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August 20, 2004

PG&E Letter DCL-04-105

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
Response to July 8, 2004, NRC Request for Additional Information Regarding License Amendment Request 04-01, "Revised Steam Generator Voltage-based Repair Criteria Probability of Detection Method for DCPP Units 1 and 2"

Dear Commissioners and Staff:

PG&E Letter DCL-04-028, dated March 18, 2004, submitted License Amendment Request (LAR) 04-01, "Revised Steam Generator Voltage-based Repair Criteria Probability of Detection Method for DCPP Units 1 and 2." LAR 04-01 proposes to update the Diablo Canyon Power Plant (DCPP) Final Safety Analysis Report Update to use a revised steam generator (SG) voltage-based repair criteria probability of detection (POD) method using plant specific SG tube inspection results. The proposed POD method is referred to as the probability of prior cycle detection (POPCD) method. The POPCD method is requested to be used on a permanent basis for all remaining cycles for DCPP Units 1 and 2 until SG replacement, starting with DCPP Unit 1 Cycle 13 and DCPP Unit 2 Cycle 13. PG&E provided responses to a June 15, 2004, NRC request for additional information in PG&E Letter DCL-04-104, "Response to NRC Request for Additional Information Regarding License Amendment Request 04-01, "Revised Steam Generator Voltage-based Repair Criteria Probability of Detection Method for DCPP Units 1 and 2," dated August 18, 2004.

On July 8, 2004, the NRC staff requested additional information required to complete the review of LAR 04-01. PG&E's responses to the staff's questions are provided in Enclosure 1.

This information does not affect the results of the technical evaluation or the no significant hazards consideration determination previously transmitted in PG&E Letter DCL-04-028.

If you have any questions, or require additional information, please contact Stan Ketelsen at (805) 545-4720.

A001

Sincerely,

FOR

David H. Oatley
Vice President and General Manager – Diablo Canyon

kjse/4328
Enclosures
cc: Edgar Bailey, DHS
Bruce S. Mallett
David L. Proulx
Diablo Distribution
cc/enc: Girija S. Shukla

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of PACIFIC GAS AND ELECTRIC COMPANY	)	Docket No. 50-275 Facility Operating License No. DPR-80
Diablo Canyon Power Plant Units 1 and 2	)	Docket No. 50-323 Facility Operating License No. DPR-82

AFFIDAVIT

James R. Becker, of lawful age, first being duly sworn upon oath says that he is Vice President – Diablo Canyon Operations and Station Director of Pacific Gas and Electric Company; that he has executed this response to the NRC request for additional information on License Amendment Request 04-01 on behalf of said company with full power and authority to do so; that he is familiar with the content thereof; and that the facts stated therein are true and correct to the best of his knowledge, information, and belief.

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

Subscribed and sworn to before me this 20th day of August 2004.

Karen T. Mason
Notary Public
County of San Luis Obispo
State of California

KAREN T. MASON
Commission # 1428454
Notary Public - California
San Luis Obispo County
My Comm. Expires Jul 31, 2007

ENCLOSURE 1

PG&E Response to the July 8, 2004, NRC Request for Additional Information Regarding License Amendment Request 04-01, "Revised Steam Generator Voltage-based Repair Criteria Probability of Detection Method for DCPP Units 1 and 2"

NRC Question 1:

It is apparent (by the recurrence of certain values in the third column of Table 3) that many of the extreme voltage growth values have some relationship in time and/or location. In order to provide a better understanding, please provide additional columns that specify the plant, the inspection date, and the steam generator in which each extreme value was found. Also, please clarify the heading for the third column in Table 3. Are the numbers in this column the number of flaws in a single generator during a single inspection, or for all generators in a single inspection? Please provide an additional column that contains the other information, so that it can be determined how many indications were in the generator that contained the flaw reported in column 1 and how many indications were found in all generators in the same inspection.

PG&E Response:

Table 1 in this letter provides an expanded version for Table 3, "Listing of Extremes of Growth," which was contained in Enclosure 2, "Extreme Values of ODSCC Indications or Growth," of Nuclear Energy Institute (NEI) Letter "Generic Letter 95-05 Alternate Repair Criteria Methodology Updates," dated June 2, 2004 (hereafter referred to as extreme growth values report). Table 1 includes the plant, inspection date, and steam generator (SG) for each extreme growth value in the table. The number of indications in Table 3 in the extreme growth values report are for a single SG in the inspection identifying the extreme value. Table 1 includes the indications in the SG with the extreme value and the total number of indications found in the inspection summed over all SGs.

In addition, as requested by the staff in a phone call on July 30, 2004, Table 4 in this enclosure provides a list of the applications of the axial outside diameter stress corrosion cracking (ODSCC) alternate repair criteria (ARC) that were the basis for the over 80 ARC inspections referred to in the first full paragraph on page 23 of the extreme growth values report. Table 4 identifies the inspections used for counting the number of indications used in the extreme growth values report by an x or a 1, where a 1 indicates an ARC inspection. Additional ARC inspections or inspections conducted similar to an ARC inspection that were not used in counting the number of indications are prefaced by a minus sign in the table. In addition, Table 4 includes the plant identifier and inspection year for each of these applicable inspections.

NRC Question 2:

For each of the 47 extreme values provided in Table 3, please provide:
- the actual bobbin voltage of the indication
- the actual bobbin voltage of the same indication from the previous inspection
- the effective full power years (EFPY) between the two inspections
- the operating temperature between the two inspections

PG&E Response:

Table 1 in this letter provides the actual bobbin voltage of the extreme growth indication at the inspection identifying the extreme value and at the prior inspection. These bobbin voltages have no temperature adjustment. Table 1 also includes the EFPY and operating temperature between the two inspections.

The cycle numbers in Table 1 with an A or B after the number represent partial cycle inspections, where A is the first partial cycle inspection and B is the second partial cycle inspection that completes the overall planned inspected interval. In particular, Cycle 7B for Plant AB-1 had a cycle length of only 0.24 EFPY. Consequently, the end-of-cycle (EOC) volts from this cycle are small but the growth rates given as volts/EFPY (listed as ΔV_2 in Table 1) are significantly higher.

NRC Question 3:

For each of the 47 extreme voltage changes provided in Table 3, please provide the associated information from inspections of that indication with a rotating probe. If the indication was inspected with a rotating probe during the inspection prior to the one in which a large bobbin voltage was found, please provide the rotating probe information from both inspections. The rotating probe information should include the maximum +Point voltage, the indicated length, average depth and maximum depth.

PG&E Response:

Table 1 includes the available rotating pancake coil (RPC) results for the inspection identifying the large growth and the prior inspection. The maximum RPC voltages are Plus Point coil volts except for the Plants AA and AB data, which are pancake coil volts. The older inspections preceded introduction of the Plus Point coil, or the pancake coil was applied for consistency with prior inspection data even after availability of the Plus Point Coil. The RPC length is given when included in the inspection report. Determination of average depths requires sizing techniques for profiling of indication depth versus length, which was not performed for axial ODSCC and thus is not included in the table.

The reporting of maximum depth from RPC data varied significantly over the time frame of the data in Table 1 since a qualified sizing technique was not available for ODSCC. The maximum RPC depths given in Table 1 were calculated specifically for this table by applying an amplitude sizing correlation found to show good

agreement with the Diablo Canyon Power Plant (DCPP) pulled tube depth profiles. This sizing correlation leads to 100 percent depth at 2.75 Plus Point coil volts and provides a consistent estimate for maximum depths. Sizing correlations are not available for pancake coil data. The pancake coil voltages for Plants AA and AB in Table 1 were multiplied by a factor of 0.65 to estimate the Plus Point coil volts for calculations of maximum depth. The factor of 0.65 is given in Section B.10.2 of EPRI Topical Report 1007904, "Steam Generator In Situ Pressure Test Guidelines, Revision 2," dated August 2003, based on comparisons of voltage measurements for electrode discharge machining (EDM) notches. The conversion from pancake coil to Plus Point coil volts adds significant uncertainty to the depth estimates.

NRC Question 4:

For each of the 47 extreme voltage growth entries in Table 3, please indicate whether the extreme voltage change is considered a random event or whether there is a suspected cause for the extreme change (e.g., V. C. Summer extremes). If the extreme voltage change was attributed to a specific cause, please discuss the corrective action implemented to limit the potential for this occurrence.

PG&E Response:

Only the V. C. Summer power plant case for growth extremes is known to have a specific cause sufficient to exclude the data from the extreme values database as discussed in Section 2.3 of the extreme growth values report and Westinghouse Electric Corporation Report SG-93-12-016, "V. C. Summer Steam Generator Tube Integrity Assessment for Cycle 8 Operation," dated December 1993. This cause was accelerated corrosion due to the following three synergistic factors: (1) caustic crevice chemistry over the operating cycle resulting from sodium throw from ammonia breakthrough of the SG blowdown demineralizers, (2) reducible copper acting as an oxidant to accelerate the corrosion, as supported by the highest copper content found in pulled tube examinations in the oxide films on the crack face and outside diameter surface of the tube in the flow distribution baffle (FDB) crevice, and (3) partially packed FDB crevices leading to a large surface area of the deposits permitting more rapid absorption of chemical contaminants than at tube support plate (TSP) intersections. The pulled tube results were a key factor in identifying the causal mechanism for the rapid corrosion of the V. C. Summer tubes. The occurrence of the same or similar phenomena have not been observed at another plant.

No specific cause justifying exclusion from the database could be clearly identified for the large growth rates for the indications in Table 3 of the extreme growth values report. Consequently, the Table 3 results are considered to be random events. The Plant Y-2 extreme value can be attributed to a causal factor based on exponential voltage growth associated with throughwall penetration and normal growth in depth for an indication at or near throughwall at the beginning-of-cycle (BOC). However, for the purposes of Table 3 of the extreme growth values report, the Plant Y-2 and

similar occurrences should be included as they represent a random combination of BOC depth and growth. The limited BOC RPC data in Table 1 for the extreme growth values does not permit a meaningful assessment of how many indications in Table 1 have a causal factor similar to that found for Plant Y-2. NEI submitted letter "ARC Guidelines for Preventive Repair of Large +Point Indications and Noise Requirements for Voltage Based ARC," on April 13, 2004, which provided an enhanced inspection plan to reduce the potential for extreme growth values attributable to near throughwall indications left in service. Pending NRC approval to use the probability of prior cycle detection (POPCD) implementation on a permanent basis, DCPP committed to perform 100 percent Plus Point coil inspection of bobbin indications greater than 1.7 volts to reduce the potential for an extreme growth in PG&E Letter DCL-04-028, "License Amendment Request (LAR) 04-01, Revised Steam Generator Voltage-based Repair Criteria Probability of Detection Method for DCPP Units 1 and 2," dated March 18, 2004.

The Table 3 results of the extreme growth values report (and Table 1 in this letter) show that Plant AC-2 had 17 large growth rates identified at the end of the eighth cycle (EOC-8) across all four SGs. This unit (SGs since replaced) had drilled hole, stainless steel TSPs. Since there is no TSP corrosion in this unit, it is speculated that the crevices may not be packed as tightly as found for carbon steel TSPs, and the more loosely packed crevices might more readily absorb chemical contaminants than the hard packed carbon steel crevices. This could be partly similar to what occurred in the V. C. Summer SGs (in the large holes at the FDB). The potential crevice conditions and the high 620 degrees Fahrenheit operating temperature may have been causal factors for the high growth rates. However, since these causal factor considerations are based on speculation, the indications are conservatively included as random events to increase the frequency of extreme growths in SGs with 3/4 inch tubing.

It is also speculated that the 8 large growth rates per EFPY found for Plant AB-1 at EOC-7B may be a consequence of larger growth rates initially found after a plant shutdown combined with the short operating cycle, which leads to a large EFPY adjustment to the growth rates. However, larger initial growth rates following a shutdown cannot be adequately verified and these indications are also conservatively included as extreme values to increase the extreme growth frequency for 3/4 inch tubing.

An additional example of a potential cause for large growth rates is that for the EOC-4 results for Plant AA-1. An operating chemistry review documented in Westinghouse Electric Corporation Report WCAP-14046, Revision 3, "Braidwood Unit 1 Technical Support for Cycle 5 Steam Generator Interim Plugging Criteria," dated March 1995, identified high sodium to chloride molar ratios indicative of caustic crevice conditions over Cycle 3 and into Cycle 4. Actions were taken to improve the molar ratio and boric acid additions were made to improve crevice chemistry but these actions did not prevent the large growth rates found for Cycles 5A and 6. These results indicate that chemistry was a contributing factor to

the large growth rates, but the evidence is not considered sufficient to clearly identify chemistry as the causal factor for the large growth rates.

NRC Question 5:

For the V. C. Summer case, where 5 large-voltage indications were found in SG "B" in one inspection, please provide for each of the indications in Table 4:
- the bobbin voltage from the previous inspection for the 5 indications in Table 4
- the EFPY between the two inspections
- if there is rotating probe data on any of these flaws from the previous inspection, the rotating probe information as requested in question 3, above.
- the operating temperature between the two inspections
- the number of other indications in SG "B" for the 1993 inspection
- the same information for any large-voltage indications in SGs "A" and "C" in 1993
- the number of other indications in SGs "A" and "C" in 1993.

PG&E Response:

The requested information is provided in Table 2 of this letter as obtained from Report SG-93-12-016 and supplemental Westinghouse data. RPC volts for a known voltage calibration are only available for the three pulled tubes identified in Table 2. Meaningful RPC volts are not available for the other two tubes identified in Table 4 of the extreme growth values report since the calibration is not known and is clearly different from current practice to normalize at 20 volts for a throughwall EDM notch. The 1991 inspection was not an ARC inspection and the indications were not reported during the inspection. Reevaluation of the bobbin data to the ARC guidelines identified the flaws with the bobbin voltages given in Table 2.

NRC Question 6:

The report attributes the V. C. Summer large-voltage indications to an atypical physical cause, rather than to a random occurrence of extreme voltage growth (outliers). When there are unexpected observations, there is often an attempt to explain them with the concurrence of other known factors, but rarely enough information available to prove or disprove the hypothesized causal relationship. How would the information in this Extreme Values report provide a suitable statistical test for deciding whether to treat a similar occurrence in the future as a manifestation of random outliers or a non-random occurrence?

PG&E Response:

The information in the extreme growth values report cannot provide a suitable statistical test. The classification as a nonrandom occurrence must be made on the information in the destructive exam report and/or a known plant transient such as a major chemistry excursion (none established for ARC data). V. C. Summer is considered a physical cause based on data from both the destructive exam report

and the operating chemistry history as discussed in the response to Question 4. PG&E agrees that there is rarely enough information to prove or disprove a causal relationship. When this information is inconclusive, the indications are treated as random events such as discussed in the Question 4 response.

NRC Question 7:

How would the information in this report provide a suitable statistical test for deciding how to treat (random or causal) an occurrence of extreme bobbin voltage indications in successive inspections at the same plant?

PG&E Response:

A statistical test for deciding whether an extreme growth value is random or causal has not been defined due to the general difficulty in defining a causal relationship. The occurrences in successive inspections would be treated as random unless there is specific destructive exam and/or field data, such as a large chemistry excursion, identifying a causal event.

For the extreme growth values of Table 1 of the extreme growth values report, Plant A-1 had extreme values in successive Cycles 14 and 15. For the operating temperatures of plants with 7/8 inch tubing (about 610 degrees Fahrenheit or less), only the Cycle 15 indication in SG C exceeds the extreme growth values report guideline of 5 volts/EFPY for an extreme value. Tube R2C85 in SG C from Plant A-1 was pulled at EOC-14 and destructively examined. The destructive exam identified fatigue striations at the flaw which were likely attributable to pressure pulse cleaning following the EOC-13 inspection. The associated fatigue likely contributed to the higher voltage for this indication. The indications at EOC-15 followed a mid-cycle inspection due to a leaker not related to TSP indications and SG C was not inspected during the mid-cycle outage. The conclusions on the contributing causes are not sufficient to exclude the data from the extreme growth database.

Plant AA-1 had extreme values in successive Cycles 4 and 5A (mid-cycle inspection). None were found in Plant AA-1 Cycle 5B, but extreme growths were found again in Cycle 6. Plant AB-1 had extreme values in Cycle 6 with none in Cycle 7A and reoccurrence of extreme values in Cycle 7B. Potential contributing factors for these large growths were discussed in the response to Question 4.

For plants currently applying the TSP ARC, there have been either no large growth rates greater than 5 volt/EFPY or single occurrences as given in Table 1 of the extreme growth values report for Plants W-2 and Y-2.

NRC Question 8:

Please explain how the "judgment" (stated on page 22) for limiting the number of extremes in the simulation is used in the analysis. If it is used, please provide the

basis for the statement that 5E-5 is the appropriate value. In demonstrating the adequacy of such an approach, please provide a case for 3/4-inch tubes in a generator that operates at 620 degrees Fahrenheit. The data in Table 3 indicates that 38 of the 42 extremes for the 3/4-inch tubes occur as multiple outliers in a single inspection, with as many as 7 occurring in a single inspection, while the outlier data for the 7/8-inch tubes has only 5 examples from 5 separate inspections.

PG&E Response:

The 5E-5 value is not directly used in the Monte Carlo analyses for extreme growth values. The recommended method for implementation is to include multiple extremes in the analysis until the probability of occurrence for an extreme is less than unity for the operating temperature and number of Monte Carlo simulations being performed. Table 6 of the extreme growth values report provides examples for 100,000 simulations of a SG with 500 indications and at an operating temperature of 603 degrees Fahrenheit. For 7/8 inch tubing, calculations for 2 simultaneous extremes would be required. Calculations for 4 simultaneous extremes would be required for 3/4 inch tubing. Larger numbers of extremes would be required for increases in operating temperature or number of simulations.

Table 1 of this letter provides data that can be used to more clearly identify the multiple extreme voltage growth indications found in a single inspection. For 7/8 inch tubing, 2 extreme voltage growth indications occurred in the Plant A-1 Cycle 15 inspection although only 1 would be considered an extreme voltage growth indication (i.e., growth greater than 5 volts/EFPY) for the operating temperatures of plants with 7/8 inch tubing (i.e., about 610 degrees Fahrenheit or less). For 3/4 inch tubing: Plant AA-1 had 4 extreme voltage growth indications for Cycle 4 and 9 extreme voltage growth indications for Cycle 6; Plant AB-1 had 3 extreme voltage growth indications for Cycle 6 and 8 extreme voltage growth indications for Cycle 7B; and Plant AC-2 had 17 extreme voltage growth indications for Cycle 8. For these outages, the extreme values method would predict probabilities in the range of about 36 percent to 52 percent for 1 or more extreme voltage growth indications. The extreme values method would not be expected to predict the number of extreme voltage growth indications found in these inspections. Probable, although not uniquely verifiable, contributing causes for the number of extreme voltage growth indications found in these inspections are discussed in the response to Question 4.

There have only been two isolated occurrences of large growth values for plants currently applying the TSP ARC (see Table 1 of the extreme growth values report for Plants W-2 and Y-2).

NRC Question 9:

Please discuss whether the use of this methodology would have resulted in a conservative projection of the end-of-cycle conditions for the 2003 outage at Diablo

Unit 2 (i.e., benchmark this methodology for your prior cycle). In addition, discuss the effects this methodology has on your current projections (in terms of number of indications, severity of indications, probability of burst, and accident induced leakage). Could you have left additional tubes in service for the current cycle if this methodology was used? What would the effect of leaving those tubes in service have been with respect to (1) your projections for the end-of-cycle condition, and (2) the probability of finding an additional indication with extreme bobbin voltage growth at your next inspection.

PG&E Response:

The methodology would not be expected to result in the conservative projection of the EOC conditions for any one specific outage for any specific SG if the appearance of a singularly large extreme growth actually occurred. Results that are being strongly influenced by the appearance of such an extreme value and the time of occurrence of the largest extreme cannot be predicted absolutely because the largest extreme is a random variable. The methodology was developed to account for large extremes on an average basis. Therefore an error in the application of the methodology would be indicated if it resulted in a conservative prediction of the EOC conditions for an outage when the largest extreme occurred.

Benchmarking was performed for the limiting DCPP SG (2-4) for the probability of burst (POB) integrity calculation at EOC-11 to provide numerical comparisons. The as-found condition results were taken from Table 6-13 of the 2R11 SG 90-day report contained in Enclosure 4 of PG&E Letter DCL-03-076 dated June 23, 2003. The EOC-11 projections were recalculated using actual SG 2-4 Cycle 11 voltage dependent growth with breakpoints at 0.59 and 1.66 (Tables 3-9 thru 3-11 of PG&E Letter DCL-03-076 provide the growth distributions), the DCPP POPCD through 2R11, and with and without the extreme (outlier) growth method. These results are compared with the as-found conditions, with and without the R44C45-2H flaw detected as a 21.5-volt flaw during Unit 2 refueling outage 11 (2R11). Table 3 of this Enclosure provides the results of these calculations.

Comparison of the POB for calculations that contain no effect of the R44C45-2H flaw in either the as-found distribution or EOC-11 growth distribution shows a slight under prediction of the EOC-11 conditions. Comparison of the POB for calculations that contain the R44C45-2H flaw in both the as-found distribution and the Cycle 11 growth distribution also shows a slight under prediction of the EOC-11 conditions. The results of both of these comparisons are similar to those presented in the 2R11 90-day report (Table 6-13 of PG&E Letter DCL-03-076) where the differences were determined to be related to the as-found calculation's susceptibility to be inflated due to the application of the nondestructive examination analyst uncertainty as a percentage of the flaw voltage on the large number of higher voltage indications at EOC-11.

The last comparison is the application of the new extreme growth method that used the growth from the R44C45-2H flaw only in the extreme distribution. The extreme method does not conservatively project EOC-11 POB conditions when the as-found distribution includes the R44C45-2H flaw. The difference is expected since the method randomly determines the probability of an extreme growth occurring in the population of flaws returned to service for the cycle and applies the extreme growth only in a random manner. The intent of the extreme growth method is to provide additional conservatism to projections that utilize POPCD in operational assessments. By comparing the POB results to the EOC-11 projection that did not use the R44C45-2H flaw or the extreme growth method, the increase in POB due to the application of the extreme growth method can be quantified (i.e., increase of 4.3E-04, which is the difference between 3.98E-03 and 3.55E-03). As previously discussed with the NRC staff and presented above, the extreme growth method cannot predict the actual occurrence of an extreme growth occurring during a given cycle. It can only provide the impact of the probability of occurrence based on past industry experience, weighed against the population of flaws being returned to service. Therefore, the application of the extreme growth method in operational assessments will not produce conservative results in projections when they are compared to as-found conditions that contain an indication that experienced the largest extreme growth during the cycle (i.e., the R44C45-2H flaw).

The DCPP Unit 2 EOC-12 conditions were also re-predicted using the extreme growth methodology and the results were presented in response to NRC question 9e in PG&E Letter DCL-04-104 dated August 18, 2004. A preventive repair criteria of 1.2 volts was used in 2R11, and the resulting EOC-12 POB in SG 2-4 using DCPP POPCD and voltage dependent growth with the R44C45-2H flaw growth rate in the upper bin was 6.62E-03, leaving some margin to the 1.0E-02 criteria. This is a very conservative prediction because the BOC-12 upper voltage range (greater than 1.66 v), although only slightly populated with indications resulting from POPCD and a 1.2 volt repair criteria, is significantly affected by the frequency of occurrence of the 11.9 volt/EFPY growth rate (1 out of 20 indications) during the simulations. If this growth rate is removed from the input file, a more realistic POB at EOC-12 in SG 2-4 is 3.30E-03, leaving even more margin. After applying the extreme growth method to this simulation, the POB increases to 3.43E-03 (increase of 1.3E-04). These results demonstrate the effect of having the 11.9 volt/EFPY growth available to the simulation directly, versus including it in application of the extreme growth method. Based on the extreme growth method combined with the margin already available, DCPP could have utilized the standard 2.0-volt repair limit at 2R11, which would have resulted in an EOC-12 POB calculated at 7.97E-03 for SG 2-4.

The total number of indications projected to exist at EOC-12 is not affected by the use of the extreme growth method. The number of indications projected to exist at EOC-12 in SG 2-4 is approximately 1670 and is a function of the DCPP POPCD used in the simulations. The main difference in EOC-12 distributions between the extreme growth method versus including the R44C45-2H flaw growth in the upper

growth distribution is the distribution of indications in the upper tail. The use of the extreme method results in a much lower population of indications in the upper tail of the projected distribution and thus a lower POB. Figure 1 provides a portion of the EOC-12 distribution upper tail in the higher voltage ranges and demonstrates the lower number of indications in this range using the extreme growth method, compared to the calculation that used a R44C45-2H flaw growth rate in the upper voltage growth bin. In order to more easily illustrate the differences, the number of indications is not adjusted for the number of trials that were run in the simulations (500,000). As is shown, the number of high voltage indications is significantly different in this voltage range and thus ultimately affects the chance of a burst tube condition during the simulations. Therefore, the number of trials that had at least one burst below the steam line break (SLB) burst margin requirement of 2405 psi were 1646 for the extreme growth simulation, compared to 3213 for the case where high growth was directly included in the upper bin, resulting in the POB differences listed in the previous paragraph for EOC-12.

Leaving the additional tubes in service (i.e., using the 2.0-volt repair limit) would not have significantly increased the potential for an extreme voltage growth to occur at EOC-12. Extensive Plus Point coil inspections were performed at 2R11 to aid in identifying potential indications that had a high Plus Point coil voltage and a lower bobbin coil voltage. Figure 2 provides the results of this comparison. The NEI letter dated April 13, 2004, provides industry guidance for a preventive repair criteria for bobbin indications less than or equal to 2.0 volts when the corresponding Plus Point coil voltage is greater than 1.9 volts. If this guidance is taken into account for the 2R11 data, there were 3 indications at EOC-11 that met this criterion and would have been repaired. Based on the Plus Point coil inspections performed at 2R11 and the lessons learned from the discovery of the R44C45-2H flaw, as well as the relative infrequent occurrences of extreme growth in 7/8 inch tubing SGs, there is no reason to suggest that an extreme growth would occur during Cycle 12, even using a 2-volt repair criteria at 2R11.

NRC Question 10:

You indicated that the frequency of occurrence of extreme voltage changes does not appear to be increasing. In addition, you indicated that the nature of the population of indications does not appear to be a significant factor other than indirectly through the number of indications. Please discuss the basis for these statements and discuss how you plan to monitor these assumptions and your proposed corrective actions if your assumptions are not satisfied.

PG&E Response:

The statement in Section 1.0 of the extreme growth values report that the frequency of occurrence of indications greater than 5 volts/EFPY does not appear to be increasing is based on the general observation of the inspection years for the data given in Table 1 of this response. The inspection years having extremes are 1994

(2 plants), 1995, 1996, 1997 (2 plants), 1998, 2002 and 2003 (2 plants). No extreme voltage growth indications were identified in 1999 to 2001. None have been identified in 2004 through the spring outages. Thirty-four of the 47 indications in Table 1 occurred in the 1996, 1997 and 2001 inspections at 3 plants. These data support the general observation that the frequency of extreme voltage growth indications is not increasing with time.

Section 6.1.1 of the extreme growth values report includes the statement that the maturity of the population does not appear to be a significant factor other than indirectly through the number of indications and the number of indications in service at or near throughwall in depth. Maturity is intended to relate to the number of years of operation with axial ODSCC at TSP intersections, particularly with the ARC implemented. Some plants have operated with ODSCC for many years with no occurrences of extreme growth values in the mature population (e.g., Plants P-1, W-1, Y-1, A-2, AC-1, AE-1). Maturity of the population does tend to increase the number of indications and the number of indications left in service just below the repair limit (i.e., highest potential for at or near throughwall indications). The number of indications is directly included in the extreme values analysis methodology. This conservatively addresses the number of near throughwall indications, which are the more likely candidates for large voltage increases.

As noted in Section 11.0 of the extreme growth values report, the database of Table 3 will be updated in each ARC addenda and plants applying the extreme growth methods will identify occurrences of extreme growths (i.e., greater than 5 volts/EFPY) in their 90-day reports. These data provide the basis for updating Table 3, monitoring the trends relative to time for extreme voltage growth occurrences and including any changes in the trends in the analysis. The most important corrective action for any change in the extreme growth trends is to ensure that the changes are promptly included in the analyses, which is accomplished by the data updates. Any need for additional corrective actions would be based on the specific occurrences, frequencies, etc. and cannot be readily defined prior to the event.

<u>NRC Question 11:</u>

Near the end of the Introduction section, you provide an example where a voltage change of 5 volts per effective full power year (EFPY) is added to a 2 to 4 volt indication and indicate that it remains below the structural limit for 7/8-inch tubes. Given that the voltage change is in effective full power years, discuss why this voltage change was not adjusted for a typical cycle length (e.g., 1.5 EFPY). In addition, please provide a similar example for 3/4-inch tubes and discuss whether the extreme voltage change methodology should be changed to result in a lower threshold value (i.e., different than 5 volts per EFPY).

PG&E Response:

The addition of a 7.5-volt growth (5 volts/EFPY at 1.5 EFPY) to the ARC repair limits would exceed the SLB structural limits at 2405 psi of about 5.67 volts for 3/4 inch tubing but not the 9.62 volt limit for 7/8 inch tubing, based on values from EPRI Topical Report NP 7480-L, Addendum 5, "Steam Generator Tubing Outside Diameter Stress Corrosion Cracking at Tube Support Plates Database for Alternate Repair Limits, Update 2002," dated January 2003. The ARC burst probability reporting guideline of $1x10^{-2}$ would not be exceeded for a single indication of either tube size. For 7/8 inch tubing at 9.5 volts, the single indication burst probability is about $9x10^{-4}$, and for 3/4 inch tubing at 8.5 volts, the single indication burst probability is about $8x10^{-3}$.

The application of a 5-volt/EFPY value to define an extreme growth value is more conservative for 7/8 inch tubing than for 3/4 inch tubing. The threshold could be lowered for 3/4 inch tubing but simplicity in the definition and compensating factors in the analysis led to the recommended single value for both tube sizes.
For 3/4 inch tubing, the 5-volt/EFPY value leads to a high frequency of occurrence for extreme growth (i.e., 42 values at the typical operating temperature near 620 degrees Fahrenheit) and the addition of a few more values would not substantially change the probability of an extreme voltage growth indication, which is proportional to the number of extreme voltage growth indications in the analysis (i.e., 4 additional extreme voltage growth indications increases the probability by about 10 percent for 3/4 inch tubing). When applying the extreme values methodology, the growth rates exceeding the 5-volt/EFPY threshold are included in the extreme growth analysis and excluded from the growth rate distribution used in the Monte Carlo analyses. The inclusion of large growths in the growth distribution has a greater influence on burst and leakage than including them in the extreme growth analysis. Overall, it is considered to be appropriate to apply the 5-volt/EFPY threshold for an extreme growth value to both 3/4 inch and 7/8 inch tubing.

NRC Question 12:

In adjusting the voltage changes for temperature, the "standard" temperature was quoted as 610°F (pg. 19), 620°F (pg. 20), and 603°F (pg. 8). Please clarify.

PG&E Response:

The use of the three reference or standard temperatures is to permit tabulations of extreme growth values that are representative of operating SGs and that linear interpolation between temperatures is an acceptable approximation. Table 3 of the extreme growth values report, which is to be maintained and updated as part of the ARC database reports, is based on the three reference temperatures. The text sections cited in the question are included to apply each of the reference temperatures with the context of the report. The extreme values and frequency are to be applied in the analysis at the plant specific operating temperature.

NRC Question 13:

In Section 2.0 of your report, you indicate that it "appears from the discussions that it is technically desirable to keep track of normal and extreme values for the probability of burst and growth rate, however, it is somewhat impractical because there are no criteria that could be applied based on the results of the calculations." The basis for this statement is not clear. Are there parameters directly related to the expected occurrence of outliers that would be useful for cycle-specific projections? For example, would it be useful to project the probability of finding an outlier that exceeds 10 volts (or some other voltages) in the next inspection? Is there a useful measure for the burst probability and leakage rate contributions from outliers, alone? Such projections could still be useful without acceptance criteria for them, because they would provide a visible reminder that outliers are included in the process and a means to check whether their occurrence is staying within or straying from expectations.

PG&E Response:

The basis for the "no criteria" part of the cited statement is that the ARC acceptance guidelines are based on total burst probability or leakage and no criteria are applicable to the extreme voltage growth portion of the total values. The "practical" element relates to complications introduced in the Monte Carlo codes if it is necessary to calculate and edit specific contributions to burst probability or leakage.

The extreme growth rates are tracked through the updates of Table 3 of the extreme growth values report. This table provides the key parameters related to the expected occurrence of extreme voltage growth indications that is useful for cycle-specific projections. The probability of finding an extreme voltage growth above a specific threshold in the operational assessment is obtained from the projected EOC voltage distribution, which is edited by the Monte Carlo codes and typically included in 90-day reports.

A measure of the contributions to burst and leakage from extreme voltage growth indications is useful information particularly for the initial applications of the extreme values methodology and as a means of checking against expectations. It should be noted that the expectations will increase with additions to the database. These results can be and are generally expected to be obtained by running Monte Carlo operational assessments with and without the extreme growth model in the analyses such as given in the DCPP analysis results provided in response to Question 9.

NRC Question 14:

In Section 7 of your report, you discuss plants who are authorized to implement the voltage-based tube repair criteria in Generic Letter 95-05. Please clarify whether Prairie Island 2 should have been included in the list (the staff is aware that it has not yet implemented the criteria similar to Beaver Valley 2).

PG&E Response:

The statement in Section 7 of the extreme growth values report identified the 7 plant sites for which the ARC are still being applied. Since Prairie Island Unit 2 could potentially implement the ARC in the future, it should have been included with the statement that it may implement the ARC in the future although there are no immediate plans for implementation of the ARC.

Table 1
Supplemental Data for Extremes of Growth
(ARC Data Through Spring 2004, *M* = 115,179 Total ARC Bobbin Indications)

Index	Tube Dia.	Plant	Cycle	Insp. Date	EFPY	Temp. °F	SG	Ind. in SG	Ind. in all SGs	Tube Row & Column	EOC Bobbin Volts	EOC RPC Volt	EOC RPC L(in.)	EOC[1] RPC Dmax	BOC Bobbin Volts	BOC RPC Volt	BOC RPC L(in.)	BOC[1] RPC Dmax	ΔV_2 600°F	ΔV_2 603°F	ΔV_2 610°F	ΔV_2 620°F
2	7/8	A-1	14	Apr-97	1.320	610.9	C	1140	3074	R2C85	13.74	4.9	0.71	100%	1.36	NA	NA	NA	7.22	7.77	9.18	11.62
11	7/8	A-1	15	Nov-98	1.290	610.9	C	1362	3502	R20C42	10.15	10.52	0.73	100%	1.23	NA	NA	NA	5.32	5.72	6.77	8.57
40	7/8	A-1	15	Nov-98	1.290	610.9	B	1101	3502	R2C75	7.17	3.92	0.69	100%	1.43	NA	NA	NA	3.43	3.68	4.36	5.51
20	3/4	AA-1	4	May-94	1.147	609.0	A	706	2731	R45C41	8.33	8.25	0.40	100%	1.66	NA	NA	NA	4.68	5.04	5.96	7.54
37	3/4	AA-1	4	May-94	1.147	609.0	A	706	2731	R18C23	5.54	6.72	0.48	100%	0.50	NA	NA	NA	3.54	3.81	4.50	5.69
3	3/4	AA-1	4	May-94	1.147	609.0	D	694	2731	R37C34	10.44	8.62	NA	100%	0.68	NA	NA	NA	6.86	7.37	8.71	11.03
9	3/4	AA-1	4	May-94	1.147	609.0	D	694	2731	R23C12	8.82	8.78	NA	100%	0.76	NA	NA	NA	5.66	6.09	7.20	9.11
21	3/4	AA-1	5A	Sep-95	0.714	609.0	C	1526	3935	R15C73	5.13	4.89	0.73	100%	1.01	1.17	0.43	76%	4.65	5.00	5.91	7.48
13	3/4	AA-1	6	Apr-97	1.035	614.0	A	1770	6784	R41C65	8.94	6.07	0.42	100%	1.47	NA	NA	NA	5.16	5.55	6.57	8.31
14	3/4	AA-1	6	Apr-97	1.035	614.0	A	1770	6784	R15C74	8.55	5.04	0.41	100%	1.23	NA	NA	NA	5.06	5.44	6.43	8.14
7	3/4	AA-1	6	Apr-97	1.035	614.0	C	2104	6784	R16C41	9.82	9.30	0.43	100%	1.52	1.64	0.609	83%	5.74	6.17	7.29	9.23
8	3/4	AA-1	6	Apr-97	1.035	614.0	C	2104	6784	R11C108	10.48	9.37	0.43	100%	2.19	1.99	0.601	86%	5.73	6.16	7.29	9.22
22	3/4	AA-1	6	Apr-97	1.035	614.0	C	2104	6784	R16C76	7.41	7.06	0.55	100%	0.89	NA	NA	NA	4.51	4.85	5.73	7.25
26	3/4	AA-1	6	Apr-97	1.035	614.0	C	2104	6784	R13C73	9.15	7.84	0.39	100%	2.94	2.76	0.547	92%	4.29	4.62	5.46	6.91
27	3/4	AA-1	6	Apr-97	1.035	614.0	C	2104	6784	R15C69	7.31	6.61	0.45	100%	1.13	NA	NA	NA	4.27	4.59	5.43	6.87
30	3/4	AA-1	6	Apr-97	1.035	614.0	C	2104	6784	R27C79	7.83	7.21	0.41	100%	1.85	NA	NA	NA	4.13	4.45	5.26	6.65
28	3/4	AA-1	6	Apr-97	1.035	614.0	D	2102	6784	R15C7	8.82	7.38	0.44	100%	2.64	3.34	0.538	96%	4.27	4.59	5.43	6.87
25	3/4	AB-1	6	Sep-94	1.277	608.0	A	802	3075	R3C3	7.64	5.74	NA	100%	0.93	NA	NA	NA	4.34	4.66	5.51	6.97
33	3/4	AB-1	6	Sep-94	1.277	608.0	A	802	3075	R20C7	7.10	3.69	NA	97%	1.14	NA	NA	NA	3.85	4.14	4.89	6.19
4	3/4	AB-1	6	Sep-94	1.277	608.0	C	899	3075	R20C7	10.95	4.59	NA	100%	1.09	NA	NA	NA	6.37	6.85	8.10	10.25
29	3/4	AB-1	7B	May-96	0.240	609.0	A	1023	5719	R13C4	3.49	2.31	NA	89%	2.23	0.58	0.376	63%	4.23	4.55	5.38	6.80
5	3/4	AB-1	7B	May-96	0.240	609.0	B	1791	5719	R21C103	3.33	1.24	NA	77%	1.47	NA	NA	NA	6.24	6.71	7.94	10.04
10	3/4	AB-1	7B	May-96	0.240	609.0	B	1791	5719	R14C109	3.44	3.53	NA	97%	1.83	NA	NA	NA	5.40	5.81	6.87	8.69
15	3/4	AB-1	7B	May-96	0.240	609.0	B	1791	5719	R19C104	4.45	2.16	NA	88%	2.95	0.91	0.502	72%	5.04	5.41	6.40	8.10
6	3/4	AB-1	7B	May-96	0.240	609.0	C	2040	5719	R12C16	2.38	NA	NA	NA	0.64	NA	NA	NA	5.84	6.28	7.42	9.40
16	3/4	AB-1	7B	May-96	0.240	609.0	C	2040	5719	R24C28	2.23	NA	NA	NA	0.73	NA	NA	NA	5.04	5.41	6.40	8.10
17	3/4	AB-1	7B	May-96	0.240	609.0	C	2040	5719	R40C79	2.72	NA	NA	NA	1.24	NA	NA	NA	4.97	5.34	6.32	7.99
24	3/4	AB-1	7B	May-96	0.240	609.0	C	2040	5719	R38C81	2.21	2.15	NA	88%	0.91	NA	NA	NA	4.36	4.69	5.55	7.02
34	3/4	AC-2	8	Mar-01	1.254	620.0	A	611	3580	R23C24	8.05	7.03	0.63	100%	0.38	NA	NA	NA	3.80	4.09	4.83	6.12
39	3/4	AC-2	8	Mar-01	1.254	620.0	A	611	3580	R20C80	7.32	6.47	0.67	100%	0.39	NA	NA	NA	3.44	3.69	4.37	5.53
41	3/4	AC-2	8	Mar-01	1.254	620.0	A	611	3580	R22C78	7.05	5.40	0.66	100%	0.22	NA	NA	NA	3.39	3.64	4.30	5.45
47	3/4	AC-2	8	Mar-01	1.254	620.0	A	611	3580	R22C30	6.95	5.61	0.61	100%	0.61	NA	NA	NA	3.14	3.38	4.00	5.06

Table 1
Supplemental Data for Extremes of Growth
(ARC Data Through Spring 2004, *M* = 115,179 Total ARC Bobbin Indications)

Index	Tube Dia.	Plant	Cycle	Insp. Date	EFPY	Temp. °F	SG	Ind. in SG	Ind. in all SGs	Tube Row & Column	EOC Bobbin Volts	EOC RPC Volt	EOC RPC L(in.)	EOC[1] RPC Dmax	BOC Bobbin Volts	BOC RPC Volt	BOC RPC L(in.)	BOC[1] RPC Dmax	ΔV_2 600°F	ΔV_2 603°F	ΔV_2 610°F	ΔV_2 620°F
19	3/4	AC-2	8	Mar-01	1.254	620.0	B	1229	3580	R15C89	9.72	7.61	0.71	100%	0.18	NA	NA	NA	*4.73*	*5.08*	*6.01*	*7.61*
44	3/4	AC-2	8	Mar-01	1.254	620.0	B	1229	3580	R20C48	6.93	4.90	0.44	100%	0.20	NA	NA	NA	*3.34*	*3.59*	*4.24*	*5.37*
31	3/4	AC-2	8	Mar-01	1.254	620.0	C	972	3580	R20C106	8.16	7.19	0.58	100%	0.30	NA	NA	NA	*3.90*	*4.19*	*4.95*	*6.27*
32	3/4	AC-2	8	Mar-01	1.254	620.0	C	972	3580	R20C73	8.07	7.43	0.61	100%	0.28	0.86	NA	79%	*3.86*	*4.15*	*4.91*	*6.21*
36	3/4	AC-2	8	Mar-01	1.254	620.0	C	972	3580	R19C79	7.69	6.88	0.46	100%	0.53	NA	NA	NA	*3.55*	*3.82*	*4.51*	*5.71*
42	3/4	AC-2	8	Mar-01	1.254	620.0	C	972	3580	R22C92	7.36	7.20	0.55	100%	0.54	NA	NA	NA	*3.38*	*3.64*	*4.30*	*5.44*
12	3/4	AC-2	8	Mar-01	1.254	620.0	D	768	3580	R24C47	11.06	9.05	0.37	100%	0.34	NA	NA	NA	*5.31*	*5.71*	*6.76*	*8.55*
18	3/4	AC-2	8	Mar-01	1.254	620.0	D	768	3580	R10C109	10.37	5.05	0.62	100%	0.44	NA	NA	NA	*4.92*	*5.29*	*6.26*	*7.92*
35	3/4	AC-2	8	Mar-01	1.254	620.0	D	768	3580	R25C72	7.45	4.62	0.68	100%	0.27	NA	NA	NA	*3.56*	*3.83*	*4.52*	*5.73*
38	3/4	AC-2	8	Mar-01	1.254	620.0	D	768	3580	R24C68	7.85	4.93	0.7	100%	0.85	NA	NA	NA	*3.47*	*3.73*	*4.41*	*5.58*
43	3/4	AC-2	8	Mar-01	1.254	620.0	D	768	3580	R25C47	7.21	6.07	0.54	100%	0.47	NA	NA	NA	*3.34*	*3.59*	*4.25*	*5.37*
45	3/4	AC-2	8	Mar-01	1.254	620.0	D	768	3580	R24C46	7.06	6.71	0.58	100%	0.39	NA	NA	NA	*3.31*	*3.56*	*4.20*	*5.32*
46	3/4	AC-2	8	Mar-01	1.254	620.0	D	768	3580	R23C42	6.82	6.12	0.57	100%	0.30	NA	NA	NA	*3.23*	*3.48*	*4.11*	*5.20*
23	7/8	W-2	12	Nov-03	1.373	609.7	3	307	1545	R8C58	9.76	8.56	0.75	100%	1.98	NA	NA	NA	*4.49*	*4.83*	*5.71*	*7.22*
1	7/8	Y-2	11	Feb-03	1.643	603.0	4	982	1873	R44C55	21.5	12.24	0.75	100%	2.00	2.47	0.71	100%	*11.04*	*11.87*	*14.04*	*17.77*

Notes:
1. Maximum depth calculated from amplitude sizing for Plus Point coil volts by applying a correlation based on 2.75 Plus Point coil volts for 100 percent depth. When volts are pancake coil data (Plants AA and AB), pancake coil volts are adjusted by factors of 0.65 for 3/4 inch tubing (Reference: EPRI Topical Report 1007904, Section B.10.2), respectively, to estimate Plus Point coil volts.

Table 2
1.22 EFPY, Operating Temperatures of 619, 617, and 616 degrees Fahrenheit for SGs A, B, and C Respectively

	1993 Inspection				1991 Inspection	
SG B Tube	**Field Bobbin Volts**	**RPC Maximum Volts 300 kHz (Pancake Coil)**	**RPC Length (inch)**	**RPC Max-imum Depth[4]**	**Bobbin Volts[1]**	**RPC Volts**
R42C43	22.32[2]	10.8	0.64	100%	0.73	Not Inspected
R28C41	11.59[2]	7.7	0.72	100%	1.09	Not Inspected
R33C20	9.84[2]	6.4	0.56	100%	0.56	Not Inspected
R31C45	7.72	Confirmed[3]	Not Reported		0.50	Not Inspected
R30C45	6.02	Confirmed[3]	Not Reported		0.31	Not Inspected
SG	**Total No. Bobbin Indication Calls Excluding 5 Largest**	**Largest Bobbin Volts Excluding 5 Largest**				
A	122	3.13-FDB(TSP 1)				
B	214	2.81-TSP 2				
C	212	2.22-TSP 2				

Notes:
1. 1991 Field calls were no detectable degradation. Bobbin volts based on reanalysis of 1991 data to ARC bobbin coil analysis guidelines.
2. Bobbin coil volts after cross calibration to reference laboratory standard are 22.9, 11.8 and 9.8 for these pulled tubes. These tubes were pulled and destructively examined.
3. RPC confirmed but voltages not available for current calibration methods.
4. Maximim depth calculated from amplitude sizing for Plus Point coil volts. Pancake coil volts adjusted by factor of 0.65 to estimate Plus Point coil volts.

Table 3
SG 2-4 EOC-11 POB Comparison

As Found	Projected *
w/o R44C45-2H flaw – 3.84E-03	w/o Extreme and w/o R44C45-2H flaw growth – 3.55E-03
w/ R44C45-2H flaw – 2.38E-02	w/o Extreme, with R44C45-2H flaw in growth – 2.31E-02
	w/ Extreme and w/o R44C45-2H flaw in growth – 3.98E-03

* Used SG Cycle 11 Voltage Dependent Growth, DCPP POPCD

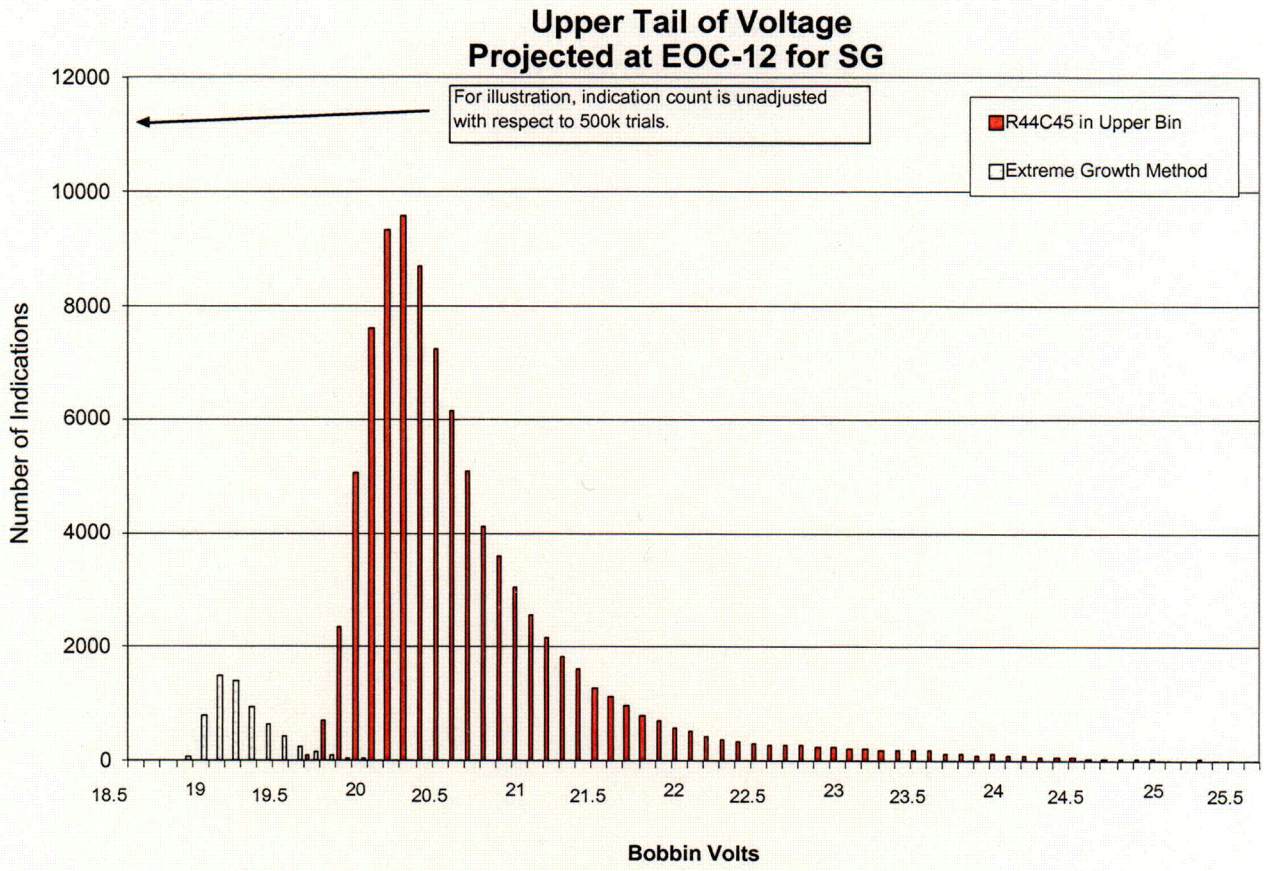
Table 4
Summary of ODSCC Inspections by Calendar Year

Plant Data			Inspection Year (1 = IPC/ARC Inspection, x = pre-IPC/ARC Inspection Conducted Similar to ARC Inspection)																
Plant	Tube Dia. (inch)	No. SGs	1986 to 1991[1]	1992	1993	1994	1995	1995b	1996	1997	1998	1999	2000	2001	2002	2003	2004	No. Plant Insp.[2]	No. SG Insp.
AA-1	3/4	4				1	1	1		1								4	16
AB-1	3/4	4				1	1		1									3	12
R-1	3/4	4		x	1		1											3	12
AE-1	3/4	4							-x		-x	1		1	1		-1	3	12
AC-1	3/4	4				-x	-1		1	1		1						3	12
AC-2	3/4	4								1	1	1		1				4	16
DW-1	3/4	4												-x	1	1		2	12
3/4" Tube Totals																		**22**	**92**
P-1	7/8	3	x (2)		x		1		1	1			1	1		1		9	21
D-1	7/8	4			x	1	1		-1		-1							3	12
Y-1	7/8	4								-x		1	1		1		1	4	16
Y-2	7/8	4							-x		1	1		1		1		4	20
A-1	7/8	3	x (4)	x		1	1			1	-1	1						9	27
A-2	7/8	3	x (2)	x	1		1		1		1	1						9	27
F	7/8	2	x (4)	x	x	x	1		1		-1							9	18
U-1	7/8	2								1	1	1		1		1		5	10
W-1	7/8	4				-x	1			1	1		-1	1				4	16
W-2	7/8	4							1	1		1	1		1	1		6	24
L	7/8	4	-1	-1														0	8
7/8" Tube Totals																		**62**	**199**
Overall Totals			12	4	5	5	9	1	6	9	6	9	3	6	4	5	0	**84**	**291**

Table 4 Notes:

1. A number in parentheses indicates that number of pre-ARC inspection datasets that were counted.
2. A minus in front of a designation indicates that the data were not used in the total count of indications, e.g., -1 and –x. There were no meaningful large extreme indication growth rates associated with the unavailable complete data sets (unavailable for the compilation of the database). Six 3/4 inch and ten 7/8 inch diameter tube set totals were not included in the overall indication total. If these data were available for inclusion, the number of extremes would not increase while the total number of ARC inspections would increase to 100 and the total number of indications in the population would correspondingly increase. The omission of total indication data is a conservative treatment of the large extremes probability.

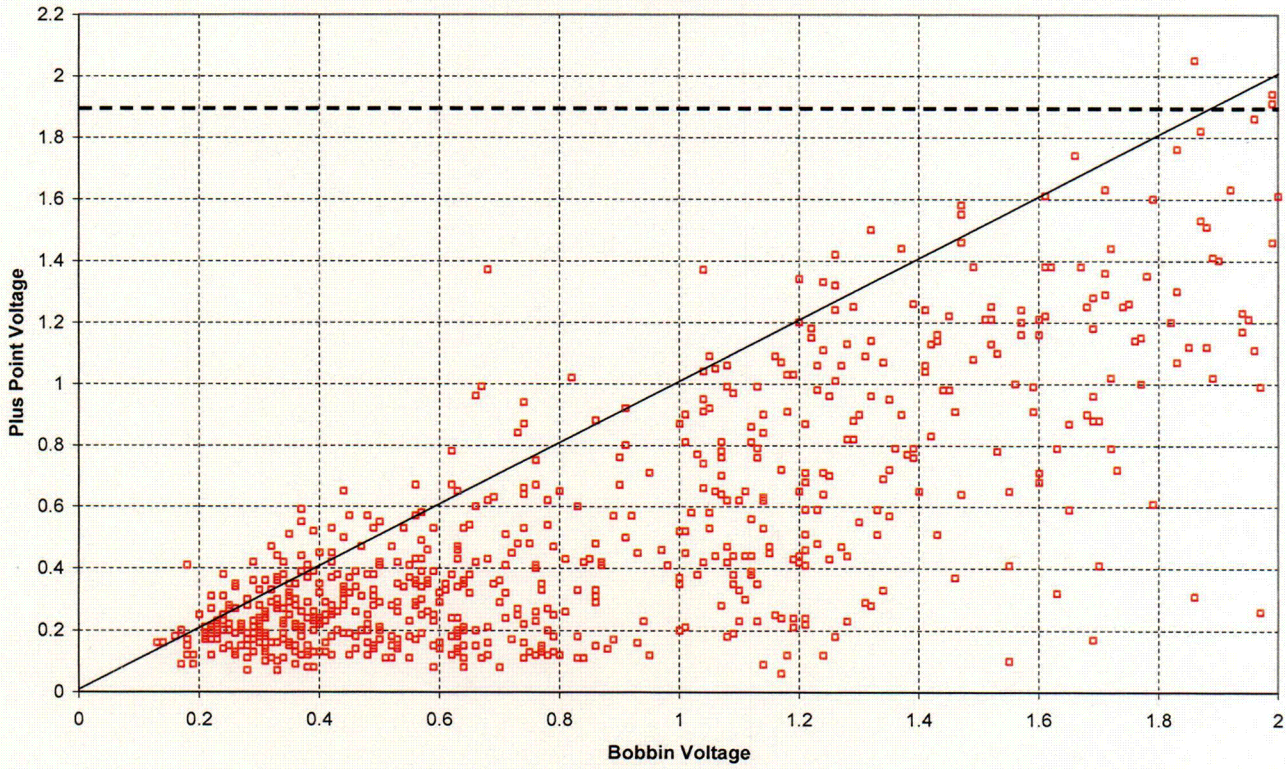
Figure 1


Upper Tail of Voltage
Projected at EOC-12 for SG
For illustration, indication count is unadjusted with respect to 500k trials.
R44C45 in Upper Bin
Extreme Growth Method
Number of Indications
12000
10000
8000
6000
4000
2000
0
18.5
19
19.5
20
20.5
21
21.5
22
22.5
23
23.5
24
24.5
25
25.5
Bobbin Volts

C01

Figure 2

Plus Point to Bobbin Voltage Comparison for ODSCC at TSPs
DCPP-2 All SGs 2R11



C02