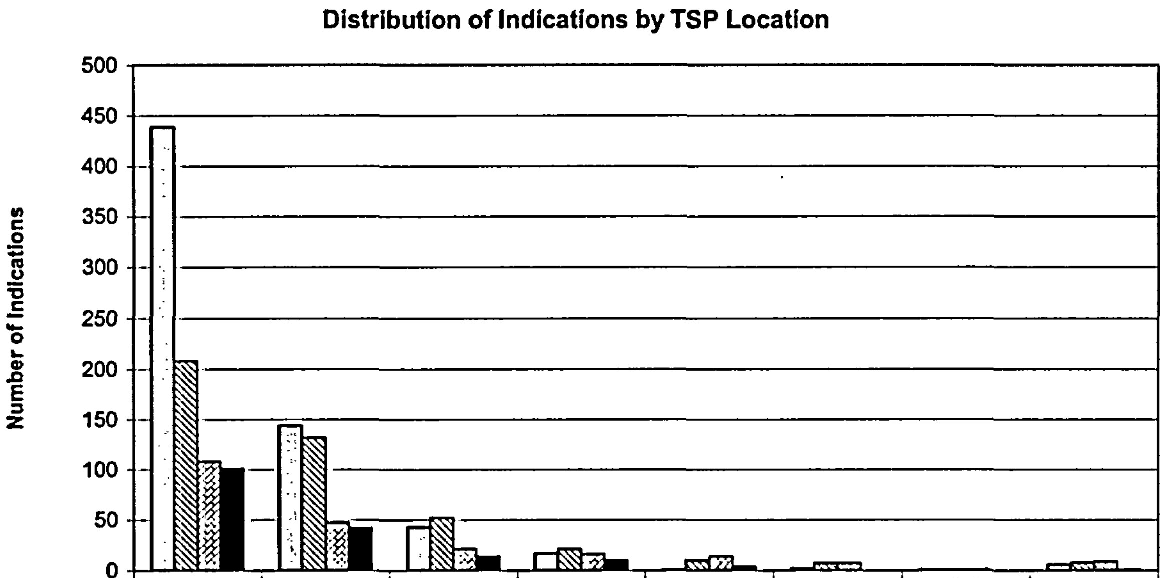


Figure 3-7: 1R12 DOS vs. TSP Elevation



	1H	2H	3H	4H	5H	6H	7H	CL
SG 1-1	439	144	43	17	1	2	1	6
SG 1-2	208	132	52	21	10	7	1	8
SG 1-3	108	47	21	16	14	7	1	9
SG 1-4	101	42	14	10	4			1

Tube Support Plate

Figure 3-8: Cycle 12 Growth Distributions SGs 1-1 and 1-2

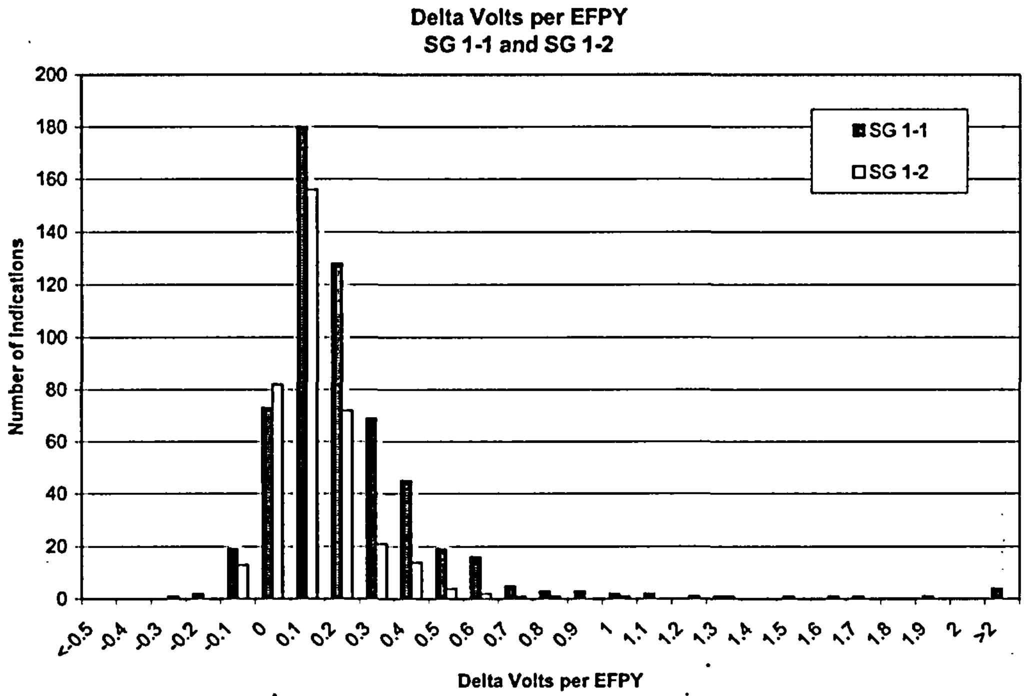


Figure 3-9: Cycle 12 Growth Distributions SGs 1-3 and 1-4

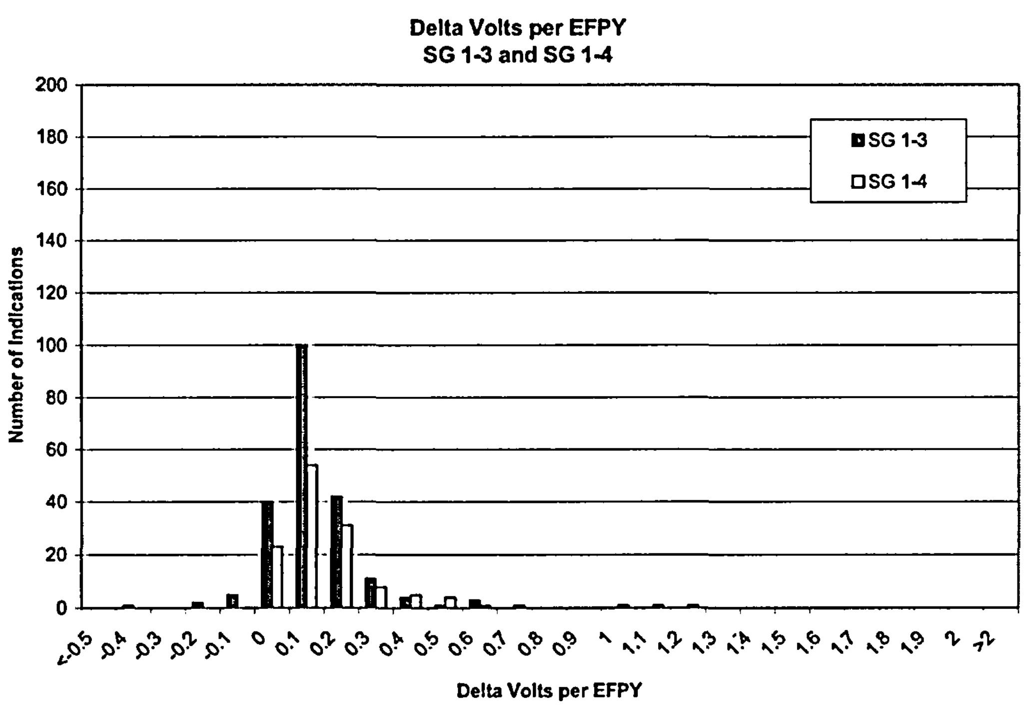


Figure 3-10: SG 1-1 and SG 1-2 Cycle 12 Growth vs. BOC Voltage

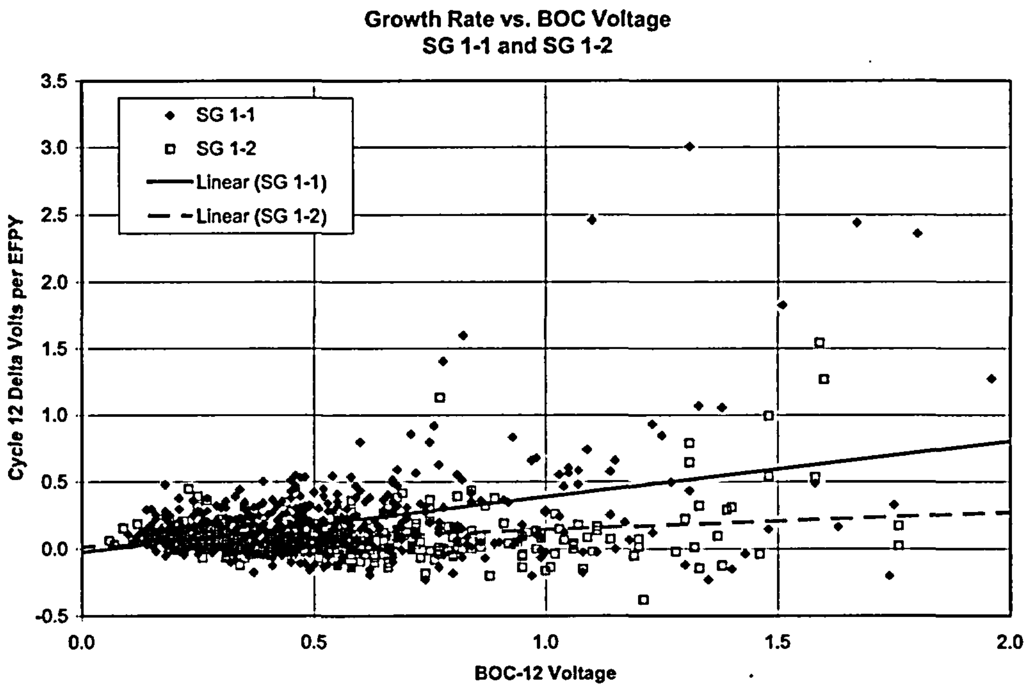


Figure 3-11: SG 1-3 and SG 1-4 Cycle 12 Growth vs. BOC Voltage

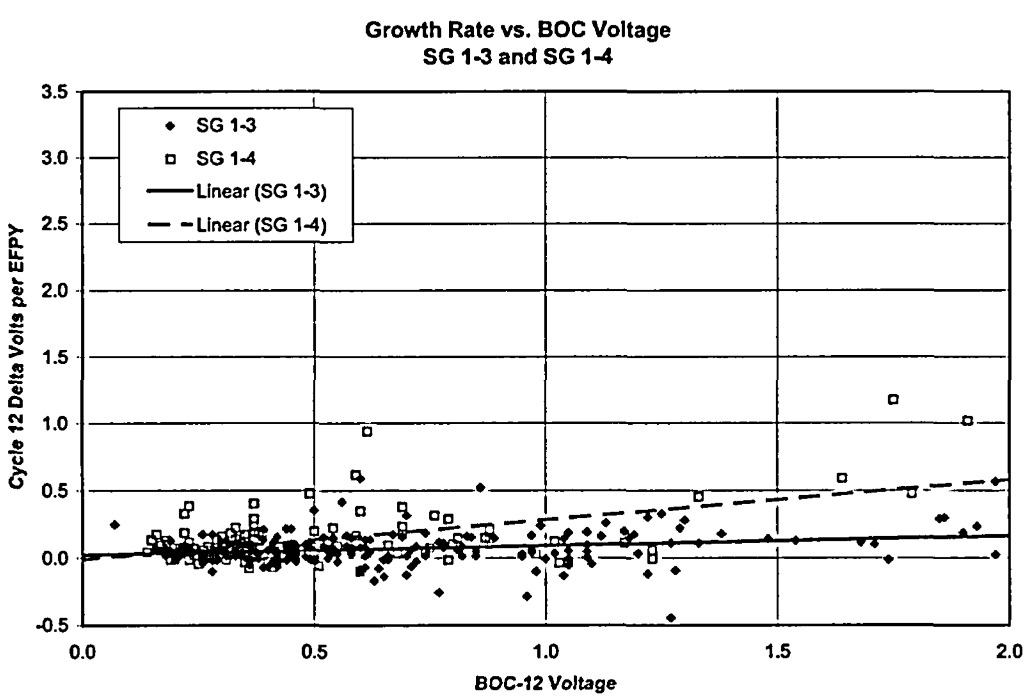


Figure 3-12: SG 1-1 Cycle 12 VDG Breakpoint Analysis Results

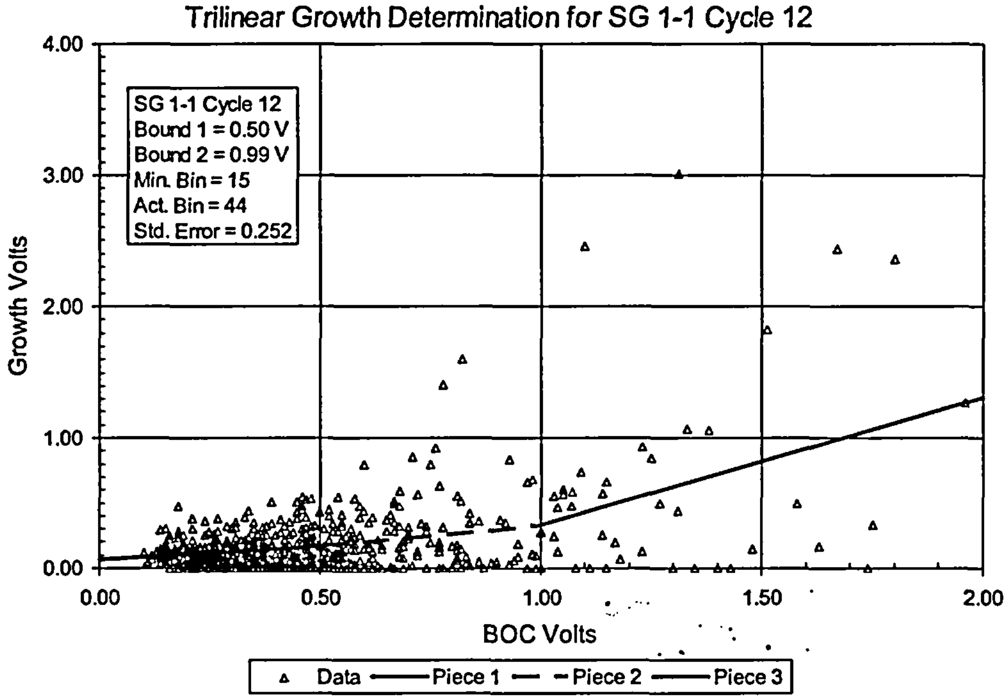


Figure 3-13: SG 1-2 Cycle 12 VDG Breakpoint Analysis Results

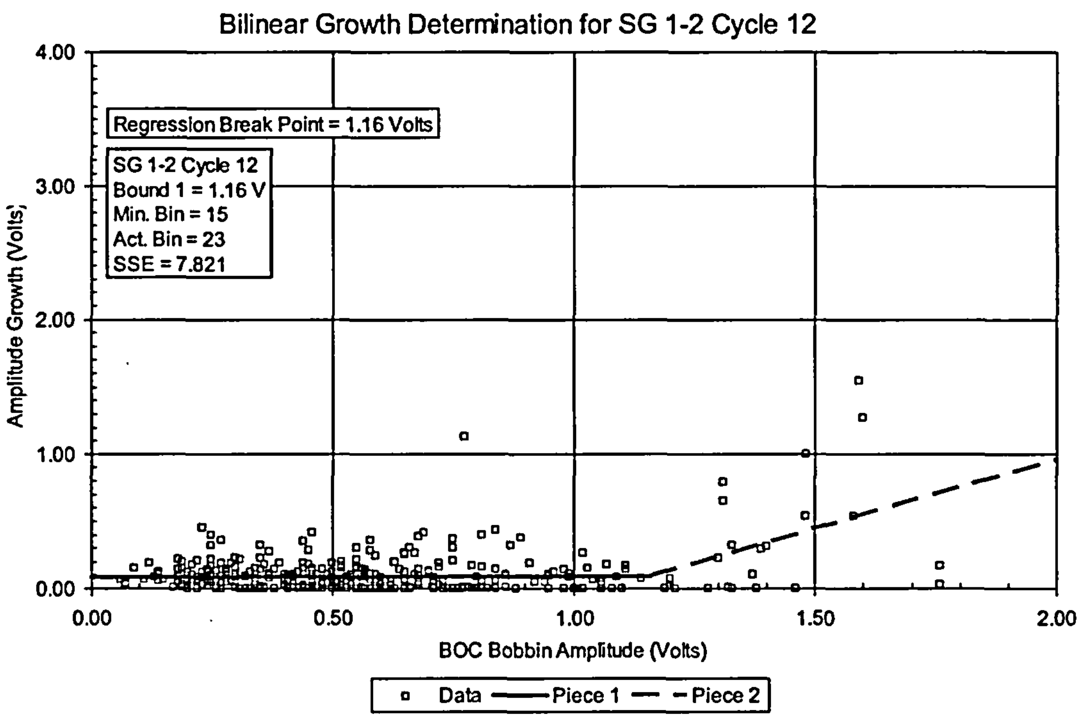


Figure 3-14: SG 1-3 Cycle 12 VDG Breakpoint Analysis Determination

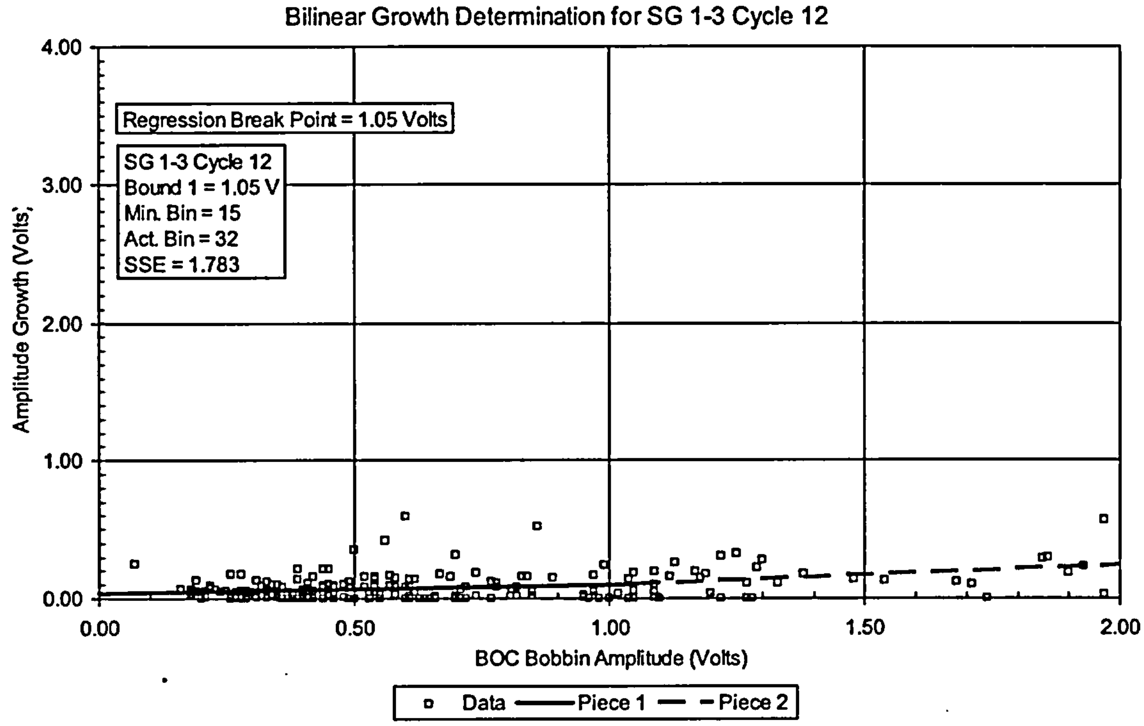


Figure 3-15: SG 1-4 Cycle 12 VDG Breakpoint Analysis Determination

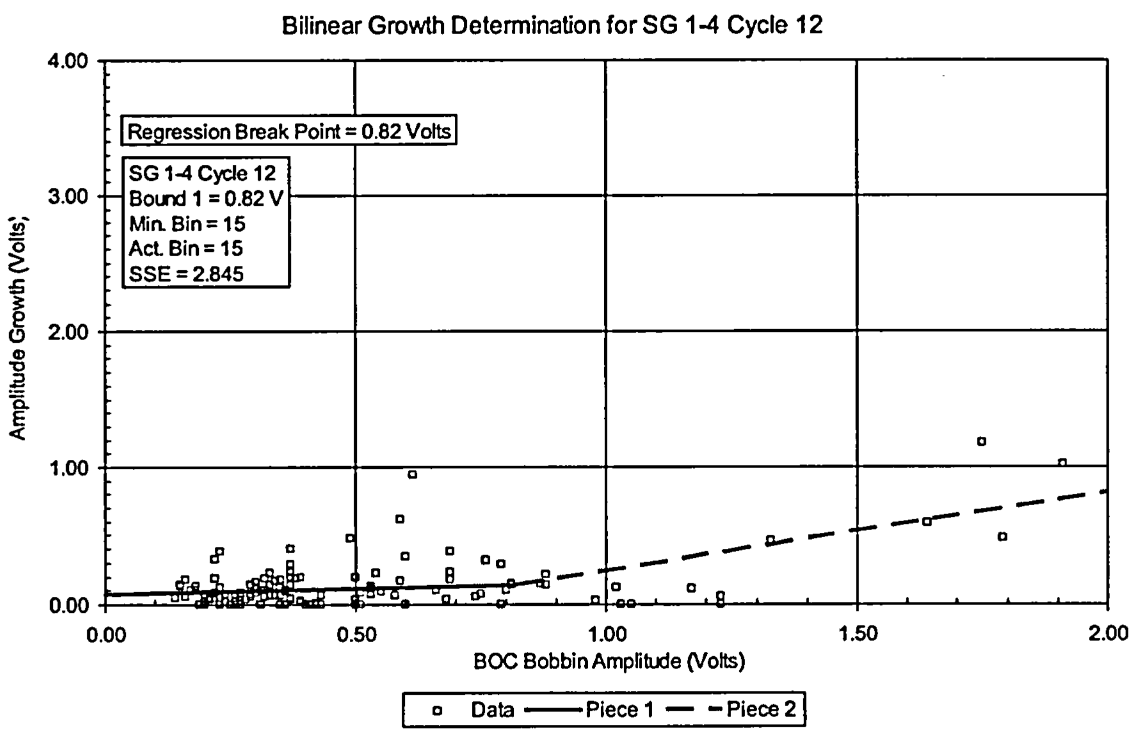


Figure 3-16: Cycle 12 VDG Breakpoint Analysis Determination – All SGs

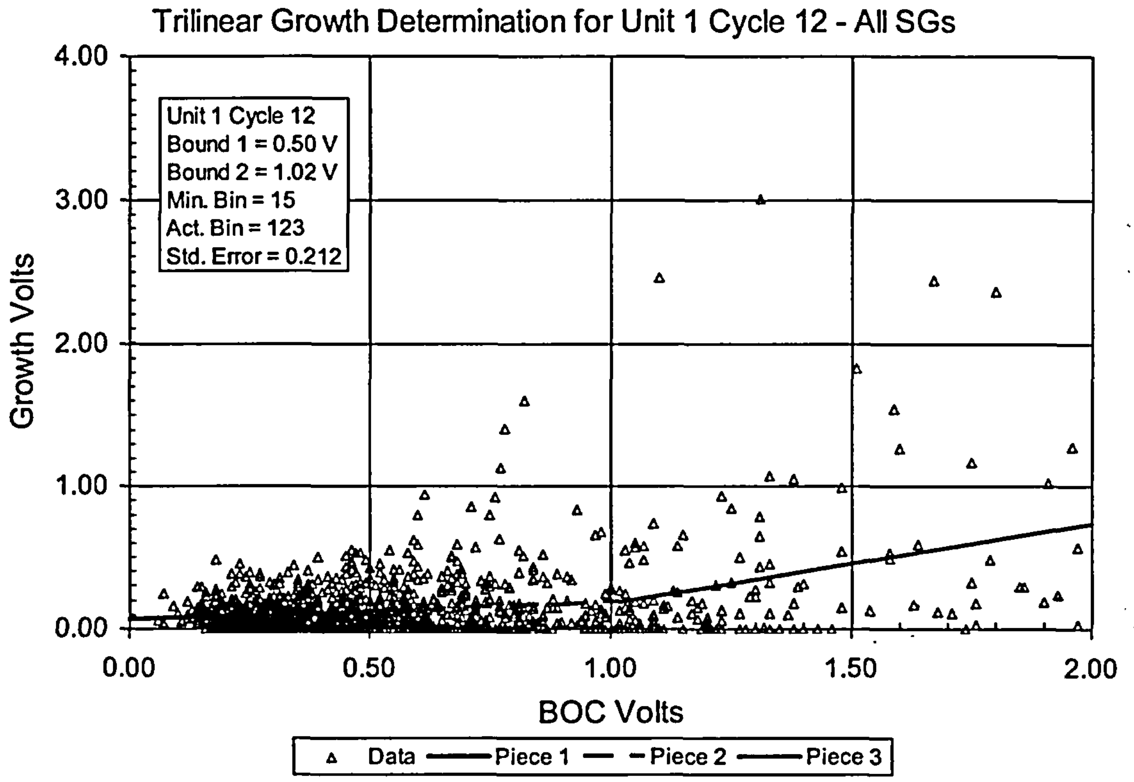


Figure 3-17: SG 1-1 Cycle 12 VDG Curves

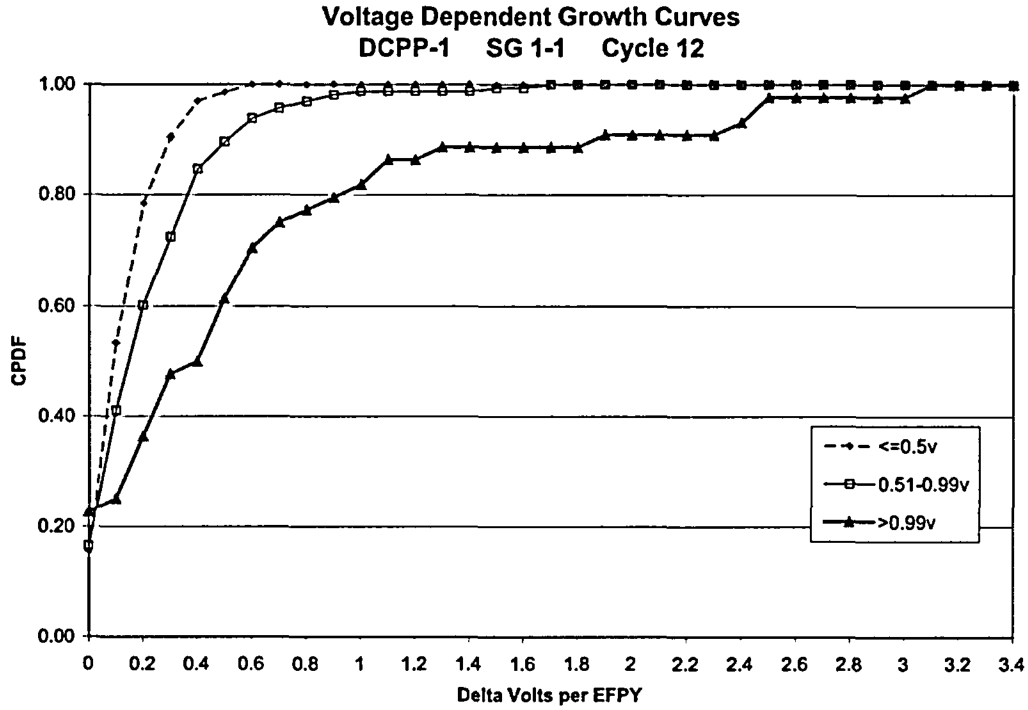


Figure 3-18: SG 1-2 Cycle 12 VDG Curves

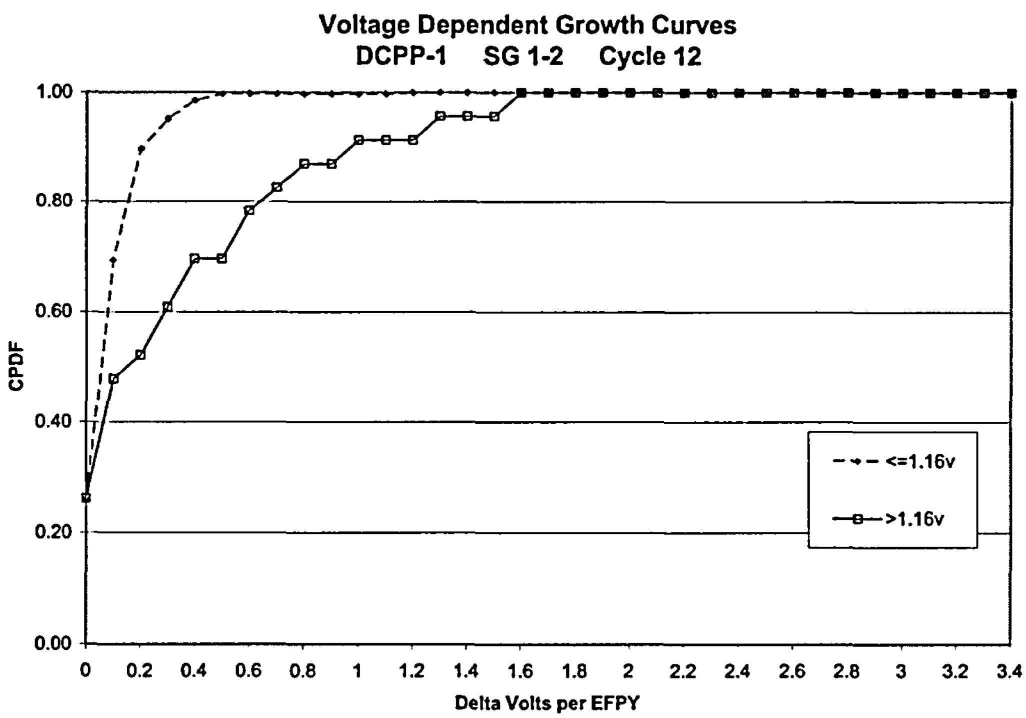


Figure 3-19: SG 1-3 Cycle 12 VDG Curves

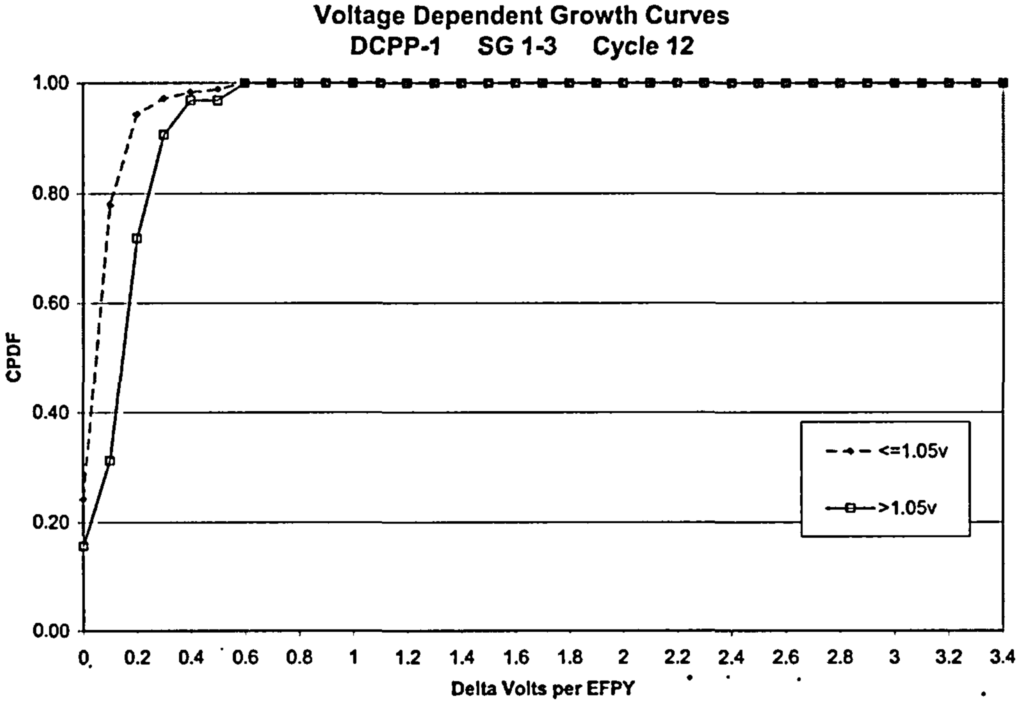


Figure 3-20: SG 1-4 Cycle 12 VDG Curves

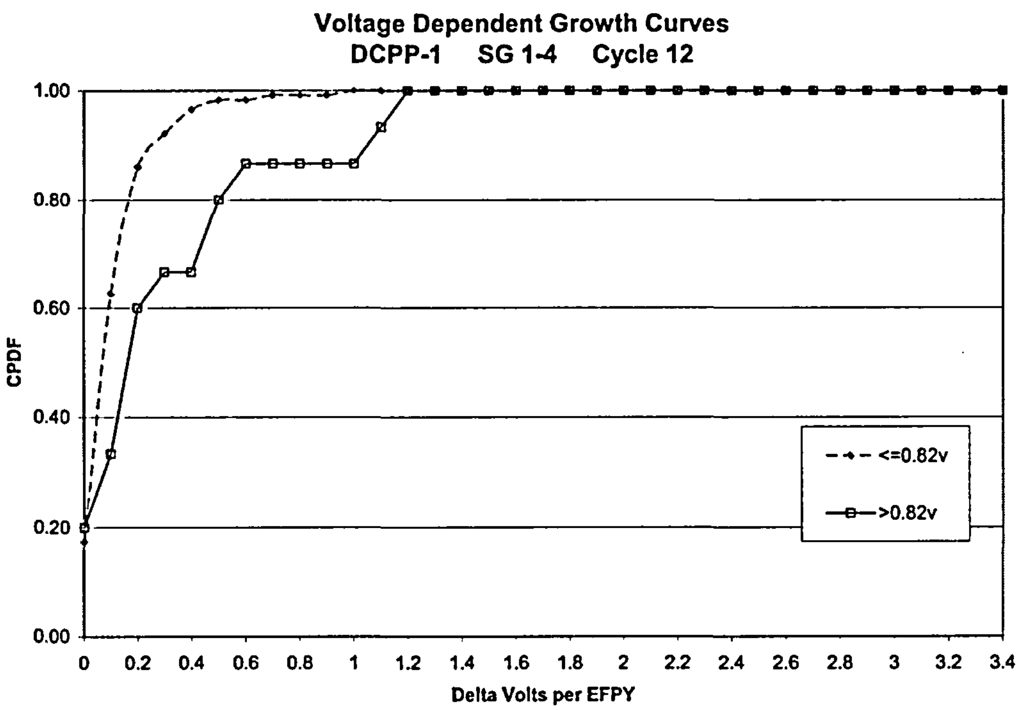


Figure 3-21: Cycle 12 VDG Curves for All SGs Combined

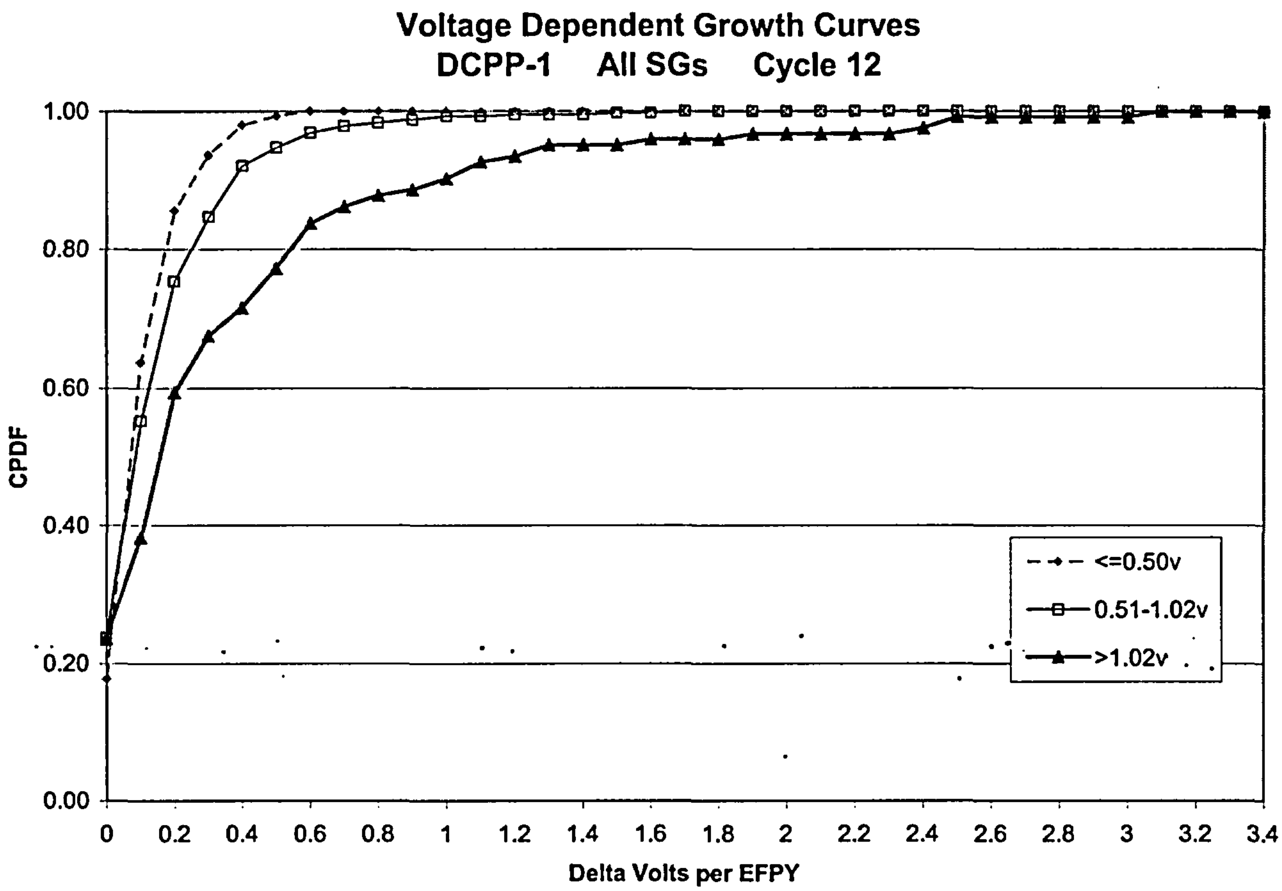


Figure 3-22: Historical Change in Growth and BOC Voltage All SGs

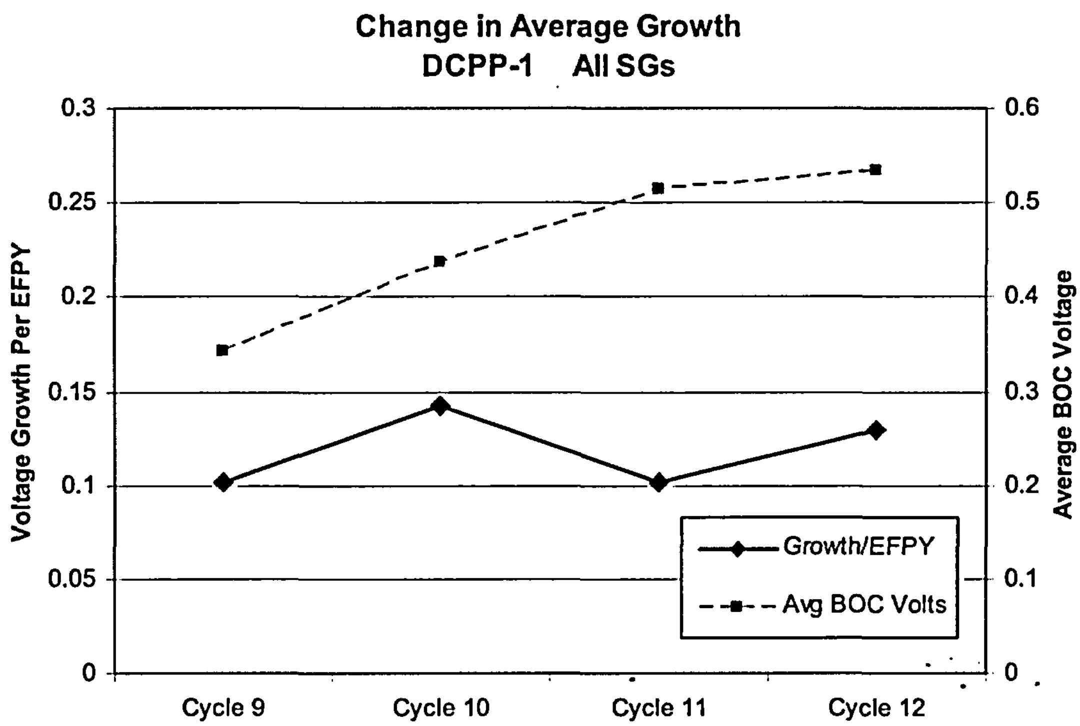


Figure 3-23: Cycle 12 vs. Cycle 11 SG Composite Growth Comparison

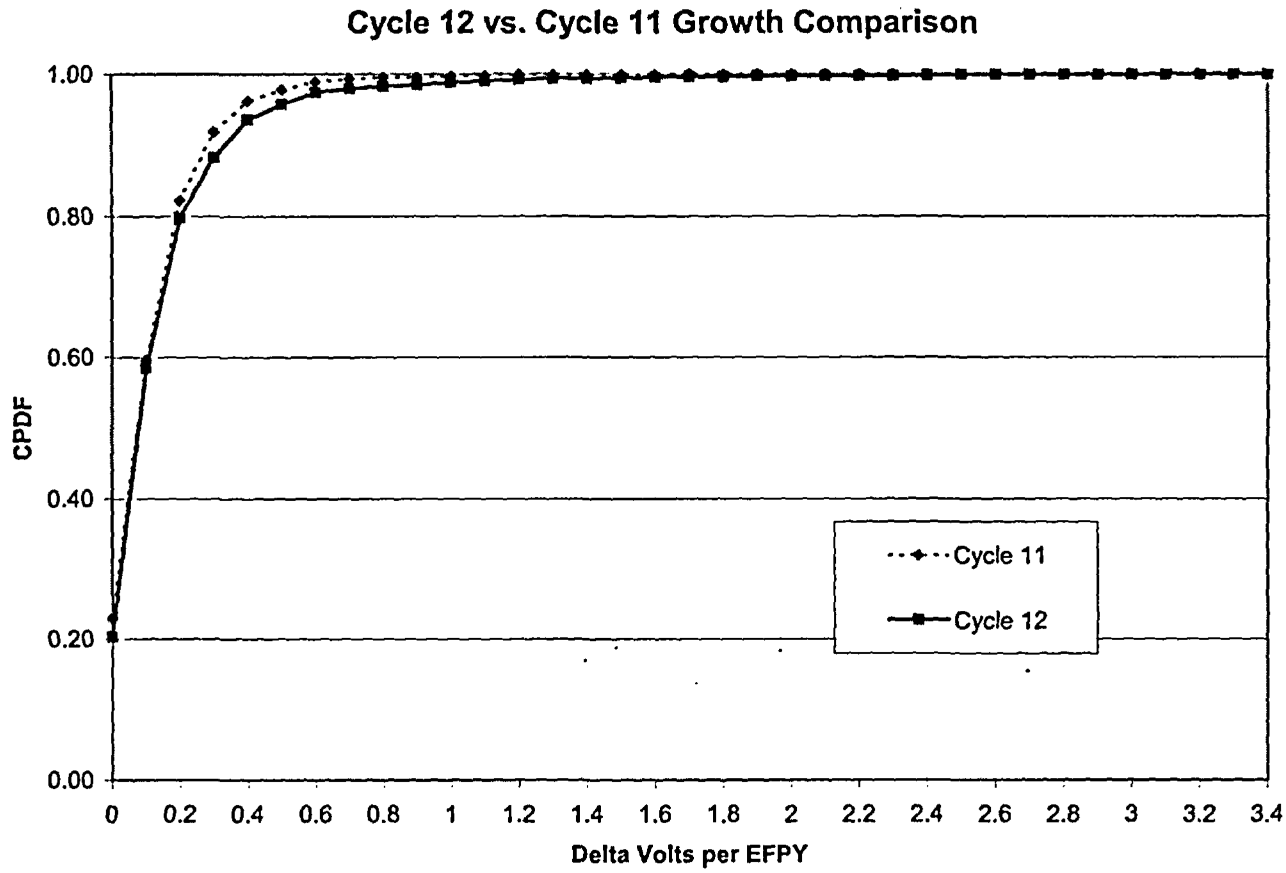


Figure 3-24: Cycle 12 Independent Growth Curves - All SGs

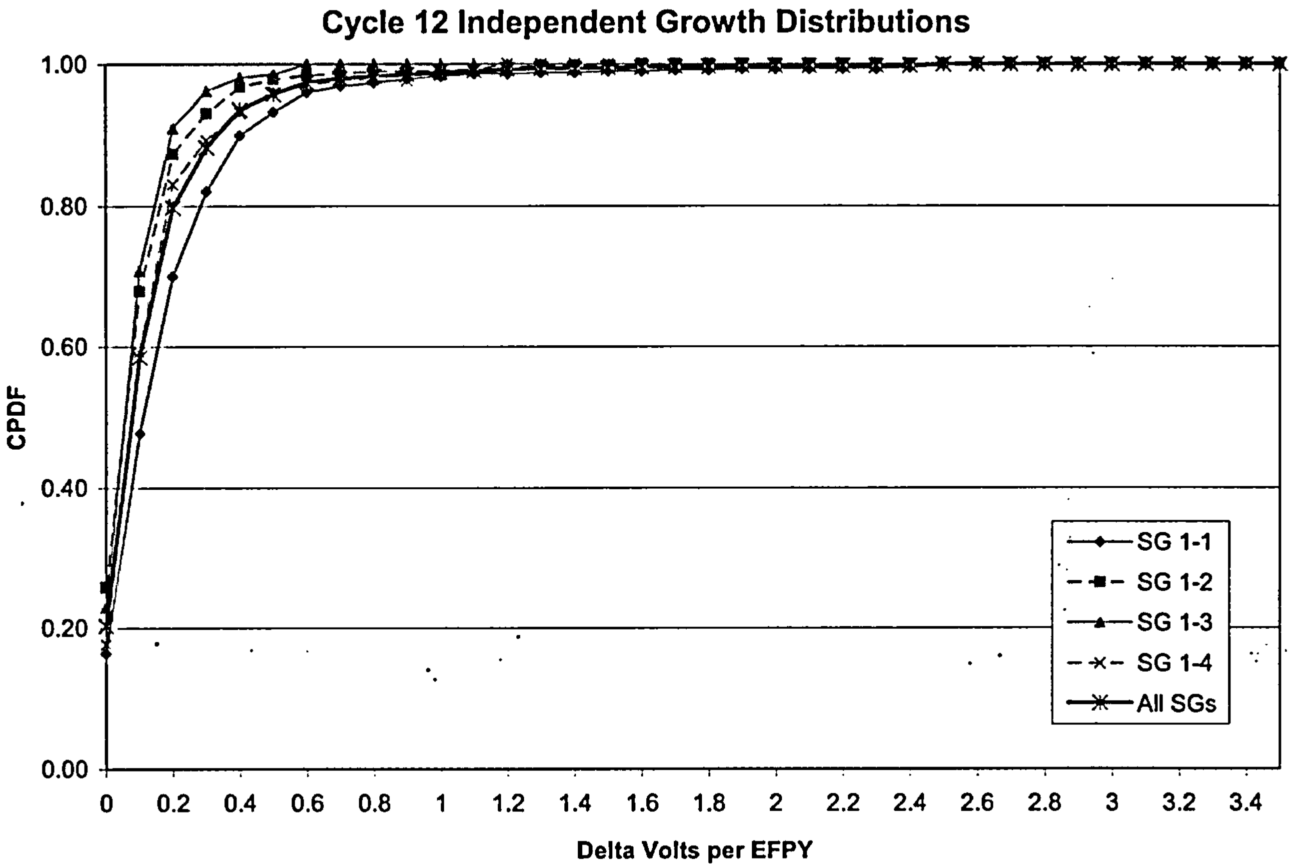


Figure 3-25: Cycle 11 vs Cycle 12 Growth Comparison SG 1-1

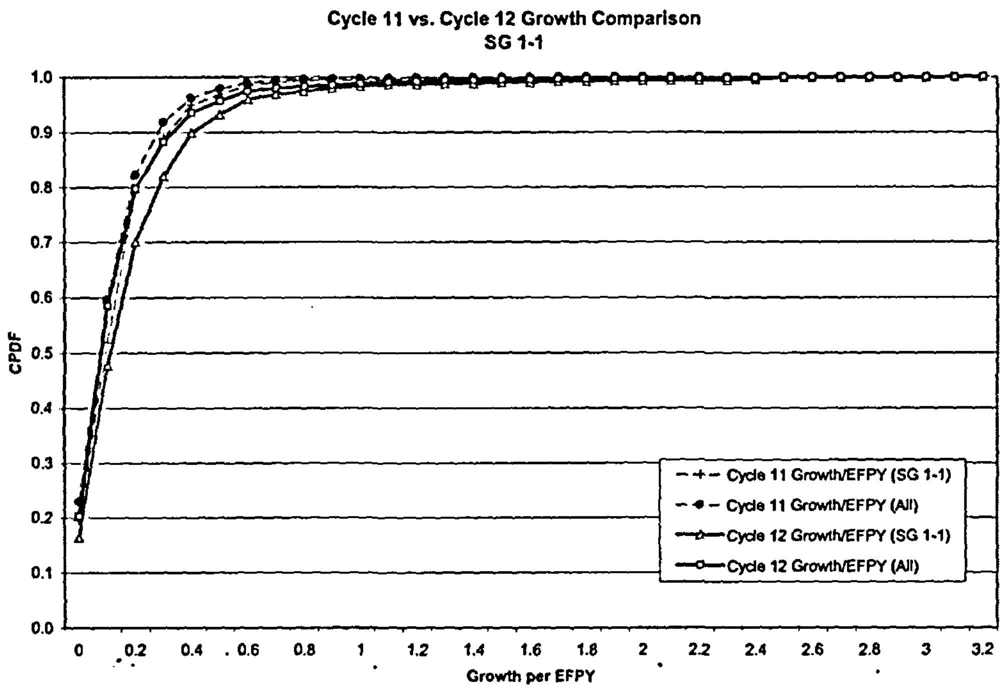


Figure 3-26: Cycle 11 vs Cycle 12 Growth Comparison SG 1-2

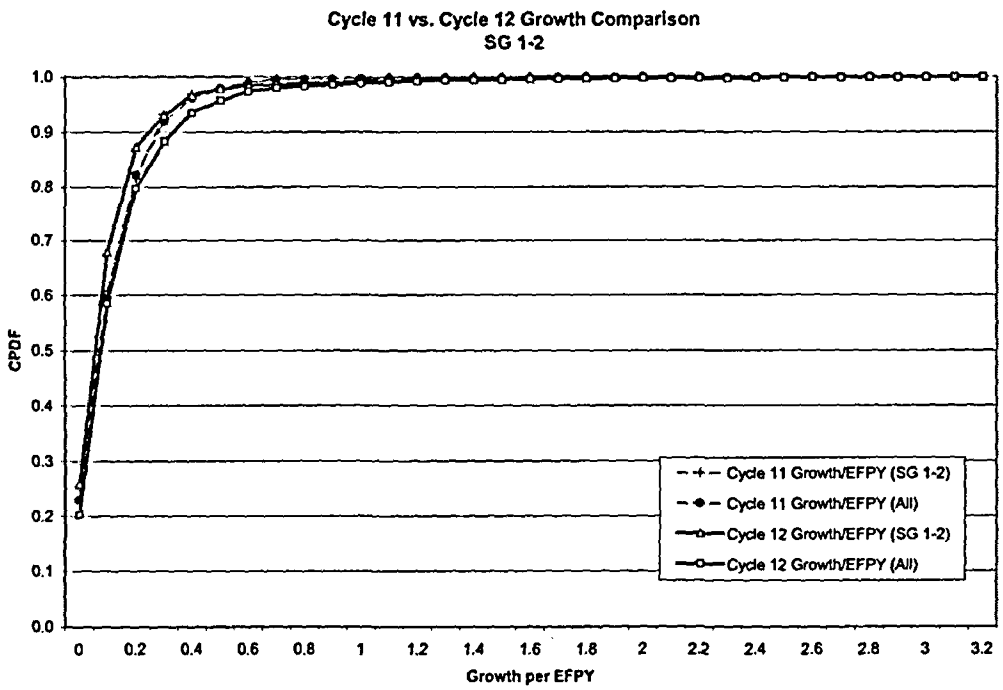


Figure 3-27: Cycle 11 vs Cycle 12 Growth Comparison SG 1-3

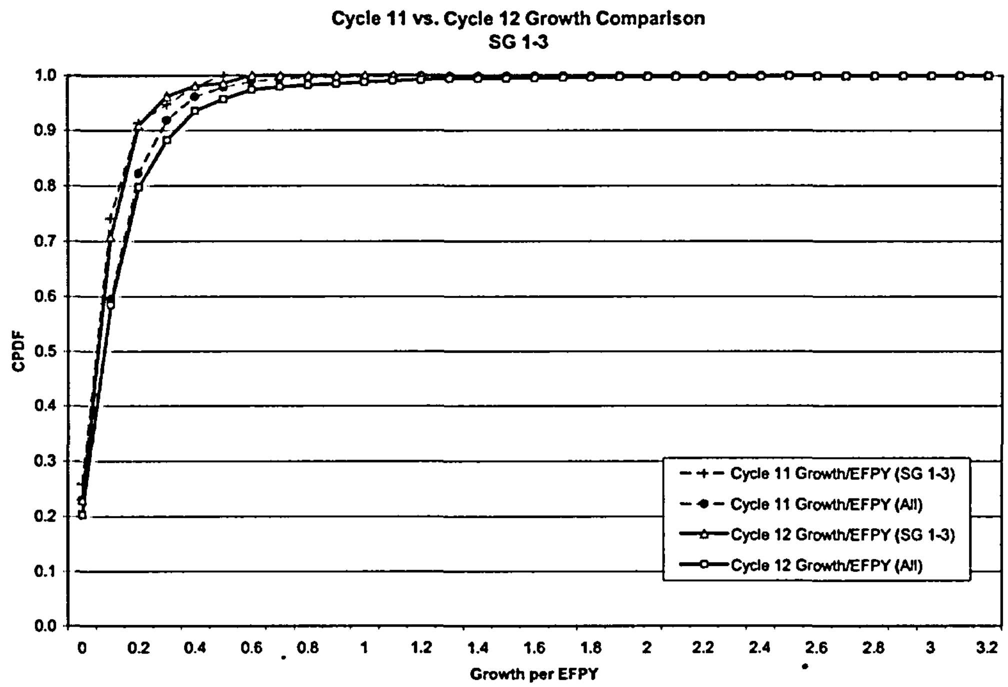


Figure 3-28: Cycle 11 vs Cycle 12 Growth Comparison SG 1-4

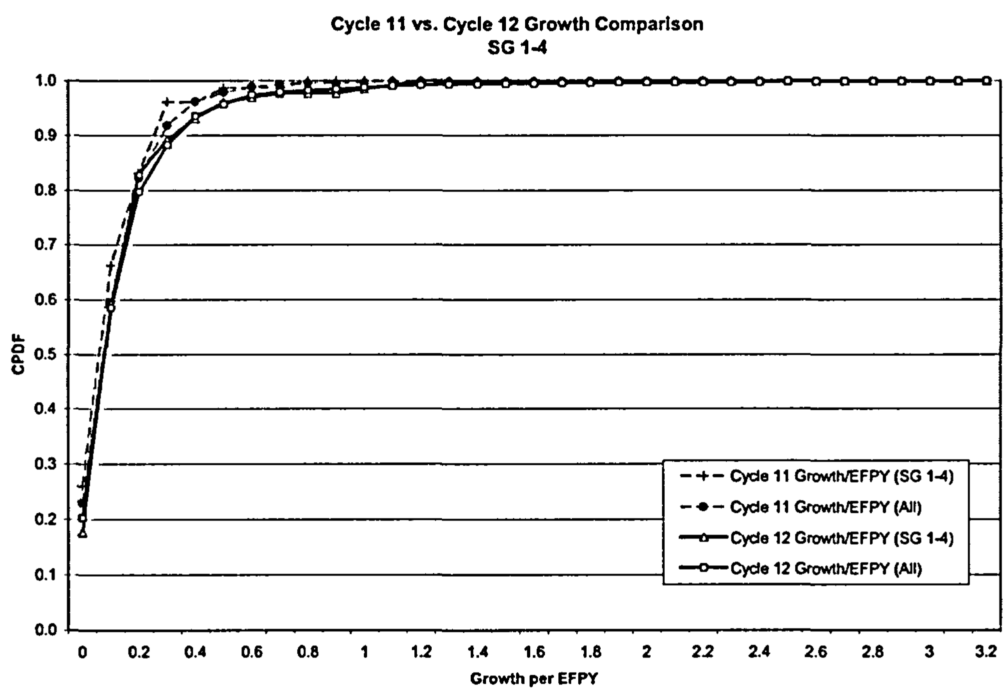


Figure 3-29: 1R12 Probe Wear Voltage Comparison

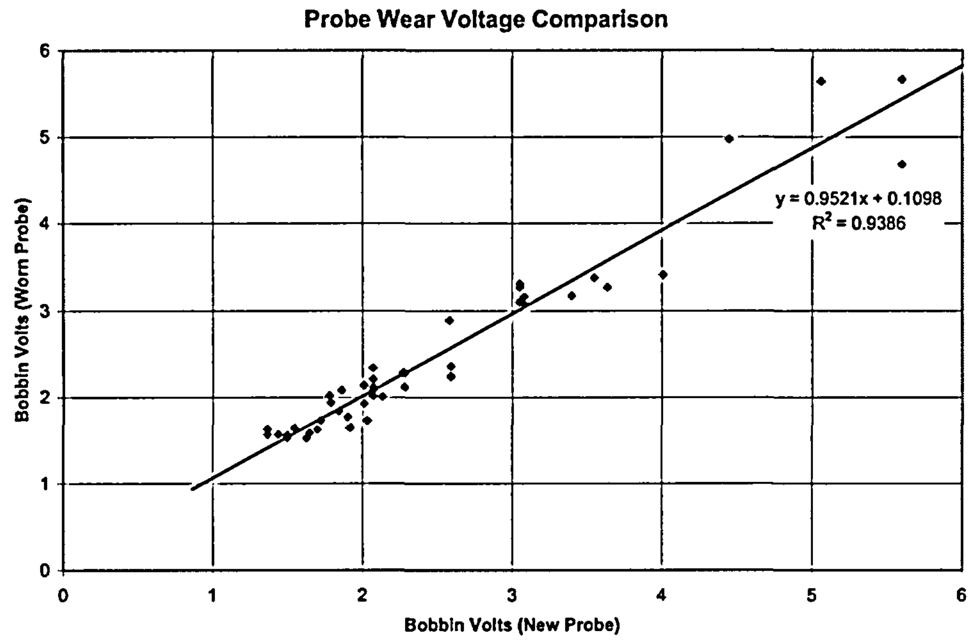
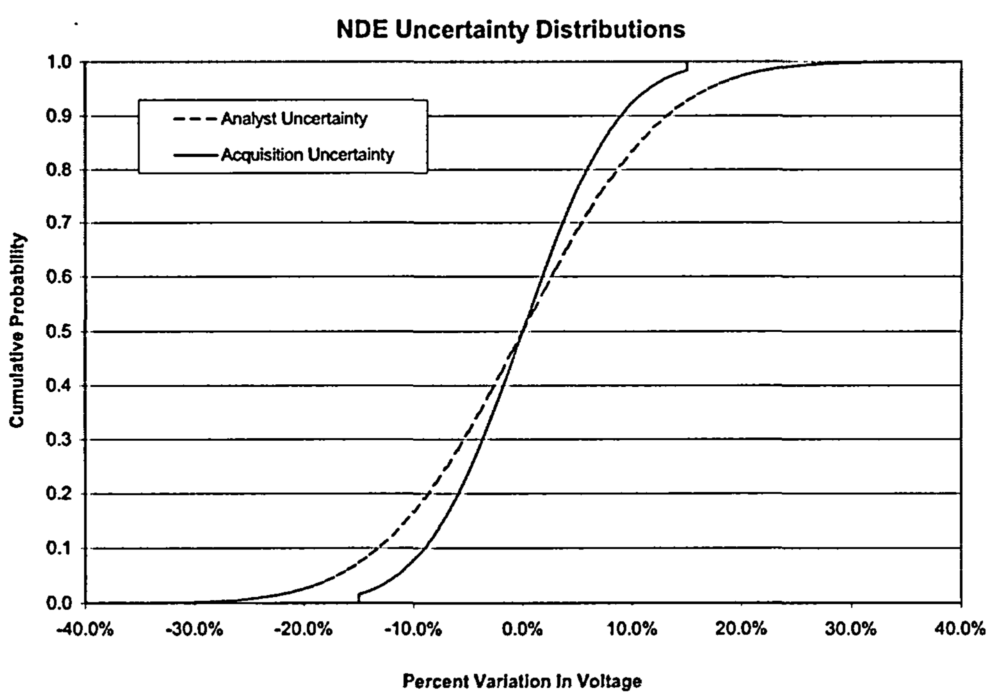


Figure 3-30: Bobbin Voltage Uncertainty Distributions

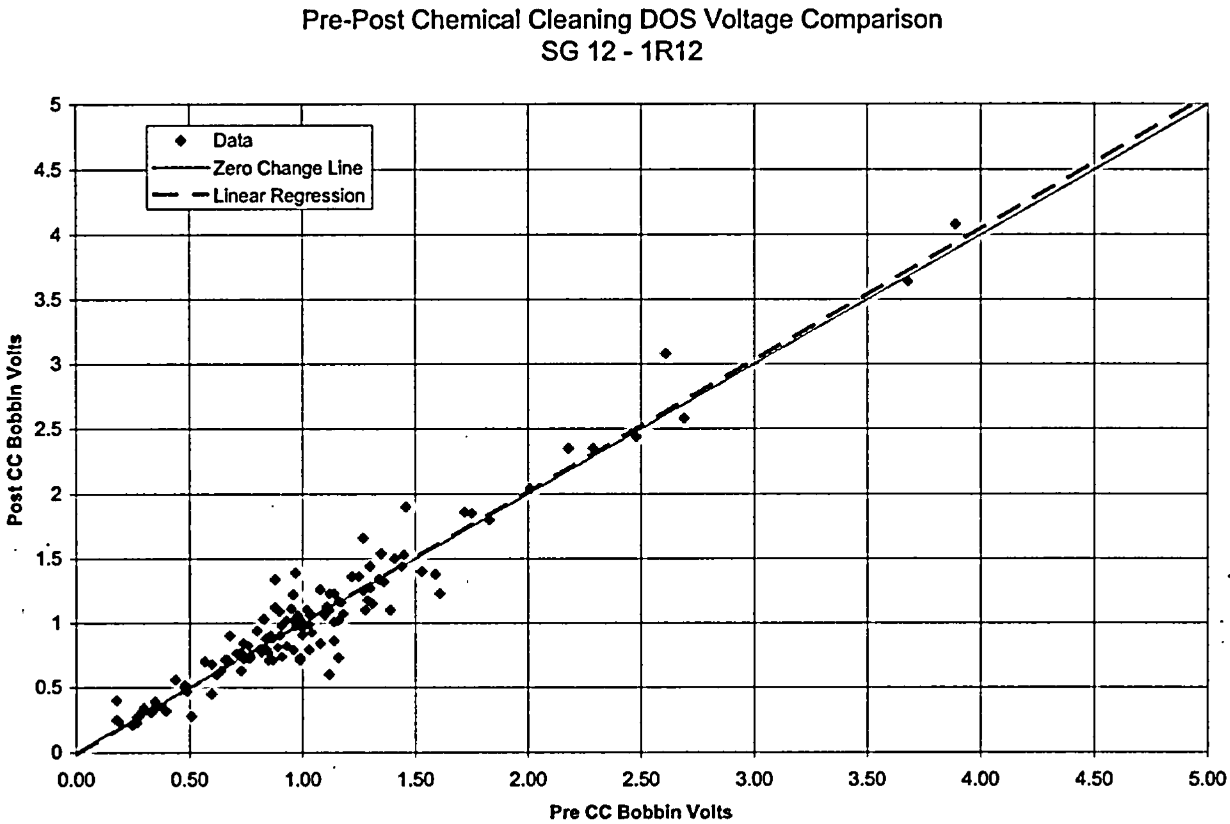


4.0 Chemical Cleaning

During 1R12, chemical cleaning (CC) was performed on all four steam generators. GL 95-05 requires that, if the SGs are chemically cleaned, the impact of CC on the BOC voltage distribution and on voltage growth rates shall be evaluated. The TSP crevice cleaning step was not performed, so PG&E's judgment was that the TSP ODSCC signals would not be affected by CC. This judgment was determined to be correct based on the following assessment.

The 1-3 and 1-4 SGs were ECT inspected prior to CC and the 1-1 and 1-2 SGs were ECT inspected after CC. However, 192 tubes in SG 1-2, containing the 100 largest known DOS voltages left in service in Cycle 12, were inspected with a bobbin coil both prior to the CC and after the CC to facilitate a comparison for the GL 95-05 voltage-based ARC. Additionally, 9 tubes in SG 1-2 were inspected with Plus-point at the top of tubesheet and selected TSP elevations where known flaws existed, both prior to CC and after CC. The bobbin coil results were compared for these 192 tubes in order to assess the impact of the chemical cleaning on the SGs that were inspected prior to cleaning and to assess any impact on growth rates. Figure 4-1 contains the results of the comparison for DOSs detected before and after CC. The results indicate a relatively small change between the voltages, with as many above the "no change" line as below. No indications had bobbin voltages increase from below the 2.0 volt repair limit to greater than 2.0 volts as a result of chemical cleaning. A regression line was fit to the data, and it lies on top of the no change line; again indicating no change between the voltages. Additionally, there were no DOS that were detected during the pre-CC inspection that were not detected in the post-CC data, or vice versa, again indicating no affect of the CC on the DOS population. There were no differences between the Plus point inspections as well. These conclusions of this study are consistent with the fact that the TSP crevices were not targeted for cleaning during the process, with only the edges of the plate area being cleaned. In summary, there is no need for adjustments in the populations or in the voltages of any of the DOS indications detected during 1R12 due to the fact that CC was performed.

Figure 4-1: Chemical Cleaning Effect on DOS Voltage



5.0 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 databases used for the evaluations in this report use the data from Reference 8 plus the results from the tubes pulled during the 2R11 outage at Diablo Canyon. During 2R11, a 21.5 volt indication was detected at a 2H intersection in SG 2-4. Due to the potential impact of this large indication on the databases, new correlation parameters were calculated in 2003 using the latest EPRI database plus the 2R11 pulled tube results. The 2R11 pulled tube results plus the updated ARC correlation parameters were included in the 2R11 90-Day Report (Ref. 27). Since the updated correlation parameters have already been provided to the NRC, these parameters were used again for the tube integrity evaluations provided in this report.

The correlation parameters presented in this section do not include the results from the tube that was removed during the 1R12 outage. A summary of the results from the 1R12 pulled tube are presented in Section 5.3. These results will be incorporated into the next addendum of the EPRI database and are expected to have a negligible impact on the ARC burst and leak rate correlations.

5.1 Conditional Probability of Burst

For the case of the burst pressure versus voltage correlation, the Addendum 5 database contained in Ref. 8, as modified by the addition of the DCPP pulled tubes meets all GL 95-05 requirements and was used in both the as-found calculations and the EOC-13 projections. The correlation parameters were taken from Reference 20 and are shown in Table 5-1.

Table 5-1: Burst Pressure vs. Bobbin Amplitude Correlation

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

Parameter	Addendum 5 + DCPP 2R11 Database
Intercept, a_0	7.48475
Slope, a_1	-2.39502
r^2	79.6 %
Std. Dev., σ_{Error}	0.88248
Mean Log(*V*)	0.306657
SS of Log(*V*)	51.4665
N (data pairs)	99
Structural Limit (2560 psi) (1)	7.54 V
Structural Limit (2405 psi) (1)	9.45 V
p Value for a_1 (2)	$1.4 \cdot 10^{-35}$
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 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.

5.2 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 5 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 Addendum 5 voltage dependent leak rate correlation is 2.3% which meets the 5% threshold for an acceptable correlation specified in Generic Letter 95-05. Additionally, when adding the DCPP-2 data to the database, the Addendum 5+ correlation is improved with the new p-value at 1.0%. FANP computer simulations included 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 20 and are shown in Tables 5-2 and 5-3.

Table 5-2: Probability of Leak Correlation

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

Parameter	Addendum 5 + DCPP 2R11 Database
Intercept, b_1	-5.0503
Slope, b_2	7.4342
V_{11} (1)	1.3299
V_{12}	-1.7253
V_{22}	2.6861
DoF (2)	115
Deviance	31.47
Pearson SD	0.594
MSE	0.274

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 5-3: Leak Rate vs. Bobbin Amplitude Correlation (2405 psi)

$Q = 10^{[b_3 + b_4 \log(Volts)]}$	
Parameter	Addendum 5 + DCPP 2R11 Database
Intercept, b_3	-0.664317
Slope, b_4	1.106101
Index of Deter., r^2	17.5%
Std. Error	0.772757
Mean of Log(*Q*)	0.55024
Std. Dev. of Log(*Q*)	0.83625
p Value for b_4	1.0%
Data Pairs, *N*	31
Mean of Log(*V*)	1.09805
SS of Log(*V*)	2.99300
Note: The number of significant figures reported simply corresponds to the output from the calculation code and does not represent true engineering significance.	

5.3 Summary of Destructive Examination Results 1R12 Pulled Tube

During 1R12, sections of one tube were removed from SG 1-1 (R20C54). This tube contained confirmed ODSCC indications at 1H that was selected to be leak and burst tested in order to be added to the Ref. 8 databases. Another section of this tube had a dent signal only (DNT) in the region of 2H (no degradation was detected with either bobbin or rotating coils during the in-generator eddy current testing). This section was also leak and burst tested.

The tube removed from DCPP-1 was sent to Lynchburg for destructive examination and laboratory testing. Room temperature leak rate tests were performed on the 1H region and 2H region of the tube with FANP in-situ pressure testing equipment. Room temperature testing was performed in accordance with EPRI Guidelines. The 1H region leaked slightly at SLB conditions. In order to evaluate ligament tearing at SLB conditions, the 1H leak test was terminated at SLB differential pressure, the crack faces were then oxidized, and then the test was resumed for room temperature burst testing. A freespan section was tensile tested to obtain material properties for the tube. Ref. 21 contains the detailed results of all tests performed on the samples.

Table 5-4 summarizes the results of the NDE performed on the area of interest in the pulled tube specimen.

Table 5-4: Bobbin and Plus Point Eddy Current Inspection Results Summary

Bobbin Data										
Tube Sample No.	Location in SG	Initial Exam			Post Tube Pull (Platform)			In Lab		
		Call	Volts	Phase	Call	Volts	Phase	Call	Volts	Phase
R20C54	01H + 0.13"	DOS	5.60	69	DOS	6.71	69	DOS	6.83	68
R20C54	02H + 0.11"	DNT	3.27	175	DNT	1.11	168	DNT	1.29	170
Plus Point Data (re-review following destructive exam – Reference 14)										
R20C54	1H + 0.04" 1H + 0.04" 1H + 0.11"	SAI#1 SAI #2 SAI #3	3.99 0.27 0.11	61 94 87	SAI#1 SAI#2 SAI#3	4.61 0.23 0.10	53 102 125	SAI/90% SAI/73% SAI/68%	4.48 0.20 0.13	54 79 85
R20C54	02H	NDD	N/A	N/A	SVI	0.18	112	SVI	0.15	110

The results of the room temperature leak and burst testing are listed in Table 5-5 below. Based on the evaluation of the leak and burst results, the pulled tube from 1R12 (R20C54 at 01H) was prototypical of those contained in the database and justify the continued use of the voltage-based ARC for DCPP Unit 1.

Table 5-5: Pulled Tube Burst and Leak Test Results

Tube Section	Bobbin Amplitude (Volts)	Yield + Ultimate (ksi)	Burst Pressure (ksi)	Approximate Leak Rate at SLB (2405 psi) (gpm)
R20C54 (freespan)	NDD	158.67	11.695	0
R20C54-1H	5.6	158.67	5.819	0.002
R20C54-2H	3.27 DNT	158.67	10.428	0

6.0 Benchmarking of EOC-12 Conditions

This section provides comparisons of the as-found EOC-12 voltages, POBs, and leak rates to the projected results using 0.6 POD and DCPP POPCD from 5 inspections.

Table 6-1 provides a comparison of the projected EOC-12 conditions using the constant POD of 0.6 to the as-found conditions. This table shows the voltage distributions as well as the POB and leak rate results. The projected EOC-12 results were not taken from the 1R11 90-Day Report (Ref. 7); rather, the SG 1-1 projections were based on results calculated in Case 4 of Table 3-5 of FANP Document 86-5039942-00 (Ref. 19) submitted to NRC in DCL-04-019 dated March 16, 2004. The SG 1-2, 1-3, and 1-4 projections were also recalculated based on enhanced growth distribution development guidelines described in Reference 25. The projection for SG 1-1 utilized a voltage dependent growth distribution that was supplemented with data from SG 2-4 Cycle 10. SGs 1-2, 1-3, and 1-4 used a composite Cycle 11 voltage dependent growth distribution. The results of these calculations are provided in Table 6-1. Figures 6-1 through 6-4 show the projected and as-found voltage distributions graphically. As expected, the 0.6 POD overestimates the number of indications greater than 1 volt. The POB and leak rate results were overpredicted in SGs 1-1, 1-2, and 1-3. In SG 1-4, the POB and leak rate were slightly underpredicted resulting from the very small underprediction in the number of >2 volt flaws (5.87 predicted versus 6 found).

For comparison purposes, the EOC-12 projections were recalculated using the POPCD methodology, including use of extreme growth, and were submitted in Table 4 of Reference 25. The results are also captured in Table 6-2 of this report. The POPCD included all DCPP Units 1 and 2 data through 2R11. The growth distributions used for the POPCD methodology were the same as that used for the 0.6 POD method, with the exception that the extreme growth method was added. As shown in Table 6-2, the POBs for SG 1-1 and SG 1-4 were slightly underestimated by 6.0×10^{-5} and 4.4×10^{-5}, respectively. However, these underpredictions don't meet the definition for a significant underprediction using POPCD as defined in Reference 26. The leak rate for SG 1-4 was also slightly underpredicted by 0.04 gpm. Again, this negligible underprediction does not meet the level of significance as defined in Reference 26. (Reference 26 defines a significant underprediction of the POB as 10% of the reporting threshold or an order of magnitude, and a significant underprediction of the leak rate is defined as 0.5 gpm or an order of magnitude.) Table 6-2 also shows that the total number of indications was overpredicted in all cases using the site-specific POPCD.

In conclusion, the projections using both the 0.6 POD and the DCPP POPCD correlation provided reasonable results relative to the as-found conditions. As discussed above, the cases that were underpredicted were only slightly underpredicted. Therefore, no adjustments to either of the methodologies are warranted at this time.

Table 6-1: As-found EOC-12 vs. Projected EOC-12 Conditions Using 0.6 POD

Voltage Bin	SG 1-1		SG 1-2		SG 1-3		SG 1-4	
	As-Found	Projected	As-Found	Projected	As-Found	Projected	As-Found	Projected
0.1	2	0.13	0	0.26	0	0.05	0	0.11
0.2	16	3.83	10	3.29	3	1.15	5	2.17
0.3	73	16.62	30	9.49	23	4.45	15	5.27
0.4	115	35.46	54	22.28	30	10.62	23	11.35
0.5	78	60.93	71	45.33	36	19.6	43	18.21
0.6	74	83.6	73	71.07	24	28.09	19	23.4
0.7	64	82.22	45	76.37	24	28.76	15	22.92
0.8	35	72.72	48	68.37	12	25.08	9	18.56
0.9	36	56.69	26	56.73	10	20.77	11	14.54
1	42	44.78	16	45.19	12	17.3	7	10.68
1.1	20	36.54	17	34.86	11	14.56	5	7.82
1.2	18	33.31	12	29.05	4	13.21	3	6.26
1.3	16	28.69	8	24.09	6	11.91	8	5.04
1.4	7	22.29	9	19.64	4	10.31	2	4
1.5	16	17.81	3	15.88	4	8.64	0	3.14
1.6	2	14.49	2	12.73	3	7.19	1	2.53
1.7	4	11.44	1	10.09	3	6.04	0	2.12
1.8	3	8.72	2	7.8	6	5.14	0	1.82
1.9	3	6.58	3	5.98	2	4.4	0	1.57
2	2	4.84	0	4.39	0	3.73	0	1.31
2.1	9	3.78	1	3.26	1	3.11	1	1.09
2.2	0	3.34	0	2.56	1	2.6	1	0.92
2.3	5	2.71	0	2.05	0	2.13	0	0.78
2.4	1	2.2	2	1.68	3	1.72	0	0.66
2.5	0	2.18	1	1.42	0	1.37	0	0.55
2.6	0	1.9	2	1.13	0	1.06	2	0.44
2.7	1	1.45	0	0.84	0	0.79	0	0.33
2.8	1	1.12	0	0.63	0	0.59	0	0.24
2.9	0	0.96	0	0.47	1	0.44	0	0.18
3	0	0.89	0	0.36	0	0.32	0	0.13
3.5	4	5.10	1	1.43	0	0.81	0	0.40
4	0	3.33	1	0.49	0	0.29	2	0.12
4.5	2	2.77	1	0.11	0	0.07	0	0.02
5	0	1.19	0	0.02	0	0.03	0	0.01
5.5	1	1.10	0	0.01	0	0.00	0	0.00
6	2	1.87	0	0.00	0	0.00	0	0.00
6.5	1	1.40	0	0.00	0	0.00	0	0.00
7	0	0.00	0	0.00	0	0.00	0	0.00
>7	0	0.00	0	0.00	0	0.00	0	0.00
Total	653	679.00	439	579.33	223	256.33	172	168.66
<=1	535	456.98	373	398.38	174	155.87	147	127.21
>1	118	222.01	66	180.96	49	100.47	25	41.48
>2	27	37.30	9	16.45	6	15.34	6	5.87
>5	4	4.38	0	0.01	0	0.00	0	0.00
POB	1.43E-03	1.88E-03	2.14E-04	2.23E-04	7.45E-05	1.44E-04	1.41E-04	8.37E-05
Leak Rate	0.96	1.47	0.31	0.54	0.16	0.34	0.15	0.14

Table 6-2: As-found EOC-12 vs. Projected EOC-12 Conditions Using DCPP POPCD and Extreme Growth Method

Voltage Bin	SG 1-1		SG 1-2		SG 1-3		SG 1-4	
	As-Found	Projected	As-Found	Projected	As-Found	Projected	As-Found	Projected
0.1	2	0.81	0	16.05	0	0.28	0	0.64
0.2	16	17.99	10	32.63	3	5.72	5	12.07
0.3	73	48.02	30	55.64	23	13.65	15	20.02
0.4	115	82.49	54	75.51	30	25.30	23	33.70
0.5	78	119.51	71	89.89	36	36.22	43	39.91
0.6	74	135.33	73	105.90	24	41.24	19	37.80
0.7	64	116.40	45	97.37	24	37.66	15	33.65
0.8	35	91.58	48	77.87	12	29.41	9	23.04
0.9	36	63.54	26	58.79	10	21.76	11	16.28
1	42	45.79	16	43.22	12	16.32	7	10.82
1.1	20	34.61	17	31.11	11	12.53	5	7.27
1.2	18	30.19	12	24.78	4	10.76	3	5.59
1.3	16	24.99	8	19.78	6	9.34	8	4.27
1.4	7	18.36	9	15.60	4	7.82	2	3.28
1.5	16	14.16	3	12.27	4	6.40	0	2.47
1.6	2	11.25	2	9.60	3	5.21	1	1.94
1.7	4	8.69	1	7.46	3	4.31	0	1.57
1.8	3	6.50	2	5.66	6	3.59	0	1.31
1.9	3	4.83	3	4.23	2	3.02	0	1.10
2	2	3.43	0	2.98	0	2.51	0	0.89
2.1	9	2.64	1	2.11	1	2.06	1	0.71
2.2	0	2.38	0	1.62	1	1.70	1	0.60
2.3	5	1.89	0	1.26	0	1.38	0	0.50
2.4	1	1.50	2	1.01	3	1.10	0	0.41
2.5	0	1.55	1	0.84	0	0.87	0	0.34
2.6	0	1.35	2	0.63	0	0.66	2	0.26
2.7	1	0.97	0	0.42	0	0.49	0	0.18
2.8	1	0.70	0	0.27	0	0.35	0	0.13
2.9	0	0.57	0	0.18	1	0.26	0	0.09
3	0	0.52	0	0.12	0	0.18	0	0.06
3.5	4	3.42	1	0.77	0	0.51	0	0.23
4	0	2.02	1	0.26	0	0.19	2	0.07
4.5	2	1.63	1	0.05	0	0.05	0	0.01
5	0	0.66	0	0.01	0	0.02	0	0.01
5.5	1	0.60	0	0.00	0	0.00	0	0.00
6	2	1.15	0	0.00	0	0.00	0	0.00
6.5	1	0.60	0	0.00	0	0.00	0	0.00
7	0	0.10	0	0.00	0	0.00	0	0.00
>7	0	0.03	0	0.02	0	0.01	0	0.01
Total	653	902.73	439	795.91	223	302.85	172	261.19
<=1	535	721.45	373	652.87	174	227.56	147	227.92
>1	118	181.28	66	143.05	49	75.29	25	33.27
>2	27	24.28	9	9.57	6	9.82	6	3.59
>5	4	2.48	0	0.02	0	0.01	0	0.01
POB	1.43E-03	1.37E-03	2.14E-04	2.96E-04	7.45E-05	2.04E-04	1.41E-04	9.73E-05
Leak Rate	0.96	1.03	0.31	0.41	0.16	0.25	0.15	0.11

Figure 6-1: As-found SG 1-1 vs Projected Voltage Distributions from 1R11 revised OA (0.6 POD)

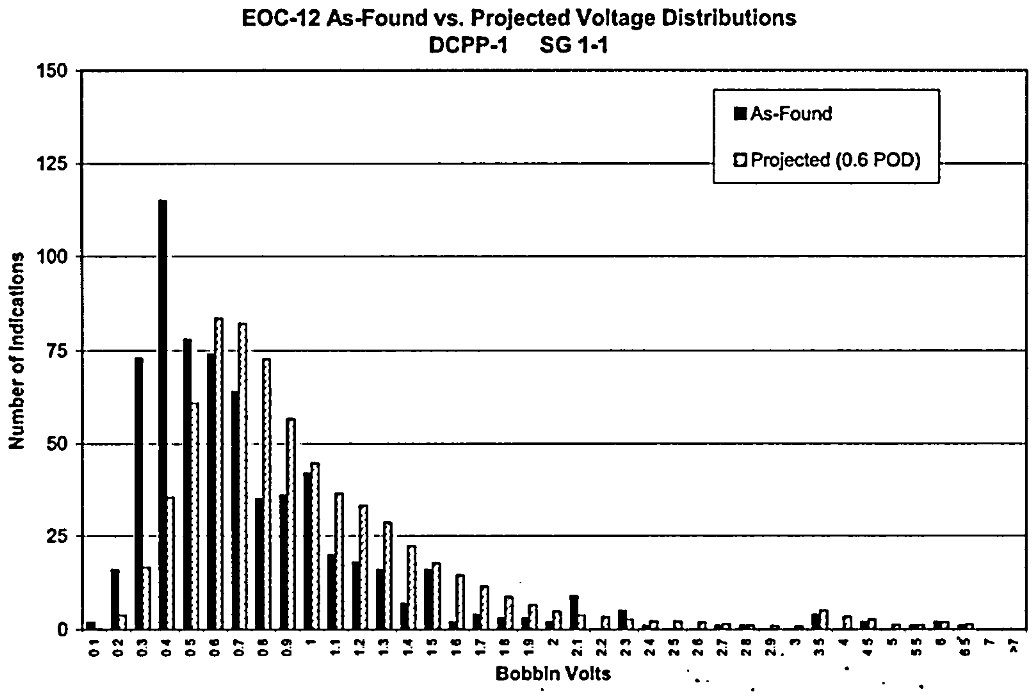


Figure 6-2: As-found SG 1-2 vs Projected Voltage Distributions from 1R11 revised OA (0.6 POD)

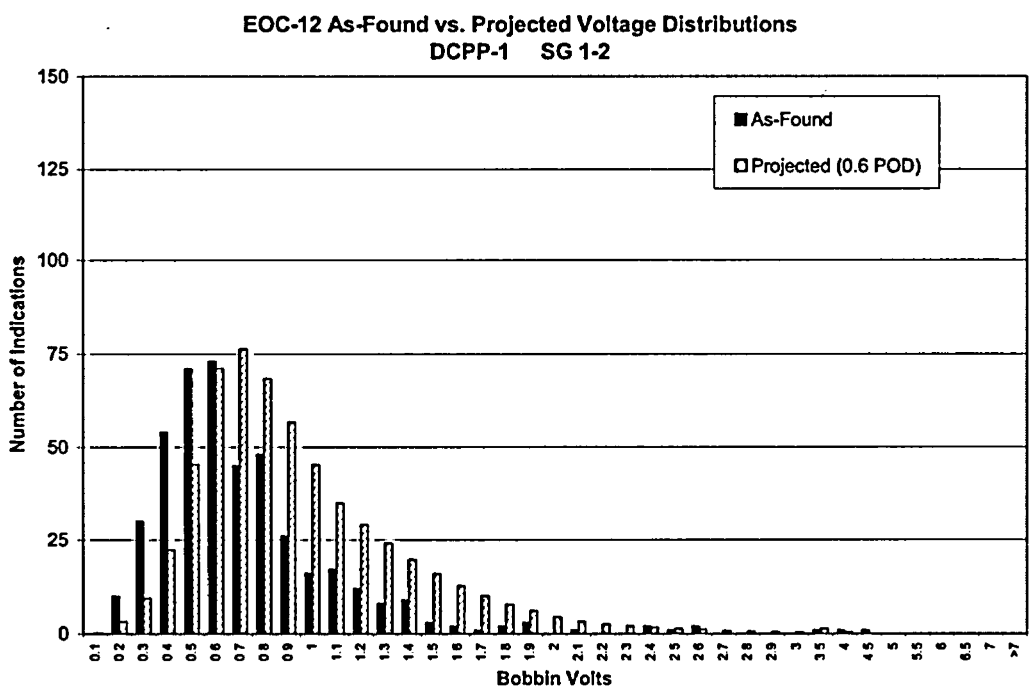


Figure 6-3: As-found SG 1-3 vs Projected Voltage Distributions from 1R11 revised OA (0.6 POD)

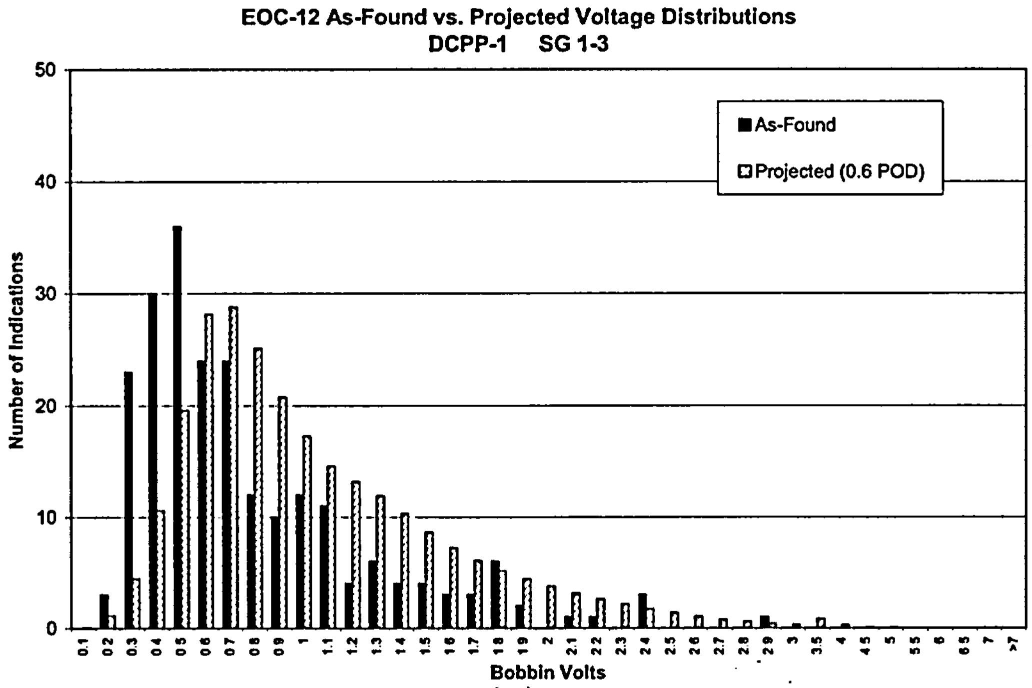
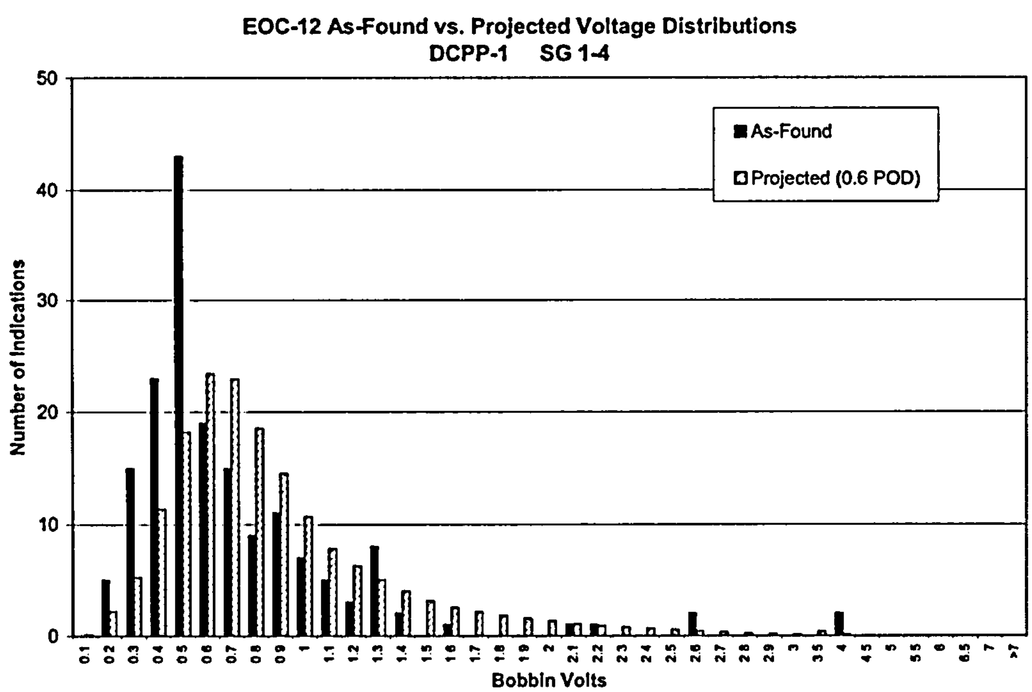


Figure 6-4: As-found SG 1-4 vs Projected Voltage Distributions from 1R11 revised OA (0.6 POD)



7.0 EOC-13 Projections for Probability of Burst and Leak Rate

This section provides the results of the EOC-13 POB and leak rate projections. FANP uses Monte Carlo codes, as described in Refs. 4 and 5, to provide the burst and leak rate analysis simulations. These evaluations are based on the methods in Ref. 6 (for burst) and the new slope sampling method for calculating the leak rate as defined in Section 9 of Ref. 8.

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-13 POB and Leak Rate Projections

Input Description	Section or Table Reference	Comments
BOC Voltage Distribution	Table 3-3	
Repaired Voltage Distribution	Table 3-3	
NDE Uncertainties	Section 3.5; Table 3-17	
POD	Section 7.1	0.6 POD from GL 95-05
Growth	Section 3.2; Table 3-12	
Cycle Length	Section 7.1	1.36 EFPY
Tube Integrity Correlations	Tables 5-1 through 5-3	Addendum 5 plus 2R11 tube pull
Material Properties	Section 7.1	

POD

As discussed previously, PG&E currently has a submittal under NRC review to allow the use of a voltage dependent probability of prior cycle detection (POPCD). Since this review has not been completed, the results in this section will use the constant POD of 0.6 as specified in GL 95-05. The probability of detection is used to account for the detection capability of the bobbin coil. The Monte Carlo codes calculate an assumed number of indications being returned to service at BOC-13 based on the following formula.

$$N_{BOC13} = \frac{N_{EOC12}}{POD} - N_{repaired}$$

where:

N_{BOC13}	=	Number of bobbin indications being returned to service for the next operating cycle
N_{EOC12}	=	Number of bobbin indications reported in the current inspection
POD	=	Probability of Detection
$N_{repaired}$	=	Number of bobbin indications repaired after the last cycle

Material Properties

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-13 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.

Cycle Length

The estimated cycle length for Unit 1 Cycle 13 is 1.36 EFPY. This value was used in all projections for EOC-13 conditions.

7.2 *Projected EOC-13 Voltage Distributions*

The EOC-13 voltage distributions are obtained by applying a Monte Carlo sampling process to the BOC-13 voltages. This process randomly assigns NDE uncertainty values and a growth value to each of the BOC-13 indications. The EOC-13 voltage distributions are then used to calculate a leak rate and probability of tube burst. Section 3.2 provides information on the growth distributions that were used in the analyses. Table 7-2 and Figures 7-1 through 7-4 provide the projected EOC-13 voltage distributions.

Table 7-2: Projected EOC-13 Voltage Distributions (0.6 POD)

Voltage Bin	EOC -13 Projected Distributions with 0.6 POD VDG			
	SG11	SG12	SG13	SG14
<=0.1	0.35	0.10	0.03	0.05
0.2	3.50	2.35	0.96	1.19
0.3	16.48	11.01	5.71	5.54
0.4	47.65	28.54	17.04	14.32
0.5	86.44	54.34	29.03	25.68
0.6	112.58	78.15	38.46	36.44
0.7	112.72	83.28	37.34	35.08
0.8	98.47	78.05	32.64	28.97
0.9	82.97	68.75	27.48	22.61
1	68.33	56.96	22.43	18.10
1.1	58.68	45.51	17.94	14.54
1.2	49.90	34.68	14.24	11.27
1.3	39.95	26.23	11.22	8.62
1.4	31.88	20.40	9.11	6.81
1.5	25.45	16.87	7.99	5.83
1.6	19.82	14.38	7.33	5.12
1.7	15.85	12.13	6.66	4.42
1.8	14.36	10.28	6.08	3.76
1.9	12.89	8.47	5.54	3.01
2	11.05	7.03	5.11	2.33
2.1	9.78	6.03	4.76	1.89
2.2	9.41	5.31	4.38	1.65
2.3	9.46	4.48	3.84	1.43
2.4	9.33	3.67	3.23	1.18
2.5	8.85	3.00	2.70	0.96
2.6	8.31	2.61	2.33	0.83
2.7	7.50	2.31	2.04	0.74
2.8	6.70	2.08	1.79	0.68
2.9	6.43	1.97	1.59	0.66
3	5.94	1.77	1.39	0.61
3.1	5.16	1.54	1.19	0.54
3.2	4.45	1.27	0.99	0.47
3.3	3.78	1.00	0.81	0.38
3.4	3.06	0.80	0.67	0.30
3.5	2.39	0.67	0.57	0.26
3.6	1.85	0.58	0.48	0.23
3.7	1.44	0.53	0.42	0.23
3.8	1.13	0.50	0.37	0.22
3.9	0.98	0.45	0.31	0.21
4	1.03	0.38	0.25	0.19
4.1	1.12	0.31	0.20	0.17
4.2	1.09	0.26	0.16	0.14
4.3	0.96	0.21	0.13	0.12
4.4	0.80	0.19	0.11	0.11
4.5	0.65	0.21	0.11	0.11
4.6	0.64	0.30	0.16	0.13
4.7	0.90	0.42	0.21	0.17
4.8	1.43	0.48	0.24	0.20
4.9	1.90	0.44	0.22	0.20
5	2.00	0.36	0.20	0.16
5.1	1.80	0.27	0.17	0.12
5.2	1.50	0.21	0.15	0.08
5.3	1.18	0.19	0.16	0.06
5.4	0.92	0.21	0.17	0.07
5.5	0.77	0.22	0.16	0.08
5.6	0.81	0.20	0.14	0.08
5.7	0.97	0.16	0.11	0.06
5.8	1.02	0.12	0.09	0.05
5.9	0.94	0.09	0.07	0.03
6	0.81	0.07	0.06	0.02
7	3.32	0.23	0.19	0.09
8	0.91	0.05	0.01	0.03
9	0.35	0.01	0.00	0.01
10	0.18	0.00	0.00	0.00
>10	0.09	0.00	0.00	0.00
Total	1043.33	703.67	339.66	269.67

Figure 7-1: SG 1-1 EOC-13 Projected Voltage Distributions Using 0.6 POD

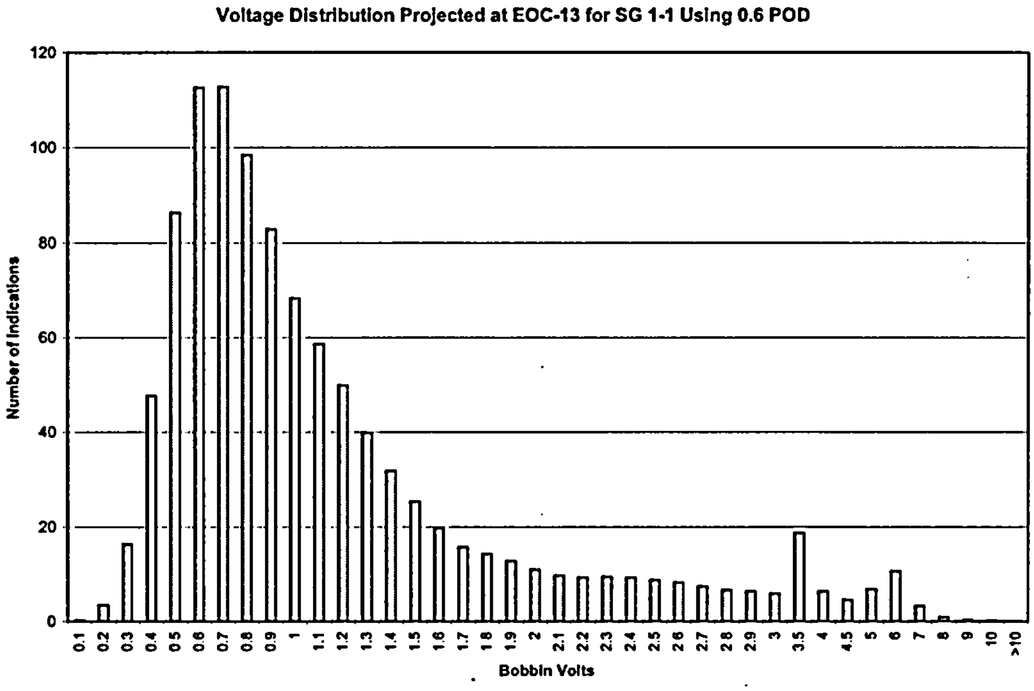


Figure 7-2: SG 1-2 EOC-13 Projected Voltage Distributions Using 0.6 POD

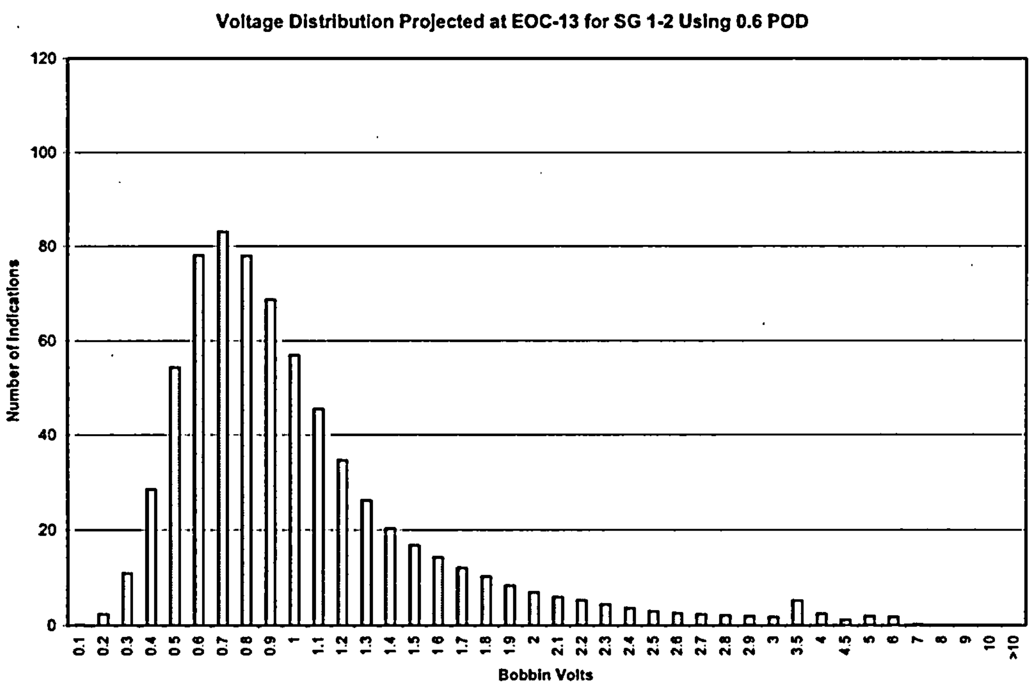


Figure 7-3: SG 1-3 EOC-13 Projected Voltage Distributions Using 0.6 POD

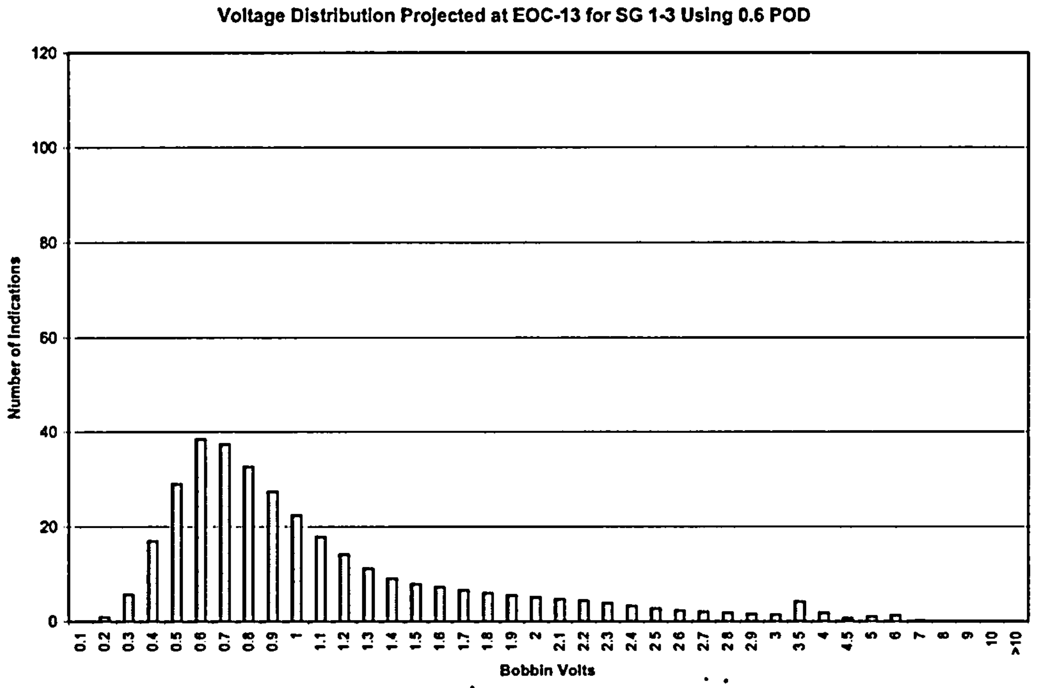
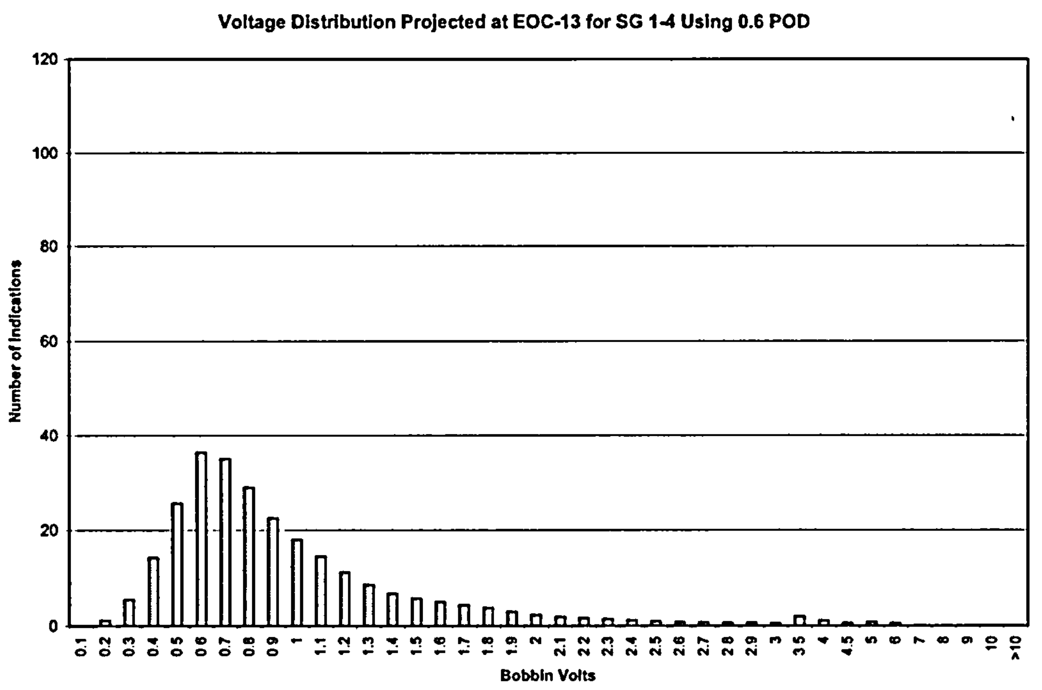


Figure 7-4: SG 1-4 EOC-13 Projected Voltage Distributions Using 0.6 POD



7.3 Projected Tube Burst Probability and Leak Rate for EOC-13

Calculations to predict SLB leak rate and tube burst probability for each steam generator in DCPP Unit 1 at the projected EOC-13 conditions were performed using the NRC-required constant POD of 0.6. As described in Section 3.2, voltage dependent growth was used for all steam generators. SG 1-1 used a SG-specific growth distribution based on the Cycle 12 growth results. The other steam generators used a composite Cycle 12 growth distribution. Both of the growth distributions used for these calculations conservatively utilized a "delta volts adjustment" as discussed in Section 3.2, even though this adjustment is committed to be used by DCPP only in conjunction with POPCD. The results of these calculations are shown in Table 7-3. As shown in Table 7-3, even with the use of the conservative constant POD of 0.6, all of the results are below the acceptance criteria.

Table 7-3: Projected Leak Rate and Burst Probability at EOC-13 POD 0.6 VDG

Steam Generator	Projected Number of Indications at EOC-13	Probability of Burst		SLB Leak Rate
		Best Estimate	95% UCL (1 or More Failures)	(gpm)
SG 1-1	1043	6.46×10^{-3}	6.65×10^{-3}	4.32
SG 1-2	704	1.14×10^{-3}	1.22×10^{-3}	1.33
SG 1-3	340	7.68×10^{-4}	8.36×10^{-4}	0.89
SG 1-4	270	4.52×10^{-4}	5.05×10^{-4}	0.51
Reporting Threshold			1.0×10^{-2}	10.5

8.0 Probability of Prior Cycle Detection and EOC-13 Projections Using DCPP POPCD

As mentioned earlier, DCPP currently has a submittal under NRC review that would allow the use of a voltage dependent Probability of Prior Cycle Detection (POPCD) in their operational assessment calculations. This submittal has not yet been approved. However, an update of the DCPP POPCD correlation that includes the 1R11 POPCD results, based on 1R12 inspections, is being provided in this document. In addition, POB and leak rate calculations which use the updated POPCD correlation and methods are also being provided in this section. The POB and leak rate results using POPCD are provided for information only and will be used to benchmark the new methodology when the 1R13 inspection results become available.

8.1 Updated DCPP POPCD Correlation

The POPCD method, which is based on results from actual field inspections, allows the POD to approach 1.0 at bobbin voltages above 1.6 volts (i.e., without applying uncertainties or confidence levels). This larger POD realistically drops the detection uncertainty that is added for the larger volt flaws, thereby lowering the number of these larger indications in the voltage distribution. Reference 10 provided the DCPP-specific correlation through 2R11 (five inspections). The data from Reference 10 has since been updated to include the 1R12 results, also referred to as the 1R11 POPCD data. Tables 8-1 and 8-2 provide the 1R11 and composite POPCD data, respectively. The composite POPCD includes results from six inspections (2R8, 1R9, 2R9, 1R10, 2R10, and 1R11). Tables 8-3 and 8-4 provide the POPCD results in a matrix format requested by the NRC. Table 8-3 contains the 1R11 POPCD data and Table 8-4 contains the updated composite POPCD data. Table 8-5 provides the correlation parameters for the composite data set.

Figure 8-1 provides a comparison of the new correlation to the previous correlation, along with the Unit 1 Cycle 12 specific correlation. The POPCD has improved over the entire range of potential voltages. Table 8-6 provides a direct comparison of the best estimates of the previous and current POPCD values up through 10 volts.

LAR 04-01 (Reference 16) indicated that the largest undetected voltage in the DCPP POPCD database (through 5 inspections) is less than 1.5 volts. With the addition of the 6^{th} inspection, the largest undetected prior cycle indication is 1.56 volts (SG 12 R22C54 1H). This intersection had a 1.77 volt DOS in 1R12 and was NDD in the prior cycle based on 1R11 lookback analysis. 1.56 volts is calculated as 1.77 volts less the average voltage growth rate over Cycle 12. The subtraction of the average growth is expected to yield a more conservative voltage estimate for the prior cycle undetected indication.

8.2 *Input to Industry POPCD Database*

Tables 8-7 and 8-8 provide the 1R11 and the composite POPCD results in the EPRI format. The EPRI recommended format differs slightly from the DCPP format in that DCPP treats EOCn RPC NDD indications as no detection as requested by the NRC (listed in Column G of Table 8-1 and Table 8-2), whereas EPRI treats these as detection. The data in Tables 8-7 and 8-8 will be incorporated into the next addendum of the EPRI ODSCC Database Report.

8.3 *NRC Requested Information for POPCD in 90-Day Report*

LAR 04-01, as supplemented by Reference 25, provides a summary of the 90 day reporting requirements if POPCD is implemented. Even though POPCD was not implemented for Unit 1 Cycle 13, PG&E is providing this reporting information in support of NRC approval of LAR 04-01.

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 will be applied to assess the need for methods adjustments:

- *The probable causes for the underpredictions will be assessed and documented in the 90-day report. If the underpredictions are significant relative to the burst probability reporting threshold or site specific allowable leak rate, an assessment must be made of the potential need to revise the ARC analysis methods, and this assessment must be documented in the ARC 90-day report. A significant underprediction of burst probability is defined as 10 percent of the reporting threshold, i.e., 0.001. A significant underprediction of MSLB leak rate is defined as 0.5 gpm. A method assessment will also be made for smaller burst probabilities (e.g., underpredicted by less than 0.001) or leak rates (e.g., underpredicted by less than 0.5 gpm) if the condition monitoring results are underpredicted by an order of magnitude.*

- *An assessment will also be made for significant underestimates of the number of indications based on the following criterion. If the total number of as-found indications is underestimated by greater than 15 percent, a methods assessment will be performed to determine the cause and corrective actions will be proposed in the 90-day report. The evaluation will include an assessment of the need to increase the number of predicted low voltage indications at the BOC to determine the effect on EOC projections. An underestimate of the less than 1 volt population when accompanied by an increase in the population above 1 volt may be partially attributable to conservative growth rates which would increase the population above about 1 volt.*

  Note: Growth rates will typically be the first potential cause examined for ARC underpredictions. Potential POD effects as the cause for underpredictions will also be assessed if the probable cause for the low predictions is a larger than anticipated undetected indication or due to cumulative numbers of indications above about 1 volt. The

90-day report will document any recommended changes to POD or growth methodology indicated by the assessments.

PG&E Reporting and Assessment of Potential Underpredictions: As discussed in Section 6, new EOC-12 projections were performed in order to benchmark the POPCD and extreme growth methods. As shown in Table 6-2, the POBs for SG 1-1 and SG 1-4 were slightly underestimated. However, these underpredictions don't meet the definition for a significant underprediction using POPCD as defined above. The leak rate for SG 1-4 was also slightly underpredicted. Again, this underprediction does not meet the level of significance as defined above. Table 6-2 also shows that the total number of indications was overpredicted in all cases using the site-specific POPCD.

- *The composite multi-cycle POPCD data will be updated in the 90-day report, along with the associated POPCD distribution curve and the POPCD method regression parameters, to include data from the just completed cycle. A separate POPCD data table and POPCD distribution curve will also be provided to include only data from the just completed cycle.*

PG&E Reporting: Tables 8-1 and 8-2 provide the DCPP POPCD data tables from the just completed cycle and composite multi cycles, respectively. Figure 8-1 provides the POPCD distribution curves for just completed cycle and composite multi cycles. Table 8-4 provides the POPCD log logistic regression parameters for the updated composite multi cycles.

- *The composite multi-cycle POPCD matrix data will be updated in the 90-day report to include data from the just completed cycle. Separate POPCD matrix data tables will also be provided to include only data from the just completed cycle.*

PG&E Reporting: Table 8-3 provides the POPCD matrix table including data from only the just completed cycle, and Table 8-4 provides the composite multi-cycle POPCD matrix table.

- *To assess the POPCD method for potential changes over time, the 90-day report will compare the multi-cycle POPCD distribution applied for the last operational assessment with the POPCD distribution obtained for only the last operating cycle. Differences in the two POPCD distributions will be assessed relative to the potential for significant changes in detection capability.*

PG&E Reporting: Figure 8-1 shows the previous POPCD curve that was used for the benchmarking calculations performed for Section 6 of this document. This figure also shows the POPCD curves for the just completed cycle and for the updated composite dataset. The 1R11 POPCD correlation (based on the 1R12 inspection results) is higher than the previous composite POPCD over the entire range of expected voltages. Therefore, the updated composite POPCD curve is also improved over the entire range of expected voltages.

- *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 Plus Point voltage is greater than 0.5 volt. If there are a significant number of occurrences of these "disappearing flaws", the cause will be evaluated independent of the Plus Point 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.)*

PG&E Reporting: During the 1R12 inspection, there was only one previously reported RPC confirmed ODSCC indication that was not detected with Plus Point in 1R12 (SG 1-2 R7C20 2H). The previous Plus Point voltage for this flaw was only 0.09v and the previous bobbin voltage was 0.35v. Because the Plus Point voltage was less than 0.5 volt, and there was only one occurrence, no assessment is required in the 90 day report.

During the 1R12 inspection, there were also four previously confirmed DOS indications that were reported as bobbin INRs (Indication Not Reportable) during 1R12. All four of these locations were Plus Point inspected in 1R12 as committed to the NRC and confirmed as axial ODSCC. These four locations were, therefore, treated as AONDBs in the analyses for this report.

8.4 EOC-13 Projections Using Updated POPCD Correlation

This section provides the EOC-13 projections using the updated POPCD correlation. These projections include the EOC-13 voltage distributions as well as the POB and leak rate results. These calculations also include the application of a new method of accounting for the potential for an extreme growth rate, submitted in NEI letter to NRC, "Revision to ODSCC ARC Task – Extreme Values of ODSCC Growth," July 9, 2004 (Ref. 22; note – the July 9 report replaced the earlier Ref. 24 June 2 report). These results are provided for information only and will be used to benchmark the new methodologies when the EOC-13 results become available. The "calculations of record" use the constant POD of 0.6 and are provided in Section 7 of this report.

The BOC voltage distributions and the normal growth distributions used in these calculations are the same as those used for the calculations using the constant 0.6 POD. See Section 7 for information on these inputs. For the calculations using the POPCD and extreme growth methods, however, an additional input is required that defines the extreme growth distribution. The inputs for the extreme growth distribution include the number of extreme growths recorded across the industry for 7/8" plants, the total number of growth values recorded across the industry, and the growth rates for the extremes. Table 3 in Enclosure 1 of Reference 22 contains a list of industry extreme growths for both ¾" and ⅞" plants. This table shows the industry growth values normalized to temperatures of 600F, 603F, 610F, and 620F. The table includes data through Spring 2004 outages, including 1R12. Since Diablo Canyon Unit 1 operates at 604F, the growth values used for these calculations were adjusted for a temperature of 604F. This adjustment was done by linearly interpolating between the 603F and 610F values as permitted in Enclosure 1 of Reference 22. These extreme growth values are shown in Table 8-9.

Table 8-10 provides the projected EOC-13 voltage distributions for all four steam generators using the POPCD and extreme growth methods. The projected EOC-13 voltages are also provided graphically in Figures 8-2 through 8-5. The projected EOC-13 POB and leak rate results are provided in Table 8-11, and are within the acceptance criteria.

Table 8-1: 1R11 POPCD Results

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	2	0	1	3	27	0	1	1	3	31	0.088
0.11-0.20	8	19	1	12	99	2	1	3	28	114	0.197
0.21-0.30	9	77	2	11	133	56	2	5	88	202	0.303
0.31-0.40	22	106	0	17	68	33	3	6	128	121	0.514
0.41-0.50	31	103	4	7	44	20	4	8	138	75	0.648
0.51-0.60	29	103	5	4	18	18	1	7	137	41	0.770
0.61-0.70	19	64	6	2	5	4	0	3	89	11	0.890
0.71-0.80	24	45	5	0	2	4	0	3	74	6	0.925
0.81-0.90	20	28	0	3	4	0	1	3	48	8	0.857
0.91-1.00	15	24	4	0	3	0	0	0	43	3	0.935
1.01-1.10	14	20	1	1	3	0	0	2	35	4	0.897
1.11-1.20	11	9	0	1	0	0	0	0	20	1	0.952
1.21-1.30	10	7	2	1	0	0	0	0	19	1	0.950
1.31-1.40	12	5	0	0	0	0	0	1	17	0	1.000
1.41-1.50	5	1	0	0	0	0	0	0	6	0	1.000
1.51-1.60	6	0	0	1	0	0	0	0	6	1	0.857
1.61-1.70	4	0	0	0	0	0	0	0	4	0	1.000
1.71-1.80	9	0	0	0	0	0	0	0	9	0	1.000
1.81-1.90	3	0	1	0	0	0	0	0	4	0	1.000
1.91-2.00	5	0	0	0	0	0	0	0	5	0	1.000
2.01-2.10	0	0	0	0	0	0	0	0	0	0	
2.11-2.20	0	0	2	0	0	0	0	0	2	0	1.000
2.21-2.30	0	0	2	0	0	0	0	0	2	0	1.000
2.31-2.40	0	0	4	0	0	0	0	0	4	0	1.000
2.41-2.50	0	0	0	0	0	0	0	0	0	0	
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	1	0	0	0	0	0	1	0	1.000
2.81-2.90	0	0	0	0	0	0	0	0	0	0	
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	1	0	0	0	0	0	1	0	1.000
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	
4.11-4.20	0	0	0	0	0	0	0	0	0	0	
4.21-4.30	0	0	0	0	0	0	0	0	0	0	
4.31-4.40	0	0	0	0	0	0	0	0	0	0	
4.41-4.50	0	0	0	0	0	0	0	0	0	0	
4.51-4.60	0	0	0	0	0	0	0	0	0	0	
4.61-4.70	0	0	0	0	0	0	0	0	0	0	
4.71-4.80	0	0	0	0	0	0	0	0	0	0	
4.81-4.90	0	0	0	0	0	0	0	0	0	0	
4.91-5.00	0	0	0	0	0	0	0	0	0	0	
5.01-5.10	0	0	0	0	0	0	0	0	0	0	
5.11-5.20	0	0	0	0	0	0	0	0	0	0	
5.21-5.30	0	0	0	0	0	0	0	0	0	0	
5.31-5.40	0	0	0	0	0	0	0	0	0	0	
5.41-5.50	0	0	0	0	0	0	0	0	0	0	
5.51-5.60	0	0	0	0	0	0	0	0	0	0	
5.61-5.70	0	0	0	0	0	0	0	0	0	0	
5.71-5.80	0	0	0	0	0	0	0	0	0	0	
5.81-5.90	0	0	0	0	0	0	0	0	0	0	
5.91-6.00	0	0	0	0	0	0	0	0	0	0	
Total	258	611	43	63	406	137	13	42	912	619	

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 8-2: DCPP Composite POPCD Results

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	5	1	1	26	78	0	1	7	7	105	0.063
0.11-0.20	21	56	3	112	488	3	26	30	80	629	0.113
0.21-0.30	58	254	7	143	649	85	27	66	319	904	0.261
0.31-0.40	91	371	17	121	452	122	29	51	479	724	0.398
0.41-0.50	99	356	12	72	243	50	14	43	467	379	0.552
0.51-0.60	106	294	13	42	131	39	8	32	413	220	0.652
0.61-0.70	92	204	10	29	64	8	7	26	306	108	0.739
0.71-0.80	75	130	12	19	39	5	5	12	217	68	0.761
0.81-0.90	77	92	2	19	18	0	5	8	171	42	0.803
0.91-1.00	51	62	5	4	8	0	0	3	118	12	0.908
1.01-1.10	49	36	7	7	9	0	0	4	92	16	0.852
1.11-1.20	28	30	2	4	3	0	2	5	60	9	0.870
1.21-1.30	32	25	2	3	4	0	0	1	59	7	0.894
1.31-1.40	39	14	2	2	1	0	0	2	55	3	0.948
1.41-1.50	18	8	1	1	0	0	0	0	27	1	0.964
1.51-1.60	13	4	1	1	0	0	0	0	18	1	0.947
1.61-1.70	14	1	0	0	0	0	0	0	15	0	1.000
1.71-1.80	17	1	0	0	0	0	0	0	18	0	1.000
1.81-1.90	10	0	1	0	0	0	0	0	11	0	1.000
1.91-2.00	15	1	0	0	0	0	0	0	16	0	1.000
2.01-2.10	0	0	0	0	0	0	0	0	0	0	
2.11-2.20	0	0	7	0	0	0	0	0	7	0	1.000
2.21-2.30	0	0	5	0	0	0	0	0	5	0	1.000
2.31-2.40	0	0	6	0	0	0	0	0	6	0	1.000
2.41-2.50	0	0	0	0	0	0	0	0	0	0	
2.51-2.60	0	0	2	0	0	0	0	0	2	0	1.000
2.61-2.70	0	0	1	0	0	0	0	0	1	0	1.000
2.71-2.80	0	0	4	0	0	0	0	0	4	0	1.000
2.81-2.90	0	0	3	0	0	0	0	0	3	0	1.000
2.91-3.00	0	0	0	0	0	0	0	0	0	0	
3.01-3.10	0	0	1	0	0	0	0	0	1	0	1.000
3.11-3.20	0	0	1	0	0	0	0	0	1	0	1.000
3.21-3.30	0	0	1	0	0	0	0	0	1	0	1.000
3.31-3.40	0	0	2	0	0	0	0	0	2	0	1.000
3.41-3.50	0	0	1	0	0	0	0	0	1	0	1.000
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	2	0	0	0	0	0	2	0	1.000
3.91-4.00	0	0	0	0	0	0	0	0	0	0	
4.01-4.10	0	0	1	0	0	0	0	0	1	0	1.000
4.11-4.20	0	0	1	0	0	0	0	0	1	0	1.000
4.21-4.30	0	0	0	0	0	0	0	0	0	0	
4.31-4.40	0	0	2	0	0	0	0	0	2	0	1.000
4.41-4.50	0	0	0	0	0	0	0	0	0	0	
4.51-4.60	0	0	0	0	0	0	0	0	0	0	
4.61-4.70	0	0	0	0	0	0	0	0	0	0	
4.71-4.80	0	0	0	0	0	0	0	0	0	0	
4.81-4.90	0	0	0	0	0	0	0	0	0	0	
4.91-5.00	0	0	0	0	0	0	0	0	0	0	
5.01-5.10	0	0	1	0	0	0	0	0	1	0	1.000
5.11-5.20	0	0	0	0	0	0	0	0	0	0	
5.21-5.30	0	0	1	0	0	0	0	0	1	0	1.000
5.31-5.40	0	0	0	0	0	0	0	0	0	0	
5.41-5.50	0	0	1	0	0	0	0	0	1	0	1.000
5.51-5.60	0	0	0	0	0	0	0	0	0	0	
5.61-5.70	0	0	0	0	0	0	0	0	0	0	
5.71-5.80	0	0	0	0	0	0	0	0	0	0	
5.81-5.90	0	0	0	0	0	0	0	0	0	0	
5.91-6.00	0	0	0	0	0	0	0	0	0	0	
Total	910	1940	141	605	2187	312	124	290	2991	3228	

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 8-3: 1R11 POPCD Summary from 1R12 Inspection Results

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	8												
		Not Plugged		19	549	43	55		1		12				
	BDD w/ RDD	Plugged	35												
		Not Plugged			43	11	145						4		1
	BDD w/ RND	Plugged													
		Not Plugged		1	6	1	2		10		6		3		
BND at EOCn	BND w/o RPC	Plugged													
		Not Plugged		7	399	17	39		12	No Count	No Count	12	41	No Count	No Count
	BND w/ RDD	Plugged	21												
		Not Plugged				1	6			No Count	No Count	5	50	No Count	No Count
	BND w/ RND	Plugged													
		Not Plugged								No Count	No Count	5	3	No Count	No Count

Table 8-4: DCPP Composite POPCD Summary

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	28												
		Not Plugged		59	1569	305	217		36		36				
	BDD w/ RDD	Plugged	113												
		Not Plugged		2	310	43	337		1				8		2
	BDD w/ RND	Plugged	3												
		Not Plugged		4	73	8	36		60		36		3		3
BND at EOCn	BND w/o RPC	Plugged													
		Not Plugged		50	2134	109	470	5	103	No Count	No Count	36	132	No Count	No Count
	BND w/ RDD	Plugged	39												
		Not Plugged			2	1	17			No Count	No Count	8	71	No Count	No Count
	BND w/ RND	Plugged													
		Not Plugged			1	3	5		5	No Count	No Count	16	10	No Count	No Count

Table 8-5: DCPP POPCD LogLogistic Parameters

Parameter	Previous POPCD LogLogistic Parameters through 5 DCPP inspections	Updated POPCD LogLogistic Parameters through 6 DCPP inspections
Number of Data Points	4688	6219
a.0 (intercept)	1.644	1.844
a.1 (slope)	4.659	4.781
V11	0.00522	0.00407
V12	0.01043	0.00806
V22	0.02654	0.02022

Table 8-6: Updated DCPP POPCD Correlation Comparison to Previous POPCD Correlation (Best Estimate)

Volts	Previous POPCD Correlation (Five Inspections)	Updated POPCD Correlation (Six Inspections)
0.1	0.047	0.050
0.2	0.166	0.183
0.3	0.312	0.342
0.4	0.448	0.485
0.5	0.560	0.600
0.6	0.648	0.686
0.7	0.716	0.751
0.8	0.767	0.799
0.9	0.807	0.836
1	0.838	0.863
1.1	0.863	0.885
1.2	0.882	0.902
1.3	0.898	0.916
1.4	0.911	0.927
1.5	0.922	0.936
1.6	0.931	0.944
1.7	0.938	0.950
1.8	0.944	0.955
1.9	0.950	0.960
2	0.955	0.964
2.5	0.971	0.977
3	0.980	0.984
3.5	0.985	0.988
4	0.988	0.991
4.5	0.991	0.993
5	0.993	0.994
5.5	0.994	0.995
6	0.995	0.996
6.5	0.996	0.997
7	0.996	0.997
7.5	0.997	0.998
8	0.997	0.998
8.5	0.997	0.998
9	0.998	0.998
9.5	0.998	0.999
10	0.998	0.999

Table 8-7: 1R11 POPCD Results In Industry Format

Column	A	B	C	D	E	F	G	H	I	J
DCPP 1R11 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	2	1	1	3	27	0	1	4	30	0.118
0.11-0.20	9	19	1	12	99	2	3	29	113	0.204
0.21-0.30	11	77	2	11	133	56	5	90	200	0.310
0.31-0.40	24	107	0	17	68	33	6	131	118	0.526
0.41-0.50	31	107	4	7	44	20	8	142	71	0.667
0.51-0.60	29	104	5	4	18	18	7	138	40	0.775
0.61-0.70	19	64	6	2	5	4	3	89	11	0.890
0.71-0.80	24	45	5	0	2	4	3	74	6	0.925
0.81-0.90	21	28	0	3	4	0	3	49	7	0.875
0.91-1.00	15	24	4	0	3	0	0	43	3	0.935
1.01-1.10	14	20	1	1	3	0	2	35	4	0.897
1.11-1.20	11	9	0	1	0	0	0	20	1	0.952
1.21-1.30	10	7	2	1	0	0	0	19	1	0.950
1.31-1.40	12	5	0	0	0	0	1	17	0	1.000
1.41-1.50	5	1	0	0	0	0	0	6	0	1.000
1.51-1.60	6	0	0	1	0	0	0	6	1	0.857
1.61-1.70	4	0	0	0	0	0	0	4	0	1.000
1.71-1.80	9	0	0	0	0	0	0	9	0	1.000
1.81-1.90	3	0	1	0	0	0	0	4	0	1.000
1.91-2.00	5	0	0	0	0	0	0	5	0	1.000
2.01-2.10	0	0	0	0	0	0	0	0	0	
2.11-2.20	0	0	2	0	0	0	0	2	0	1.000
2.21-2.30	0	0	2	0	0	0	0	2	0	1.000
2.31-2.40	0	0	4	0	0	0	0	4	0	1.000
2.41-2.50	0	0	0	0	0	0	0	0	0	
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	1	0	0	0	0	1	0	1.000
2.81-2.90	0	0	0	0	0	0	0	0	0	
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	
3.11-3.20	0	0	0	0	0	0	0	0	0	
3.21-3.30	0	0	1	0	0	0	0	1	0	1.000
3.31-3.40	0	0	0	0	0	0	0	0	0	
3.41-3.50	0	0	0	0	0	0	0	0	0	
3.51-3.60	0	0	0	0	0	0	0	0	0	
3.61-3.70	0	0	0	0	0	0	0	0	0	
3.71-3.80	0	0	0	0	0	0	0	0	0	
3.81-3.90	0	0	0	0	0	0	0	0	0	
3.91-4.00	0	0	0	0	0	0	0	0	0	
4.01-4.10	0	0	0	0	0	0	0	0	0	
4.11-4.20	0	0	0	0	0	0	0	0	0	
4.21-4.30	0	0	0	0	0	0	0	0	0	
4.31-4.40	0	0	0	0	0	0	0	0	0	
4.41-4.50	0	0	0	0	0	0	0	0	0	
4.51-4.60	0	0	0	0	0	0	0	0	0	
4.61-4.70	0	0	0	0	0	0	0	0	0	
4.71-4.80	0	0	0	0	0	0	0	0	0	
4.81-4.90	0	0	0	0	0	0	0	0	0	
4.91-5.00	0	0	0	0	0	0	0	0	0	
5.01-5.10	0	0	0	0	0	0	0	0	0	
5.11-5.20	0	0	0	0	0	0	0	0	0	
5.21-5.30	0	0	0	0	0	0	0	0	0	
5.31-5.40	0	0	0	0	0	0	0	0	0	
5.41-5.50	0	0	0	0	0	0	0	0	0	
5.51-5.60	0	0	0	0	0	0	0	0	0	
5.61-5.70	0	0	0	0	0	0	0	0	0	
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	
Total	264	618	43	63	406	137	42	925	606	

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 8-8: DCPP Composite POPCD Results 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	5	2	1	26	78	0	7	8	104	0.071
0.11-0.20	42	61	3	112	488	3	30	106	603	0.150
0.21-0.30	71	268	7	143	649	85	66	346	877	0.283
0.31-0.40	99	392	17	121	452	122	51	508	695	0.422
0.41-0.50	99	370	12	72	243	50	43	481	365	0.569
0.51-0.60	107	301	13	42	131	39	32	421	212	0.665
0.61-0.70	93	210	10	29	64	8	26	313	101	0.756
0.71-0.80	76	134	12	19	39	5	12	222	63	0.779
0.81-0.90	78	96	2	19	18	0	8	176	37	0.826
0.91-1.00	51	62	5	4	8	0	3	118	12	0.908
1.01-1.10	49	36	7	7	9	0	4	92	16	0.852
1.11-1.20	29	31	2	4	3	0	5	62	7	0.899
1.21-1.30	32	25	2	3	4	0	1	59	7	0.894
1.31-1.40	39	14	2	2	1	0	2	55	3	0.948
1.41-1.50	18	8	1	1	0	0	0	27	1	0.964
1.51-1.60	13	4	1	1	0	0	0	18	1	0.947
1.61-1.70	14	1	0	0	0	0	0	15	0	1.000
1.71-1.80	17	1	0	0	0	0	0	18	0	1.000
1.81-1.90	10	0	1	0	0	0	0	11	0	1.000
1.91-2.00	15	1	0	0	0	0	0	16	0	1.000
2.01-2.10	0	0	0	0	0	0	0	0	0	
2.11-2.20	0	0	7	0	0	0	0	7	0	1.000
2.21-2.30	0	0	5	0	0	0	0	5	0	1.000
2.31-2.40	0	0	6	0	0	0	0	6	0	1.000
2.41-2.50	0	0	0	0	0	0	0	0	0	
2.51-2.60	0	0	2	0	0	0	0	2	0	1.000
2.61-2.70	0	0	1	0	0	0	0	1	0	1.000
2.71-2.80	0	0	4	0	0	0	0	4	0	1.000
2.81-2.90	0	0	3	0	0	0	0	3	0	1.000
2.91-3.00	0	0	0	0	0	0	0	0	0	
3.01-3.10	0	0	1	0	0	0	0	1	0	1.000
3.11-3.20	0	0	1	0	0	0	0	1	0	1.000
3.21-3.30	0	0	1	0	0	0	0	1	0	1.000
3.31-3.40	0	0	2	0	0	0	0	2	0	1.000
3.41-3.50	0	0	1	0	0	0	0	1	0	1.000
3.51-3.60	0	0	0	0	0	0	0	0	0	
3.61-3.70	0	0	0	0	0	0	0	0	0	
3.71-3.80	0	0	0	0	0	0	0	0	0	
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	1	0	0	0	0	1	0	1.000
4.11-4.20	0	0	1	0	0	0	0	1	0	1.000
4.21-4.30	0	0	0	0	0	0	0	0	0	
4.31-4.40	0	0	2	0	0	0	0	2	0	1.000
4.41-4.50	0	0	0	0	0	0	0	0	0	
4.51-4.60	0	0	0	0	0	0	0	0	0	
4.61-4.70	0	0	0	0	0	0	0	0	0	
4.71-4.80	0	0	0	0	0	0	0	0	0	
4.81-4.90	0	0	0	0	0	0	0	0	0	
4.91-5.00	0	0	0	0	0	0	0	0	0	
5.01-5.10	0	0	1	0	0	0	0	1	0	1.000
5.11-5.20	0	0	0	0	0	0	0	0	0	
5.21-5.30	0	0	1	0	0	0	0	1	0	1.000
5.31-5.40	0	0	0	0	0	0	0	0	0	
5.41-5.50	0	0	1	0	0	0	0	1	0	1.000
5.51-5.60	0	0	0	0	0	0	0	0	0	
5.61-5.70	0	0	0	0	0	0	0	0	0	
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	
Total	957	2017	141	605	2187	312	290	3115	3104	

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 8-9: Extreme Growth Distribution for 7/8" Plants at 604F

Number of Extreme Growths (>5v/EFPY)	3
Growth Population	56874
Extreme Voltage Growth 1 (per EFPY)	12.18
Extreme Voltage Growth 2 (per EFPY)	7.97
Extreme Voltage Growth 3 (per EFPY)	5.87

Table 8-10: Projected EOC-13 Voltage Distributions Using POPCD

Voltage Bin	EOC-13 Projected Distributions with DCPP POPCD			
	SG11	SG12	SG13	SG14
<=0.1	12.77	0.55	0.17	0.28
0.2	50.02	11.14	3.96	5.58
0.3	89.31	39.92	17.47	19.94
0.4	149.40	69.08	38.94	34.34
0.5	186.98	96.74	52.23	46.28
0.6	189.82	107.97	56.19	51.25
0.7	161.27	97.81	46.27	42.98
0.8	123.40	81.31	35.59	32.02
0.9	93.84	65.12	27.01	22.63
1	69.46	50.32	20.16	16.62
1.1	54.41	38.20	15.05	12.44
1.2	43.06	28.02	11.26	9.11
1.3	32.68	20.42	8.45	6.67
1.4	25.80	15.33	6.58	5.06
1.5	20.32	12.33	5.61	4.20
1.6	15.61	10.22	5.00	3.61
1.7	12.57	8.41	4.43	3.05
1.8	11.45	7.10	3.99	2.58
1.9	10.08	5.82	3.60	2.06
2	8.58	4.77	3.27	1.58
2.1	7.64	4.02	2.99	1.25
2.2	7.09	3.50	2.71	1.08
2.3	6.41	2.90	2.34	0.90
2.4	5.52	2.30	1.91	0.71
2.5	4.68	1.83	1.55	0.55
2.6	4.25	1.57	1.31	0.46
2.7	3.85	1.36	1.13	0.39
2.8	3.49	1.20	0.97	0.35
2.9	3.39	1.13	0.85	0.34
3	2.97	0.99	0.74	0.30
3.1	2.41	0.84	0.62	0.26
3.2	1.91	0.66	0.50	0.21
3.3	1.44	0.49	0.39	0.16
3.4	1.02	0.37	0.32	0.11
3.5	0.71	0.29	0.27	0.09
3.6	0.48	0.25	0.23	0.07
3.7	0.34	0.23	0.20	0.07
3.8	0.32	0.21	0.18	0.07
3.9	0.39	0.19	0.15	0.06
4	0.45	0.15	0.12	0.05
4.1	0.42	0.11	0.09	0.03
4.2	0.35	0.07	0.07	0.02
4.3	0.27	0.05	0.06	0.01
4.4	0.23	0.04	0.05	0.01
4.5	0.28	0.06	0.06	0.02
4.6	0.53	0.13	0.09	0.04
4.7	0.87	0.22	0.13	0.08
4.8	1.09	0.26	0.15	0.10
4.9	1.07	0.25	0.14	0.10
5	0.91	0.19	0.12	0.08
5.1	0.71	0.14	0.10	0.05
5.2	0.54	0.10	0.09	0.03
5.3	0.40	0.09	0.09	0.02
5.4	0.34	0.11	0.10	0.03
5.5	0.40	0.12	0.10	0.04
5.6	0.47	0.11	0.08	0.04
5.7	0.46	0.08	0.06	0.03
5.8	0.39	0.06	0.05	0.02
5.9	0.31	0.04	0.04	0.01
6	0.23	0.03	0.03	0.01
7	0.55	0.06	0.08	0.01
8	0.01	0.00	0.00	0.00
9	0.01	0.01	0.00	0.00
10	0.00	0.00	0.00	0.00
>10	0.02	0.01	0.01	0.01
Totals	**1430.49**	**797.43**	**386.48**	**330.55**

Table 8-11: Projected Leak Rate and Burst Probability at EOC-13 Using POPCD and Extreme Growth Model

Steam Generator	Projected Number of Indications at EOC-13	Probability of Burst		SLB Leak Rate
		Best Estimate	95% UCL (1 or More Failures)	(gpm)
SG 1-1	1430	2.25×10^{-3}	2.37×10^{-3}	2.50
SG 1-2	797	6.66×10^{-4}	7.29×10^{-4}	0.82
SG 1-3	386	4.50×10^{-4}	5.03×10^{-4}	0.54
SG 1-4	331	2.20×10^{-4}	2.58×10^{-4}	0.27
Reporting Threshold			**1.0×10^{-2}**	**10.5**

Figure 8-1: 1R11 POPCD Comparison to Composite POPCD

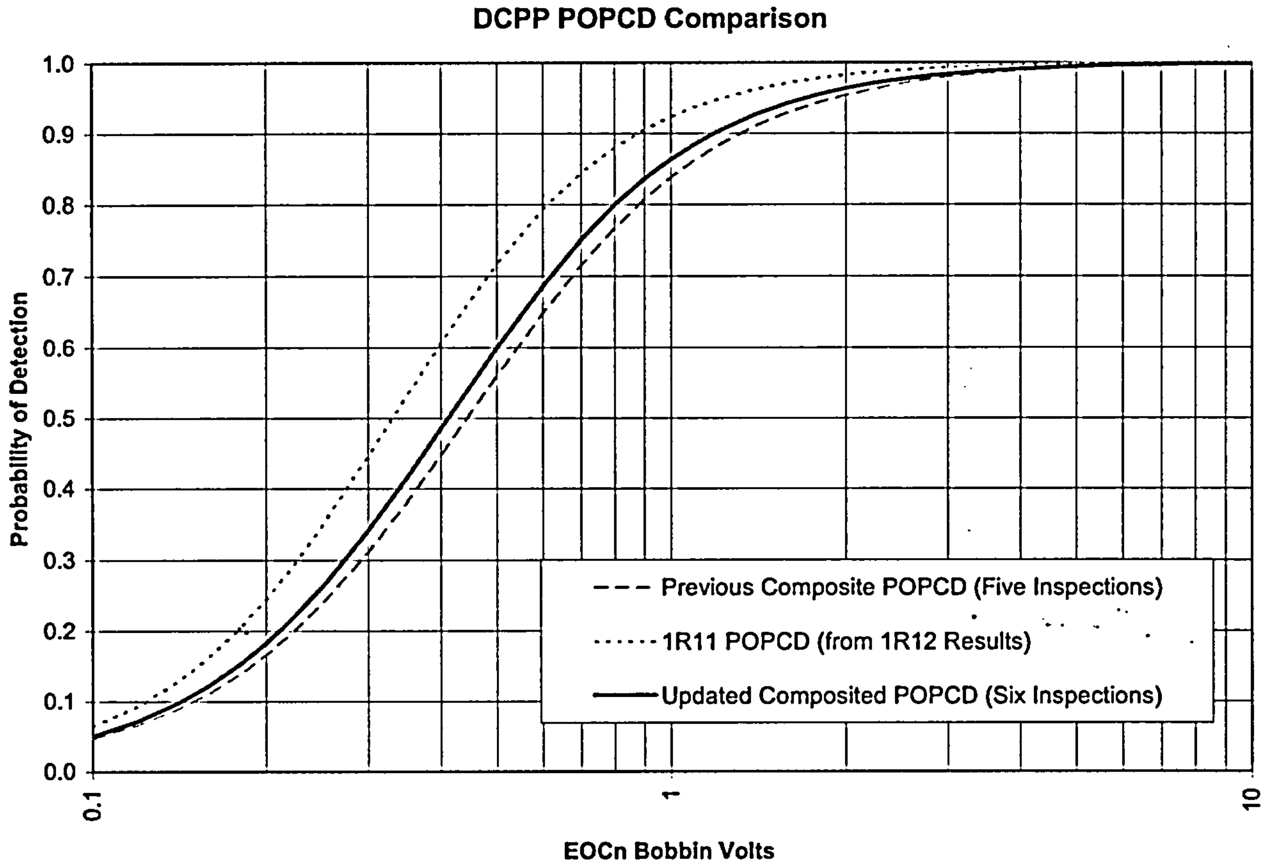


Figure 8-2: SG 1-1 Projected EOC-13 Voltage Distribution Using POPCD and Extreme Growth

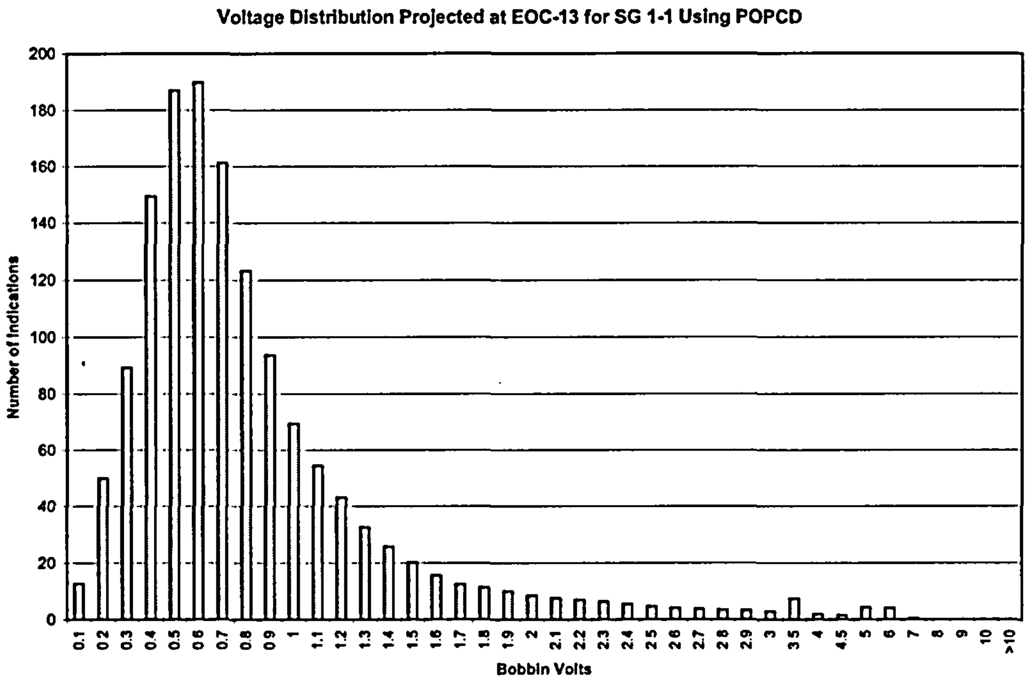


Figure 8-3: SG 1-2 Projected EOC-13 Voltage Distribution Using POPCD and Extreme Growth

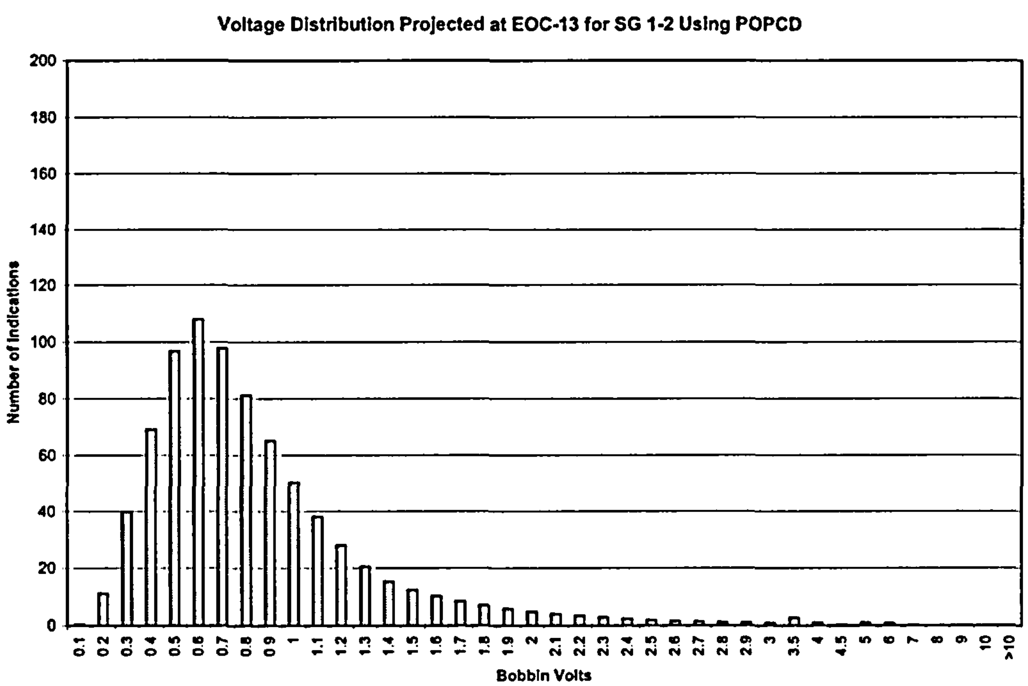


Figure 8-4: SG 1-3 Projected EOC-13 Voltage Distribution Using POPCD and Extreme Growth

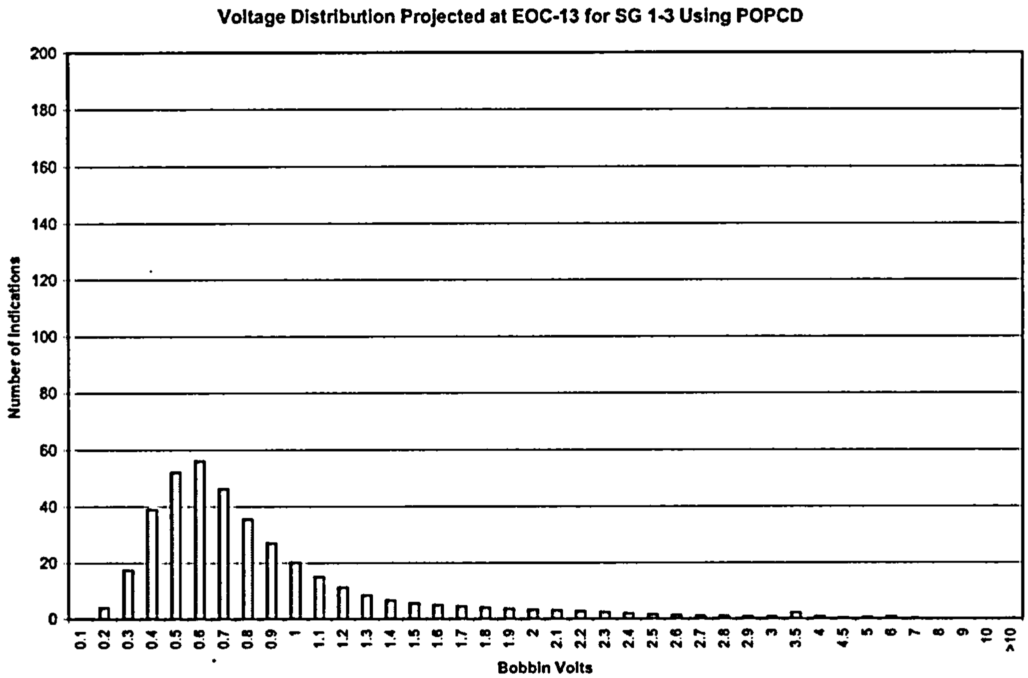
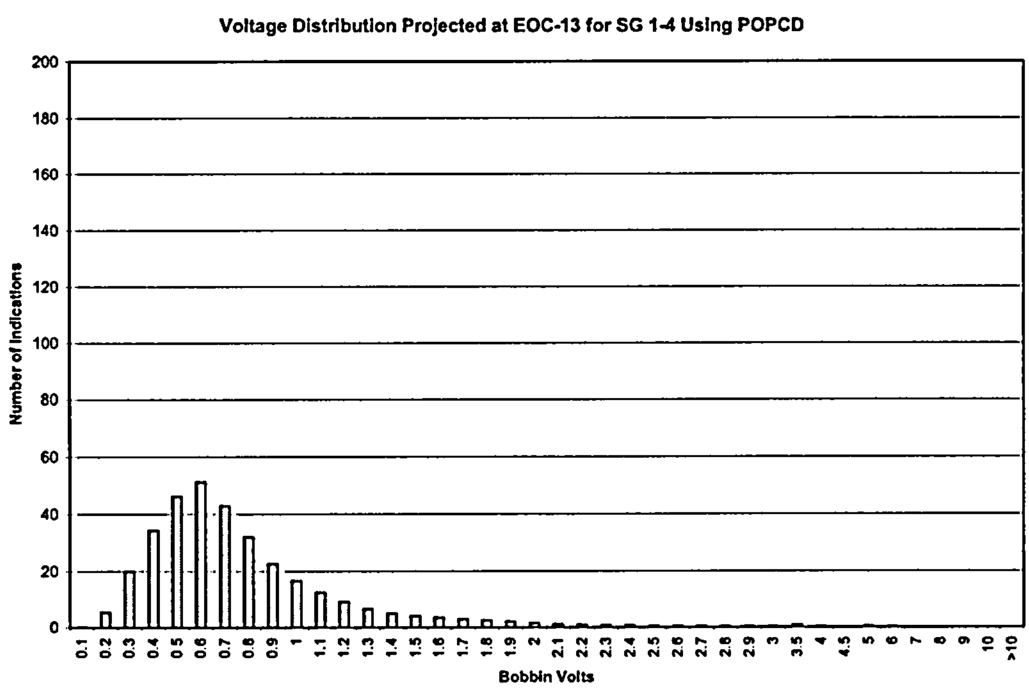


Figure 8-5: SG 1-4 Projected EOC-13 Voltage Distribution Using POPCD and Extreme Growth



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

18. PG&E Letter, Patrick Nugent to Jeff Fleck, "EFPY Data for Cycle 12 and Cycle 13", March 26, 2004.

19. FANP Document 86-5039942-00, "DCPP Unit 1 Voltage-Based ARC Benchmarking Results and Revised EOC-12 Projections", submitted to NRC in PG&E letter DCL-04-019 dated March 16, 2004.

20. Westinghouse Letter to Diablo Canyon (Rice to Arhar), Revised ARC Database Parameters Including Tubes Removed During 2R11, June 23, 2003.

21. FANP Document 51-5046570-00, "Examination of Diablo Canyon Unit 1 Steam Generator Tube No. R20C54", August 2004.

22. NEI Letter to NRC, "Revision to ODSCC ARC Task – 'Extreme Values of ODSCC ARC Growth'", July 9, 2004.

23. FANP Document 32-5049263-00, "DCPP Unit 1 R12 Voltage-Based ARC 90-Day Report".

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. 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.

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

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DESIGN VERIFICATION CHECKLIST

Document Identifier 86 - 5049264 - 00

Title DCPP Unit 1 R12 Voltage-Based ARC 90-Day Report

1.	Were the inputs correctly selected and incorporated into design or analysis?	☒ Y	☐ N	☐ N/A
2.	Are assumptions necessary to perform the design or analysis activity adequately described and reasonable? Where necessary, are the assumptions identified for subsequent re-verifications when the detailed design activities are completed?	☐ Y	☐ N	☒ N/A
3.	Are the appropriate quality and quality assurance requirements specified? Or, for documents prepared per FANP procedures, have the procedural requirements been met?	☒ Y	☐ N	☐ N/A
4.	If the design or analysis cites or is required to cite requirements or criteria based upon applicable codes, standards, specific regulatory requirements, including issue and addenda, are these properly identified, and are the requirements/criteria for design or analysis met?	☐ Y	☐ N	☒ N/A
5.	Have applicable construction and operating experience been considered?	☐ Y	☐ N	☒ N/A
6.	Have the design interface requirements been satisfied?	☐ Y	☐ N	☒ N/A
7.	Was an appropriate design or analytical method used?	☒ Y	☐ N	☐ N/A
8.	Is the output reasonable compared to inputs?	☒ Y	☐ N	☐ N/A
9.	Are the specified parts, equipment and processes suitable for the required application?	☐ Y	☐ N	☒ N/A
10.	Are the specified materials compatible with each other and the design environmental conditions to which the material will be exposed?	☐ Y	☐ N	☒ N/A
11.	Have adequate maintenance features and requirements been specified?	☐ Y	☐ N	☒ N/A
12.	Are accessibility and other design provisions adequate for performance of needed maintenance and repair?	☐ Y	☐ N	☒ N/A
13.	Has adequate accessibility been provided to perform the in-service inspection expected to be required during the plant life?	☐ Y	☐ N	☒ N/A
14.	Has the design properly considered radiation exposure to the public and plant personnel?	☐ Y	☐ N	☒ N/A
15.	Are the acceptance criteria incorporated in the design documents sufficient to allow verification that design requirements have been satisfactorily accomplished?	☐ Y	☐ N	☒ N/A
16.	Have adequate pre-operational and subsequent periodic test requirements been appropriately specified?	☐ Y	☐ N	☒ N/A
17.	Are adequate handling, storage, cleaning and shipping requirements specified?	☐ Y	☐ N	☒ N/A
18.	Are adequate identification requirements specified?	☐ Y	☐ N	☒ N/A
19.	Is the document prepared and being released under the FANP Quality Assurance Program? If not, are requirements for record preparation review, approval, retention, etc., adequately specified?	☒ Y	☐ N	☐ N/A

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DESIGN VERIFICATION CHECKLIST

Document Identifier 86 - 5049264 - 00

Comments:

Verified By:	Jeffrey M Fleck	[signature]	9/2/04
(First, MI, Last)	Printed / Typed Name	Signature	Date

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