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ComEd

October 10, 1996

Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Attn: Document Control Desk

Subject: Braidwood Station Unit 1
NRC Docket Number: 50-456

Operating Interval Between Eddy Current Inspections for Circumferential Indications in the Braidwood Unit 1 Steam Generators

References: See Attachment

In the Reference 1, the Commonwealth Edison Company (ComEd) provided the Nuclear Regulatory Commission (NRC) with the "Braidwood Unit 1 Cycle Length Assessment Report Addendum" which justified operation of the Braidwood Unit 1 for a full cycle prior to steam generator tube inspection. This report was supplemented via Reference 2. Reference 3 transmitted the NRC's Request for Additional Information (RAI) on the elimination of the Braidwood Cycle Length. References 4 through 7 provided ComEd's response to the RAIs. Reference 9 contained 5 additional RAIs. Attached is ComEd's response to those RAIs.

ComEd understands through discussions with the Staff, that there is a low likelihood that the review of ComEd's proposal to eliminate the mid-cycle inspection of the Braidwood steam generators will be completed successfully prior to the scheduled inspection date. ComEd intends to continue to plan and is prepared to conduct the outage per our commitment. As a result of this, ComEd is withdrawing the license amendment request dated August 30, 1996 (Reference 8).

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If you have any questions concerning this correspondence please contact Denise Saccomando, Senior PWR Licensing Administrator at (630) 663-7283.

Sincerely,

Harold Gene Stanley
Site Vice President
Braidwood Station

Attachments

cc:

D. Lynch, Senior Project Manager-NRR
R. Assa, Braidwood Project Manager-NRR
C. Phillips, Senior Resident Inspector-Braidwood
A. B. Beach, Regional Administrator-RIII
Office of Nuclear Safety-IDNS

References

1. H. Stanley letter to the Nuclear Regulatory Commission dated August 2, 1996, transmitting Operating Interval Between Eddy Current Inspections for Circumferential Indications in the Braidwood Unit 1, Steam Generator Tubes

2. H. Stanley letter to the Nuclear Regulatory Commission dated August 20, 1996, transmitting Operating Interval Between Eddy Current Inspections for Circumferential Indications in the Braidwood Unit 1, Steam Generator Tubes

3. D. Lynch letter to I. Johnson letter transmitting Requests for Additional Information dated September 9, 1996, Pertaining to Operating Interval Between Eddy Current Inspections for Circumferential Indications in the Braidwood Unit 1 Steam Generators

4. H. Stanley letter to the Nuclear Regulatory Commission dated September 10, 1996, transmitting Response to Request for Additional Information

5. H. Stanley letter to the Nuclear Regulatory Commission dated September 17, 1996, transmitting Response to Request for Additional Information

6. H. Stanley letter to the Nuclear Regulatory Commission dated September 20, 1996, Supplement to Response to Request for Additional Information Pertaining to Operating Interval Between Eddy Current Inspections for Circumferential Indications

7. H. Stanley letter to the Nuclear Regulatory Commission dated September 24, 1996, Response to Request for Additional Information Pertaining to Operating Interval Between Eddy Current Inspections for Circumferential Indications

8. H. Stanley letter to the Nuclear Regulatory Commission dated August 30, 1996, transmitting Request to Amend Technical Specification for Steam Generators

9. M. Lynch letter to I. Johnson dated October 3, 1996, transmitting Requests for Additional Information on the Proposed Deletion of the Braidwood Unit 1 Mid-Cycle Steam Generator Tube Inspection

REQUEST FOR ADDITIONAL INFORMATION RELATED TO THE PROPOSED DELETION OF THE BRAIDWOOD, UNIT 1 MID-CYCLE STEAM GENERATOR TUBE INSPECTION DOCKET NO. STN 50-456

1. The data provided in Table 5 in the submittal dated September 24, 1996, indicate that a number of steam generator (SG) tubes burst axially during testing and several exhibited mixed mode cracking. Explain the basis for including these data in the burst correlation's. Since both axial and circumferential flaws were identified in a number of the pulled tubes, discuss the uncertainty involved in using other data obtained from in-situ tests when the morphology of the cracking could not be definitively determined.

   Response (10/10/96):

   As identified in Table 5, indications which burst in the axial direction have for the most part been indications with minimal degradation (low voltage) bursting at pressures near virgin tube burst pressures. This clearly demonstrates that tubes with substantial circumferential degradation will not burst under accident conditions.

   Axial cracking present in pulled tubes along with circumferential cracking would result in lower burst pressures and higher leak rates compared to tubes with circumferential cracks alone. If axial cracking in combination with circumferential cracks significantly influenced burst or leakage, tubes would have leaked at higher rates or burst at the axial crack. No tubes with mixed mode cracks, identified in Table 5, burst axially at the area of degradation (failure occurred at locations away from the TTS degradation). Consequently, conservative burst and leak rate correlation's would result from testing tubes with both axial and circumferential cracks. This would be true for both pulled tube tests and insitu tests.

2. The staff has evaluated the data supplied by the licensee in Table 19b to verify the validity of the licensee's proposed correction factors of 0.58 and 0.76. Based on this evaluation, the staff has concluded that using fixed values to convert voltage data could result in significant errors in the analysis. This conclusion is based on the level of scatter observed in a sample of data provided in this table. The staff also assessed the correction factor used by the licensee to adjust 0.115-inch coil probe voltages to equivalent 0.80-inch coil probe voltages. The results of this staff assessment do not support the licensee's proposed correction factor of 0.78. Specifically, the staff's assessment indicates that the use of fixed values of correction factors to adjust voltages for different calibration procedures and probes can lead to significant errors in the adjusted voltages. In addition, the normalization values used by the licensee were non-conservative based on values determined in the staff's independent assessment. Accordingly, due to the high degree of scatter in the data, discuss whether it is more appropriate to bound the normalization factors at an elevated confidence level when adjusting voltages.

Response (10/10/96):

Linear regression analysis of field data acquired using two different normalization techniques with two different coils was presented in response to Question 19 in the September 24, 1996 submittal. The data was included in Table 19b. Results of the regression analysis of maximum and average voltages identified that a linear relationship between the two different normalization techniques exists using the 0.080" and 0.115" RPC, and identified the relationships between voltages from the two coils.

For the 0.080" RPC, the slope of the regression line for the 20 Volt normalization as a function of the 10 Volt normalization, was calculated to be 0.51 with an r-squared value of 0.957 and a standard error of 0.046. These results indicate that there is a good linear fit of the normalization data with a small error band around the linear relationship for the 0.080" RPC data.

For the 0.115" RPC, the slope of the regression line for the 20 Volt normalization as a function of the 10 Volt normalization, was calculated to be 0.68 with an r-squared value of 0.857 and a standard error of 0.114. These results indicate that there is a good linear fit of the normalization data with a small error band around the linear relationship for the 0.115" RPC data.

Taking the ratio of the normalization correction factors (slopes of the regression lines) for the two coils (0.51/0.68) provides a correction factor for data acquired with the 0.115" RPC relative to the 0.080" RPC. Applying this factor provides voltages consistent with data acquired with the 0.080" RPC. Applying the coil size correction factor to the 0.115" RPC data and plotting the data (now consistent with 0.080" RPC voltages) with the 0.080" RPC for the two normalization techniques was performed to assess the coil size correction factor. Linear regression analysis of this data resulted in a slope of 0.51 with an r-squared value of 0.91 and a standard error of 0.068.

The data obtained for the field study was analyzed using the voltage integral software. Analyst uncertainty as determined by blind test of Byron Unit 1 indications (presented in response to Question 25 of the September 24, 1996 submittal) was determined to be 32% and 30% for average and maximum volts, respectively. Scatter in the field data is expected as a result of the analyst uncertainty associated with analyzing the data. Results of the regression analyses show the scatter associated with voltage normalization and coil size is well within the scatter associated with analyst uncertainty. Analyst uncertainty is accounted for in the end of cycle distributions and does not need to be double counted in either the burst or leak correlation's.

Therefore, the probabilistic analyses of the field data supports the use of a constant normalization and coil size correction factor without the application of additional confidence levels. The coil size and normalization correction factors identified in response to RAI Questions 19 and 20 have been determined and applied consistent with the voltage normalization procedures used for application of GL 95-05.

3. The correction factor for converting voltages from 0.115-inch coils to 0.080-inch coils varies significantly based on independent staff calculations using the data supplied in Table 19b as discussed in Item 4 below. This conclusion introduces uncertainty into the proposed voltage threshold for SG tube leakage. Discuss the effects of this uncertainty on your conclusions.

   Response (10/10/96):

   This question has been addressed in response to Question 2. An electronic version of the data included in Table 19b has been provided to the staff for independent calculation. Scatter in the field data is expected as a result of the analyst uncertainty associated with analyzing the data. Results of the regression analyses show the scatter associated with the coil size correction factor is well within the scatter associated with analyst uncertainty. Analyst uncertainty is accounted for in the end of cycle distributions and does not need to be double counted in either the burst or leak correlation's.

4. Clarify the normalization of voltage data. For example, in your response to Item 5 of the staff's request for additional information (RAI) dated September 9, 1996, and in submittal dated August 2, 1996, it is stated that no calibration corrections were applied to measurements recorded when the probe voltage was set at 10 volts on the 100-percent through-wall hole. However, the values listed in Table 5 of the response to the previous RAI do not appear to correlate with data provided elsewhere in the submittal. For example, one of the six leakage datum has a reported average voltage of 1.66 volts. Applying a correction factor of 0.75 to adjust for probe coil differences results in a voltage greater than any of the date in Figure 14a. Clarify this apparent discrepancy.

   Response (10/10/96):

   Industry voltage data used for burst correlation and probability of leak is based upon the 0.080" RPC data normalized to 20 Volts on a 100% axial EDM notch. The data in Figure 14a plots leak rate versus 0.080" RPC data normalized to 20 Volts on a 100% EDM axial notch. The voltage value stated in Question 4 of the October 3, 1996 RAI of 1.66 Volts is data normalized to 10 Volts on a 100% TW hole and therefore cannot be used with Figure 14a. Data in the columns 10V on a 100% TW hole in Table 5 of the September 24, 1996 submittal are not corrected for coil size. The data in columns titled 20 Volts on 100% EDM notch are corrected for normalization and coil size and should be used for burst and leak rate correlation's. Therefore, there is no discrepancy, the data in the 20 Volts on 100% EDM Notch is the fully normalized data and is the only column in Table 5 used for ECT parameters in the leak and burst correlation's.

5. Several values important in assessing the end-of-cycle (EOC) structural and leakage integrity of Braidwood 1 SG tubes been modified since the submittal dated August 2, 1996. For example, the burst and leakage correlation's in response to the prior RAI have been adjusted to account for industry material property data and revised values for analyst error. Accordingly, re-evaluate the Braidwood 1 EOC assessment considering all changes to the proposed methodology. Address the use of bounding voltage correction values as discussed in Item 3 above and the limiting growth rate distribution in light of the responses to Items 2 and 3 of the prior RAI.

Response (10/10/96):

The results in the September 24, 1996 submittal and presented on October 4, 1996 have been updated to include the modified normalization correction factor, coil size correction factor, analyst uncertainty and industry LTL properties as reported in response to RAI questions submitted on September 24, 1996.

The question on growth rates is addressed for the Braidwood Unit 1 cycle length assessment in the September 24, 1996 submittal response to Question 3 and is repeated below.

Application of the EOC approach, discussed in the September 10, 1996, submittal, applies the Byron EOC-6 distribution to Braidwood directly without growth rates. This distribution provides for the entire population of indications in the worst steam generator (SG) at Byron, Unit 1 in 1994 (EOC-6) and therefore is conservative. The basis for concluding that this assumption is conservative is Braidwood Unit 1, in the Spring 1997, will have operated for a slightly shorter period than Byron Unit 1 had operated prior to their 1994 inspection. Therefore, the question on growth rates is not applicable to the Braidwood Unit 1 cycle length assessment.

Additional response is provided to address the question on the use of growth rates from nearly full operating intervals in lieu of short cycle operating intervals.
An assessment was performed of Byron Unit 1 growth rates to determine the appropriate intervals to be used. Because Braidwood Unit 1 full cycle operation was being evaluated, growth rates from as near a full cycle as possible were considered to minimize the uncertainty associated with short interval growth rates. Figure 5a and 5b presents the maximum and average growth rates for the three Byron Unit 1 intervals for which inspections sensitive to circumferential indications were performed (1994 to 1995, 1994 to 1996 and 1995 to 1996). The growth rates are for 0.080" RPC data normalized to 1 year of operation. The data was analyzed as a part of the 1996 voltage integral software look-back and includes indications repaired in 1995 and 1996.

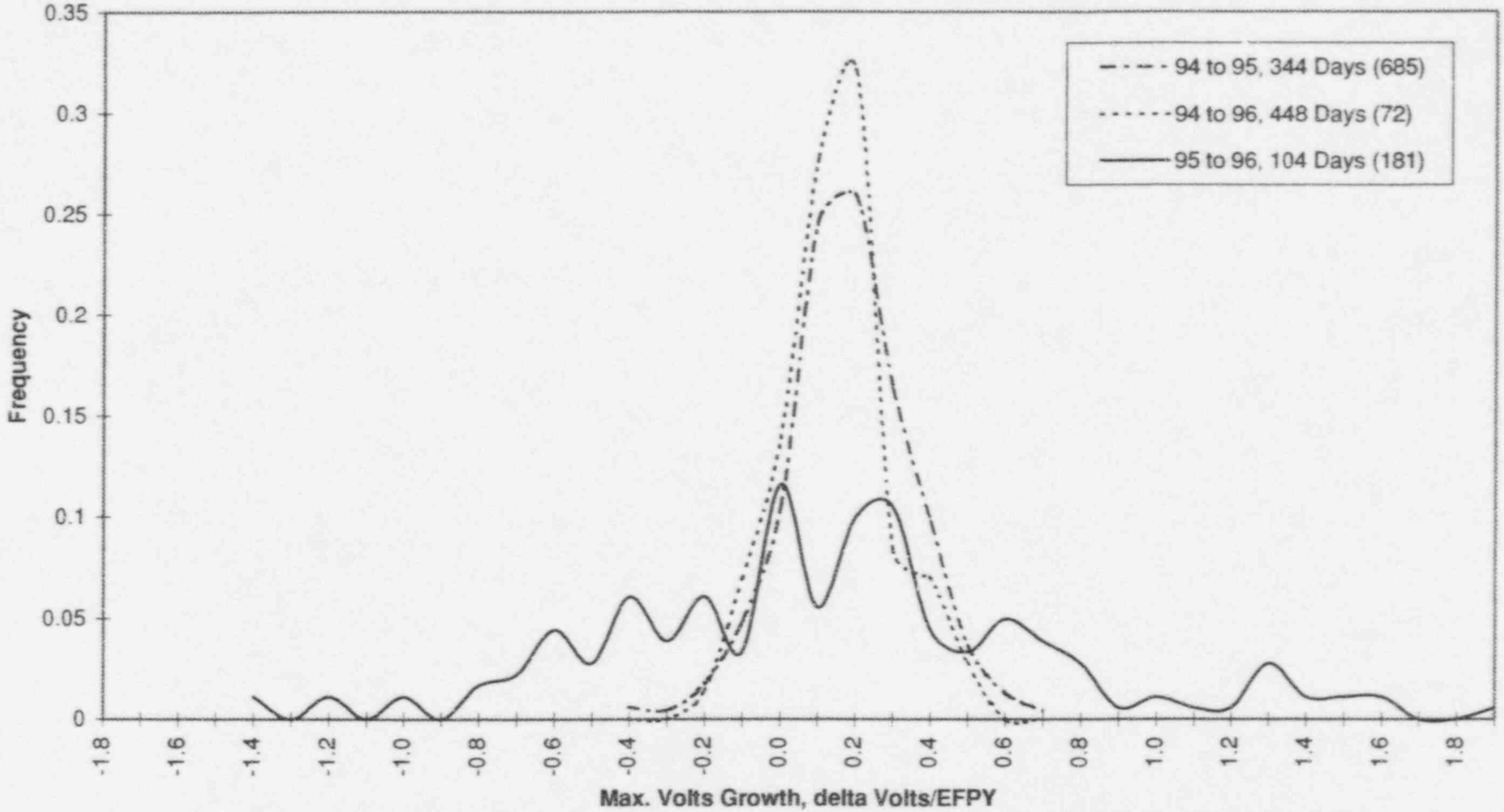
The distribution of growth rates shown in Figures 5a and 5b provide the following observations: the growth rate distributions for longer intervals, approximately one full cycle of operation (1994 to 1995 and 1994 to 1996), are smooth with relatively short tails and is peaked at the middle. The distribution for the short operating interval, approximately one quarter of an operating cycle (1995 to 1996) is not smooth, has long tails in both directions and is flat. The curves on the figures show that there is a significant difference in the short and long cycle growth rates.

Because there are some large short interval growth rates, an evaluation of the voltage distribution of 1995 and 1996 indications present in 1994 was performed. If the large short interval growth rates were real it would be expected that the distribution of indications present from 1994 to 1996 would be significantly greater than the distribution of indications present from 1994 to 1995. Figures 5c and 5d show the Frequency of indications versus the maximum and average voltage in volts, respectively. The figures show that there is no significant difference in size of indications present from 1994 to 1995 compared to 1994 to 1996. This indicates that full cycle growth rates are appropriate for a full operating cycle evaluation.

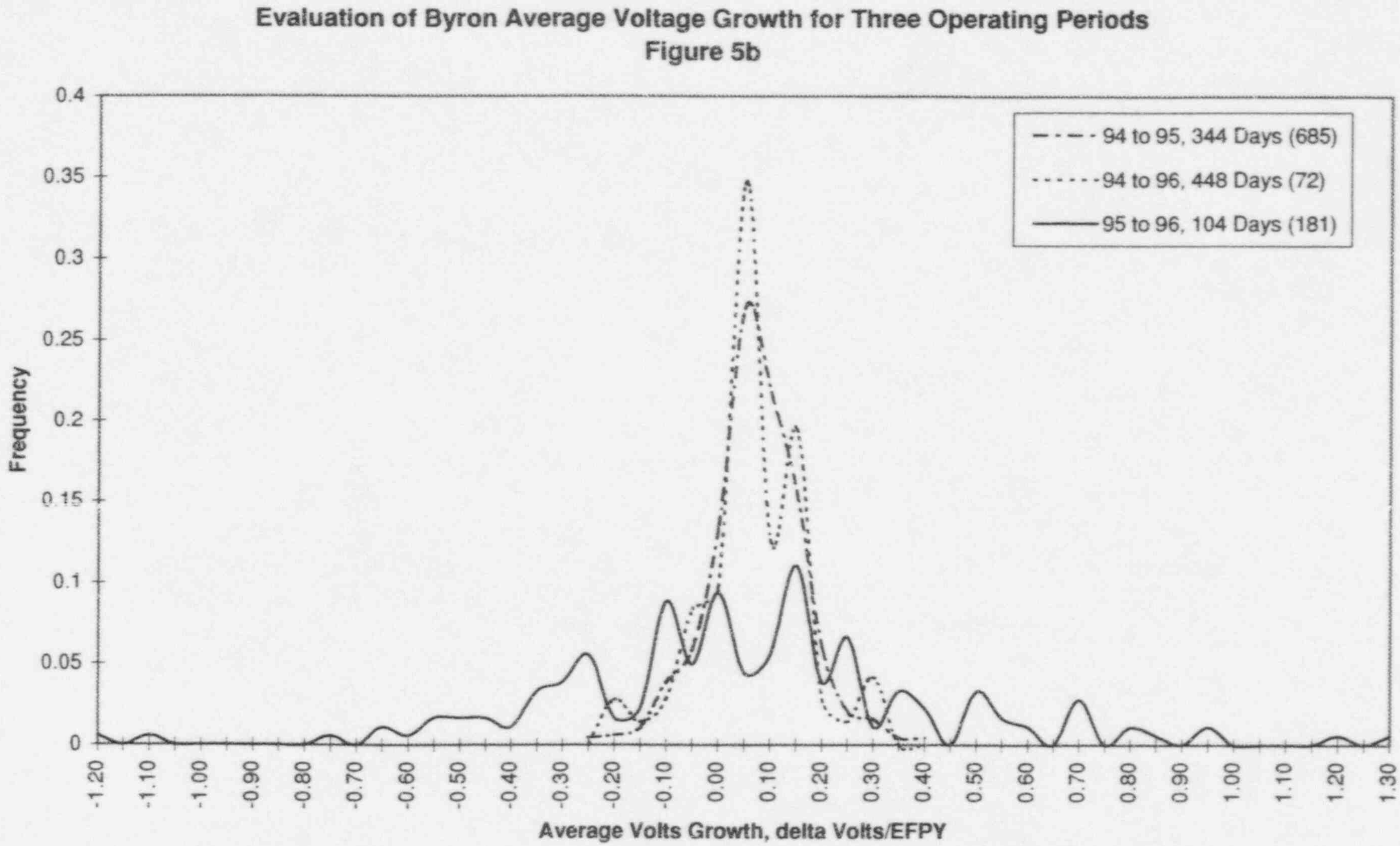
As discussed in response to Questions 2 and 3 the use of the bounding voltage correction values is appropriate. Scatter in the field data is expected as a result of the analyst uncertainty associated with analyzing the data. Results of the regression analyses show the scatter associated with voltage normalization and coil size is well within the scatter associated with analyst uncertainty. Analyst uncertainty is accounted for in the end of cycle distributions and does not need to be double counted in either the burst or leak correlation's.

Results of the probabilistic analyses of the field data supports the use of a constant normalization and coil size correction factor without the application of additional confidence levels. The coil size and normalization correction factors identified in response to RAI Questions 19 and 20 have been determined and applied consistent with the voltage normalization procedures used for application of GL 95-05.

Evaluation of Byron Maximum Voltage Growth for Three Operating Intervals
Figure 5a



Conclusion: Significant Difference in the Short Cycle Growth Rate Distribution Compared to the Growth Rate Distributions Obtained from Full Cycle Operation



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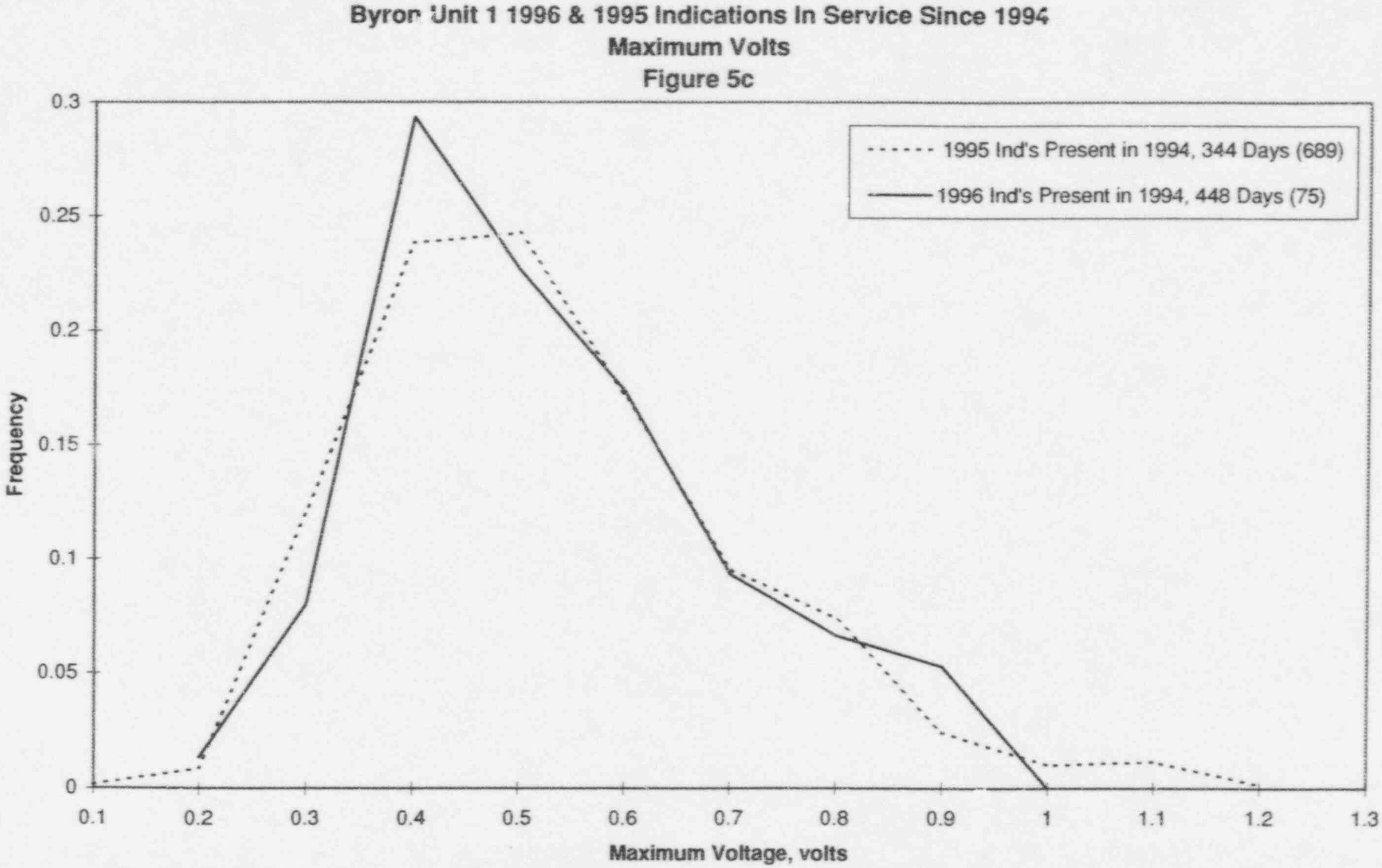
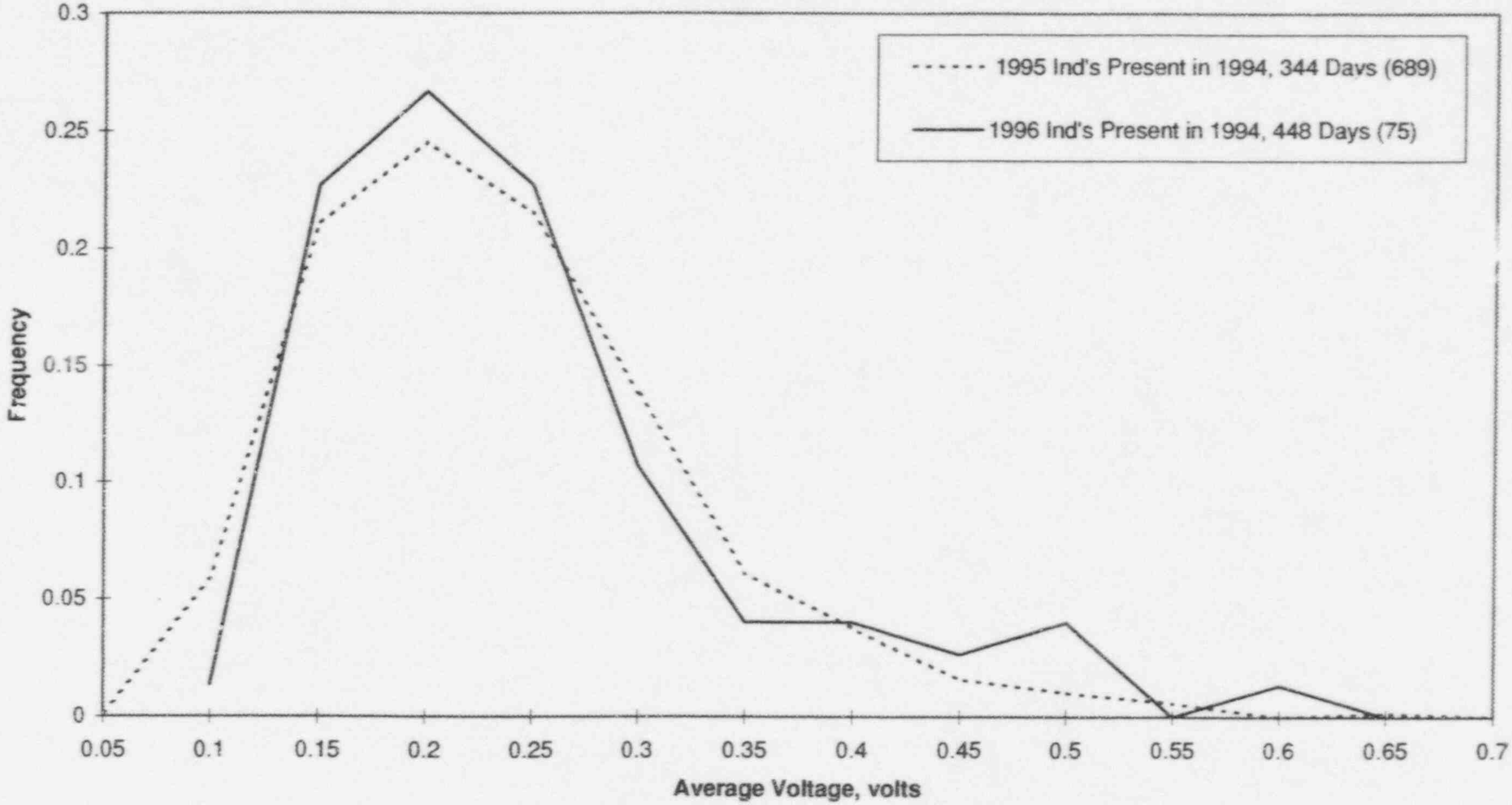


Conclusions: No Significant Difference in Size of Indications Present from 1994 - 1995 Compared to 1994 - 1996. This Indicates that Full Cycle Growth Rates are Appropriate for a Full Operating Cycle

Byron Unit 1 1996 & 1995 Indications In Service Since 1994
Average Volts
Figure 5d



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