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Downers Grove, IL 60515-5701

September 17, 1996

ComEd

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

Att.: Document Control Desk

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

Response to Request for Additional Information Pertaining to Operating Interval Between Eddy Current Inspections for Circumferential Indications in the Braidwood Unit 1 Steam Generators

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

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 reported was supplemented via Reference 2. Reference 3 transmitted the NRC's Request for Additional Information (RAI) on the elimination of the Braidwood Cycle Length. Reference 4 transmitted ComEd's response to questions: 2, 4, 10, 14, and 16. Attachment A of this submittal, reiterates this response in conjunction with additional responses to the RAI. A subsequent submittal will be forwarded to the Staff to complete ComEd's response to the RAI.

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Attachment B highlights information that has been revised subsequent to its submitted via References 1 and 4. The revised information does not change the conclusions discussed in ComEd's previous submittals.

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
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C. Phillips, Senior Project Manager-Braidwood
A. W. Beech, Regional Administrator-RIII
Office of Nuclear Safety-IDNS

ATTACHMENT A

REQUEST FOR ADDITIONAL INFORMATION

RELATED TO THE BRAIDWOOD, UNIT 1 CYCLE LENGTH ASSESSMENT

BASED ON STEAM GENERATOR (SG) TUBE

CIRCUMFERENTIAL INDICATION GROWTH RATES

DOCKET NUMBER 50-456

1. In the license's submittal dated August 2, 1996, a morphology assessment was provided which attempts to demonstrate the similarity between circumferential crack indications in Braidwood, Unit 1 to Byron, Unit 1 based on the relationship between the maximum and the average eddy current (EC) voltages. However, the licensee did not provide a sufficient basis for assuming an eddy current voltage assessment is indicative of degradation morphology. Accordingly, provide data supporting the assumption that circumferential flaws (either real and/or simulated) with morphologies different from that found at Byron Unit 1 demonstrate a different and clearly distinct relationship between the average and the maximum EC voltage such that differing morphologies could be distinguished.

Response:

ComEd has concluded that the outside diameter stress corrosion cracking (ODSCC) observed at the top-of-the-tubeshee (TTS) roll transition is primarily the result of tube fabrication, residual stress and operating temperature. Therefore, the same degradation and rates of degradation are expected at both Byron Unit 1 and Braidwood Unit 1. Eddy current testing (ECT) and characterization serve as a confirmation of this expectation and to identify specific tubes for repair.

Demonstration that the degradation morphology on the OD of tubes at the TTS at Braidwood Unit 1 is consistent with the circumferential indications found at Byron Unit 1 and other units is based on several factors. These factors include: Alloy 600 tubing production, location, temperature, environment, stress, and steam generator fabrication process. The EC rotating pancake coil (RPC) average and maximum voltages were used to provide additional confirmation that the morphology for circumferential indications at the TTS at Braidwood Unit 1 is within the experience base at Byron Unit 1 and other plants with circumferential indications at the TTS.

The basis for concluding that the morphology of circumferential indications at the TTS at Braidwood Unit 1 is within the industry experience base include:

(1) The indications at Braidwood Unit 1 are in the same location and have the same orientation as indications at Byron Unit 1 and other affected industry plants,

(2) the environment and temperature at Braidwood Unit 1 is the same as Byron Unit 1 in the affected region. In addition, there is no chemistry environment at Braidwood Unit 1 that would produce more adverse conditions relative to circumferential ODSCC compared to Byron Unit 1. Further, there are no conditions that would produce copper deposits that would interfere with degradation detection near the TTS,

(3) the stress and fabrication process in roll transitions at the TTS is the same as at Byron Unit 1 and other similarly designed Westinghouse plants,

(4) the indications at Braidwood Unit 1 have the same EC attributes as Byron Unit 1 and other affected plants in the industry,

(5) other modes of degradation that are specifically dependent on Alloy 600 condition, residual stress, environment and temperature have occurred at Byron Unit 1 and Braidwood Unit 1, and

(6) pulled tubes from Byron Unit 1 and Braidwood Unit 1 demonstrate the same Alloy 600 microstructure and degradation morphologies.

Additional NDE confirmation that the Braidwood Unit 1 circumferential indications are within the Byron Unit 1 and industry experience base is provided by the plots of EC maximum versus average voltage in Figures 1a and 1b. Figure 1a shows the industry data base for pulled tubes (56 data points) and the bounds that encompass the data. These data include data from Byron Unit 1. These data also include a range of degradation levels including a tube where the percent degraded area (PDA) was approximately 94% (also see response to Question 9). Figure 1b shows a comparison of the bounds for the industry experience with the indications detected during the February 1995 and October 1995 inspections at Braidwood 1. A comparison of the industry experience base, as represented by the bounding lines, with the Braidwood indications provides additional confirmation that the morphology at Braidwood Unit 1 is within the industry experience base. Three conclusions are reached based on Figures 1a and 1b.

1) Two EC parameter bounds can be defined that encompass all roll transition circumferential ODSCC degradation observed in the industry.

2) All Braidwood Unit 1 indications are within these bounds.

3) The trend in the Braidwood Unit 1 indication distribution is toward smaller indications.

ComEd has provided the NRC with all data on roll transition, circumferential ODSCC that exists from tube pulls. There is no data to suggest a different morphology.

Therefore, there is no data to support a "different and clearly distinct relationship between average and maximum EC voltage." Therefore, no basis exists to determine that different morphologies need to be distinguished.

2. **In Section 4.3 of the licensee's submittal dated August 2, 1996, it is stated that Braidwood Unit 1 growth rates had not been determined at the time of the submittal due to difficulty in converting the EC test data. State when this work will be completed and submitted to the NRC. If this conversion has been completed, submit the results of the asses ment.**

Response:

Byron Unit 1 growth data has been used in assessment of Braidwood Unit 1 BOC-6 distributions because the Byron data is a statistically significant number of data points (over 750), meets the requirements of GL 95-05 and some of the growth rates span an entire operating cycle. Byron data for the two periods for which it was calculated (1994 to 1995 and 1994 to 1996) span long periods of operation (342 and 448 days > 500°F) minimizing the uncertainty in extrapolating the data to the proposed operating interval for Braidwood Unit 1 of 461 Days.

Two 0.080" RPC inspections have been performed at Braidwood Unit 1, one in February 1995 and one in October 1995 (EOC-5). The duration between the inspections is 202.74 days > 500°F.

Twenty three indications were detected and repaired in the October 1995 inspection. All 23 were present in the look-back to the February 1995 inspection. The growth rate data is calculated by subtracting the February 1995 voltage reading from the October 1995 voltage reading. The difference is then divided by the operating period (202.74 days) and multiplied by 365 to provide the growth rate per year. The growth rate data is then put at the top of 0.1 volts and 0.05 volts bins (e.g. 0.44 volts would be placed in the 0.5 maximum voltage bin and 0.45 average voltage bin), for maximum and average voltage growth, respectively. The growth rate results are shown in Figures 2a and 2b for maximum and average voltage, respectively.

Application of the EOC approach, discussed in the September 10, 1996 submittal (Attachment A), applies the Byron EOC-6 distribution to Braidwood directly without growth rates. This distribution provides for the entire population of indications in the worst 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 in 1994.

3. **The licensee's assessment of Byron Unit 1 growth rates considered inspection data from three inspection outages. Supply the growth rate data for each of the three intervals between these outages; i.e., the interval between the first and second SG tube inspections, the interval between the second and third inspection outages and the interval between the first and third inspection outages. Indicate which of the**

intervals exhibited the largest growth rate on an effective full power year (EFPY) basis. Provide these data in tabular form separated into the voltage bins shown in Figures 4.3 and 4.4 of your August 2, 1996, submittal. Explain how the indications were: placed in a particular bin. That is, state whether EC voltage values were truncated or rounded up to the higher voltage bin (e.g., 0.45 volts would be raised to 0.5 volts).

Response:

Byron Unit 1 growth rate data for the three operating intervals is provided in Tables 3a and 3b. The growth rate data is calculated by subtracting the voltage at the beginning of the inspection interval from the voltage at the end of the inspection interval. The difference is then divided by the operating period (342, 448 and 104 days for the three intervals) and multiplied by 365 to provide the growth rate per year. The growth rate data is then put into 0.1 and 0.05 interval voltage growth rate bins, for maximum and average voltage growth, respectively (e.g. 0.44 would be placed in the 0.5 maximum voltage growth rate bin and in the 0.45 average voltage growth rate bin).

Growth rates for the three intervals (1994 to 1995, 1994 to 1996 and 1995 to 1996) are presented in Table 3a for maximum voltage and Table 3b for average voltage. Growth rate data from 1994 to 1995 comes from the results of the 1995 (SG B) and 1996 (SG C) look-backs, the remaining growth rates come from the 1996 indication look-backs.

The interval showing the greatest variation in growth rates normalized to a year is the shortest interval between the 1995 and 1996 tube inspections. This variation in growth rate for the 1995 to 1996 interval is considered to be a result of inaccuracies that occur when changes in degradation levels are measured for relatively short time intervals. Because corrosion cracks do not grow uniformly, measurement over short time intervals results in scatter that is not representative of the average growth rate over the interval of interest. This can easily be seen by comparing the data from the three intervals. If the short interval growth rates are really representative, the variation seen in the 1995 to 1996 interval would also be seen in the 1994 to 1996 interval.

A contributing factor of the scatter in the growth rates, is the multiplication of any ECT sizing error, for the short interval, by a factor greater than three to normalize the data to one year. For this reason, Byron Unit 1 growth data for the intervals 1994 to 1995 and 1994 to 1996 were used in assessment of Braidwood Unit 1 end of cycle six, EOC-6, distributions because the Byron data is a statistically significant number of data points (over 750), meets the requirements of GL 95-05 and the growth rates span an entire operating cycle. Byron data for the two periods for which it was calculated (1994 to 1995 and 1994 to 1996) in the August 2, 1996, submittal span long periods of operation (342 and 448 days > 500°F) minimizing the uncertainty in extrapolating the data to the proposed operating interval for Braidwood Unit 1 of 461 days.

Application of the EOC approach, discussed in the September 10, 1996, submittal (Attachment A), 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.

4. **Clarify the language in Section 4.2.2 of the text which states: "...one hundred three (103) indications identified during the 1994 EC inspection were re-analyzed with the 0.080 inch RPC probe."**

Response:

The statement refers to the scope of the voltage integral look-back re-analysis performed during June of 1996. During the re-analysis the indications detected and repaired in SG B and SG C in 1994 were re-analyzed. This total represents 103 indications. A total of 128 indications in all SG's were detected and repaired at Byron Unit 1 in 1994. Subsequent to issuing the Braidwood Cycle Length Assessment Report dated August 2, 1996, the remaining 25 Byron Unit 1 1994 indications have been re-analyzed.

5. **Supply in tabular form, the data used in the burst pressure and leakage correlations in the submittal dated August 2, 1996, including the following information: (1) the metallographic results (i.e., the percent degraded area, the maximum depth circumferential extent), if available; (2) the SG tube material properties; (3) the EC voltage measurements (maximum and average voltages) Indicating which inspection probe was used; (4) the maximum test pressure; and (5) the burst pressure and/or leak rate. As stated by the staff during the meeting held on August 26, 1996, some of the SG tube burst data in the correlations relating EC voltage values to burst pressure may have come from SG tubes which burst axially rather than circumferentially. Identify in this table which data points in the correlations burst axially as well as those that exhibited mixed mode cracking as determined from the destructive metallurgical examinations. Also, identify any indications that leaked during in-situ pressure testing at a rate beyond the pump capacity.**

Response:

Table 5 provides a summary of the tube pull burst and insitu pressure test data requested in RAI Question 5. All the data are for top-of-the-tubesheet OD circumferential indications. A description of each of the columns is provided below:

Test Method: This column identifies whether the test was a burst test, whether the tube was taken to failure, insitu pressure tested or, whether the tube is taken to a target pressure to confirm structural integrity. Additionally, as discussed in response to Question 6 three large voltage indications maintained structural integrity at normal operating pressure. In no cases did a tube

with a TTS circumferential indication burst during insitu pressure or under normal operating conditions.

Metallographic Results: For tubes pulled from steam generators, metallographic sizing of the defects have been performed. The results are documented for percent degraded area (PDA), Maximum depth (deepest crack penetration into the tube wall), and circumferential extent of the degradation.

Coil Size: The coil size used to acquire ECT data corresponding to the recorded voltages. All burst data was acquired with the 0.080" RPC. Insitu pressure test data has been acquired with the 0.080" and 0.115" RPC.

10V on 100% TW Hole: Maximum and average voltage results for the indication obtained by normalizing to 10 volts on a 100% throughwall hole. No corrections are applied to this data. For one tube, this flaw did not exist on the calibration standard and therefore the data is not included.

20V on 100% EDM Notch (normalized): The data in column "10V on 100% TW hole", is corrected in this field to the normalization procedure used in Byron and Braidwood look-backs. A correction factor of 0.58 (August 2, 1996 submittal) is used to correct the analysis data to 20V on a 100% TW EDM notch. The data in column "10V on 100% TW hole" is also corrected where the 0.115" RPC probe is used. The correction factor applied to the 0.115" RPC data is 0.76 (August 2, 1996 submittal).

Insitu Pressure: Maximum pressure, in ksi, achieved during insitu pressure testing. No corrections are applied to this data.

Burst Pressure: Maximum pressure, in ksi, achieved prior to burst of the tube or EDM simulant specimen.

Operating Pressure: Normal operating differential pressure in ksi for tubes which were not burst tested or insitu pressure tested.

Leak Rate: Actual measured leak rate during tube pull or insitu leak testing in gpm.

Adjusted Leak Rate: Actual measured leak rate corrected to Braidwood Unit 1 main steam line break conditions (2560 psi, 600°F)

Insitu Leak Rate > Make-up at Maximum Pressure: In some cases during insitu pressure testing the target test pressure could not be achieved due to excessive leakage through the crack for which the test pump could not adequately make-up the necessary flow. This column indicates if this were the case during testing. Leak rate testing is performed at pressures which the test pump had adequate capacity to maintain leakage flow.

Yield Strength: Where tube pull data is available, the yield strength is reported in ksi.

Ultimate Strength: Where tube pull data is available, the ultimate strength is reported in ksi.

Axial or Circumferential Failure: During burst testing, the mode of failure is defined as axial or circumferential. In one case the burst test was terminated after high pressures were achieved (>10 ksi) due to the failure of a test rig weld.

Mixed Mode: Tube pull burst tests for which metallographic examination identified mixed mode cracking is identified in this column.

6. **Analytical predictions of circumferential burst pressure as a function of the percent of degraded SG tube area (PDA) are generally two-part correlations. Specifically, a constant upper bound value dictates the axial burst pressure for SG tube with limited degradation; However, more severely degraded tubes are governed by a relationship indicating lower circumferential burst pressures with increasing values of PDA. Since EC voltage may be related to PDA, it is possible that an empirical relationship between voltage and burst pressure may follow a trend similar to that predicted by analytical correlations. The voltage-burst pressure relationship included in the submittal dated August 2, 1996, is a monotonically decreasing function over all voltages. Discuss the basis for such a relationship in light of current analytical models for circumferential burst pressure.**

Response:

Available service data indicate that voltage and PDA do not necessarily follow the same trends especially at relatively high degradation levels. Burst pressure capability has been predicted to diminish relatively rapidly as a function of PDA once the PDA is beyond the value associated with axial tube burst. Available service data, however, indicate that the decrease in burst pressure as a function voltage is much more gradual for burst pressures lower than those associated with axial tube burst.

This is illustrated in Figures 6a and 6b, where burst pressure is plotted as a function of maximum and average voltage, respectively. The tubes corresponding to the three high voltage points in the figures were not burst or insitu pressure tested, and the plotted pressures for these three tubes are normal operating differential pressures (see data presented in response to Question 5). The pressure differentials shown in the figures have been corrected for Industry LTL material properties. None of these three tubes burst at normal operating differential pressures.

The dashed lines in the figures are extensions of the limit curves and were drawn as a comparison with the high voltage points at normal operating pressure. The dashed portion of the limit curves show there is a gradual drop in burst pressure immediately beyond the voltage associated with the range of available burst data. The information in Figures 6a and 6b also provides further confirmation that the deterministic burst curves are conservative, especially for average voltage where extremely large margins are indicated at high voltages.

7. **In Section 5.3 of the submittal dated August 2, 1996, it is stated that the assessment provided follows the methodology in NRC Generic Letter (GL) 95-05. However, a $2x10^{-2}$ frequency of indications greater than the structural limit is the proposed acceptance criteria as stated in Section 5.4. This latter value is twice the value given in GL 95-05. Accordingly, clarify the discussion on the basis for using this proposed acceptance criteria. In addition, provide a detailed discussion on the technical basis underlying the assumptions in the analysis which is intended to demonstrate that the conditional probability of burst for the SG tubes with voltage beyond the structural limit is less than about 10^{-4} when the frequency of indications is less than $2x10^{-2}$.**

Response:

The frequency of $2x10^{-2}$ is not intended to serve the same purpose as the conditional failure probability criteria of $1x10^{-2}$ in GL 95-05. ComEd believes sufficient data is not available to construct a probabilistic burst correlation as a function of voltage, therefore, a deterministic burst curve was used. Because a deterministic curve was used, and the available data base did not extend much beyond the structural limit, it was not possible to determine explicitly the conditional probability of burst for the entire distribution as specified in GL 95-05. Consequently, criteria were developed to provide a measure that could be used near the structural limit to determine if there was acceptable margin against burst for an EOC distribution.

The frequency less than $2x10^{-2}$ beyond the structural limit is not intended to ensure the conditional probability of burst is less than 10^{-4}. The criteria to ensure adequate margin against tube burst has two parts. The first part specifies that the frequency of tubes greater than the structural limit was less than $2x10^{-2}$, or, in other words, that 98% of the tubes would have voltages less than the structural limit at the EOC. The second part of the criteria (submitted to the NRC on August 2, 1996) specified that the conditional failure probability per tube would be less than 10^{-4}; this part provides assurance that the burst probability for a tube at or near the structural limit is very low. The information provided to the NRC in the August 20, 1996, submittal demonstrated that the conditional failure probability per tube at the structural limit is less than 10^{-4} for the deterministic burst curve.

This combined criteria was defined to ensure that there were relatively few tubes in the EOC distribution beyond the structural limit, and that the contribution to probability of burst would come from very few tubes or fractions of tubes at voltages beyond the structural limit, where the likelihood of having tubes with voltages this high in service would be low. There is additional margin provided by the deterministic burst curve where it is clear that the probability of burst at pressures on the burst curve is significantly less than one. Further, the response to Question 6 showed that the burst pressure does not drop rapidly beyond the structural limit, is conservative relative to available data for high voltage indications; consequently, the probability of burst does not rise rapidly beyond the structural limit. These additional margins are not quantified but provide defense in depth to the 10^{-4} per tube value at the structural limit.

In response to a Staff request, ComEd is evaluating the feasibility of developing probabilistic correlations of burst pressure as a function of voltage as described Question 8.

8. **Provide the basis for the shape of the curve used to determine the lower bound SG tube burst pressure. Determine whether a statistical fit to the data can be established using the available data set; i.e., the statistical fit should be valid at the 5% level consistent with GL 95-05. The guidance provided in GL 95-05 with respect to empirical models should be addressed; e.g., provide the order of the regression equation. If a statistical fit to the data can be established, provide a detailed probabilistic analysis of the conditional burst probability which is consistent with the intent of GL 95-05.**

Response:

Response to be provided in subsequent correspondence.

9. **For any given EC voltage, a variety of flaw morphologies is possible. Since the staff believes that it has not been demonstrated that EC voltage can accurately predict the morphology of degradation as stated in Item 1 above, discuss the possibility that more structurally significant morphologies may exist than those used to determine the lower bound fit. For example, discuss the possibility that a very tight coplanar flaw with a 360°, 95-percent throughwall defect exhibits the same maximum EC voltage as one of the two data points connecting the lower bound curve but which may exhibit a lower burst pressure. Provide the supporting data. If different and/or lower burst pressures are possible for the same EC voltage, discuss how the proposed probabilistic analysis accounts for this uncertainty.**

Response:

ComEd does not claim that EC voltage can, at this time, predict morphology as indicated in ComEd's response to Question 1. In addition, as indicated in the response to Question 1 there are no data that demonstrate that "a variety of flaw morphologies" exist. To the contrary all data suggest there is one flaw morphology for roll transition circumferential ODSCC that exists over a range of degrees of degradation. The response to Question 1 indicates that EC voltage can be used as one of the variables to indicate if the morphology is within the known industry experience base.

Fortunately, service experience indicates there are very few instances of very deep uniform cracking due to circumferential ODSCC degradation at the TTS. There is only one known instance of a very deep uniform indication (>90% PDA) in the industry experience base. This indication is much larger than any indication detected at Byron Unit 1 or Braidwood Unit 1. This indication had a reported PDA of 94%, a maximum voltage of 9.51 volts, and an average voltage of 6.49 volts. This tube broke while being removed from the steam generator, and consequently, was not burst tested. However, because the indicated voltages are significantly greater than the

voltage structural limit obtained from the ComEd deterministic burst curve, a low burst pressure for this tube would not contradict the burst curve(See Figures 6a and 6b in the response to Question 6). The responses to Questions 6, and 7 provide additional information concerning the potential for low burst pressures and probability of burst.

10. **The burst pressure data were corrected for Braidwood lower tolerance limit (LTL) properties using information from certified material test reports. To remain consistent with the methodology in GL 95-05, burst pressure data should be normalized using material property data from the industry database used for alternate plugging criteria applications for axial cracking at SG tube support plate intersections. Accordingly, adjust the data in Figures 5.5 and 5.6 of the August 2, 1996, submittal using the industry database and determine the resulting structural limits for the average and maximum EC voltage correlations.**

Response:

The industry insitu pressure test and burst pressures have been corrected for industry LTL properties (95/95, 650°F). In the Braidwood Cycle Length Assessment Report dated August 2, 1996 the data was corrected for Braidwood Unit 1 LTL properties, plots of the industry data corrected for industry LTL properties are included as Figures 10a and 10b.

The correction factor for industry LTL properties is the ratio of the industry 95%/95% lower tolerance limit (s_y+ s_u) at 650°F to the industry room temperature mean (s_y+ s_u) (EPRI Report, NP-6864-L, PWR Steam Generator Tube Repair Limits: Technical Support Document for Expansion Zone PWSCC in Roll Transitions - Rev. 2, August 1993).

$$130.65 \text{ ksi}/154.34 \text{ ksi} = 0.847$$

The insitu pressure test and burst pressures have been multiplied by this factor and the results plotted in Figures 10a and 10b against average and maximum voltage.

For the industry burst pressure tests corrected with the industry LTL properties the structural limit for average and maximum voltages at 3xNOdP (4035 psi) become 0.88 and 3.54 volts respectively. Previously reported plant specific structural limits were 0.91 and 3.64 volts respectively.

For plant specific application of the structural limits, the Braidwood Unit 1 LTL values will continue to be used in assessment of the Braidwood Unit 1 EOC distributions.

11. **As discussed in Regulatory Guide 1.121. "Bases for Plugging Degraded PWR Steam Generator Tubes," SG tube repair criteria should consider the fatigue affects from cyclic loading forces. Discuss how these effects (e.g., fatigue, vibration, and flow-induced loadings) have been accounted for in the analysis of the proposed operating interval. Provide supporting test data.**

Response:

Current operating experience and data from pulled tubes indicate there are no discernible fatigue, vibration, or flow-induced loading effects on tubes with circumferential ODSCC indications at the TTS. The effect of any subcritical low-cycle fatigue loading that may have occurred in service is captured in the growth rate described in the response to Question 3. For high cycle vibratory fatigue loading, rapid crack growth and subsequent failure would occur in much less than an operating cycle once the crack growth threshold was exceeded. Significant industry operating experience, including operating experience at Byron Unit 1, show there are no tube failures from high cycle vibratory or fatigue loads over the operating cycle length of interest at Braidwood Unit 1. Based on this experience there is no need to include explicit fatigue, vibratory, or flow-induced loading in the Braidwood Unit 1 evaluation.

12. If a SG tube were to separate or burst, discuss the possibility that multiple failures could occur as a result of SG tube whipping or impingement. Provide the supporting data and analysis.

Response:

Response to be provided in subsequent correspondence.

13. Because of the non-coplanar nature of stress corrosion cracking in SG tube expansion transitions, EC signals from circumferential indications may exhibit both axial and circumferential degradation. Accordingly, discuss whether an assessment of SG tube degradation using voltage measurements from several scan lines (i.e., a volumetric assessment) is necessary as opposed to selecting a single scan line.

Response:

Tube failure and rupture occurs at the weakest location of the degraded tube area. The most degraded area of the tube can be assessed by the use of a single scan line for maximum and average voltage. The analysis of Braidwood Unit 1 and Byron Unit 1 data uses the same analysis methods (a single scan line) as that used to define the burst limits for maximum and average voltage. This provides a consistent analysis of the Braidwood Unit 1 and Byron Unit 1 tubes against known tube failures. A volumetric approach using more than one scan line can average undegraded areas of the tube with degraded areas to provide a non-conservative voltage signal which may not be representative of the structural integrity of the tube. Results of tube pull conclude that the area of degradation away from the crack face do not contribute to the failure of the tube. The 0.080" RPC does perform a volumetric assessment of the degraded area of a circumferential band equivalent to the size of the coil (i.e. 0.080"). Therefore, the use of a single scan line is adequate to assess the structural integrity of SG tubes.

14. The correlation of leak rate versus maximum EC voltage applies only to the end-of-cycle (EOC) EC voltage distributions derived from maximum EC voltages. Provide a similar relationship based on EC voltage integral measurements of circumferential indications. Describe, or reference if previously submitted, the procedure used to normalize the SG tube leak rates to the operating temperature and the main steam line break (MSLB) pressure of 2560 pounds per square inch (psi).

Response:

Maximum voltage was selected as the parameter to assess leakage because it provides a good measurement of the crack's depth especially when the crack is asymmetric and a segment of the crack is either through wall or substantially deeper than the remainder of the crack front. Average voltage provides a measure of the integrated degradation over the entire tube circumference and there may not be segments where the crack is either through wall or nearly through wall.

The industry leak rate data from insitu pressure tests and tube pull leak tests is provided in the response to Question 5 and is plotted in Figure 14a against average voltage. The average voltage is normalized as discussed in Section 6.2.1 of the Braidwood Cycle Length Assessment Report dated August 2, 1996. A log-logistic probability of leak vs. average ECT amplitude function was developed. The probability of leak function is based upon the data presented in Section 7.0 of the Braidwood Cycle Length Assessment Report dated August 2, 1996. A 95% confidence level of the probability of leak function is used to assess the Braidwood Unit 1 EOC leak rate for the EOC approach for average voltage. Figure 14b shows the function and its lower 95% confidence level. Because a correlation between voltage and leak rate does not exist a maximum leak rate of 0.16 gpm is assumed for each voltage bin.

Future analysis of circumferential indication distribution leak rate will continue to use maximum voltage, since it is the voltage parameter which provides the best indication of the depth of degradation.

Braidwood Unit 1 EOC leak rates are based upon leak rate testing performed at temperatures and pressures different from MSLB conditions. The test leak rates are corrected by the following procedure. Leak rate input data which are available and used to calculate a corrected leak rate at Braidwood MSLB conditions are: observed leak rate (room temperature), leak rate temperature and pressure, MSLB temperature and pressure, PICEP regression equations relating leak rate to pressure in terms of a ratio of the crack opening area to crack length. The most limiting ratio of the leak rate at MSLB temperature to room temperature is calculated using the most limiting (largest leak rate) crack opening to length ratio at MSLB pressure. From this ratio the leak rate at MSLB temperature is determined given the leak rate at test temperature. The PICEP computer code has been used by the industry for calculating MSLB leak rates in SG tubes.

15. Assuming that the maximum EC voltage is a more accurate parameter for predicting SG tube leakage, discuss the need to assess the leakage from other portions of a circumferential SG tube indication which may have voltages that are less than the maximum EC voltage recorded for a given SG tube but that may

nevertheless leak. Specifically, address the possibility that several locations in the circumferential crack pattern of a SG tube at the expansion transition may contribute to the overall leakage from the SG tube since it is possible that the individual cracks in a non-coplanar pattern could be separated by a sufficient distance such that separate EC voltages for these indications could be recorded.

Response:

No correlation of leak rate to ECT parameter has yet been identified. Therefore, the leak rate used to assess the end of cycle leak rate for Braidwood Unit 1 is based upon the maximum leakage recorded during testing of service induced cracks. The testing of these cracks were performed under pressurized conditions and leakage was measured from the entire area of degradation. Any leakage from degradation not detected by the ECT analysis is included in the leak rate assessment. Indications exceeding the leakage threshold are assigned the maximum leakage (from the entire area of degradation). Therefore the present methodology for assessing the leak rate from circumferential indications includes all leakage from the area of degradation.

16. **Given that for any EC voltage, a variety of morphologies can exist as discussed in Items 1 and 9 above, discuss the basis for assuming that there is an EC voltage cutoff for determining when a SG tube is susceptible to leaking. Discuss how the proposed methodology would account for the uncertainty in the potential for a SG tube to leak and the uncertainty in the leak rate itself. Further, given the limited amount of SG tube leakage data for circumferential indications, discuss why the bounding value of SG tube leakage which is assumed, is conservative.**

Response:

In order to provide additional conservatism in the leak rate analysis, to address limited data and uncertainties in the industry leak rate data, a log-logistic probability of leak vs. Maximum ECT amplitude function was developed. The probability of leak function is based upon the data presented in Section 7.0 of the Braidwood Cycle Length Assessment Report dated August 2, 1996. A 95% confidence level of the probability of leak function is used to assess the Braidwood Unit 1 EOC leak rate for the EOC approach. Figure 16 shows the function and its lower 95% confidence level. Because a correlation between voltage and leak rate does not exist a maximum leak rate of 0.16 gpm is assumed for each voltage bin. Operating experience has demonstrated that circumferential cracks, even those with significant degradation, do not leak significantly under normal operating conditions. This is most likely due to the presence of ligaments observed from tube pull metallographic results. The leakage assumed in the analysis is the largest leakage (corrected to Braidwood MSLB conditions) measured during tube pull or insitu pressure leak testing and provides more realistic results than the calculation approaches. The 0.16 gpm leak rate is applied to all voltage bins where leakage has been identified to occur. This conservatively applies the highest observed leak rate, corrected to MSLB conditions, to a distribution of indications which have been observed through testing to have significantly lower leak rates.

The EOC-6 leak rate will be calculated by summing the leak rate at each bin which is calculated as follows: obtain the product of the number of tubes in each bin and the probability of leak of tubes at the bin voltage then multiply by the bounding leak rate (from tube pull leak rate testing and insitu pressure testing).

This method will adequately account for uncertainties in the leakage data. Results of application of this method will be provided upon resolution of NRC questions on input parameters of the EOC analysis.

17. Provide the EC inspection data and the calibration setup files used in the burst and leakage correlation's. In addition, provide EC data for a representative range of circumferential indications and their corresponding EC voltage integral and maximum EC voltage measurements. The EC data should be provided in a format compatible with Eddynet95 software.

Response:

The eddy current inspection data are supplied on one optical disk transmitted via this response. Side A of the optical disk includes the tubes which were used to develop the burst and leakage correlations, (refer to Table 5 for the tube data). An additional fifty (50) tubes with a representative range of voltages for the circumferential indications with the maximum and average voltages are included. All of the data contains the calibration setup files. The data is formatted for the EddyNet 95 software. An optical disk with the data is being forwarded to the Senior Project Manager

18. Provide a copy of the EC data analysis guidelines used during the Braidwood Unit 1 SG tube inspections in fall 1995.

Response:

A copy of the eddy current data analysis guidelines that were used for the Braidwood Unit 1 steam generator tube inspections in the fall of 1995 is provided in Attachment 18.

19. In Section 6.2.1 of the submittal dated August 2, 1996 the EC voltage normalization procedure for adjusting the SG tube burst and leakage data is described. This EC voltage adjustment was made to obtain consistent EC voltages for circumferential indications where the calibration standard did not contain an axial EDM notch. Discuss how the EC voltages for other reflectors in the calibration standard compare with the 0.58 correction factor applied to the data. Provide a statistical analysis based on field data which supports the use of the 0.58 correction factor.

Response:

An evaluation of the application of the 0.58 normalization correction factor to other reflectors in the calibration standard has been performed. The results are shown in Table 19a. The table includes: the other reflectors included in the evaluation, the voltage normalized to 10 Volts on a 100% throughwall hole (TWH), the voltages normalized to 20 Volts on the 100% axial EDM notch and the ratio of the two voltages. The results indicate that the voltages normalized to 10 Volts on a 100% TWH and corrected with a 0.58 correction factor are consistent for the different reflectors included in the analysis.

An additional assessment of the application of the 0.58 correction factor has been performed on 50 field data points using the voltage integral software. The results of this field data assessment are presented in Table 19b and 19c for maximum and average volts, respectively. A statistical analysis of the field data has been performed using a linear regression analysis. The results from the statistical evaluation indicate that the normalization correction factor for the field data is 0.52 and 0.51 for maximum and average voltages, respectively, as determined from the slope of the mean regression line (see Figure 19a and 19b for maximum and average volts, respectively). An assessment of the impact on burst and leak of the difference between the correction factor obtained from calibration standards and the field statistical anlaysis will be provided in a subsequent submittal.

20. A 0.76 correction factor was applied to adjust 0.115-inch probe coil EC voltages to equivalent 0.080-inch probe coil EC voltages. Describe in detail the development of this correction factor, including a discussion on the number of samples reviewed, the types of defects analyzed, and the mean and standard deviation of the study sample. Additionally, provide the recorded EC voltages, if practical, or the range of circumferential indication EC voltages included in the sample. Provide a statistical analysis based on field data which supports the use of the 0.76 correction factor.

Response:

During a look-back of three hundred and fifty 1996 Byron Unit 1 indications in SG C, analysis of the indications was performed using the 0.115" and 0.080" pancake coils. The look-back was performed prior to development of the voltage integral software. Because all the 0.080" RPC indications in one SG were included, a range of indication size (0.06 to 1.11 0.080" RPC Volts) is included in the data set. The average of the three hundred and fifty 0.080" RPC voltages (mean of 0.326 Volts and standard deviation of 0.204 Volts) was compared to the average of the 0.115" RPC voltages (mean 0.431 Volts and standard deviation of 0.269 Volts). From this result a scale factor for the 0.115" RPC is calculated from the ratio of the mean voltages, or 0.326/0.431 = 0.76. This scale factor was applied to some of the insitu pressure test data included in the industry data base burst limits. The scale factor was not applied to any tube pull burst data points because the data was acquired with the 0.080" RPC. Many of the data points used in the leak rate assessment had the scale factor applied since much of the data was obtained from 0.115" RPC.

A listing of the data included in the study is provided in Table 20a.

An additional assessment of the application of the 0.76 correction factor has been performed on 50 field data points using the voltage integral software. The results of this assessment are presented in Table 20b and 20c for maximum and average volts, respectively. A statistical analysis of the field data has been performed using a linear regression analysis. The results from the statistical evaluation indicate that the normalization correction factor for the field data is 0.72 and 0.74 for maximum and average voltages, respectively, as determined from the slope of the mean regression line (see Figure 20a and 20b for maximum and average volts, respectively). The statistical analysis of field data, using the voltage integral software, supports the 0.76 correction factor applied to industry data.

21. Provide a summary of the essential variables of the inspection techniques as documented in the EC acquisition technique sheets (ACTS) and the analysis technique sheets (ANTS) for the Byron Unit 1 SG EC inspections in 1994, 1995, and 1996 and for the 1995 Braidwood Unit 1 SG EC inspections. Additionally, provide the ACTS and ANTS associated with the SG EC inspections conducted at other plants where data were obtained for use in the SG tube burst and leakage correlation's presented in the August 2, 1996, submittal. Identify and discuss how the differences in the acquisition and analysis of EC data will affect the EC voltage measurements used in the analysis.

Response:

Response to be provided in subsequent correspondence.

22. Some studies have identified a lift-off effect in SG tube expansion transitions for gimbaled probes due to SG tube geometry changes. This lift-off can decrease a probe coil's response to SG tube indications. If gimbaled probes were used in any of the inspections where data is used to support the Braidwood Unit 1 cycle length assessment, explain the basis for not accounting for this affect for EC voltage measurements in expansion transitions. Some of the data in the SG tube burst and leakage correlations were obtained from 56 tubes which had been explosively expanded into the SG tubesheet. Describe any differences between the transition geometry, particularly with respect to the length of the expansion of the explosively expanded tubes and that for roll- expanded SG tubes. Discuss the effects of the SG tube transition geometry on the recorded EC voltages. Discuss the need to account for liftoff in the EC voltage measurements for both the data used in the proposed correlations and the data obtained for the field indications

Response:

Gimbaled probe data was not used for measuring the eddy current voltages in the expansion transitions for supporting the Braidwood Unit 1 cycle length assessment.

The explosive expansion transition signals are typically more uniform in their geometry than the mechanically hard roll transitions. The roll transition signals do affect the eddy current signals. The orientation of these signals is mainly horizontal while the flaw response is vertical. The voltage integral software looks at the eddy current data in a 360° scan, any affects from the flaws or roll transitions would be included in the voltage measurements. If the roll transition signal contained any vertical component, it would be included as part of the flaw voltage measurement, which means the voltage measurement would be conservative.

Liftoff is minimized since the probe is spring loaded and surface riding. With the liftoff minimized, liftoff becomes an issue of data quality and cannot be factored into the eddy current voltage measurements.

23. In Figure 3.1 of the submittal dated August 2, 1996, the number of circumferential indications detected with the plus point coil is related to those detected with the 0.080-inch rotating pancake coil (RPC) probe. The results are presented as the number of indications as a function of EC voltages as measured with the plus point probe. Explain the relationship between the circumferential indication EC voltages as measured with the 0.080-inch coil to those measured using the plus point coil. Describe the data set used in the comparison study between the two coils. Explain the differences in the analysis guidelines for the coil study to those used during the Braidwood Unit 1 A1R05 SG tube EC inspections. In addition, the EC voltages in this figure are the maximum indication EC voltages. State whether a similar relationship has been developed using average EC voltage (i.e., voltage Integral) measurements. If so, supply the results. If not, discuss the usefulness of performing such an assessment in light of the present analysis based on EC voltage integral measurements.

Response:

Figure 3.1 of the submittal dated August 2, 1996 is intended to provide an assessment of the probability of detection of the 0.080" RPC compared to the plus point coil. This comparison was used to support application of the POD approach included in the August 2, 1996, submittal to determine a POD to be used for EOC calculations for Braidwood Unit 1. The data in the figure is not intended to establish a relationship between 0.080" RPC and plus point voltages. The conclusion drawn from the figure is that for large indications (as determined by plus point voltages) the 0.080" RPC has a high level of detection, nearly equivalent to plus point. The conclusions support that the tail of the distribution used in the Braidwood Unit 1 analysis for the POD approach is conservative when a POD of 0.2 is used across all voltage bins.

The data set used for this study is from a look-back of the 1996 Byron Unit 1 SG C TTS circumferential indications performed in May of 1996. The voltage integral software was not used in this look-back. This look-back included analysis of SG C indications with the 0.080" RPC and plus point coil. Referring to Figure 3.1, the solid line represents indications in SG C which in 1996 could only be detected with the plus point coil (no 0.080" RPC confirmation). The broken line represents plus point indications which were confirmed with 0.080" RPC. Where the two lines (solid and broken) are close to each other, the POD of the 0.080" RPC is approaching one.

A similar relationship has not been developed for average voltage. Because the figure was developed to assess the detection capability (POD) of 0.080" RPC indications as compared to plus point coil. Data presented in Figures 4.5, 4.6 and 6.1 support the trend that as the maximum voltages increase so do the average voltages. This would support the conclusion discussed above that the detection level of the 0.080" RPC voltages is high for large indications as determined by plus point coil average voltage as well as the maximum voltage.

Additionally, in order to address concerns with the number of tubes assumed in the POD approach, ComEd has evaluated two additional end of cycle distributions. These two distributions do not use the data from Figure 3.1. Instead these distributions assume that Braidwood Unit 1 EOC-6 distribution will be similar to the distribution of indications detected at Byron Unit 1 at EOC-6.

All indications detected by the 0.080" RPC were also detected by the plus point coil.

ComEd has concluded that there is not value added to defining a POD for both max and average volts for the following reasons:

- Analyst initially detects and reports based upon max volts, and
- Average volts calculation is only done after detection.

An explanation of the differences between the Braidwood Unit 1 Fall 1995 inspection guidelines and those used in the look-back studies will be provided in a subsequent submittal.

24. Data to support the assessment of the probability of detection (POD) and the SG tube burst and leakage correlations in the August 2, 1996 submittal were taken from various sources. Since the noise levels inherent in the data and SG tube wall deposits may affect the resulting EC voltage measurements, provide an assessment comparing the influence of noise and deposits on the EC signals for the SG tube burst and leakage data. Additionally, provide a discussion as to how the noise levels were determined (i.e., SG tube location, coils, and frequencies). Given that these factors may affect EC voltage measurements, provide the basis for selecting the lowest point in the scan line as the null point for EC voltage measurements.

Response:

Response to be provided in subsequent correspondence.

25. In the Braidwood Unit 1 cycle length assessment, analyst uncertainty values of 0. 19 and 0.22 were utilized. Given that a signal for a specific type of degradation may be better defined by one coil rather than another, provide an assessment of the analyst variability based on the coil of interest (e.g., the 0.080-inch probe). Additionally, state the units associated with these values. If the values are in volts, state the corresponding analyst uncertainty as a percentage value.

Response:

Response to be provided in subsequent correspondence.

26. Discuss the basis for keeping the data from the 100 SG tube and 200 SG tube tests separate for the analyst variability study. Provide and discuss the mean, standard deviation, and shape of the distribution used for the model of analyst uncertainty (e.g., a normal distribution with a mean of x and standard deviation of y). Discuss the technical basis for the distribution which was used.

Response:

Response to be provided in subsequent correspondence.

27. Discuss the basis for reevaluating the EC voltages measured in the analyst variability study based on a resolution process. Discuss whether this practice was used in the blind tests. The staff believes that this method of analyzing analyst variability is inconsistent with the methodology used in GL 95-05 (i.e., reevaluating the EC voltages). Clarify what is meant by the statement that observation EC voltages from different coils for the same indications were excluded.

Response:

Response to be provided in subsequent correspondence.

28. Describe the measures included in the blind test protocol which would have prevented an analyst from using information from one coil to locate and size the maximum EC voltage signal as seen by another coil. As discussed by the staff in the meeting held on August 26, 1996, the rotational slewing of the data via such mechanisms as the trigger offset feature in Eddynet95 could lead to additional variability in an analyst's ability to accurately size circumferential indications with an EC voltage integral measurement. Describe how this variability was accounted for in the assessment of analyst uncertainty.

Response:

Response to be provided in subsequent correspondence.

29. **If the measured EC voltages in the "look back" analysis of the Byron Unit 1 EC measurements were maximum EC voltages, explain the basis for applying these results of the analyst uncertainty measurement to the EC voltage integral measurements. If circumferential indications were sized using, the lissajous signal, explain the basis for applying a variability in sizing with the lissajous signal to measurements of maximum EC voltage determined by positioning the signal cursor in the voltage integral scan.**

Response:

Response to be provided in subsequent correspondence.

30. **Provide a copy of the EC sizing procedures used in the assessments of the analyst uncertainty, the growth rate, the burst and leakage data, and the POD. Discuss the extent of use and the influence of the following on any EC voltage measurements: (1) the use of Eddynet95 data filters; (2) the trigger offset feature and (3) the presence of 360m circumferential flaws. Address both the EC voltage integral and the EC maximum voltage measurements.**

Response:

Response to be provided in subsequent correspondence.

31. **The probe wear allowance that was developed in the August 20, 1996, submittal was based on a small sample of the total SG tubes inspected. Provide an assessment of probe wear based on all available data. The staff believes that the methodology used to determine the probe wear allowance is significantly different from that used to determine the probe wear allowance in GL 95-05. Discuss the basis for not determining the probe wear allowance in accordance with the methodology used to support the GL 95-05 probe wear allowance given that different SG tube roughness can change the amount of probe wear observed between calibration runs.**

Response:

Response to be provided in subsequent correspondence.

Table 3a. Byron 1 Growth Rate Bins and Number of Tubes for Maximum Voltage

Maximum Voltage Growth Rate Bins and Number of Tubes					
	Bins	94 to 95	94 to 96	95 to 96	
	ΔV/EFPY				
	-1.8			1	
	-1.7			1	
	-1.6			0	
	-1.5			0	
	-1.4			2	
	-1.3			2	
	-1.2			0	
	-1.1			0	
	-1.0			2	
	-0.9			1	
	-0.8			3	
	-0.7			4	
	-0.6			10	
	-0.5			3	
	-0.4	4	0	11	
	-0.3	3	0	7	
	-0.2	12	1	11	
	-0.1	33	5	5	
	0.0	71	10	21	
	0.1	169	20	10	
	0.2	177	23	17	
	0.3	112	6	19	
	0.4	67	5	8	
	0.5	25	2	6	
	0.6	9	0	8	
	0.7	3	0	7	
	0.8			5	
	0.9			1	
	1.0			2	
	1.1			1	
	1.2			1	
	1.3			5	
	1.4			3	
	1.5			1	
	1.6			2	
	1.7			0	
	1.8			0	
	1.9			1	
	SUM >>	685	72	181	

Table 3b. Byron 1 Growth Rate Bins and Number of Tubes for Average Voltage

Average VoltageGrowth Rate Bins and Number of Tubes			
Bins ΔV/EFPY	94 to 95	94 to 96	95 to 96
-1.20			1
-1.15			0
-1.10			1
-1.05			0
-1.00			0
-0.95			0
-0.90			0
-0.85			0
-0.80			0
-0.75			1
-0.70			0
-0.65			2
-0.60			1
-0.55			3
-0.50			3
-0.45			3
-0.40			2
-0.35			6
-0.30			7
-0.25	3	0	10
-0.20	4	2	3
-0.15	7	1	4
-0.10	26	2	16
-0.05	40	6	9
0.00	92	7	17
0.05	185	25	8
0.10	149	9	10
0.15	107	14	20
0.20	41	2	7
0.25	14	1	12
0.30	11	3	2
0.35	3	0	6
0.40	3	0	4
0.45			0
0.50			6
0.55			3
0.60			2
0.65			0
0.70			5
0.75			0
0.80			2
0.85			1
0.90			0
0.95			2
1.00			0
1.05			0
1.10			0
1.15			0
1.20			1
1.25			0
1.30			1
SUM >>	685	72	181

Table 5

Test Method	Metallographic Results PDA (%)	Max Depth (%)	Circ. Extent (degrees)	COIL SIZE	10 V on 100% TW Hole Max Volts	Avg Volts	20 V on 100% EDM Notch (Normalized) Max Volts	Avg Volts	Insitu Press (ksi)	Burst Press (ksi)	Operating Press (ksi)	Leak Rate (gpm)	Leak Rate Test Press. (ksi)	Adj. Leak Rate (gpm)	Insitu Leak Rate > Make-up at Max Pressure	Yld. Strength (ksi)	Ultimate Strength (ksi)	Axial or Circ. Failure	Mixed Mode
Insitu	-	-	-	0.115	1.51	0.63	0.67 (3)	0.28 (3)	4.15	-	-	n	-	n	-	-	-	-	-
Burst	65	100	360	0.080"	3.13	1.02	1.82	0.59	x	8.44	-	n	-	n	-	-	-	Circ	No
Insitu	-	-	-	0.115	3.09	1.26	1.36	0.56	4.60	-	-	0.050	2.000	0.054	yes	-	-	-	-
Insitu	-	-	-	0.115	3.62	1.66	1.60	0.73	3.60	-	-	0.150	2.000	0.161	yes	-	-	-	-
Insitu	-	-	-	0.115	2.52	1.00	1.11	0.44	4.70	-	-	0.040	4.700	0.011	-	-	-	-	-
Insitu	-	-	-	0.115	2.08	0.93	0.92	0.41	4.45	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	0.115	1.58	0.71	0.70	0.31	4.45	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	0.115	1.67	0.71	0.74	0.31	6.80	-	-	0.000	-	0.000	-	-	-	-	-
In-itu	-	-	-	0.115	1.63	0.79	0.72	0.35	6.80	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	0.115	1.31	0.57	0.58	0.25	6.80	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	0.115	1.06	0.48	0.47	0.21	6.80	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	0.115	1.92	0.71	0.85	0.31	4.45	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	0.08	3.03	0.97	1.75	0.56	4.70	-	-	0.000	-	0.000	-	-	-	-	-
Burst	49	100	360	0.080"	4.75	1.12	2.76	0.65	-	9.40	-	0.139	2.650	0.090	-	-	-	Circ	Yes
Burst	49	71	350	0.080"	3.25	1.38	1.89	0.80	-	11.20	-	n	-	n	-	-	-	Axial	No
Burst	47	91	280	0.080"	4.96	1.92	2.88	1.11	-	8.45	-	n	-	n	-	-	-	Axial	No
Insitu	-	-	-	.115"	4.53	1.53	2.00	0.67	3.90	-	-	0.011	3.000	0.0064 (4)	-	-	-	-	-
Insitu	-	-	-	.115"	3.15	1.59	1.39	0.70	3.90	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	.115"	1.69	0.90	0.74	0.40	3.90	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	.115"	3.56	1.61	1.57	0.71	3.90	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	.115"	2.04	0.90	0.90	0.40	3.90	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	.115"	1.19	0.43	0.52	0.19	7.08	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	.115"	0.61	0.17	0.27	0.07	6.70	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	.115"	1.93	0.78	0.85	0.34	6.40	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	.115"	0.64	0.29	0.28	0.13	7.00	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	.115"	1.09	0.63	0.48	0.28	7.05	-	-	0.000	-	0.030	-	-	-	-	-
Insitu	-	-	-	.115"	0.95	0.36	0.42	0.16	7.05	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	0.080"	7.56	1.47	4.38	0.85	5.30	-	-	0.029	4.200	0.010	-	-	-	-	-
Insitu	-	-	-	0.080"	2.16	1.14	1.25	0.66	5.75	-	-	0.000	-	0.000	-	-	-	-	-
Burst (1)	78	100	360	0.080"	-	-	4.14	1.02	-	4.35 (1)	-	n	-	n	-	65.45 (1)	113.95	Circ	No
Burst	35	51	360	0.080"	-	-	0.38	0.18	-	10.950	-	0.000	-	0.000	-	54.00	101.60	Axial	Yes
Burst	35	83	310	0.080"	1.10	0.47	0.64	0.27	-	10.300	-	0.000	-	0.000	-	55.80	97.40	(2)	No
Burst	54	79	360	0.080"	0.67	0.21	0.39	0.12	-	11.400	-	0.000	-	0.000	-	50.90	100.90	Axial	Yes
Burst	48	77	360	0.080"	1.58	0.68	0.92	0.39	-	12.100	-	0.000	-	0.000	-	56.10	107.80	Axial	No
Burst (1)	65	100	359	0.080"	1.94	0.56	1.13	0.32	-	7.424 (1)	-	n	-	n	-	58 (1)	106.40	Circ.	Yes
Burst	56	98	360	0.080"	0.70	0.31	0.41	0.18	-	10.600	-	0.000	-	0.000	-	51.60	102.30	Axial	No
Insitu	-	-	-	.115"	1.14	0.27	0.50	0.12	5.00	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	0.080"	1.20	0.28	0.70	0.16	5.00	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	0.080"	0.98	0.52	0.57	0.30	5.00	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	0.080"	1.45	0.54	0.84	0.31	5.00	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	0.080"	0.89	0.54	0.52	0.31	5.00	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	0.080"	1.15	0.36	0.67	0.21	5.00	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	0.080"	0.90	0.20	0.52	0.12	5.00	-	-	0.000	-	0.000	-	-	-	-	-
Insitu	-	-	-	0.080"	1.15	0.38	0.67	0.22	5.00	-	-	0.000	-	0.000	-	-	-	-	-
Operating	73	100	330	0.080"	31.12	15.25	18.05	8.85	-	-	1.375	-	-	-	-	-	-	-	-
Operating	94	100	360	0.080"	16.39	11.19	9.51	6.49	-	-	1.35	-	-	-	-	-	-	-	-
Operating	88	100	360	0.080"	10.13	4.63	5.88	2.69	-	-	1.35	-	-	-	-	-	-	-	-

(1) Based upon EDM simulant of actual tube degradation level, corrected for material properties of tube pull
(2) Test rig connection failure before tube burst
(3) Data Reported in 9/10/96 Submittal as 0.88 and 0.37 Volts for max. and avg. volts respectively
the data was acquired with 0.115" RPC and correction factor not applied, this does not change conclusions of submittals
(4) Data reported in 8/2/96 and 9/10/96 submittals as 0.00352 gpm at 3.9 ksi, actual leakage is recorded at 3.0 ksi

Table 19a

Assessment of 0.58 Correction for Other Reflectors

Voltage Normalized @ 10 volts pp on the 100% TWH		Voltage Normalized @ 20 volts pp on the 100% AXIAL EDM NOTCH		Ratio 20V 100% EDM/ 10V 100% TWH
INDICATION	**VOLTS**	**INDICATION**	**VOLTS**	
100% TW	3.78	100% TW	2.08	0.55
61% FBH	4.51	61% FBH	2.64	0.59
20% FBH	1.42	20% FBH	0.78	0.55
100% AXIAL EDM OD	16.26	100% AXIAL EDM OD	9.51	0.58
40 % AXIAL EDM OD	1.00	40 % AXIAL EDM OD	0.58	0.58
20 % AXIAL EDM ID	0.69	20 % AXIAL EDM ID	0.40	0.58
20 % CIRC NOTCH ID	0.98	20 % CIRC NOTCH ID	0.49	0.50
40 % CIRC NOTCH OD	1.24	40 % CIRC NOTCH OD	0.70	0.56

Table19b

Evaluation of Correction Factors for
Application to Industry Burst and Leak Data
Voltage Normalization Correction Factor (0.58)
Maximum Volts

20 Volt Norm 100% EDM	10 Volt Norm TWH
0.45	0.88
0.65	1.23
0.72	1.29
0.49	1.05
0.55	1.00
0.31	0.39
0.30	0.49
0.52	0.94
0.43	0.75
0.49	0.85
0.20	0.35
0.40	0.92
1.20	2.62
0.97	2.10
0.55	1.22
0.62	1.35
0.55	1.22
0.21	0.43
0.32	0.58
0.33	0.63
0.29	0.51
0.53	1.00
0.65	1.24
0.73	1.40
0.42	0.80
0.31	0.52
0.26	0.52
0.52	1.00
0.47	0.75
0.35	0.69
0.61	1.15
0.57	1.11
0.38	0.79
0.67	1.29
0.64	1.22
0.67	1.37
0.69	1.13
0.79	1.30
0.43	0.73
0.86	1.43
0.71	1.16
0.24	0.42
0.38	0.73
0.26	0.55
0.50	0.95
0.80	1.54
0.38	0.74
0.45	0.70
0.90	1.80
0.75	1.46

Table 19c

Evaluation of Correction Factor for Application to Industry Burst and Leak Data Voltage Normalization Correction Factor (0.58) Average Volts

20 V Norm 100% EDM	10 V Norm TWH
0.19	0.37
0.29	0.54
0.46	0.81
0.24	0.50
0.23	0.42
0.14	0.24
0.15	0.29
0.21	0.39
0.24	0.42
0.12	0.21
0.11	0.19
0.14	0.34
0.51	1.11
0.46	1.00
0.37	0.88
0.31	0.68
0.24	0.52
0.12	0.27
0.16	0.19
0.18	0.33
0.10	0.19
0.22	0.43
0.28	0.55
0.29	0.55
0.21	0.41
0.16	0.26
0.11	0.19
0.26	0.49
0.18	0.29
0.16	0.31
0.30	0.57
0.26	0.49
0.14	0.31
0.30	0.57
0.31	0.59
0.27	0.58
0.17	0.27
0.37	0.61
0.20	0.34
0.35	0.58
0.30	0.50
0.11	0.20
0.24	0.46
0.12	0.28
0.32	0.61
0.21	0.41
0.15	0.30
0.20	0.30
0.45	0.90
0.36	0.70

Table 20a

Data Used in Initial Coil Size Correction Factor
Comparison of 0.080" and 0.115" RPC Voltages

0.080" Volts	.115 volts
0.06	0.11
0.06	0.14
0.06	0.15
0.07	0.08
0.07	0.35
0.07	0.13
0.08	0.22
0.08	0.16
0.08	0.16
0.09	0.14
0.09	0.26
0.09	0.37
0.1	0.13
0.1	0.14
0.1	0.16
0.1	0.11
0.1	0.18
0.1	0.1
0.1	0.23
0.1	0.21
0.1	0.18
0.1	0.14
0.11	0.19
0.11	0.17
0.11	0.22
0.11	0.1
0.11	0.12
0.11	0.48
0.11	0.18
0.11	0.13
0.11	0.19
0.12	0.17
0.12	0.22
0.12	0.19
0.12	0.11
0.12	0.2
0.12	0.41
0.12	0.58
0.12	0.17
0.12	0.26
0.12	0.09
0.12	0.17
0.13	0.48
0.13	0.14
0.13	0.17
0.13	0.47
0.13	0.07
0.13	0.28
0.13	0.21
0.13	0.17
0.13	0.17
0.13	0.22
0.13	0.16
0.14	0.34
0.14	0.14
0.14	0.45
0.14	0.33
0.14	0.23
0.14	0.21
0.14	0.27
0.15	0.14

Table 20a

Data Used in Initial Coil Size Correction Factor
Comparison of 0.080" and 0.115" RPC Voltages

0.080" Volts	.115 volts
0.15	0.14
0.15	0.18
0.15	0.16
0.15	0.14
0.15	0.33
0.15	0.41
0.15	0.24
0.16	0.25
0.16	0.24
0.16	0.43
0.16	0.14
0.16	0.12
0.16	0.2
0.16	0.34
0.16	0.21
0.16	0.24
0.16	0.18
0.16	0.24
0.17	0.3
0.17	0.11
0.17	0.3
0.17	0.32
0.17	0.3
0.17	0.23
0.17	0.46
0.17	0.54
0.17	0.18
0.17	0.22
0.17	0.19
0.17	0.3
0.18	0.18
0.18	0.5
0.18	0.16
0.18	0.24
0.18	0.24
0.18	0.31
0.18	0.21
0.18	0.52
0.18	0.19
0.18	0.5
0.18	0.13
0.19	0.36
0.19	0.13
0.19	0.36
0.19	0.24
0.19	0.17
0.19	0.24
0.19	0.37
0.19	0.23
0.19	0.3
0.2	0.39
0.2	0.47
0.2	0.33
0.2	0.14
0.2	0.58
0.2	0.18
0.2	0.27
0.2	0.34
0.2	0.21
0.2	0.18
0.2	0.26

Table 20a

Data Used in Initial Coil Size Correction Factor
Comparison of 0.080" and 0.115" RPC Voltages

0.080" Volts	.115 volts
0.2	0.28
0.2	0.42
0.21	0.14
0.21	0.19
0.21	0.17
0.21	0.2
0.21	0.38
0.21	0.34
0.21	0.27
0.21	0.23
0.21	0.39
0.21	0.3
0.22	0.27
0.22	0.24
0.22	0.36
0.22	0.17
0.22	0.25
0.22	0.24
0.23	0.33
0.23	0.14
0.23	0.12
0.23	0.84
0.23	0.45
0.23	0.59
0.23	0.3
0.23	0.48
0.23	0.24
0.23	0.31
0.24	0.22
0.24	0.32
0.24	0.16
0.24	0.52
0.25	0.22
0.25	0.4
0.25	0.19
0.25	0.61
0.25	0.46
0.25	0.64
0.25	0.2
0.25	0.33
0.25	0.24
0.25	0.34
0.26	0.19
0.26	0.11
0.26	0.45
0.26	0.24
0.26	0.21
0.26	0.35
0.26	0.37
0.27	0.29
0.27	0.39
0.27	0.28
0.27	0.17
0.27	0.4
0.27	0.15
0.27	0.33
0.27	0.41
0.27	0.32
0.28	0.96
0.28	0.51
0.28	0.13

Table 20a

Data Used in Initial Coil Size Correction Factor
Comparison of 0.080" and 0.115" RPC Voltages

0.080" Volts	.115 volts
0.28	0.34
0.28	0.36
0.28	0.96
0.28	0.3
0.28	0.18
0.28	0.33
0.28	0.33
0.28	0.69
0.29	0.55
0.29	0.32
0.29	0.59
0.29	0.38
0.29	0.3
0.29	0.37
0.29	0.37
0.3	0.26
0.3	0.43
0.3	0.28
0.3	0.3
0.3	0.53
0.3	0.28
0.3	0.27
0.31	0.49
0.31	0.4
0.31	0.53
0.31	0.59
0.31	0.55
0.31	0.34
0.32	0.64
0.32	0.37
0.32	0.78
0.32	0.54
0.32	0.38
0.32	0.13
0.32	0.22
0.32	0.5
0.33	0.4
0.34	0.37
0.34	0.6
0.35	0.39
0.35	0.85
0.35	0.44
0.35	0.4
0.36	0.58
0.36	0.56
0.36	0.39
0.37	0.61
0.37	0.93
0.37	0.34
0.37	0.54
0.37	0.68
0.37	0.4
0.37	0.41
0.37	0.38
0.37	0.46
0.38	0.4
0.38	0.44
0.38	0.52
0.38	0.42
0.38	0.28
0.39	0.72

Table 20a

Data Used in Initial Coil Size Correction Factor
Comparison of 0.080" and 0.115" RPC Voltages

0.080" Volts	.115 volts
0.39	0.79
0.39	0.97
0.39	0.51
0.39	0.63
0.39	0.63
0.4	0.67
0.4	0.43
0.4	0.45
0.4	0.55
0.41	1.07
0.41	0.54
0.41	0.57
0.41	0.72
0.41	0.36
0.41	0.81
0.42	0.35
0.42	0.89
0.42	0.33
0.42	0.39
0.42	0.6
0.43	0.42
0.43	1.01
0.44	0.51
0.44	0.49
0.44	0.58
0.45	0.73
0.46	0.84
0.46	0.65
0.47	0.58
0.47	0.53
0.48	0.36
0.48	0.53
0.48	0.98
0.49	0.49
0.49	0.63
0.49	0.72
0.5	0.63
0.5	0.68
0.5	0.63
0.5	0.77
0.51	0.38
0.52	0.72
0.52	0.85
0.53	0.29
0.53	0.17
0.53	0.43
0.53	0.74
0.54	0.84
0.54	0.71
0.54	0.95
0.55	0.56
0.55	0.48
0.55	0.32
0.56	0.64
0.56	0.71
0.57	0.86
0.57	0.59
0.57	0.92
0.58	0.37
0.59	0.98
0.6	1.48

Table 20a

Data Used in Initial Coil Size Correction Factor Comparison of 0.080" and 0.115" RPC Voltages

0.080" Volts	.115 volts
0.6	1.33
0.6	0.2
0.6	1.13
0.6	0.88
0.62	1.07
0.62	1.01
0.62	0.52
0.63	0.79
0.63	0.3
0.64	0.77
0.64	0.24
0.65	0.52
0.65	0.57
0.65	0.65
0.67	0.82
0.67	0.67
0.67	0.94
0.68	0.7
0.68	0.65
0.69	1.13
0.69	0.46
0.7	0.75
0.71	0.74
0.71	1.06
0.71	0.64
0.72	1.14
0.72	0.47
0.73	0.32
0.74	0.46
0.74	0.71
0.76	0.57
0.76	1.05
0.76	1.62
0.78	0.95
0.79	0.52
0.8	0.87
0.81	1
0.81	0.86
0.85	1.04
0.86	0.51
0.88	0.6
0.89	1.19
1.06	0.89
1.09	0.77
1.11	0.4

Table 20b

Evaluation of Correction Factors for Application to Industry Burst and Leak Data Coil Size Correction Factor (0.76) Maximum Volts

0.115 Volts	0.080 Volts
0.47	0.45
0.75	0.65
1.14	1.29
0.42	0.49
0.57	0.55
0.36	0.31
0.39	0.30
0.63	0.52
0.63	0.43
0.78	0.49
0.28	0.20
0.50	0.40
1.43	1.20
1.21	0.97
0.70	0.55
0.81	0.62
0.75	0.55
0.57	0.21
0.44	0.32
0.52	0.33
0.59	0.29
0.96	0.53
1.00	0.65
1.27	0.73
0.61	0.42
0.52	0.31
0.57	0.26
0.66	0.52
0.87	0.47
0.22	0.35
1.06	0.61
0.71	0.57
0.92	0.38
1.04	0.67
1.06	0.64
0.99	0.67
0.88	0.69
0.81	0.79
0.75	0.43
1.09	0.86
0.87	0.71
0.34	0.24
0.37	0.38
0.34	0.26
0.53	0.50
1.00	0.80
0.32	0.38
0.37	0.45
1.03	0.90
1.02	0.75

Table 20c
Evaluation of Correction Factors for Application to Industry Burst and Leak Data
Coil Size Correction Factor (0.76)
Average Volts

0.115" Avg Volts	0.080" Avg Volts
0.16	0.19
0.34	0.29
0.38	0.46
0.20	0.24
0.27	0.23
0.35	0.14
0.19	0.15
0.29	0.21
0.32	0.24
0.23	0.12
0.16	0.11
0.15	0.14
0.56	0.51
0.56	0.46
0.44	0.37
0.47	0.31
0.36	0.24
0.27	0.12
0.18	0.16
0.23	0.18
0.22	0.10
0.37	0.22
0.43	0.28
0.43	0.29
0.28	0.21
0.26	0.16
0.25	0.11
0.18	0.26
0.36	0.18
0.11	0.16
0.45	0.30
0.26	0.26
0.39	0.14
0.46	0.30
0.47	0.31
0.44	0.27
0.26	0.17
0.38	0.37
0.35	0.20
0.47	0.35
0.43	0.30
0.21	0.11
0.28	0.24
0.15	0.12
0.44	0.32
0.30	0.21
0.14	0.15
0.14	0.20
0.48	0.45
[illegible]	0.36

Figure 1a. Industry Tube Pull/Insitu Indication Average Volts vs. Maximum Volts

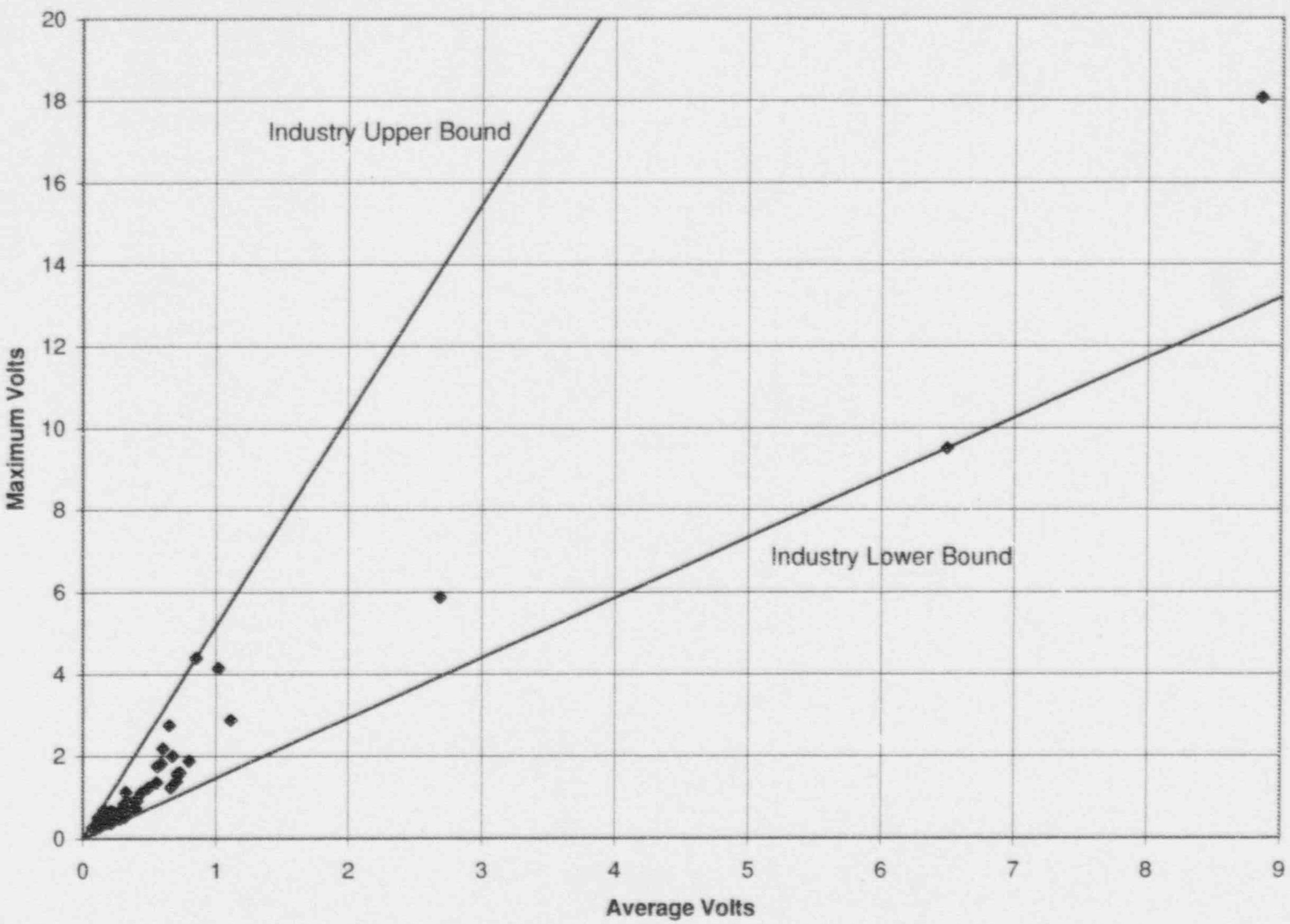
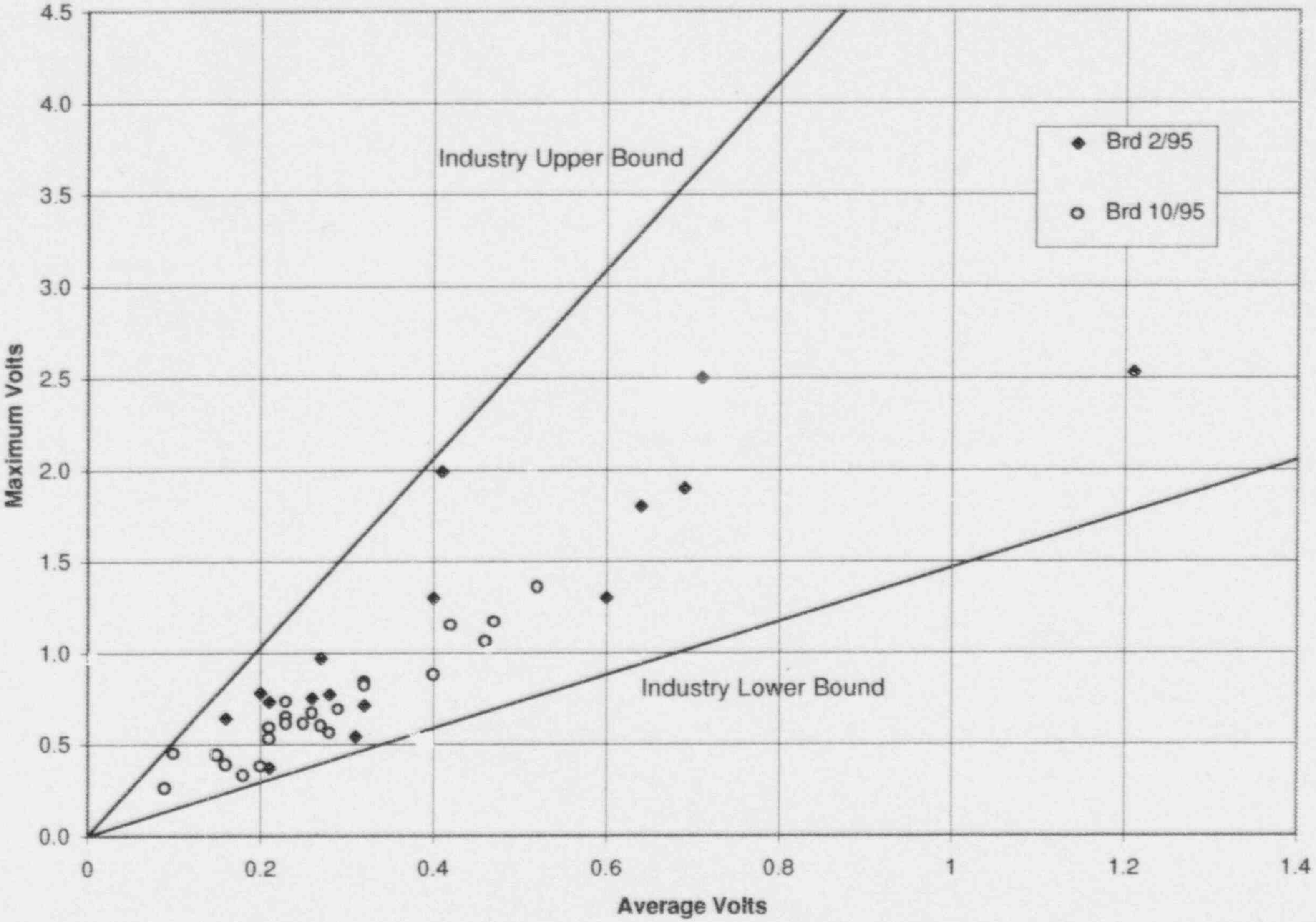


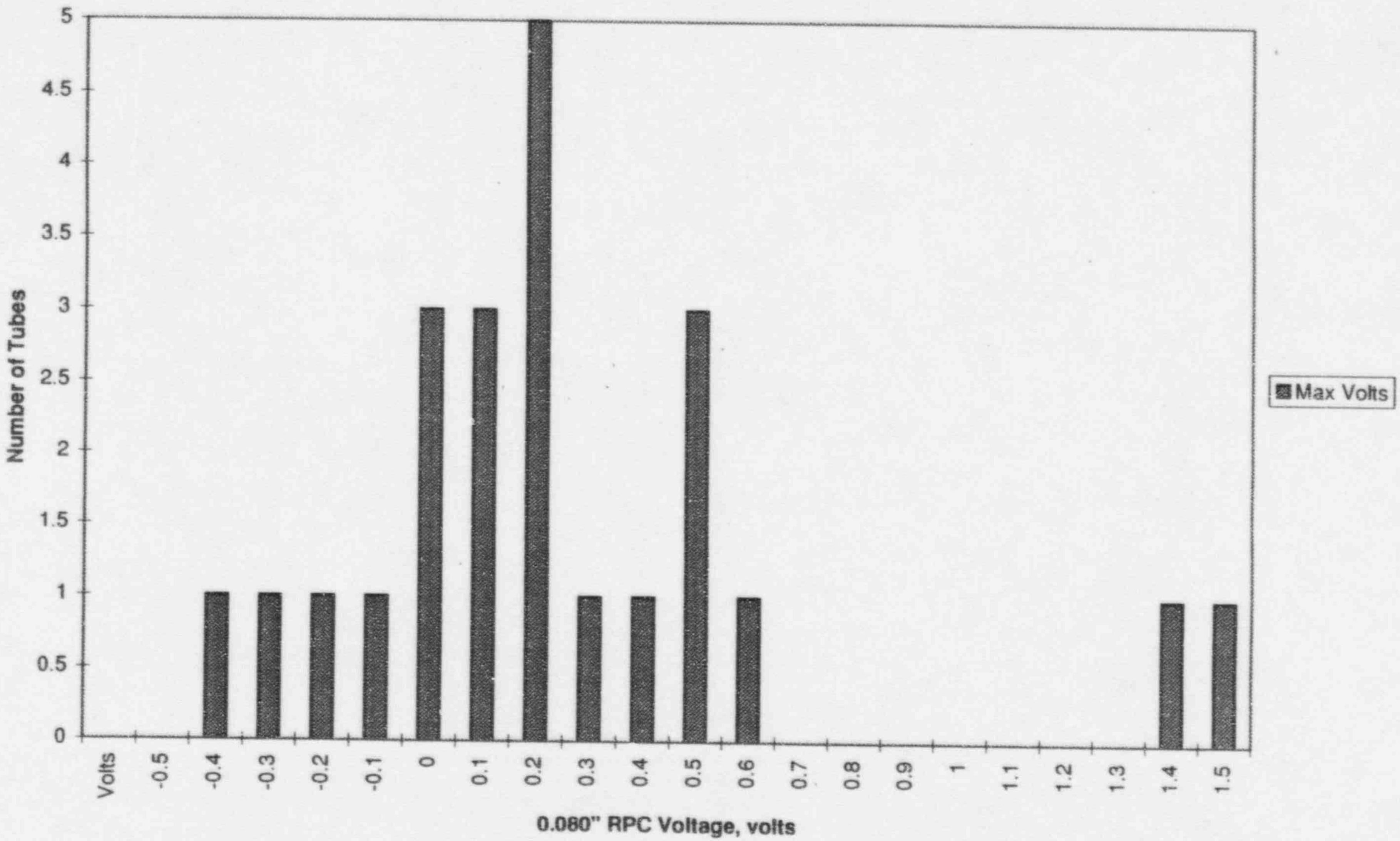
Figure 1b. Braidwood 1 Indications Average Volts vs. Maximum Volts Compared to Bounds of Industry Experience Base



Conclusion: The Size of the Indications at Braidwood are Smaller and are Bounded by Industry Data

Braidwood Unit 1 Maximum Voltage Growth 2/95 to 10/95

Figure 2a



Braidwood Unit 1 Average Voltage Growth 2/95 to 10/95
Figure 2b

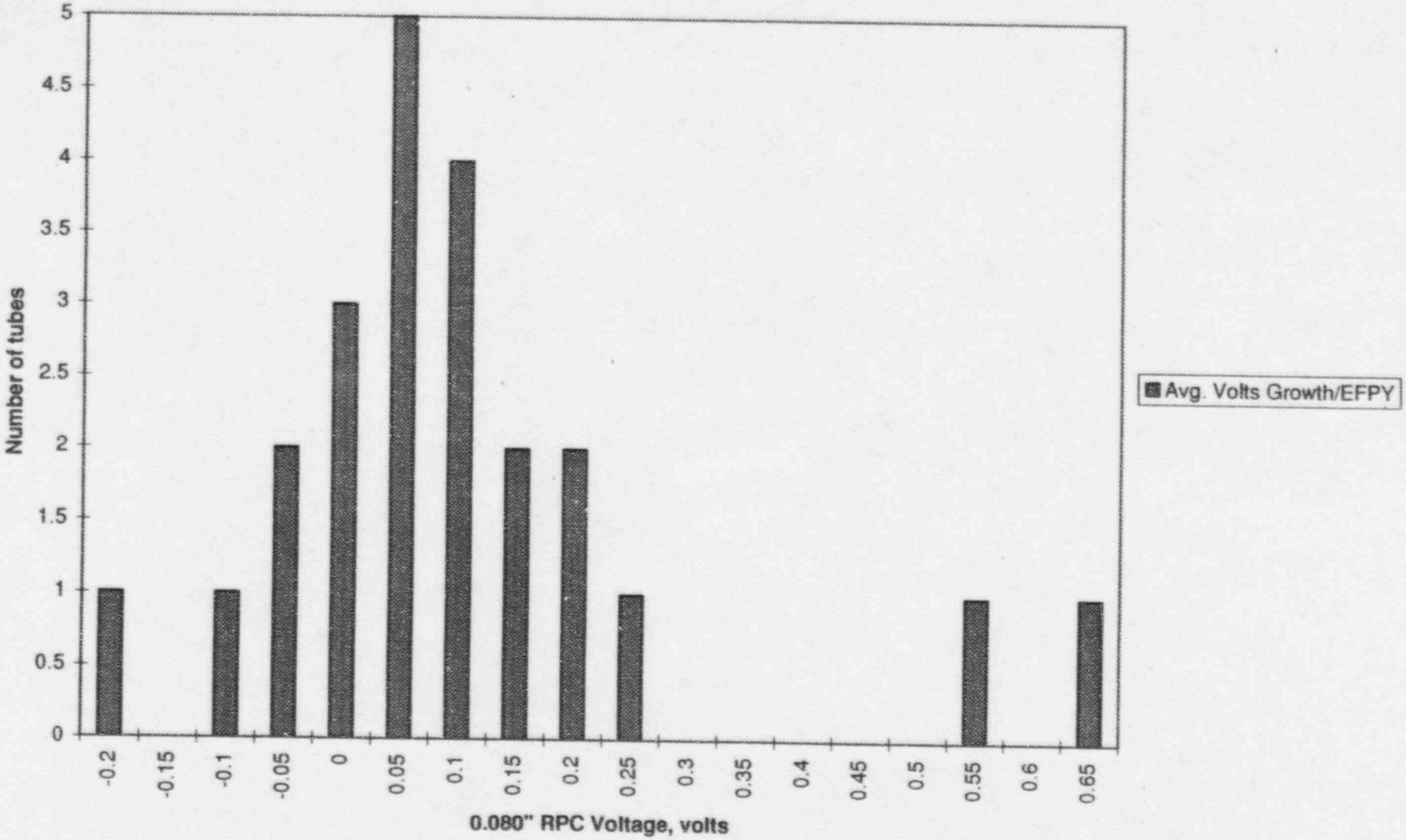


Figure 6a. Maximum Voltage vs. Adjusted Insitu or Burst Pressure

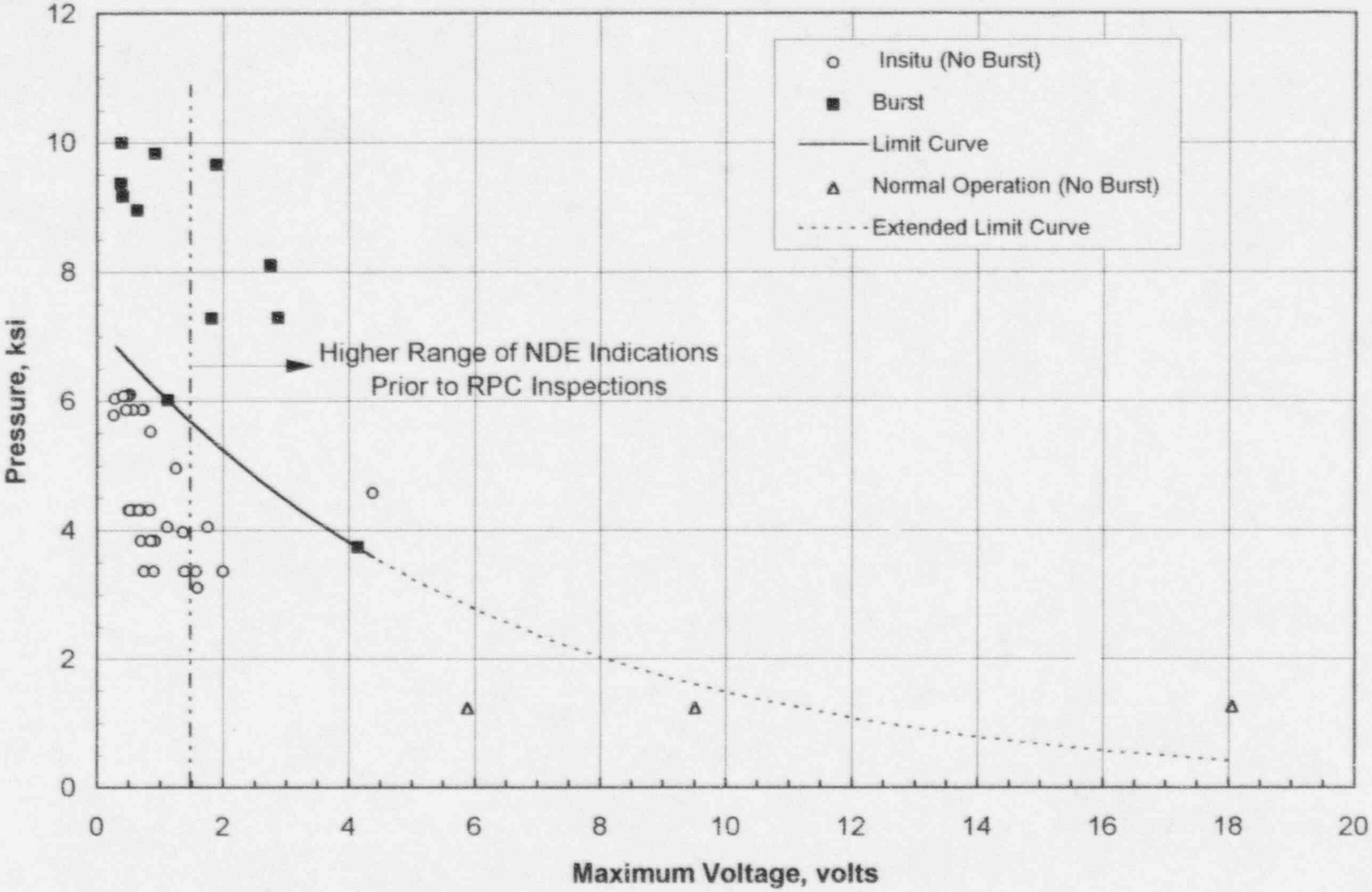
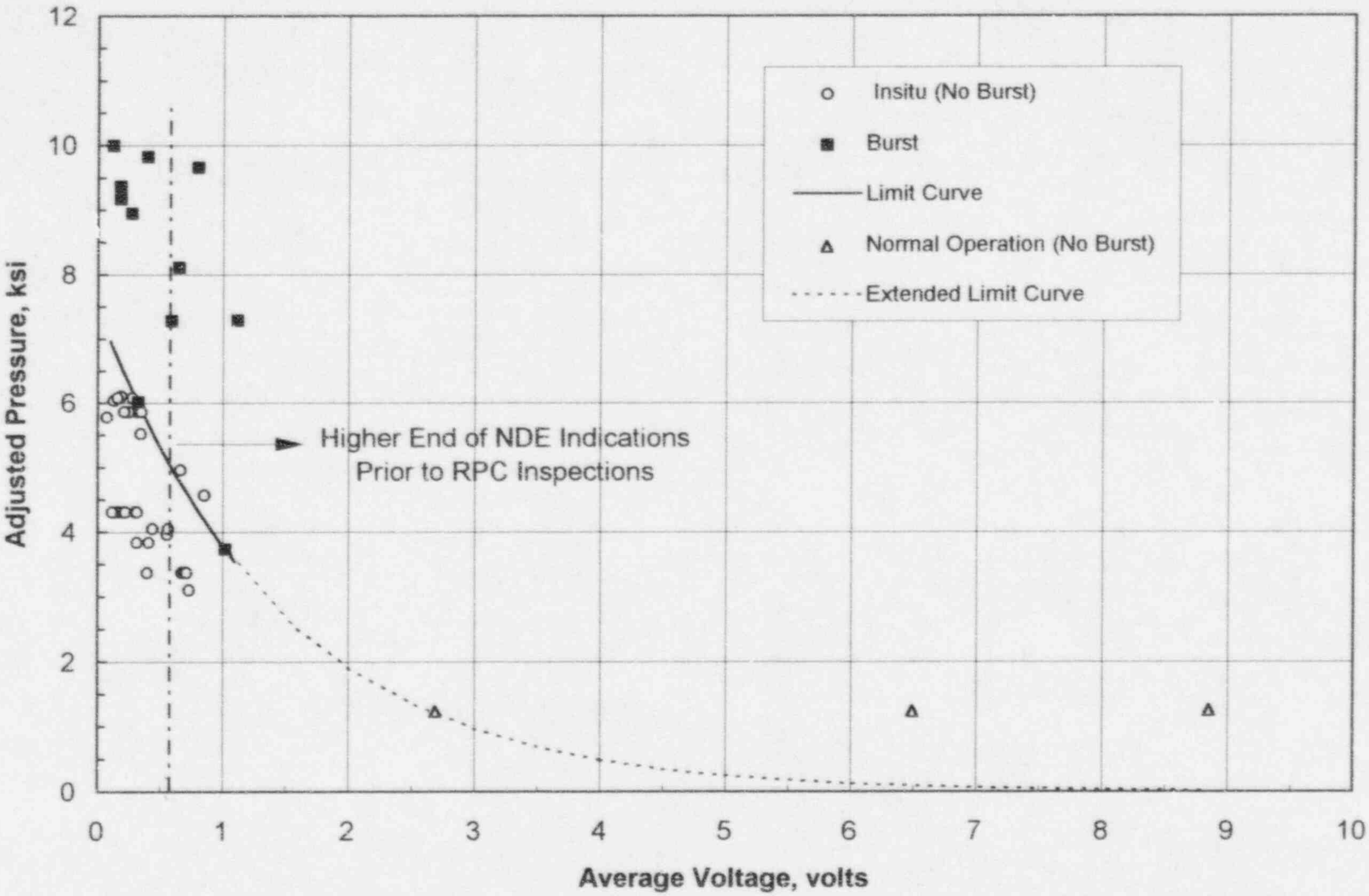
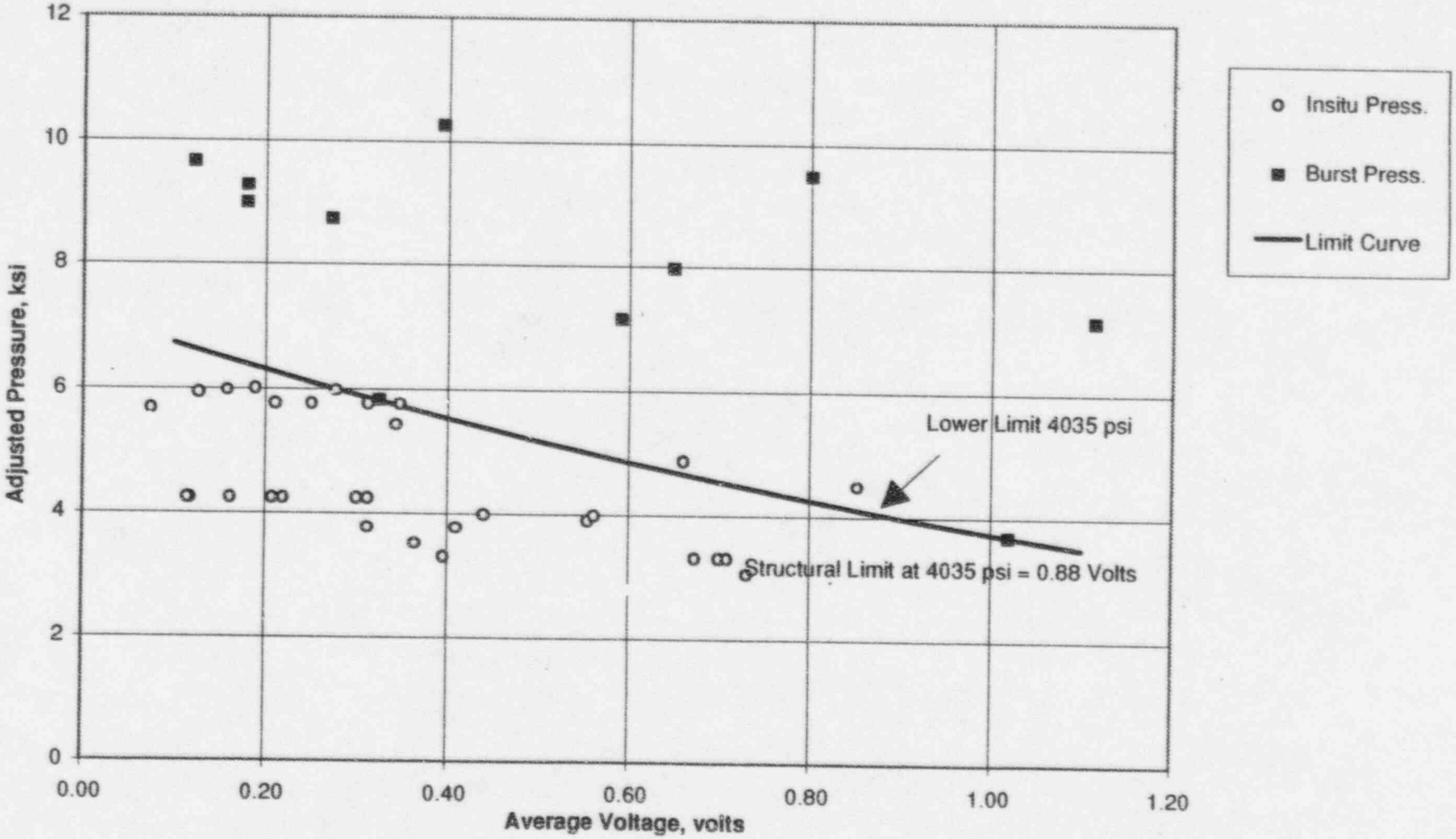


Figure 6b. Average Voltage vs. Adjusted Insitu or Burst Pressure

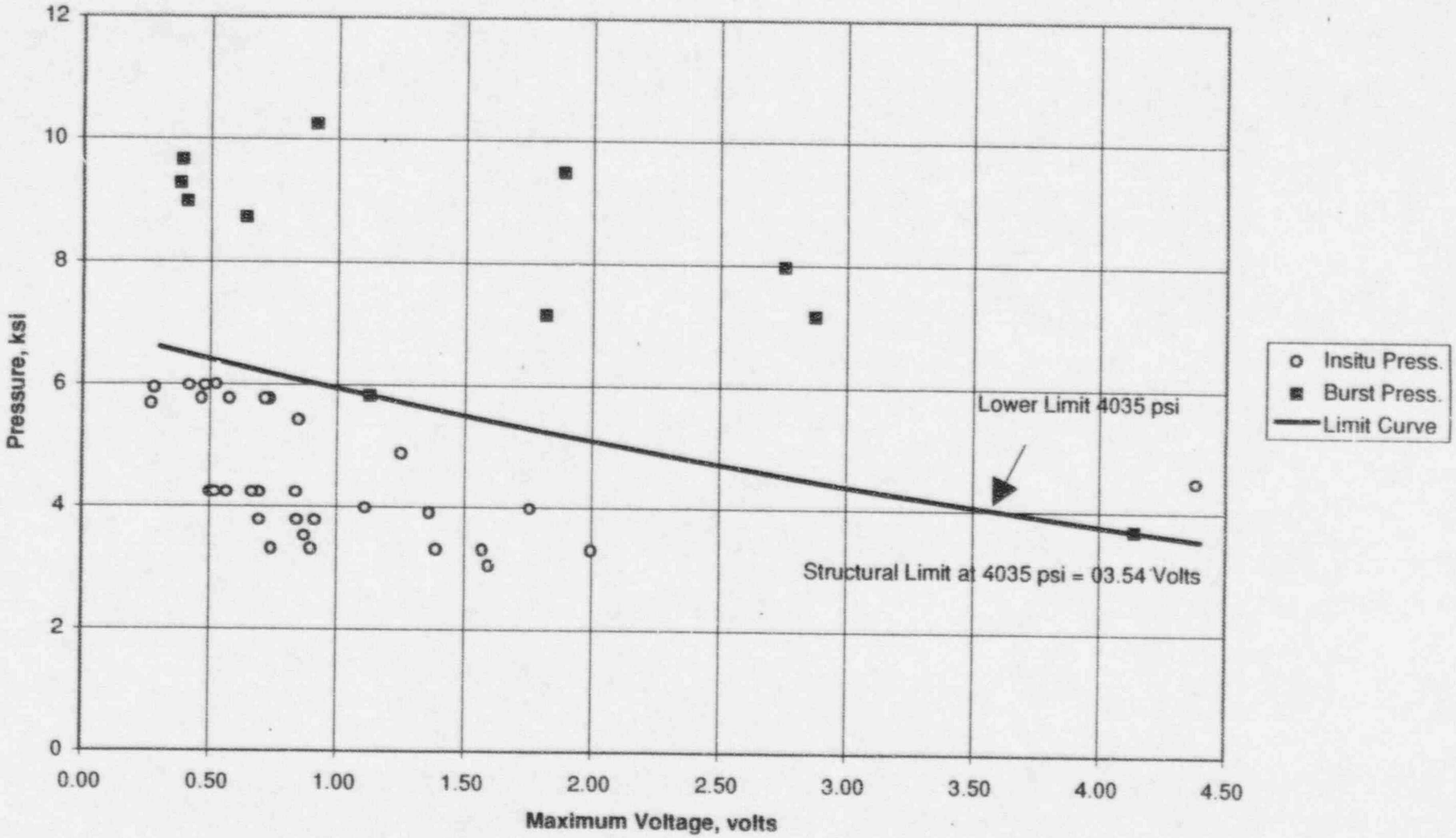


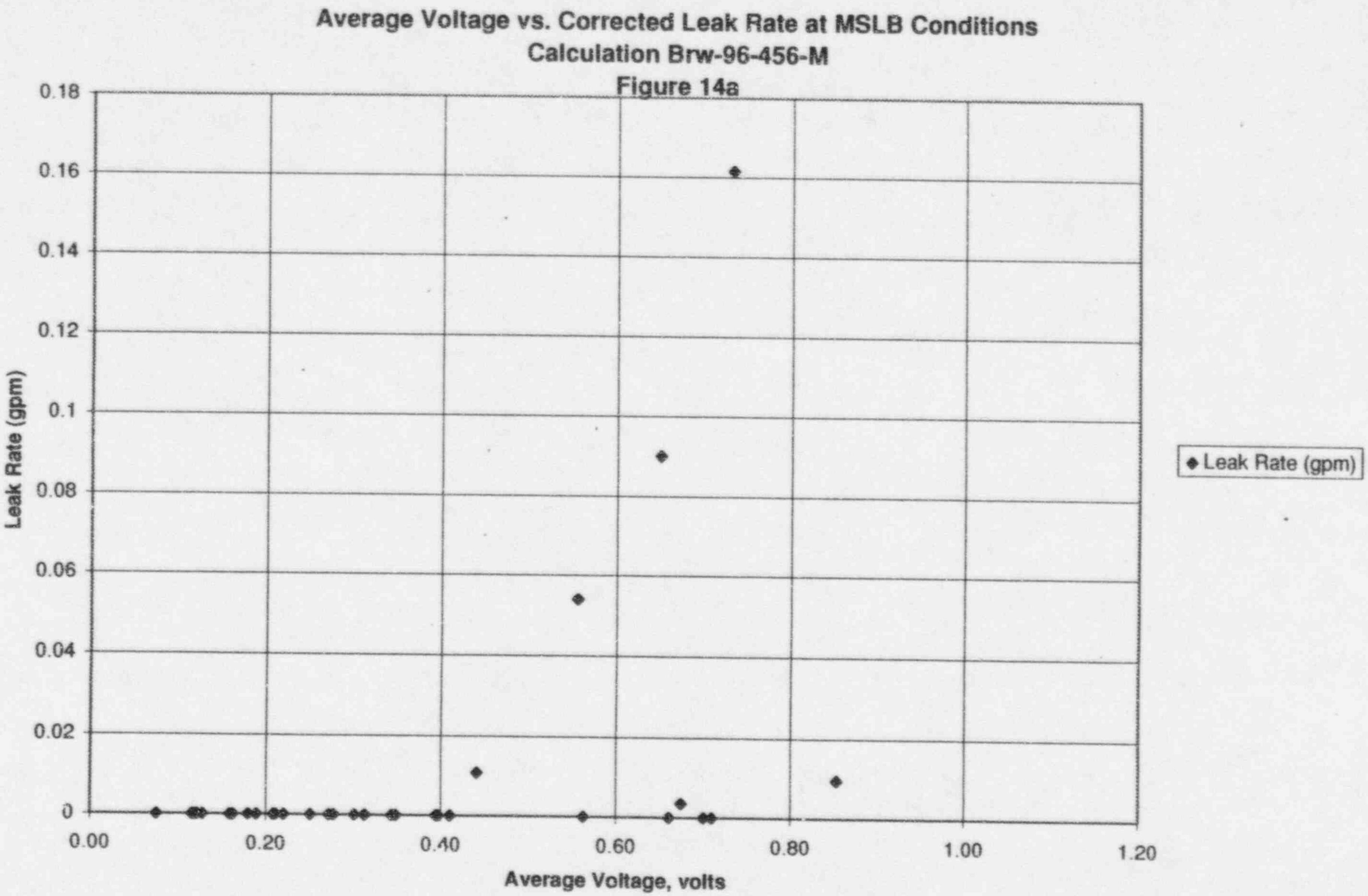
Average Voltage vs. Adjusted Insitu or Burst Pressure Corrected to Industry LTL Properties (95/95 650F) Calculation

Figure 10a



Maximum Voltage vs. Adjusted Insitu or Burst Pressure Corrected for Industry LTL
Figure 10b




Average Voltage vs. Corrected Leak Rate at MSLB Conditions
Calculation Brw-96-456-M
Figure 14a
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Leak Rate (gpm)
0.00
0.20
0.40
0.60
0.80
1.00
1.20
Average Voltage, volts
◆ Leak Rate (gpm)

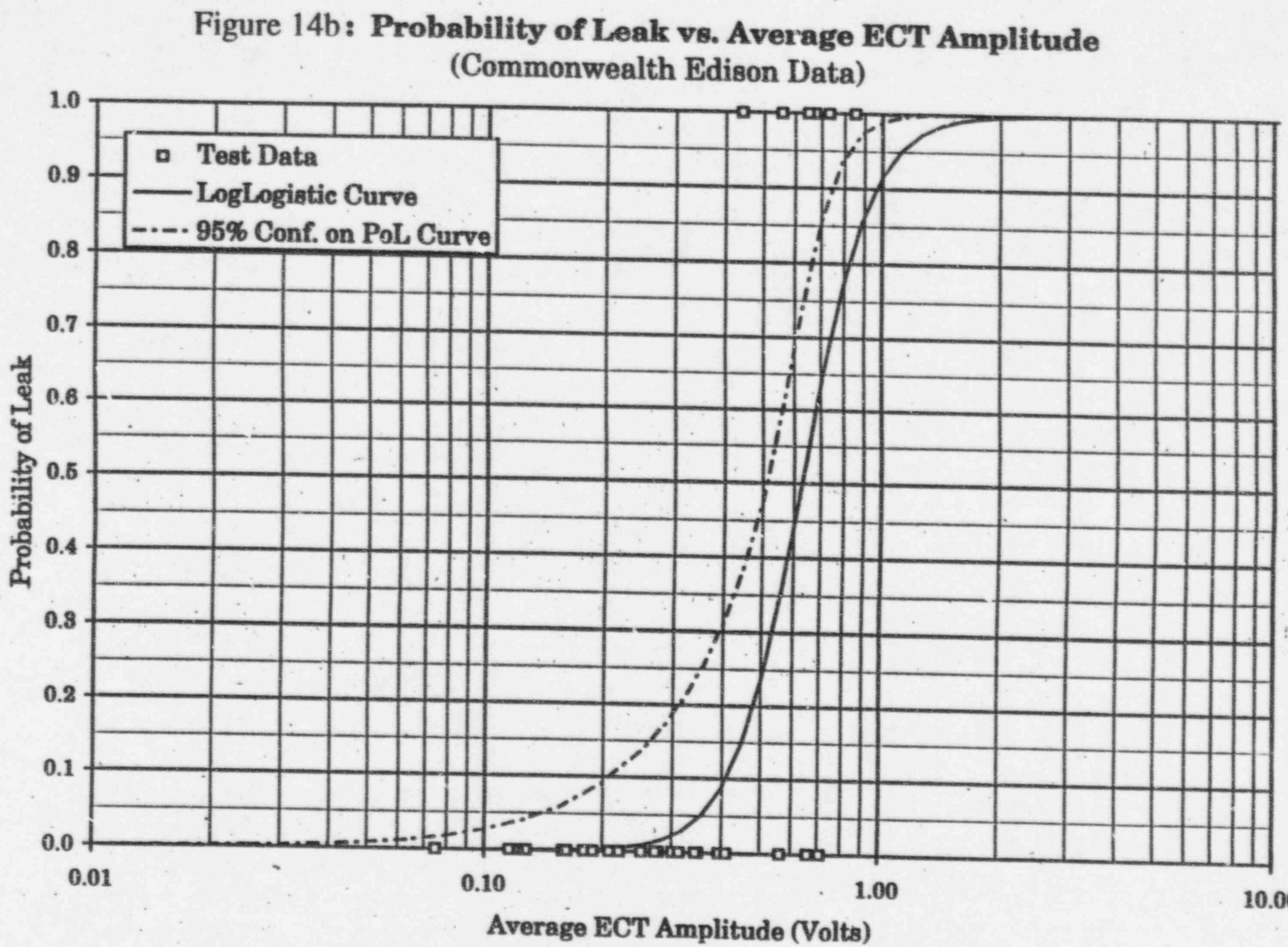


Figure 14b: Probability of Leak vs. Average ECT Amplitude
(Commonwealth Edison Data)
Test Data
LogLogistic Curve
95% Conf. on PoL Curve
Probability of Leak
Average ECT Amplitude (Volts)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.01
0.10
1.00
10.00

Figure 16: **Probability of Leak vs. Maximum ECT Amplitude**
(Commonwealth Edison Data)

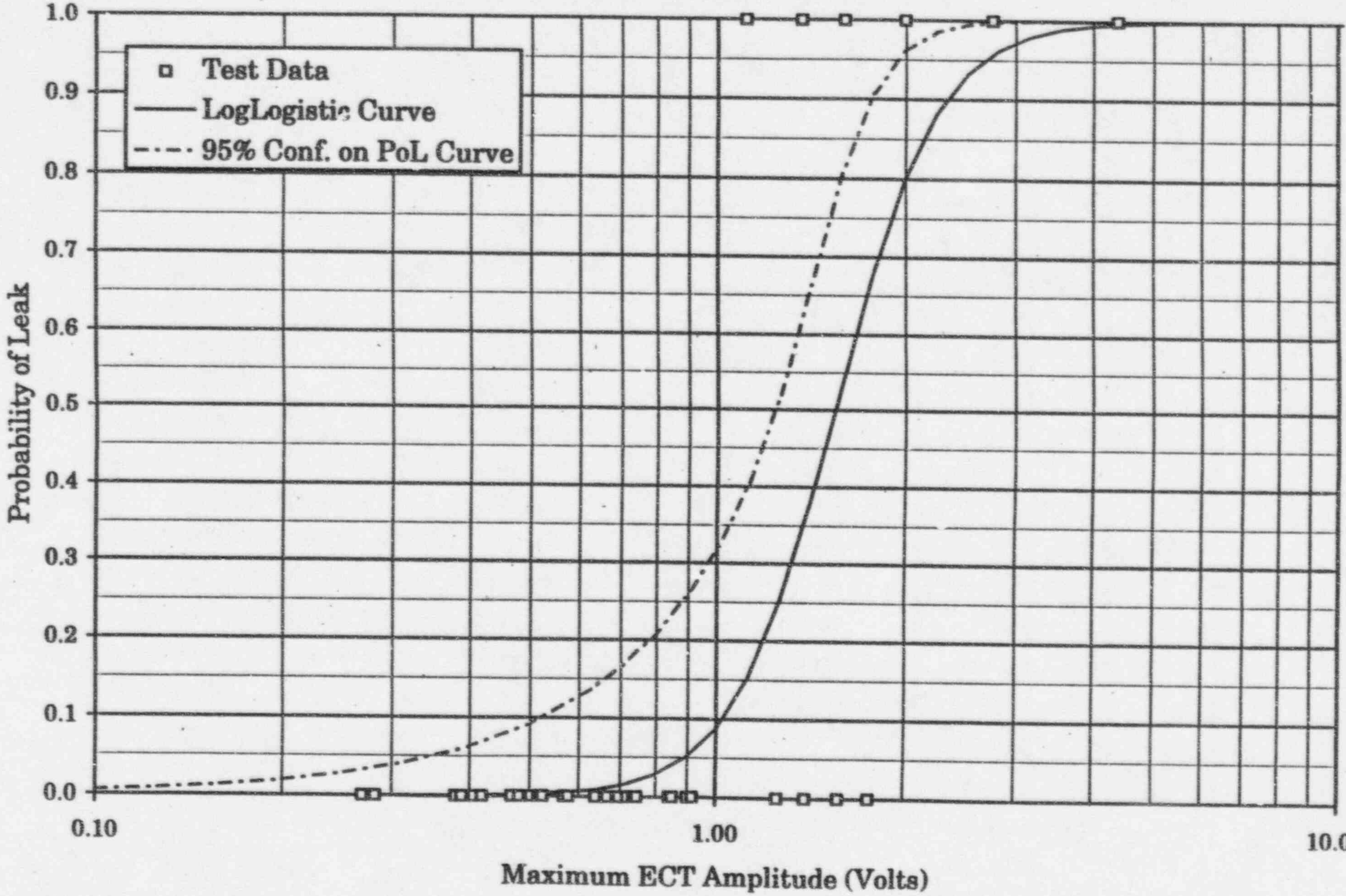


Figure 19a. Voltage Normalization Regression Analysis for Maximum Voltage

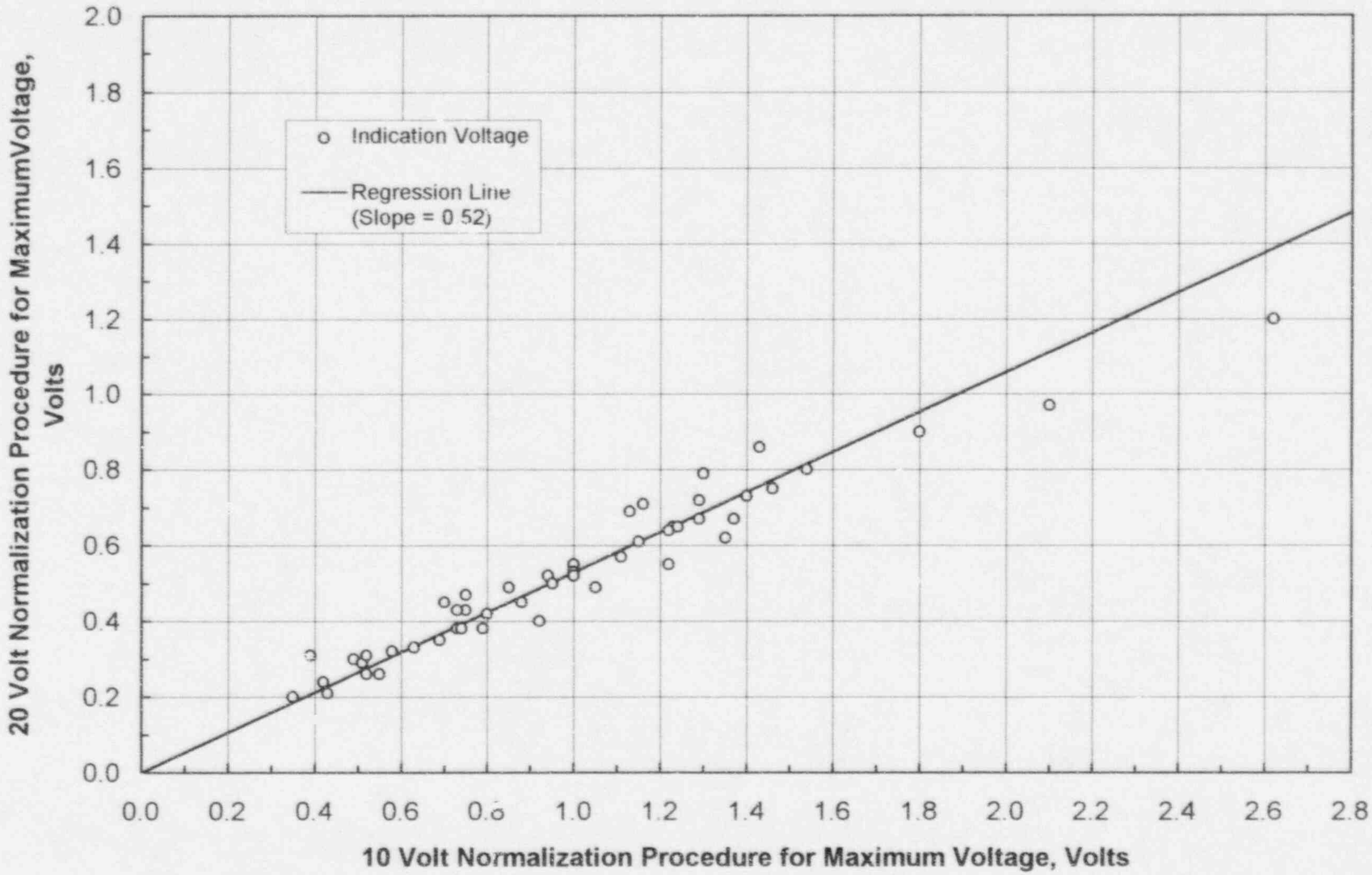


Figure 19b. Voltage Normalization Regression Analysis for Average Voltage

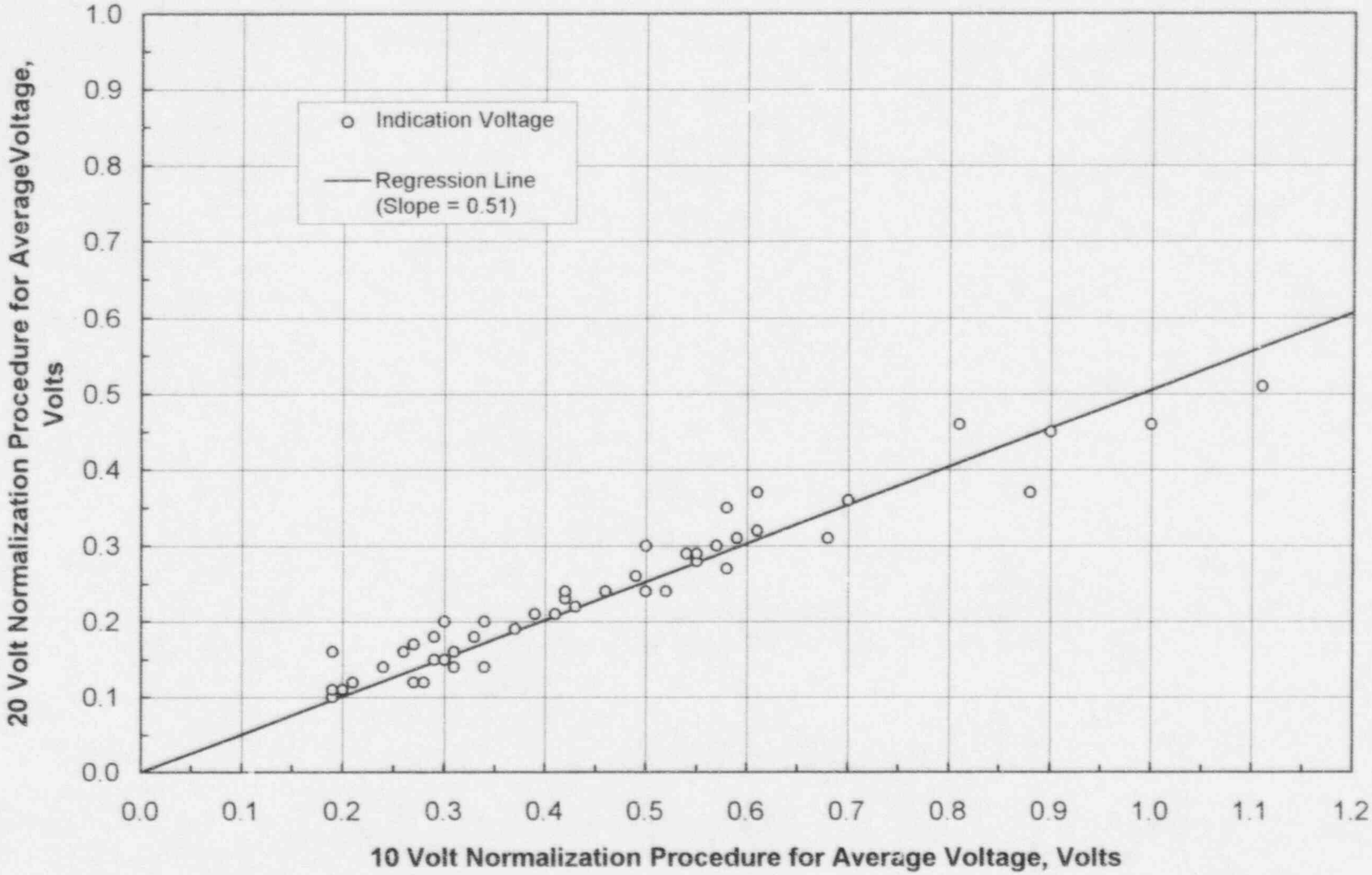


Figure 20a. Coil Size Regression Analysis for Maximum Voltage

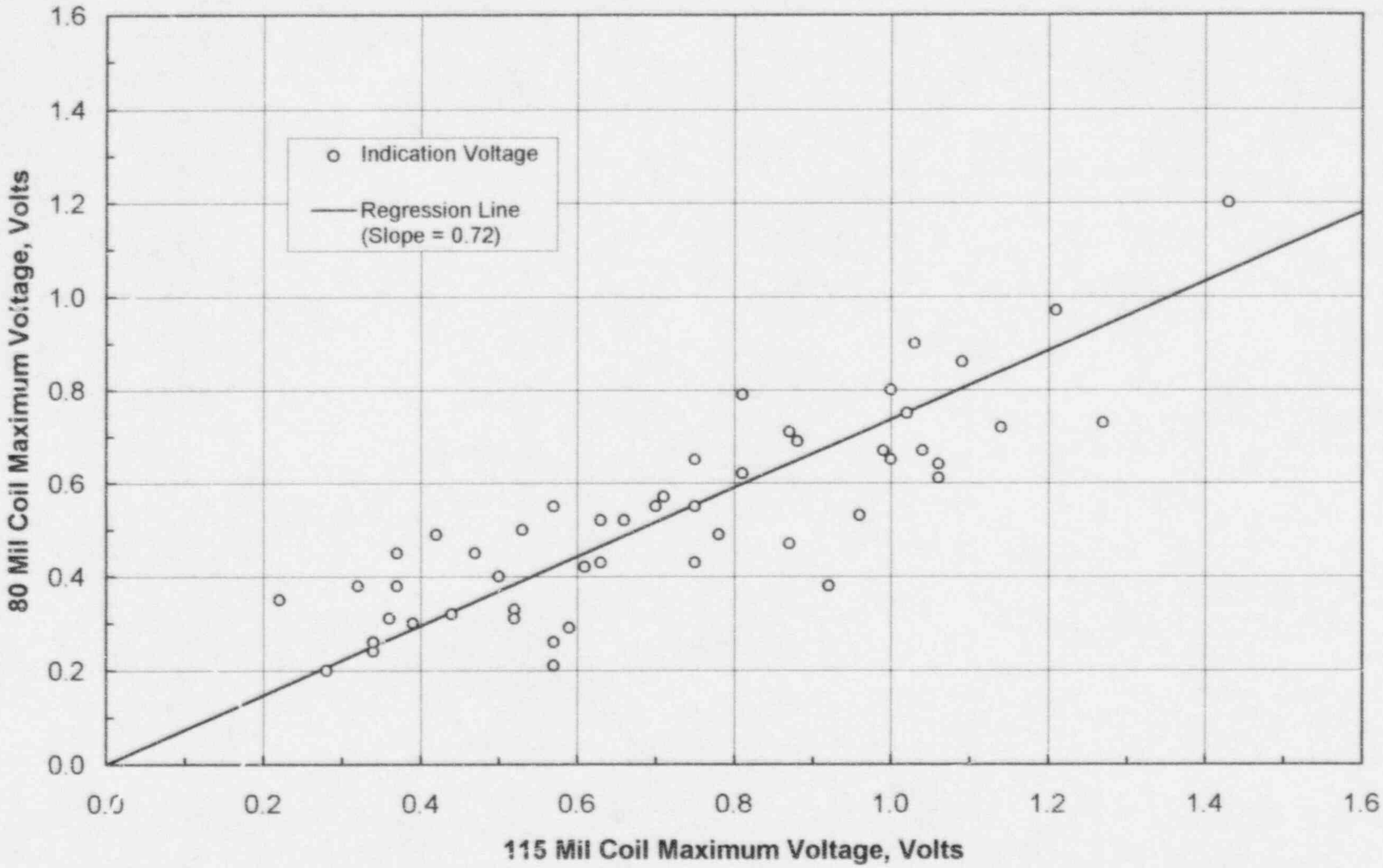
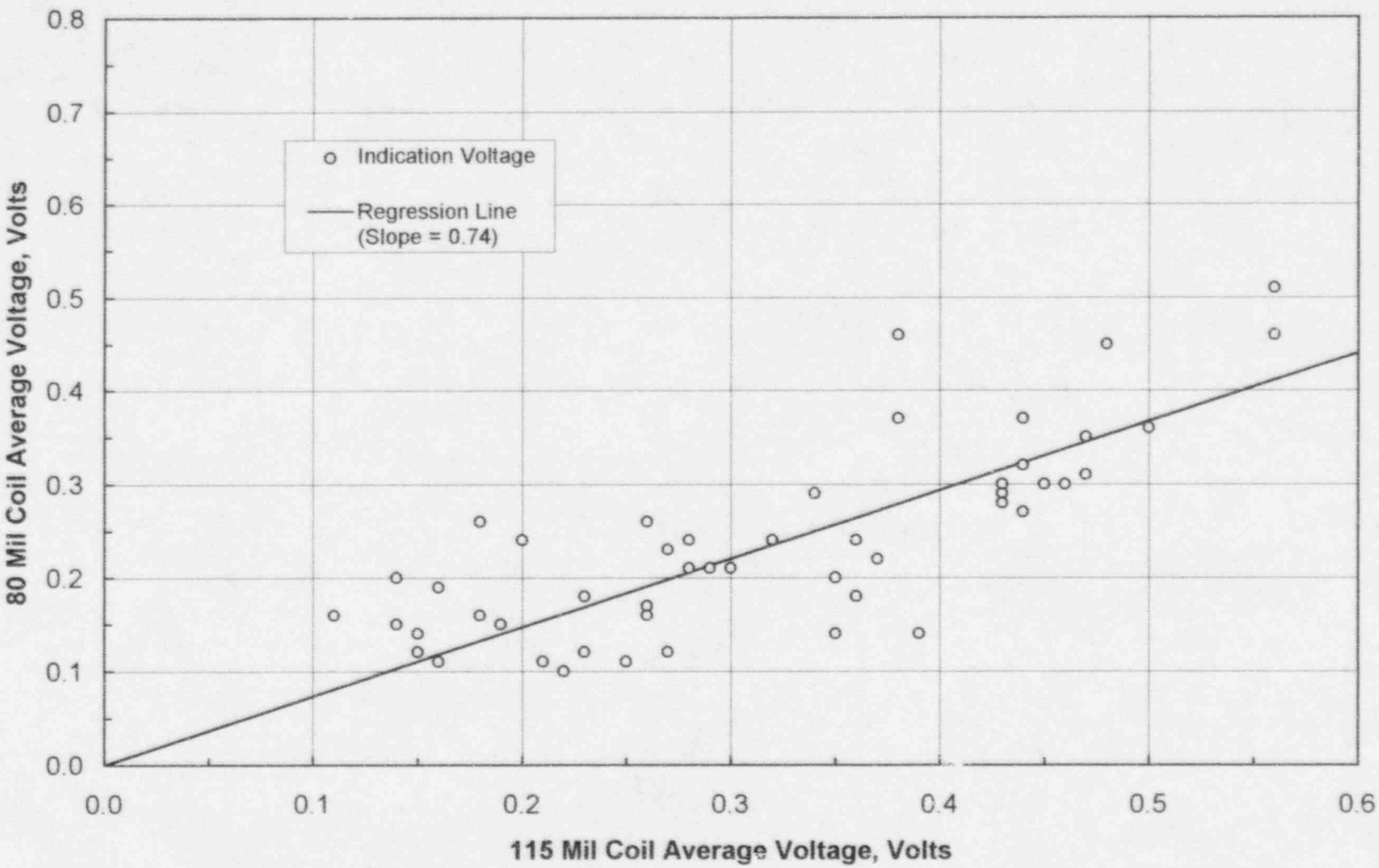


Figure 20b. Coil Size Regression Analysis for Average Voltage



ATTACHMENT 18

BRAIDWOOD INSPECTION GUIDELINES

ATTACHMENT B

CHANGES TO BRAIDWOOD UNIT 1

CYCLE LENGTH ASSESSMENT REPORT

SEPTEMBER 17, 1996

During analysis of the Braidwood Unit 1 cycle length assessment 3 changes have been identified as follows:

1. August 2, 1996, Submittal, Figure 5.5, 5.6 and 6.1 do not include one insitu pressure test point. Data for this test was acquired subsequent to the submittal and therefore it was not included in the figures. The point is located at 0.67 max Volts and 0.28 avg. Volts corresponding to a corrected test pressure of 3.577 ksi.

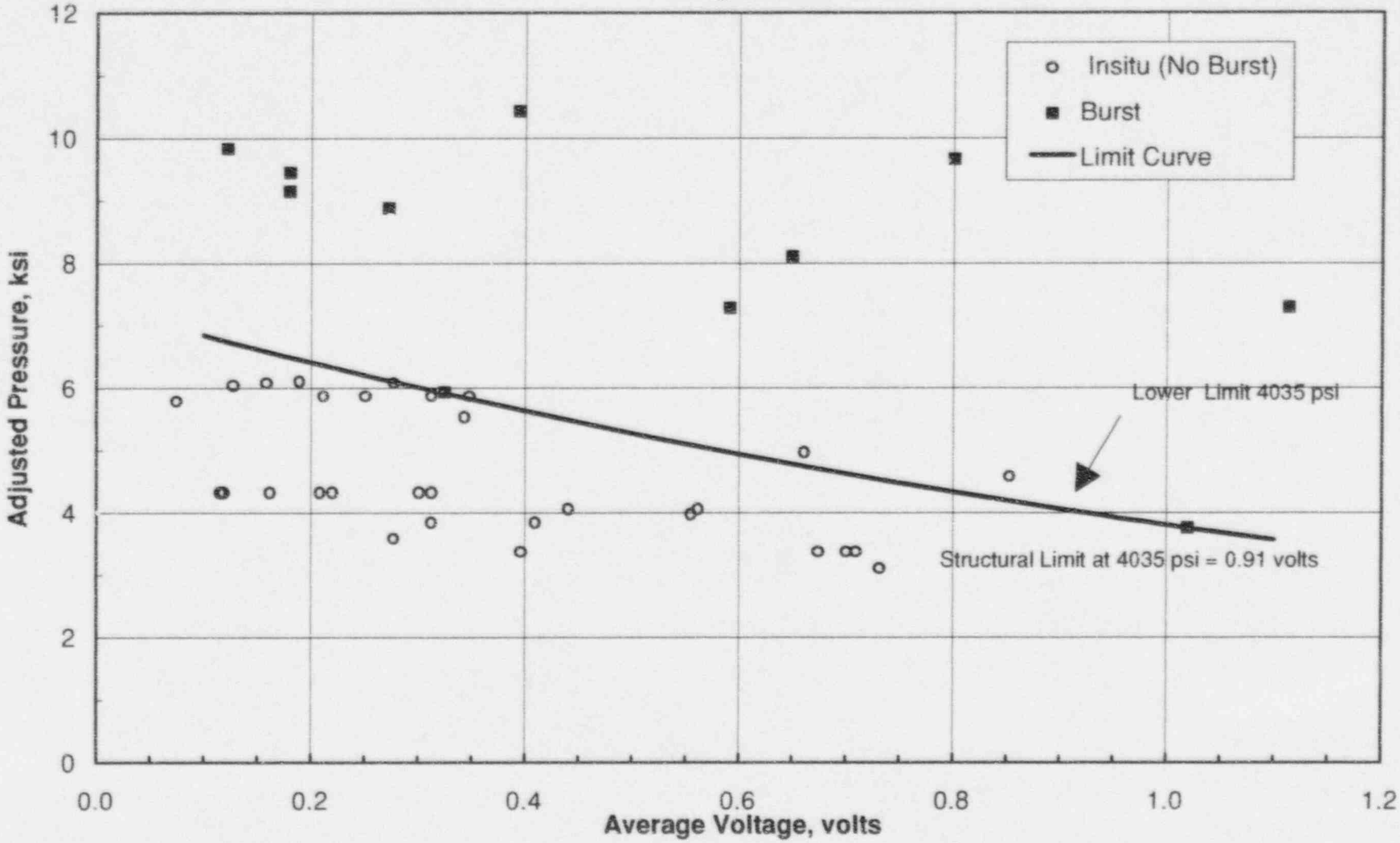
   This additional point has been included in all analyses. The additional data point does not change the results or conclusions of the report. Additionally, the axes on Figure 6.1 were incorrectly labeled in the August 2, 1996 submittal. The updated Figures 5.5, 5.6 and 6.1 are attached.

2. The leak rate of one of the data points in the August 2, 1996, submittal Figure 7.1 and Figure 14a in the September 10, 1996, submittal had an incorrect leak rate. The leak rate was previously presented on these figures as 0.00352 gpm. This leak rate was incorrectly calculated for the maximum pressure instead of the leak test pressure. The correct leak rate is 0.0064 gpm. Because a bounding leak rate is assumed for the EOC distribution this change has no effects on the report conclusions or the EOC predicted leak rate.

3. Incorrect voltages for one insitu pressure test point were presented on Figures 10a and 10b of the September 10, 1996, submittal. The voltages presented were 0.88 max and 0.63 average volts at a corrected pressure of 3.577 ksi. The voltage data were originally analyzed as 0.080" RPC and no correction applied. Further review of the data identified that the data was acquired with the 0.115" RPC and a correction factor was applied. This data point does not change the results or conclusions of the submittal.

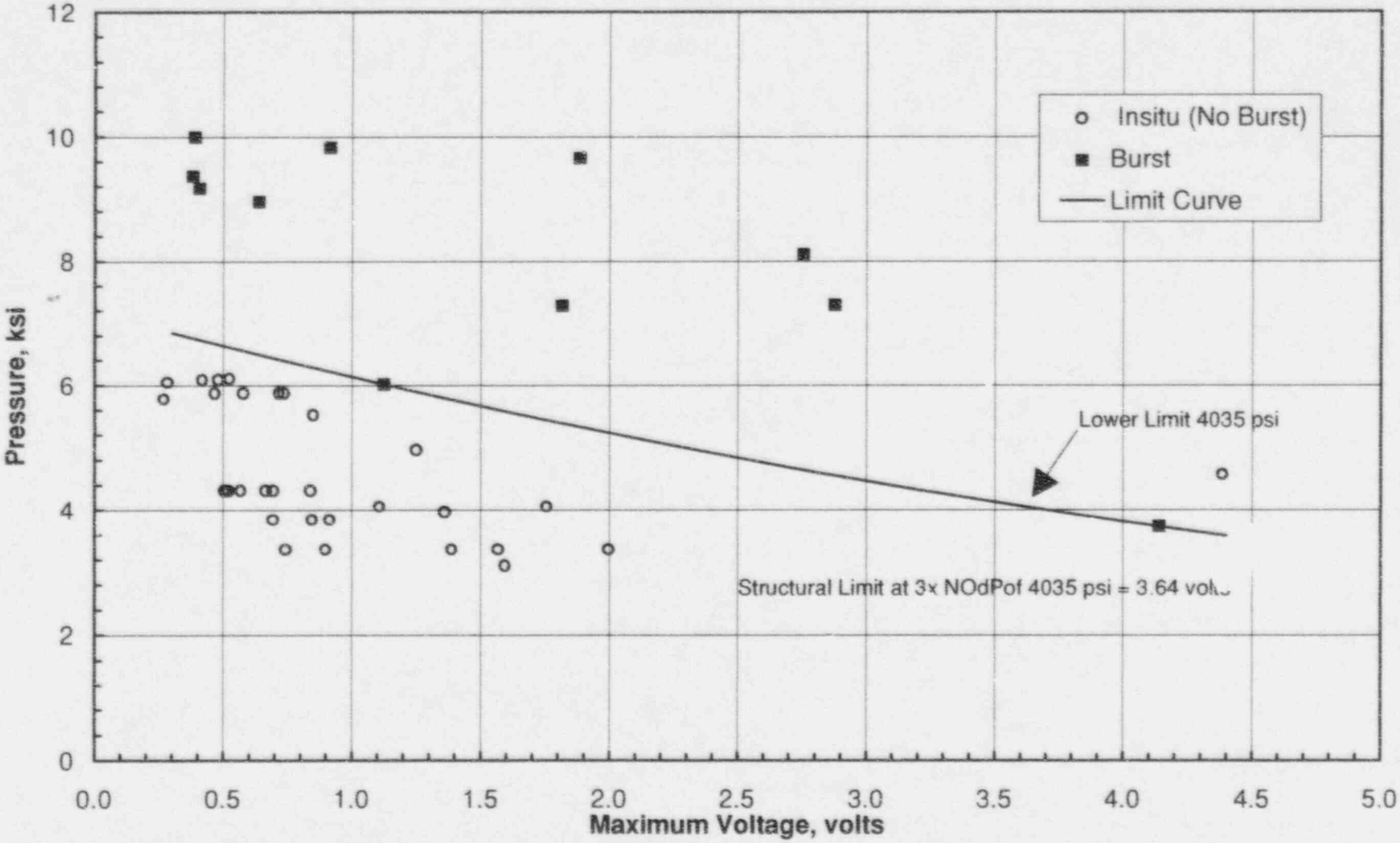
Average Voltage Structural Limit vs. Adjusted Insitu or Burst Pressure Corrected to Braidwood LTL Properties

Figure 5.5

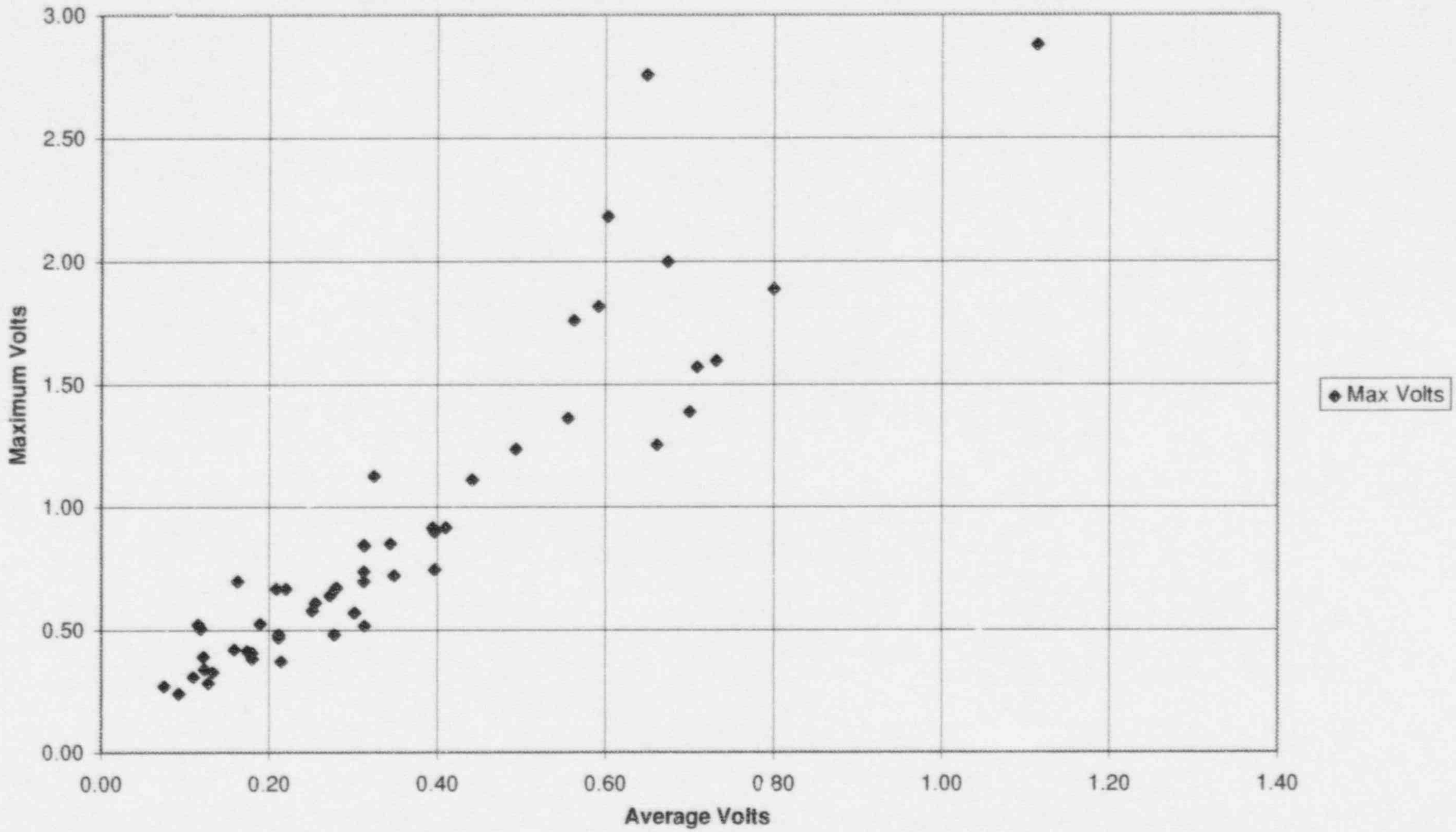


Maximum Voltage Structural Limit vs. Adjusted Insitu or Burst Pressure Corrected for Braidwood LTL Properties

Figure 5.6

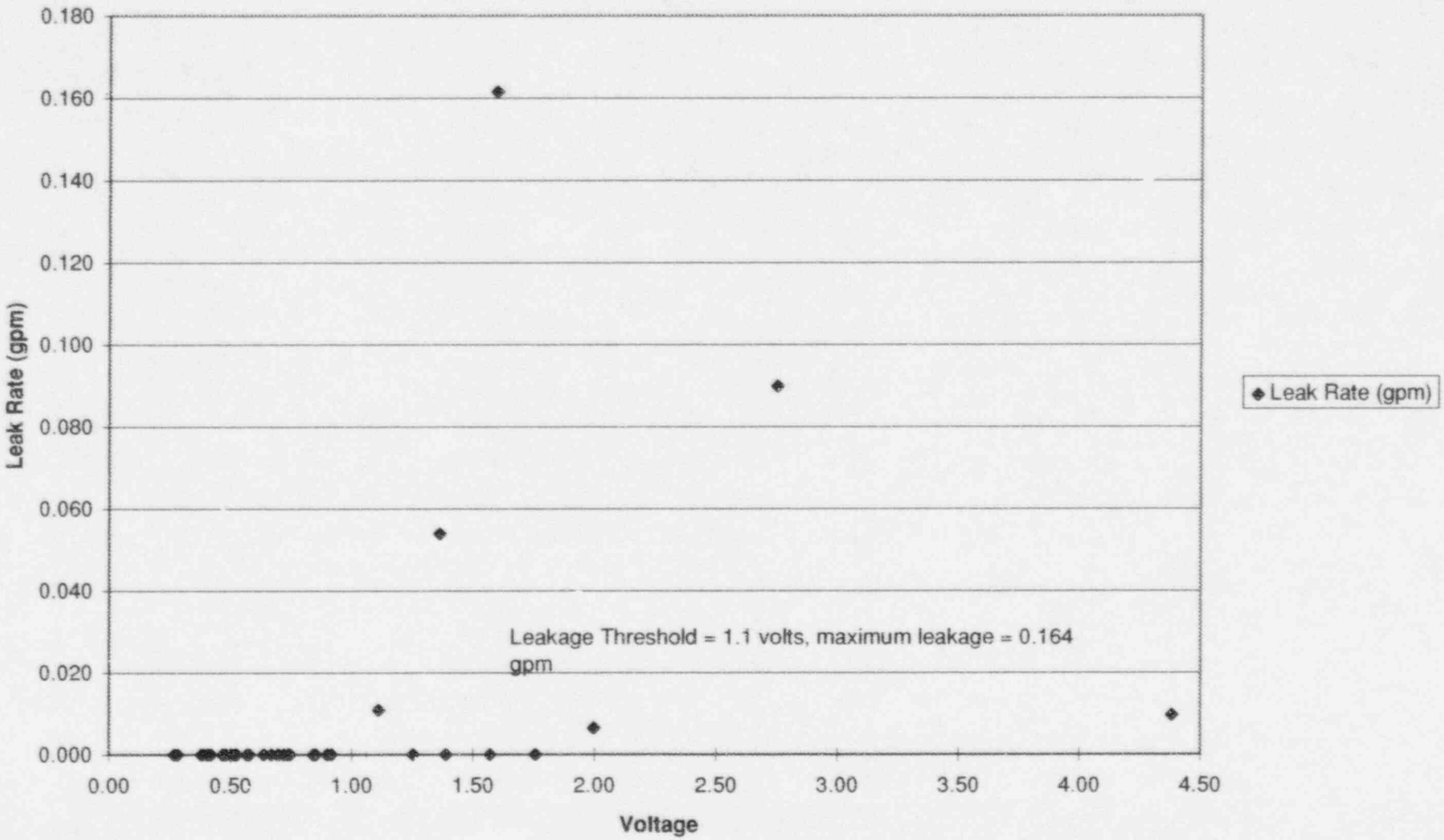


Industry Tube Pull Insitu Pressure Test Average Volts Vs Max Volts
Figure 6.1

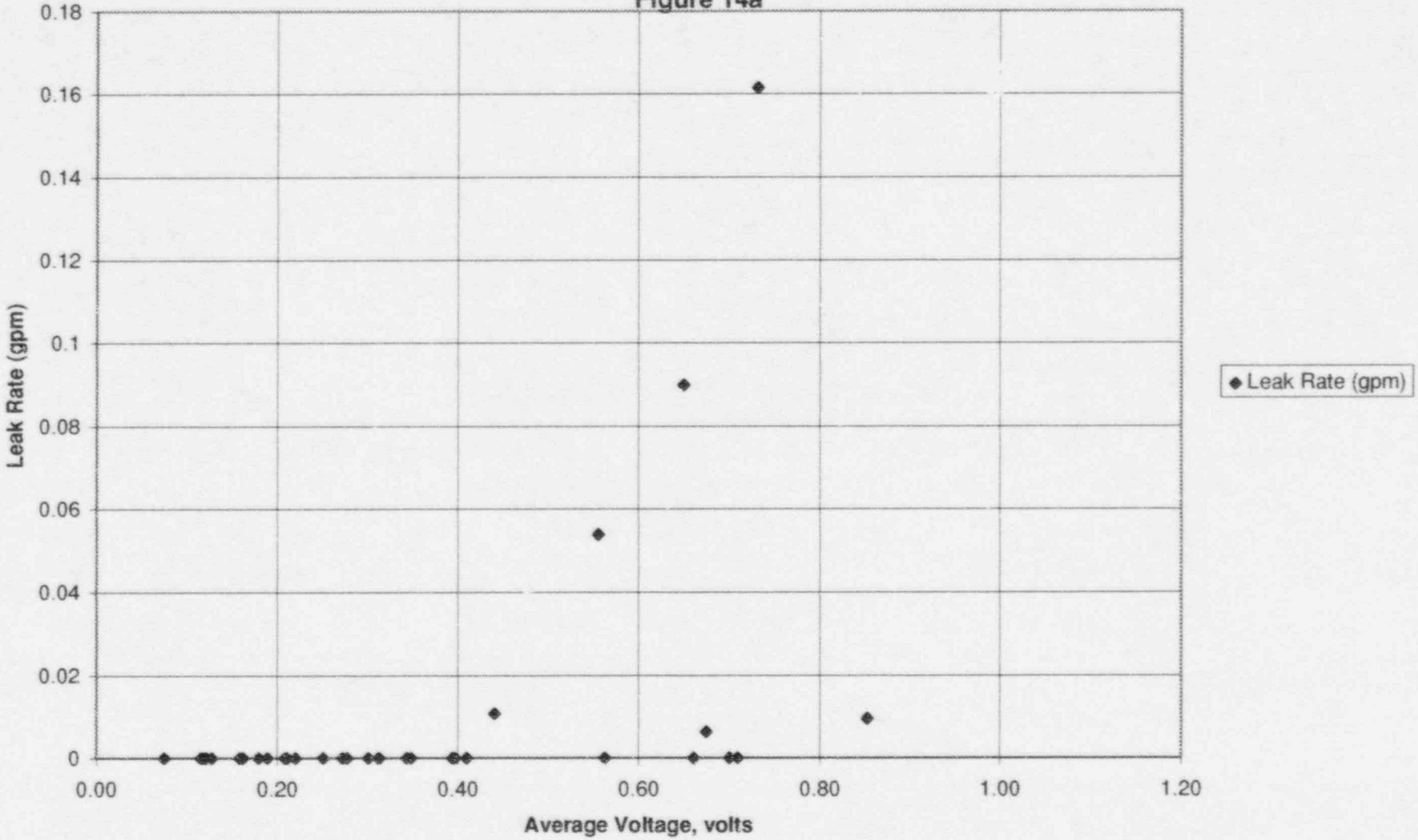


Industry Tube Pull and Insitu Pressure Test Leak Rate (Corrected for Temperature and Pressure) Vs. Maximum Voltage

Figure 7.1

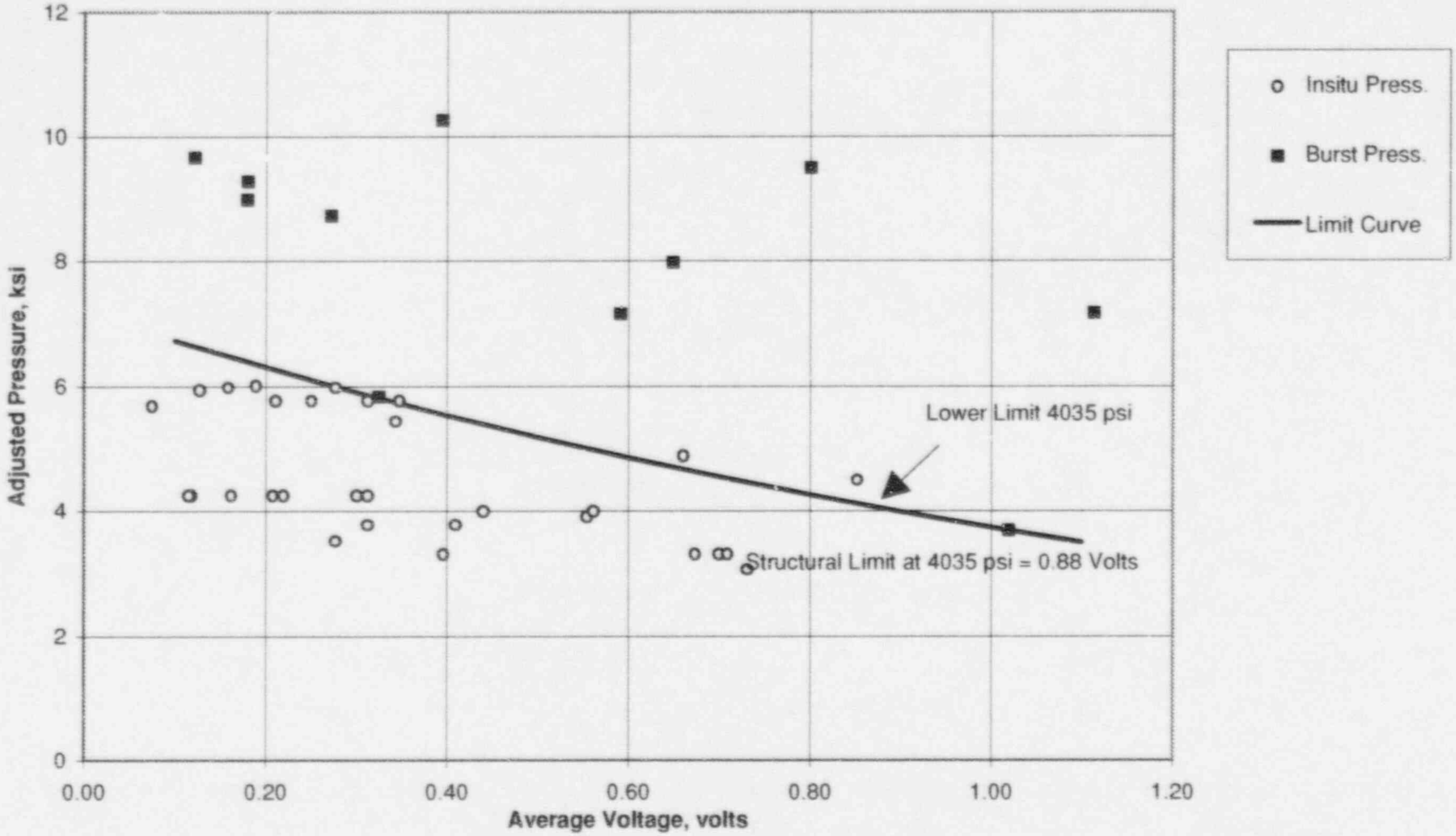


Average Voltage vs. Corrected Leak Rate at MSLB Conditions
Calculation Brw-96-456-M
Figure 14a

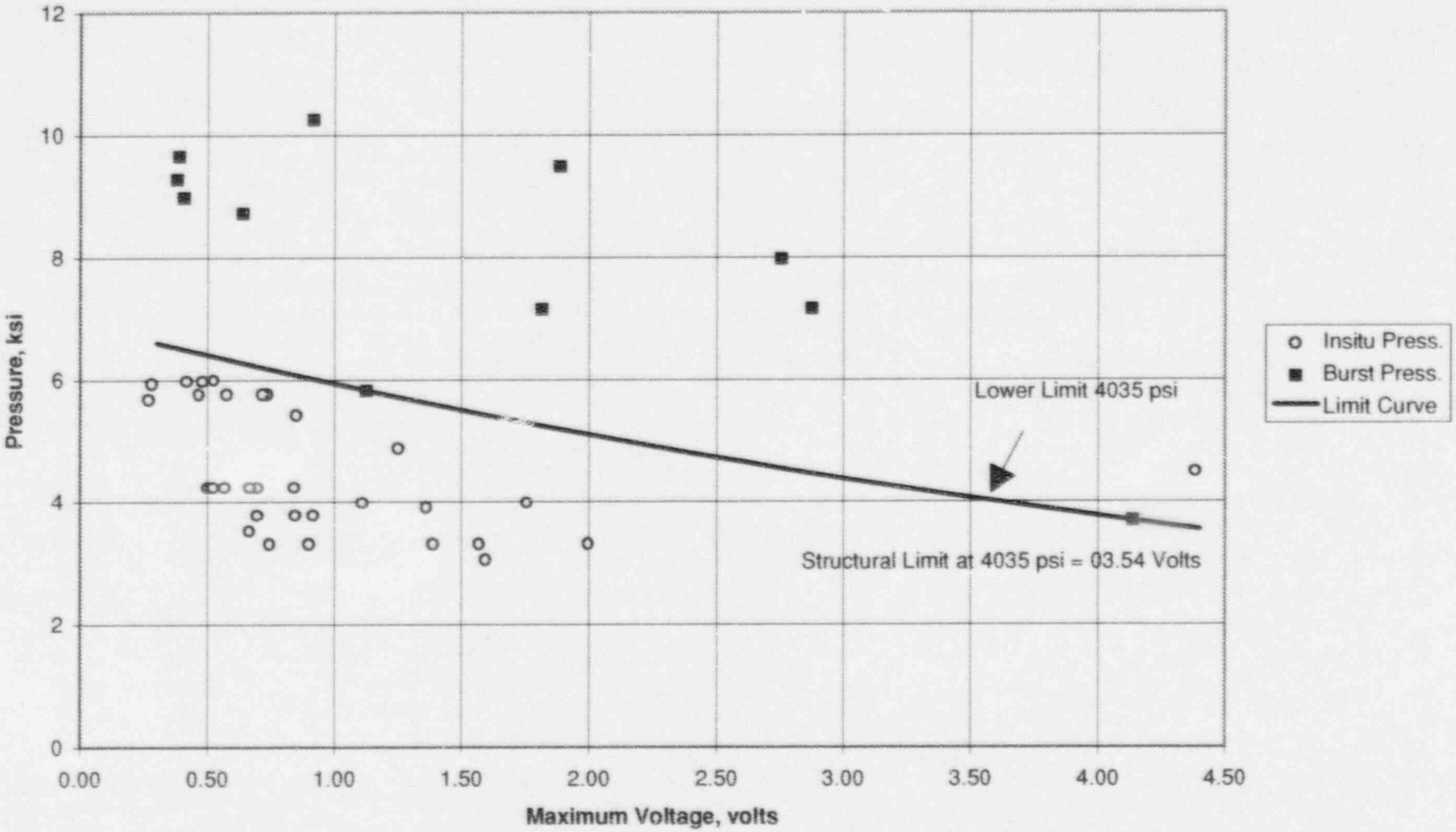


Average Voltage vs. Adjusted Insitu or Burst Pressure Corrected to Industry LTL Properties (95/95 650F) Calculation

Figure 10a



Maximum Voltage vs. Adjusted Insitu or Burst Pressure Corrected for Industry LTL
Figure 10b



ATTACHMENT 18

BRAIDWOOD INSPECTION GUIDELINES