Florida
Power
CORPORATION
Crystal River Unit 3
Docket No. 50-302

December 5, 1995
3F1295-03

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Subject: Technical Specification Change Request No. 203, Revision 0
Small Volume Eddy Current Indication Disposition

Reference: A. FPC to NRC letter, 3F0595-05, dated May 31, 1995
B. NRC to FPC letter, 3N0494-21, dated April 26, 1994
C. NRC to FPC letter, 3N1095-21, dated October 24, 1995

Dear Sir:

Florida Power Corporation (FPC) submitted the referenced proposed change to our Technical Specifications on May 31, 1995 (Reference A) as required by a Confirmatory Action Letter (CAL) dated April 26, 1994 (Reference B). That change updated the Once Through Steam Generator (OTSG) Eddy Current (ECT) disposition strategy that we developed and used in Refuel 9, as required by the CAL, to reflect the results of the Refuel 9 inspections and tube pull campaign. Our staffs discussed the proposed change during an August 30, 1995 teleconference.

Your staff followed up with a formal Request for Additional Information (RAI) dated October 24, 1995 (Reference C). A meeting was held in Rockville on November 17, 1995 to discuss the NRC's concerns on a preliminary, conceptual level so that we could more effectively respond to the RAI and so each of our technical staffs could more accurately brief their management on how we could and should proceed. FPC committed to respond to the RAI as soon as possible to facilitate a meeting which has now been scheduled for December 15. The attachments to this letter constitute FPC's response to the RAI. We plan to discuss the responses in as much depth as necessary during the December 15 meeting. We will be pleased to supplement these responses, as needed, following that meeting.

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The cover letter transmitting the RAI included a general discussion of the staff's initial reactions to our proposal. The issue was also discussed at a November 17, 1995 meeting. That meeting improved our understanding of the nature of your concerns. As noted during the meeting, we certainly agree that any sound proposal must reflect both past experience and adequately deal with likely results of future inspections. We also agree that the limited amount of data with which we are dealing creates a substantial technical challenge in developing a mutually acceptable criteria. This limited data is a result of good OTSG experience and our attempt to deal with this issue as proactively as possible. As we stated at the meeting, we may not yet be in full agreement on some points. For clarity and completeness of the docket we thought it appropriate to respond to them below.

1) We would not place as much emphasis as the cover letter does in characterizing our proposal as "voltage-based." Signal voltage is used as one input to the evaluation process to add conservatism to our proposal from a structural perspective and to provide an appropriate limit from a leakage perspective. We are relying on a conservative estimate of defect dimensions as the structural repair criteria. The proposed approach is consistent with the NRC guidance in Generic Letter 95-05 which encouraged the industry to continue efforts to improve inspection methods and repair criteria noting that ones based on physical dimensions are the most desirable when they can be achieved.

2) Signal/noise (S/N) is the ratio of signal attributable to the discontinuity with that attributable to the various amount of other signal (called noise) present in all applications. It has been and is being used as a general indicator of the ability to accurately assign a through-wall (TW) depth estimate to an indication. In the structure of the TSCRN, it may appear to be more significant than it really is. The value of 5:1: was originally chosen to achieve a sizing error of less than 10%; is the value used in past CR-3 inspections; and thus is reflected in the historical data base. The analyst guidelines actually have allowed, and recently encouraged, a best-effort to make "TW calls" on all indications regardless of S/N ratio. This practice (removing a small volume indication with an estimated depth of greater than 40%) may cause us to remove from service some defects that have sufficient volume to generate a clear signal but which are really <u>not</u> significant from either a leakage or structural viewpoint. At some point, perhaps as we implement the proposed rulemaking in this area, we may be able to agree on a criteria to 'save' these sound tubes as well. It may be possible to eliminate consideration of S/N altogether.

3) We never believed all low S/N indications were Inter-Granular Attack (IGA). We thought we had been careful not to leave others with that impression. We noted from the outset the existence of similar NDE indications at the tube support plates (TSPs) and at free-span locations at several elevations. We included related information in our previous discussions with the NRC. During Refuel 8 we were able to remove tube sections from a region (first free-span above the lower tube sheet) where the dominant defect type was found to b. IGA. We did extensive evaluations and developed a most-likely cause and repair strategy. We were unsuccessful in extracting tube segments from other locations where wear would be more-likely (i.e., at TSP interfaces) until the second tube-pull campaign (Refuel 9 in 1994). When

we did so, wear was indeed found. This was reflected in the inspection results we provided in late 1994 (in response to CAL Item 8) and earlier this year (concurrent with the TSCRN). Nevertheless, we now realize that we were apparently unsuccessful in communicating the presence of wear.

4) The letter includes the statement: "A low S/N ratio is a product of the inspection process and is not a characteristic intrinsic to a particular mode of degradation." We agree; as long as "mode of degradation" is used to refer to degradation mechanism (cause) as opposed to morphology. Morphology directly impacts inspection results (signal). We would add that low S/N ratio is fundamentally either due to a low signal OR high noise. Some of our discussions and the RAI imply that the fundamental cause is high noise. We do not agree that is the case. We have observed at least two degradation mechanisms in the CR-3 OTSG's that produce very low signals for similar reasons (both involve very limited defect volume). Our efforts to reduce noise are addressed in the associated RAI responses.

5) We do not agree with the suggestion that the most appropriate course of action is to revise our proposal to focus solely on IGA. As we stated at the meeting, and as addressed in appropriate RAI responses, we cannot readily distinguish between some of the wear (which we have termed volumetric as opposed to the more standard tapered-wear) and IGA. After considering the merits of various alternate repair criteria strategies we continue to believe that the one proposed best deals with the situation at CR-3. We understand that focussing on IGA might have been more administratively similar to the generic DSM efforts but believe technical merit should outweigh such considerations.

We do agree that our proposal differs from other alternate repair criteria in a number of ways. For some time we even hesitated calling our proposal an alternate repair criteria reflecting our recognition that there were substantial differences. We appreciate the difficulty this may cause. Our proposal is not based on a highly focussed effort to deal with one degradation mechanism, but rather is an alternate general approach that is directed at handling two defect types with similar morphology. These defect types appear to be generally dormant and are not significant from either a leakage or structural perspective. Rather than forcing our situation to fit a model not well-suited for it we would rather consider other alternatives further. While not fully developed, we would suggest:

a) We could mutually develop reporting requirements that require us to evaluate appropriate figures-of-merit (i.e., measures of growth rate, etc.) for the inspection results our program will continue to obtain. We currently reinspect (with standard bobbin coil) all low S/N tubes each outage. Trending the average voltage and/or other appropriate values would help assess any fundamental change in the nature of defects we are leaving in-service.

b) The NRC's approval of all or portions of the TSCRN could be limited in duration. If the data to be obtained this outage, other data availability and the time to further review our proposals would benefit the NRC's review we would not object to the approval being for a single fuel-cycle. This would be consistent with some of the other generic efforts. This might also indicate to the industry that, while our proposal for dealing with IGA is fairly mature and acceptable to the NRC; its application to other degradation mechanisms with similar morphology is less so. This would also allow the CR-3 program to continue to evolve.

c) If there are other specific NDE efforts or changes to the various numerical values proposed in the TSCRN that would help resolve your concerns we will work with your staff to evaluate them. We are not aware of any that would seem appropriate, but never want to close the door to improving our ISI efforts on such critical components.

FPC appreciates the attention that this matter is getting and will do whatever we can to facilitate your reviews. As noted earlier we will supplement the attached responses or address other issues as needed following the December 15 meeting. Our outage begins in late February, 1996 so we need to have reached fairly complete consensus by mid-January to allow for plant-specific analyst guidelines and other related efforts to proceed as needed.

Sincerely,

Ronald M Bright/for

Larry C. Kelley, Director
Nuclear Operations Site Support

KRW/BPW:ff

Attachments

xc: Regional Administrator, Region II
NRR Project Manager
Senior Resident Inspector

Attachment 1

FPC Responses

October 24, 1995

Requests For Additional Information

TECHNICAL SPECIFICATION CHANGE REQUEST NUMBER 203
SMALL VOLUME EDDY CURRENT INDICATION DISPOSITION

Degradation Specific Management

1. Describe your long term plans to monitor the morphology of low signal-to-noise (S/N) indications (e.g., tube pulls, destructive examinations, etc.). Reference 3 states that the B&W Owners Group Steam Generator Committee recommended pulling tubes from Oconee Units 1 and 3 in addition to those at Crystal River Unit 3 (CR-3). Describe how the results available to date from these other tube pulls support the conclusions developed based on the data from the CR-3 tube pulls. If the Oconee tube pull data are not currently available, discuss your schedule and plans for incorporating the data into your analyses. Provide a schedule of when the tube pull nondestructive examination comparison study cited on pages 2-2 and 3-6 in Reference 3 will be available.

FPC's long term plant-specific program to monitor the morphology of low S/N indications present in the CR-3 OTSGs focusses on plans for supplemental non-destructive examination(s) (NDE) during future inspection outages. The purpose of this eddy current testing (ECT) is to gather additional data on the areas within the TSCRN report where ECT can provide insights into behavior of the indication. This includes plans for random MRPC sampling below the TSCRN voltage threshold, as discussed in the response to RAI number 16. FPC's program also includes continued participation in the B&W Owner's Group (B&WOG) Steam Generator Tube Pull and Tube Integrity Programs. Together, these programs provide an examination of a wide spectrum of damage mechanisms utilizing both laboratory-grown and pulled tube defects. The purpose of the examinations is to expand the present level of knowledge on the range of mechanisms postulated to occur in OTSG tubing. Additional discussion of these two programs has been provided in earlier FPC submittals as well as during periodic meetings between the B&WOG and NRC Staff.

There are no plans to pull additional tubes from the CR-3 steam generators. The two tube pulls which have already been performed are considered to have provided the information necessary to adequately describe the currently active degradation mechanisms. This is not to say there will never be another tube pull at CR-3. Another tube pull would certainly be considered if plant-specific operating experience indicates one is needed (as was done for this, the S/N, issue).

The examination of the Oconee pulled tubes is nearing completion, with the results expected to be available some time during the first quarter of 1996. While the tube pull placed priority on indications of special interest to Oconee, the information with applicability to CR-3 has supported the conclusions reached for the CR-3 pulled tubes. Once the final Oconee pulled tube report is issued, FPC will perform a detailed review of the entire report for the purposes of gathering and applying additional data pertinent to CR-3. Assuming the Oconee examination results are available during the first quarter of 1996, the NDE comparison study cited in the RAI is expected to be completed by September 1, 1996.

2. Appendix B to Reference 3 discusses sizing of wear indications. Is a wear scar standard used at CR-3 for sizing these indications? If so, discuss the basis for applying the proposed voltage-based repair criteria to wear indications.

Appendix B to Reference 3 describes the nuclear industry experience with steam generator tube wear, including a discussion of both the rectangular (i.e., tapered) and the spheroidal wear scar geometries. The sizing discussion referred to by the RAI discussed both of these geometries. FPC's past use of wear standards at CR-3 can be discussed in similar terms.

FPC has historically followed a standard industry practice for the examination and evaluation of OTSG Tube Support Plate Wear. This practice involves a bobbin coil examination for flaw detection and initial sizing. Sizing is performed using standard phase analysis techniques employing calibration curves constructed from the ASME holes (for indications exhibiting a S/N ratio of greater than 5:1). This technique has been proven to be over-conservative for wear. Confirmatory sizing with the MRPC technique is typically applied to those wear indications which are estimated to be greater than 40% through-wall by bobbin. This method of sizing the indication is more accurate and employs a voltage-based calibration curve constructed from the simulated wear scars in the calibration standard. The MRPC also provides for characterization of the indications location, geometry, and morphology.

What FPC has termed volumetric wear (i.e., oval, circular) has only recently been confirmed in OTSG tubing. This was accomplished during the most recent CR-3 tube pull in Spring 1994. Prior to this time, the mechanism causing these indications at the TSPs was unknown. From an eddy current "signature" perspective, the volumetric wear cannot be differentiated from the pit-like IGA, even when examined with MRPC.

Once the mechanism producing the indications at the TSPs was confirmed, the 1994 tube pull examination results were focussed on the most appropriate NDE technique for addressing these indications. The criteria for assessing various ECT techniques were accuracy in detection and sizing. However, consistent with FPC's philosophy of allowing structurally sound tubes to remain in service, the optimum disposition strategy is one which, while removing defective tubes from service, does so without imposing overly-conservative repair criteria. Two disposition strategies were examined with these criteria in mind. The first involved applying historic percent thru-wall sizing criteria based on bobbin coil phase angle. Application of an alternate disposition strategy similar to that proposed for the IGA was the second strategy considered.

A review of the limited pulled tube data was conducted to confirm whether the bobbin coil phase angle technique for the low S/N ratio, oval wear was subject to the same thru-wall sizing variability as the IGA (Figure 3-1 of Reference 1). The inability to accurately size low volume IGA was one of the principal technical considerations which necessitated FPC develop an alternate disposition strategy for the CR-3 steam generators. This review was inconclusive. While the sizing error for the volumetric wear was improved with respect to that of the IGA, this was based upon a database of just five (5) indications.

The depth of the volumetric wear, as measured by metallurgical exam, ranged from 14% to 35% TW, with a number of defects in the 30-35% TW range. When the bobbin coil voltage of the defects from the laboratory exams were compared with those in the field, it was apparent there were potentially a large portion of the wear indications in the OTSGs which approached the current Technical Specification limit of 40% TW (assuming voltage is proportional to volume, and hence, depth). None of the pulled tube wear scars approached any Regulatory Guide 1.121 structural or leakage considerations. Based on this data, it was also apparent there was considerable conservatism in applying the 40% TW acceptance criteria to these indications. Thus, application of the percent through-wall criteria did not meet FPC's goal of keeping structurally sound tubes in service as well as the alternate disposition strategy did.

From an ECT analyst perspective, combining the volumetric wear with the IGA as part of a singular disposition strategy was preferable. As mentioned, indications attributable to the two mechanisms are indistinguishable when examined with NDE. Considering the two together also removed any liabilities associated with assuming all indications at the TSPs are attributable to wear. While this has been wholly supported by the pulled tube data, the amount of data is limited.

For the reasons given, the decision was made to combine volumetric wear and IGA under the umbrella of a single disposition strategy. Further, since the metal loss associated with the wear mechanism is greater than that from the IGA, it was considered conservative to include the wear within the proposed approach, from an eddy current perspective. Once this decision was made, the technical justification for the proposed strategy was revised to include consideration of data unique to both mechanisms. FPC would continue to disposition tapered wear using the standard industry practice described above.

3. The proposed voltage-based repair criteria applies only to volumetric indications located outside the tubesheet regions. Describe the eddy-current inspection procedures and quantitative data analysis criteria to distinguish between volumetric and crack-like indications.

The eddy current inspection procedure used to distinguish volumetric from crack-like indications employs rotating probe technology. Indications reported from the bobbin coil probe examination are typically selected for rotating examination to further characterize their morphology. In lieu of examining all indications that cannot be quantified with the bobbin coil a sampling plan is implemented with the application of some established selection criteria for indications which can be logically grouped based upon signal response and/or location. If results from the sampling plan reveals crack-like flaws it then becomes prudent to examine all non-quantifiable indications with the rotating technique.

The specific rotating technique used at CR-3 has been the standard 3-coil probe which contains a 0.080 inch diameter shielded pancake coil, and two directed coils; one an axially wound coil, and the other a circumferentially wound coil.

Each coil is located in the same axial plane of the probe and spaced around the probes' circumference at 120 degree intervals. Each coil is held in contact with the tubes inside surface by mechanical means while the probe is simultaneously rotated about its' major axis and traversed through the tube past the location of interest. This scanning method gathers inspection data in a helical pattern and can be processed to display the relative orientation, position and dimensions of a flaw.

The pancake coil is sensitive to both volumetric and crack-like flaws and is used as the primary detection coil during data evaluation. The pancake coil is also employed for depth and dimensional sizing of indications. The axially wound coil is sensitive to volumetric and circumferentially oriented flaws and is used for characterization of flaw orientation. The circumferentially wound coil is sensitive to volumetric and axially oriented flaws and is also used for characterization of flaw orientation.

The basic evaluation procedure used to distinguish between volumetric and crack-like indications is performed by comparing the response from the three inspection coils. These coils are calibrated by adjusting their individual gains to produce an equal response to a volumetric flaw such as a drilled hole or shallow wear scar in a calibration standard. The amplitude response from flaw indications can then be compared for the three coils applying the following logic. Volumetric flaws should produce a nearly equal signal amplitude response from each of the three inspection coils. Crack-like flaws should produce an enhanced response of larger amplitude on one of the two directed coils (axial or circumferential). Further evaluation of signal formation and C-Scan mapping of the data is employed to insure accurate disposition of the flaws morphology.

4. The eddy current signals generated by wear and IGA pitting may be significantly different due to the different morphologies for each type of degradation. The larger and more easily detectable signals from wear can bias the statistics for the IGA pits if they are used together. Discuss the potential bias from the use of both IGA and wear data in the correlations incorporating eddy current voltages.

Both volumetric wear and pit-like IGA are three-dimensional discontinuities with a spheroidal geometry. Eddy current bobbin coil signal amplitude or voltage is proportional to the removed metal volume within the coil field of view. This is the basis for establishing a correlation relating amplitude to volume. Volumetric wear will typically have a larger volume then pit-like IGA; thus signal amplitudes or voltages for wear will be larger while those for pit-like IGA will be smaller. The larger amplitude wear data will simply define the correlation curve at the upper voltage extreme whereas the smaller amplitude pit-like IGA data will define the correlation curve at the lower end. Voltage bias is not expected to be introduced by using a mixture of wear and pit-like IGA since the correlation is volume dependent.

Signal-to-Noise

5. What actions have been taken to decrease the noise or increase the defect response signal during eddy-current inspections at CR-3? Discuss the use of alternate probes (size and type), inspection frequencies, assessments of noise origin, and other potential signal improvement measures. What alternative inspection techniques have been used in the past or been considered for the next inspection of S/N indications?

Eddy current examination data has been scrutinized very closely in the past year in an attempt to identify noise sources that influence data quality. These noise sources can be divided into three major areas which include, 1) tube noise, 2) system noise and, 3) electrical interference.

1) Tube noise is either inherent due to the metallurgical and physical properties of the material or associative due to component configuration and operating environment.

   A. Inherent tube noise comes from various sources such as non-alloying elements present in the material, surface condition, pilgering, geometry and thickness variations, and heat treat condition. Inherent tube noise is seen by the eddy current field and produces signals which may interfere with the detection and/or sizing of indications. Examples of inherent tube noise are pilgering noise, permeability variations, u-bend tangents, roll expansion transitions, and absolute drift from gradual thickness variations or heat treat. Probe wobble is a dynamic noise variable caused by the modulation between the tube and the inspection probe and is usually factored in with tube noise. Inherent tube noise and probe wobble are considered to be the primary contributors to the total background noise component.

   B. Associative tube noise comes from various sources such as secondary side deposits and sludge, tube support plate and tubesheet interference, tube denting, residual stress and environmentally induced material property changes which are usually localized in a particular area of the tubing.

2) System noise is a product of the inspection system configuration and includes the eddy current and associated control instruments, the cabling and inspection probes, and the remote manipulator and guide tube

assembly.

3) Electrical interference is introduced into the signal path from various sources such as electrical power supplies, poor grounding of the inspection system components, machinery and equipment operating nearby, and malfunctioning system components and probes.

There is very little that can be done to suppress inherent tube noise with the exception of permeability variations where magnetic biased probes are used with good results. Associative tube noise is handled during data evaluation with the application of mixes and filters in an attempt to suppress the interference from known signal sources such as tube supports, tubesheets, roll transitions, copper deposits and dents. The recent introduction of new or otherwise improved filtering techniques have also increased signal resolution through noise suppression.

System noise has been reduced somewhat with the introduction of the Zetec MIZ-30 eddy current instrument, deemed quieter by some studies. The use of high performance or low-loss probe extension cables and improved connector designs have improved data quality. Efforts to reduce the length of analog signal cabling and the amount of connectors in the signal path are considered to be positive steps towards improving data quality.

Electrical interference has been decreased through the use of dedicated power supplies, power isolation instruments and line conditioners. Improved methods of grounding system components and probes have shown some promise and the introduction of fiber optic lines for data transfer have provided immunity over those distances.

Another important aspect of the data quality issue is the emphasis placed upon analyst training in the recognition of data quality. Structuring guidelines to address the issues involved with data quality and offering example data for training which presents the various types of noise sources should improve the analysts understanding of how to handle or disposition various problems encountered with data quality.

There are a few ways in which to increase the inspection sensitivity; 1) Increasing the probe diameter for bobbin inspection in an attempt to increase the fill-factor and reduce probe wobble while also increasing the density of eddy currents in the material inspected, 2) Utilizing the features of the Zetec MIZ-30 instrument which allow for operator adjustment of the Variable Probe Drive and Programmable Gain options and, 3) Performing the initial data screening with an inspection mode and frequency which is less affected by noise.

The probe diameter used is a compromise between maximum fill-factor and successful probe delivery and probe life during an examination. Typically, there is little to be gained in inspection sensitivity by increasing probe size from the optimum diameter for examination to the maximum achievable diameter.

There are two new features offered with the Zetec MIZ-30 that have been used to increase the overall inspection sensitivity. The Variable Probe Drive feature provides the operator with the capability of choosing the drive voltage applied to the coil. Increasing the probe drive voltage will increase the amplitude of the analog signal without significantly increasing system noise. The Programmable Gain feature provides the operator with the capability of choosing the degree of analog signal amplification prior to digitization of the data. Adjustment of the programmable gain provides a compromise between signal resolution and signal saturation. System noise remains constant with increasing probe drive voltage and increases as the gain is increased.

Background noise includes tubing noise and system noise. This background noise is that seen by the data analyst and is that noise component factored into any signal to noise comparisons performed to address data quality concerns. Background noise is a factor of 15 times greater than the instrument noise alone. The noise component from the tubing, which is in the form of eddy current signals, increases with probe drive voltage and instrument gain.

All other sources that produce eddy current signals result in a linear increase in signal amplitude with increases in probe drive voltage and instrument gain.

Increasing the probe drive voltage and programmable gain values will increase both the signal of interest and noise component amplitudes. Therefore it is not expected that an increase in signal to noise ratios will be achieved. For the case of programmable gain it is not expected that signal formation will be enhanced or that the formation of previously non-detectable indications (compared to data acquired at lower gain settings) will be produced. However, as the signal amplitude is increased, the physical size of an indication produced in the lissajous screen will increase and thereby make it easier for the analyst to visually detect and subsequently process the indication for evaluation.

The defect response can be increased by performing the initial data screening with an inspection mode and frequency which is less affected by noise. Typically, the differential test mode is less affected by tube noise than the absolute test mode and a frequency which offers increased depth of penetration while still remaining in the upper bounds of the probes frequency response curve is desirable. This practice is employed at CR-3 by utilizing the 400 kHz differential channel for initial data screening. CR-3 also employs a high frequency coil wrap for the bobbin probe which is tuned better for the 600 kHz frequency used for sizing and S/N calculations.

6. Appendix G to Reference 5 provided a simplified description of how noise is quantified. However, it is unclear how noise associated with an indication is measured when the signals are superimposed. Describe the procedures used at CR-3 to quantify the signal-to-noise ratio of an indication where the contribution due to noise is not easily separated from that of the indication.

The noise component is always superimposed on the signal component since the noise component is most always a continuous variable that is merely fluctuating in intensity. Therefore the total voltage of the signal vector of interest is factored against the voltage of noise vectors taken in the immediate vicinity of the signal of interest using equal window openings. In the event that the signal of interest contains unacceptable electrical interference it should be rejected and subsequently reexamined.

The procedure followed to quantify the signal to noise ratio is as follows:

1. Isolate the entire signal of interest by minimizing the lissajous trace window opening through adjustment of the associated cursor spacing.
2. Measure the peak-to-peak voltage of the signal of interest and record this reading.
3. Using the window opening established in step 1 to determine the signal of interest, move the data points to an area immediately adjacent to the signal of interest which represents typical background noise.
4. Measure the peak-to-peak voltage of the noise and note this value.
5. In some instances it may be desirable to compare noise readings both immediately before and after the signal of interest in order to establish the deviation across the area of interest.
6. Calculate the signal to noise ratio by applying the formula; S/N. Voltage of the signal of interest divided by the voltage of the noise component.

Figures 1 and 2 provide a pictorial illustration of how the S/N ratio is determined. The two Figures are bobbin coil graphics of an indication located in 1992 CR-3 pulled tube 41-44, section 2. This tube section corresponded to the first span of the 'B' OTSG and the indication illustrated was confirmed to be pit-like IGA by destructive examination. From Figure 1, the indication exhibited a bobbin coil signal amplitude of 0.90 volts. Figure 2 illustrates Steps 3 and 4 above, determining a peak-to-peak voltage value of 0.31 volts attributable to noise. Using Figures 1 and 2 in conjunction with one another, a S/N ratio of 3:1 is calculated (0.90V/0.31V) for this indication.

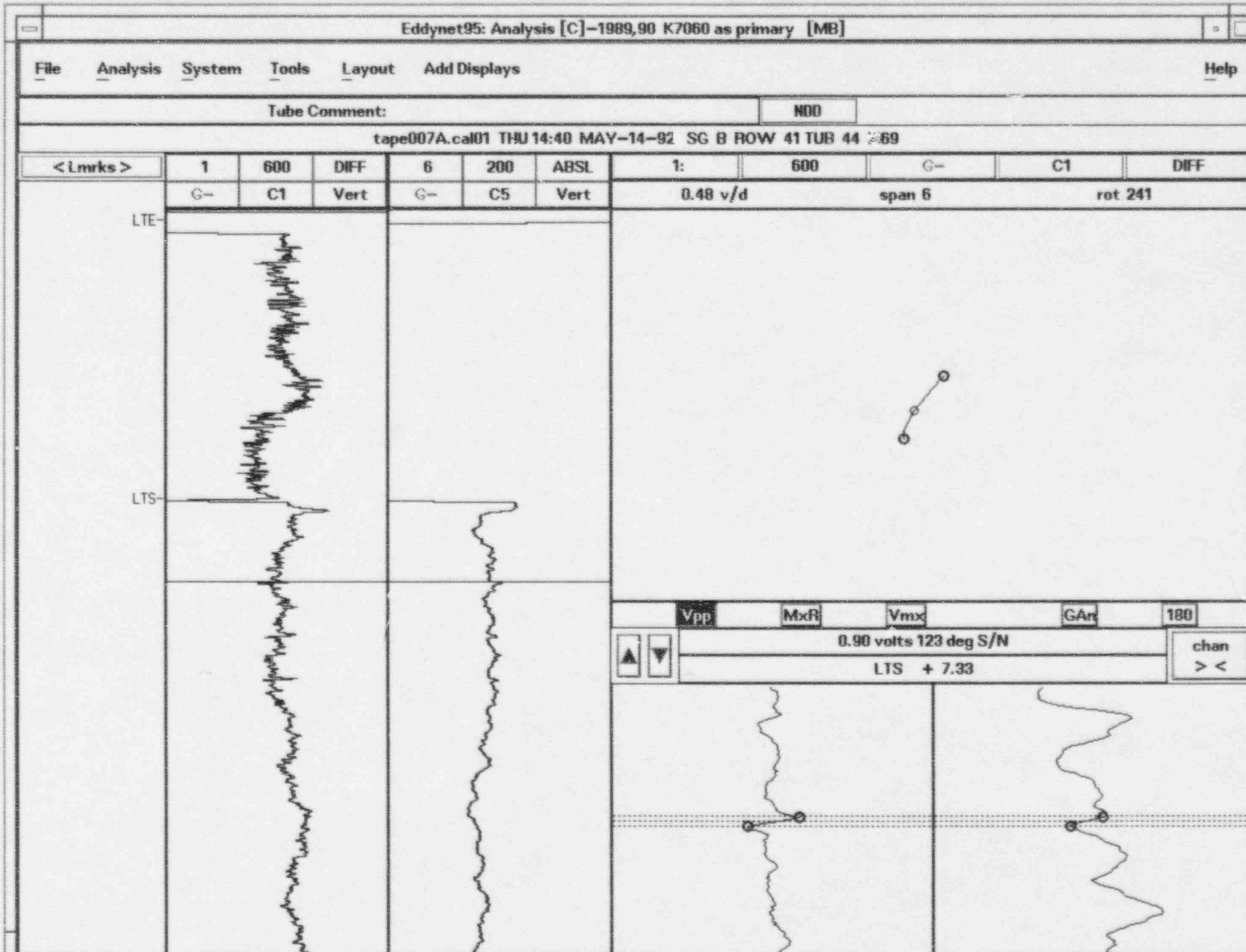
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Figure 1

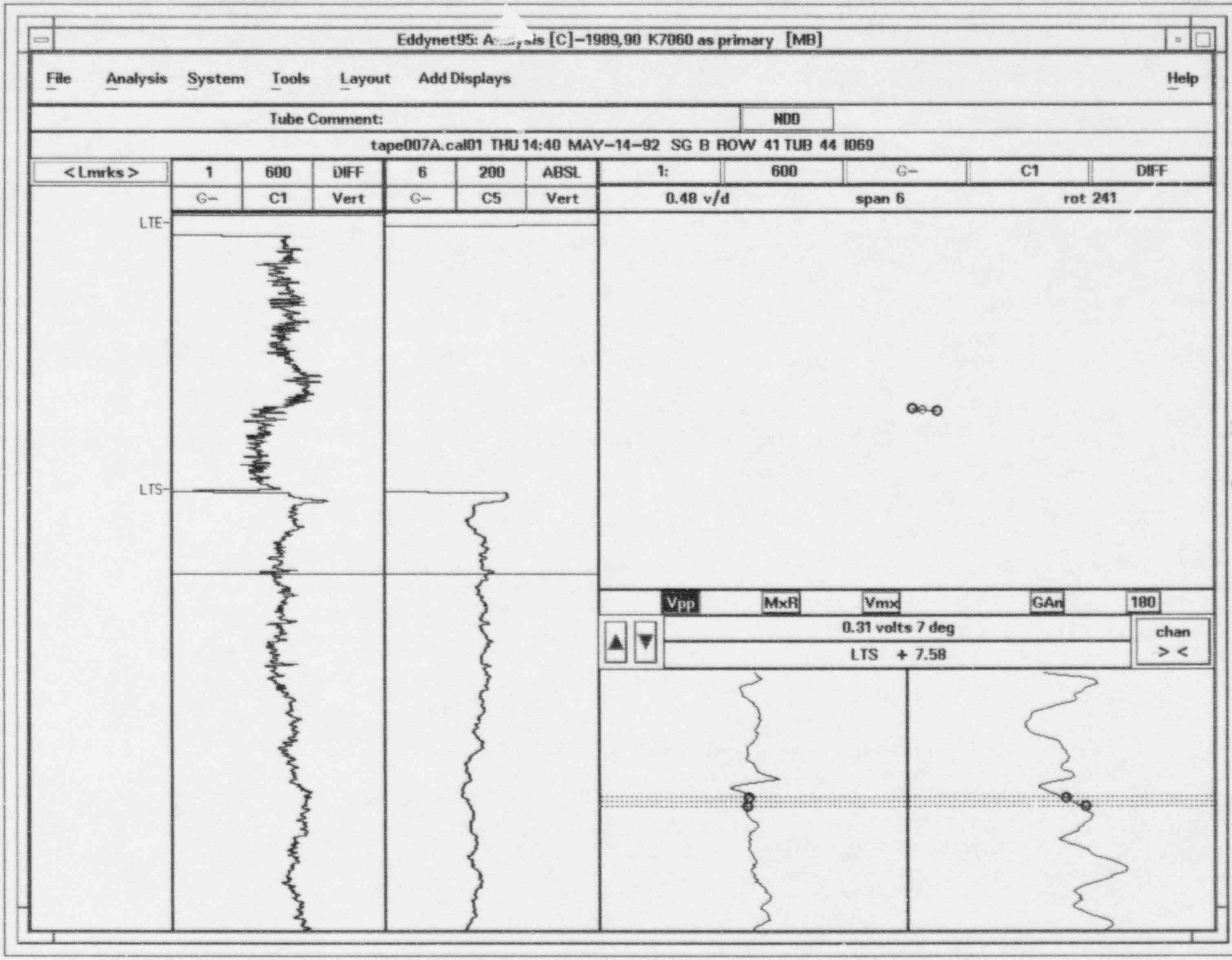
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Figure 2

7. Appendix A of Reference 2 lists the eddy current voltage amplitude for all identified S/N indications in the CR-3 steam generators. However, the table does not include quantitative data for the level of noise measured for each indication. Provide the data recorded during eddy current inspections quantifying the level of noise associated with each indication. For indications inspected in more than one outage, provide noise measurements recorded during each inspection.

The level of noise associated with each S/N indication in the CR-3 steam generators has not been recorded in a readily available format during past inspections. The information exists in the raw eddy current examination data and would require a manual re-analysis of the subject tubes in order to measure and record the noise components associated with these indications.

8. The last paragraph in Section 2.3.1.3 in Reference 3 states that "the 0.540 inch HF bobbin coil exhibited slightly better detection performance than the 0.510 inch HF bobbin coil." This section also indicated that the 0.540-inch high frequency bobbin coil gave cleaner (higher signal-to-noise ratio) and more repeatable data. Do you plan to use the 0.540 inch high frequency bobbin coil probe for upcoming inspections of CR-3 steam generator tubes? If you plan on using a bobbin coil probe with a diameter other than 0.540 inches discuss your basis for doing so in light of the above.

There are no plans to use the 0.540 inch diameter bobbin probe at CR-3 in future inspections. The 0.510 inch diameter bobbin probe is the standard probe size used for inspection of OTSG tubing and it is expected that the resolution gained from the application of the 0.540 inch diameter bobbin probe would be negligible.

There would also be difficulties encountered with the introduction of the 0.540 inch diameter bobbin probe in a production examination. It is expected that there would be difficulty delivering the probe through the full length of the tubing due to restrictions caused by dings and tube end damage. There is the possibility of stuck probes which could cause problems with probe retrieval and shorter probe life due to increased friction between the probe and tube.

9. If all indications are recorded regardless of voltage amplitude and the growth mechanism is dormant, only a small number of new indications should be detected during any outage (i.e., small voltage indications at the threshold of detection). What steps has the licensee taken to address the root cause for indications which have faded in and out from inspection to inspection?

The root cause for certain indications fading in and out from one inspection to the next is believed to be related to the small amplitude (and therefore, volume since the two are proportional) of the indications exhibiting this behavior and the detection limitations associated with this size indication. Since there is nothing which can be done to change the size of the discontinuity, the steps taken to address this phenomena are related to improvements in the NDE area. This is discussed in the responses to RAI question 5. In addition, eddy current data analyst guidelines require the analysts to address previous history for each tube in which an indication is called. This helps maintain database integrity by ensuring the analyst takes a second look at locations with previously reported indications.

In order to evaluate the frequency of this "fade" phenomena occurring, a review of previous ECT data was performed. The review started with the 1987 inservice examination results and worked towards the latest (1994) inspection, looking for S/N indications which were considered present during at least two outages, but which were not detected during each inspection of the tube containing the indication. The results of this review show that this does occur, but the occurrence is a limited scope (< 5%).

Given the results of the evaluation, a compensatory factor considered in this issue of indications fading in and out is that the indications most subject to this occurring are also those of the least structural significance. A review of operating history shows the bobbin voltage of these indications to be typically well below the minimum voltage threshold (0.9 volts) established within the TSCRN. Thus, although these indications may not be detected during each and every outage, the significance of missing an indication during an outage is minimal due the impact of these indications (assuming they are all representative of actual degradation) on the structural integrity of the tubing.

10. New S/Ns are defined as those that have voltages greater than 0.9 volts and that have not been identified in any outage since 1987. Discuss the basis for considering only indications identified during inspections since 1987 in light of the fact that some indications were first identified many years earlier.

The establishment of a cut-off date, before which indications are assumed not to have been present, is considered a conservative approach to defining new (S/N) indications. Rather than review original eddy current data tapes to determine whether an indication was present prior to the proposed cut-off date, the proposed approach considers any indication not currently in the database to be "new", and requires an initial MRPC inspection be performed for those indications exhibiting a signal amplitude greater than 0.9 volts.

The specific year (1987) was chosen based upon limitations of available historic ECT data. The eddy current test data management system used at CR-3 only contains previous tube history for inspections performed since 1987. Prior to this time, the analysis techniques and analyst guidelines were such that the results of the earlier inspections could not be readily compared with the results of an inspection today.

FPC has inspected 100% of the CR-3 steam generator tubing at least one time since 1987. In recent inspections, it has been FPC's practice to inspect tubes containing previously identified indications, at each subsequent inspection. Thus, there is a high confidence that the large majority of S/N indications present in the CR-3 OTSGs have been previously identified and are contained in the current ECT database. This would naturally include valid signals present prior to 1987.

Growth

11. Appendix B of Appendix A to Reference 5 assessed the growth of intergranular attack (IGA) patches for three tubes examined in 1989, 1990, and 1992 outages. The study concluded that there was no evidence of growth of the observed IGA patches included in the study. While past growth assessments may support your assumption of zero growth for IGA S/N indications, the basis for assuming no growth for tube wear indications is unclear. Provide the basis for this assumption.

The 1994 growth rate study performed by Packer Engineering (provided as part of the response to RAI #35) included consideration of CR-3 inservice S/N indications located at support locations. Based upon the 1994 CR-3 tube pull results, the indications present at the support plates can be attributed to wear. Thus, the results of the latest growth rate study support a conclusion that there is essentially no growth of wear indications within the CR-3 OTSGs. This conclusion is based upon a review of the entire population of indications. Refer to Section 4.4 of Reference 1 for a more detailed discussion of the results of this study.

The B&W growth rate study also included a limited number of data points on defects located at tube support plates, but the data did not support a growth rate analysis of these indications (small number of data points, significant negative mean change in bobbin voltage associated with the indications, etc.).

12. How frequently will each S/N indication be inspected in future outages?

FPC presently plans to inspect all S/N indications during each future inservice NDE inspection. However, future NDE inspection results providing information on degradation growth rate will be evaluated for justification of a statistically-based sampling plan of these tubes which would allow for less than a 100% inspection.

13. A number of growth studies have been cited in the various submittals supporting this TS amendment. Discuss how differences in probes, calibration procedures, cable lengths, calibration standards (including the use of transfer standards), probe wear, and other related factors have been accounted for in each of these studies. Indicate whether the data used in each of the studies are based on Vmax voltages or peak-to-peak voltages. It would be sufficient to address the more recent outages since they most likely used similar techniques and analysis criteria.

The three growth studies specifically referenced within the TSCRN 203 technical report were performed independent of one another. In fact, steps were taken to maintain the independence of the various studies. This meant allowing the individual organizations - EPRI, B&W, and Packer, - the latitude to utilize the technical procedure they deemed appropriate and not dictating any one single approach to the evaluation. Thus, the procedures and data used in the individual studies are not necessarily consistent, even though the results and conclusion of "little or no growth" are. Each study is summarized separately below.

The EPRI growth rate study utilized eddy current bobbin coil voltages obtained from the Refuel 8 pulled tubes which were field inspected during the 1989, 1990, and 1992 CR-3 inspection outages. Peak-to-peak voltages were used in the evaluation, with the 600 kHz channel chosen for comparison. To compare three successive outage data acquired by different diameter size probes and varying lengths of extension cable, eddy current signals from a 100% TW calibration hole were normalized to 5 volts peak-to-peak at a phase angle of 40 degrees.

The B&W study utilized eddy current bobbin coil voltages from the 1989, 1990, and 1992 CR-3 Outages. Indications which were inspected in at least two of the outages were compared against one another using the bobbin coil technique. Peak-to-peak voltages were utilized in the evaluation, in order to account for the changes to the essential variables which took place over the period of time covering the three Outages. The essential variables of this technique are probe type and operating range examination frequencies, data acquisition speed and calibration standards. Each of these variables was evaluated as were the differences in data analysis guidelines during this time. The following is a brief discussion of the variables considered and their treatment.

The 1989 and 1990 examinations were performed with a mid-range frequency bobbin probe operating at 600, 400, 200 and 35 kHz in both differential and absolute modes. The 1989 target probe speed was 14 inches per second coupled with a data sampling rate of 400 points per second, yielding recorded results of 28.6 data points per inch of tube examined. The 1990 target probe speed was 24 inches per second coupled with a data sampling rate of 800 points per second yielding recorded results of 33.3 data points per inch of tube examined. The 1992 examination was performed with a high-frequency bobbin probe operating at 600, 400, 200, and 35 kHz in both the differential and absolute modes. The target probe speed and data sample rate were the same as during the 1990 exam. While the slight differences in recording rates could result in some variation in sizing, the variation is considered acceptable since calibration curves are fit with standard reflectors acquired at the same speed.

The change in probe operating range, from a mid-range to high frequency design, was considered. For the probe and frequency combinations used during the three outages, flaw detection is equivalent and was performed each time with the 400 kHz differential channel which operates nearly equivalent for both probe types. Flaw sizing, however, should be more accurate during the 1992 exam which used the high frequency probe and evaluation of 600 kHz. This frequency is closer to the optimum test frequency for OTSG tubing and provides better phase separation for flaws of varying depths.

The calibration standards used for the three examinations were different. However, they were of similar style with equal volume and depth of artificial flaws and were therefore considered equivalent for the purposes of the comparison.

Analyst guidelines also varied somewhat between examinations. Two changes merit further discussion. The first deals with the frequency used for reporting indications. During the 1989 and 1990 exams, indications were reported with the 400 kHz differential channel when they occurred in the freespan of the tubing. A 400/200 kHz mix channel was used for indications at support intersections. During the 1992 examination, freespan indications were reported with the 600 kHz differential while support locations were reported with the 600/200 mix. Since these two frequencies offer differences in phase spread, with the 400 kHz being smaller, the calibration curves represented by these two channels display different degrees of resolution.

The second point of interest is the method used for voltage normalization. During the analysis setup it is common practice to set a specific voltage on a particular signal from the calibration standard and then "save" this voltage scale to the other data channels. By performing this voltage normalization, a common scale can be applied to all the data. During the 1989 and 1990 outages, the 400 kHz channel was set to 4 volts peak-to-peak on the signal from the broached TSP. In 1992, the 600 kHz was set to 6 volts peak-to-peak on the signal from the 4-100% drill holes. Although both procedures return a similar voltage scale, a different procedure was used to allow comparison of the data. Using the 400 kHz, the system was set at 4 volts peak-to-peak on the signal from the 4-20% flat bottom holes. Indications from all three outages were sized with the identical, identified technique and compared.

The Packer growth rate study utilized eddy current bobbin coil voltages obtained during the 1992 and 1994 CR-3 inspection outages. The study also utilized peak-to-peak voltage values. The essential variables of the 1992 and 1994 outages were maintained the same in order to facilitate the comparison.

Probe wear, as a specific effect, was not considered within any of the studies.

14. Has a growth rate study of S/N indications been performed based on rotating pancake coil (RPC) sizes (i.e., axial and circumferential length)? If so, provide the results. If not, discuss the usefulness of such a study.

A comparison of axial and circumferential extent was performed for those indications of interest which received an MRPC inspection (clip plot sizing) during both the 1992 and 1994 inspections. The study was somewhat limited due to the number of indications (33) which met the aforementioned criteria. The mean change in axial and circumferential extents were 0.008 inches and (-) 0.015 inches, respectively. The standard deviation of all changes in extent measurement is 0.047 inches.

The results of this evaluation are generally consistent with those obtained by bobbin coil voltage for the various growth rate studies. Procedures for clip plot sizing were essentially unchanged during the two inspections, although there is likely some amount of analyst variability between the two measurement data sets. This variability is enveloped/ bounded by the conservatism demonstrated for the MRPC sizing technique.

15. An S/N indication is considered to have grown if it exhibits a 0.5 volt increase from the previous inspection and has a measured voltage in excess of 0.9 volts. The basis for the 0.5 volt increase resides in the fact that this criterion was used in the previous inspections of S/N indications. Provide technical justification for not performing a subsequent RPC examination of indications previously RPC examined unless the bobbin voltage increases by 0.5 volts. If an indication was identified as having an eddy current response of 0.4 volts and was later reexamined and found to exhibit a 0.8 volt response, discuss why this indication is not considered to have grown. The staff notes that since the degradation mechanism is considered dormant and no allowance for flaw growth was used in the development of the tube repair criteria, there should be essentially no change in voltage with the exception of variations arising from nondestructive examination uncertainty. Since the probe wear model and analyst variability model being proposed have a total uncertainty of approximately 24% at an upper 95% confidence level, it seems like a much lower threshold than 0.5 volts should be used. Please discuss. Is the 0.5 volt increase determined from the most recent inspection of the indication or from the original inspection in which the indication was identified?

Voltage changes and their relationship to growth are discussed using data sets from CR-3 steam generator B; results using data from steam generator A are comparable.

- Free-span indications attributed to pit-like IGA

  Figure 3 shows a scatter plot of measured voltages for freespan indications from two consecutive outages attributed to pit-like IGA from CR-3 steam generator B. The measured voltages are essentially uniformly distributed about the zero growth line at 45 degrees indicative of no overall change. This observation is also supported by data presented in Figure 4 and Figure 5 which show amplitude change in volts and percentage respectively. Scatter plot and histogram formats are used in both figures to show changes. Voltage change was determined by taking the difference between the 1994 and 1992 data; percentage change was determined by dividing the voltage change by the average of the 1992 and 1994 measured voltages.

  The data in Figure 4 shows that the mean voltage change is +0.0015 volts (essentially no change) with a standard deviation of 0.105 volts. In terms of percentage change, the Figure 5 data shows that the mean percentage change is -0.46% with a standard deviation of 18.41%. Since the data essentially show a near-zero mean in voltage or percentage change, no strong evidence of growth exists.

- Indications at Tube Support Plates attributed to wear

  Figure 6 shows a scatter plot of measured voltages for indications from two consecutive outages attributed to wear at tube support plates from CR-3 steam generator B. As before, the measured voltages are essentially uniformly distributed about the zero growth line at 45 degrees indicative of no overall change or growth. This observation is also supported by data presented in Figure 7 and Figure 8 which show amplitude change in volts and percentage respectively. Scatter plot and histogram formats are used in both figures to show changes. Voltage change was determined by taking the difference between the 1994 and 1992 data; percentage change was determined by dividing the voltage change by the average of the 1992 and 1994 measured voltages.

  The data in Figure 7 shows that the mean voltage change is +0.012 volts (essentially no change) with a standard deviation of 0.165 volts. In terms of percentage change, the Figure 8 data shows that the mean percentage change is +0.83% with a standard deviation of 24.6%. Since the data essentially show a near-zero mean in voltage or percentage change, no strong group evidence for growth exists. However, a few individual data points exceeding a + 0.5 volt change likely show evidence for small growth.

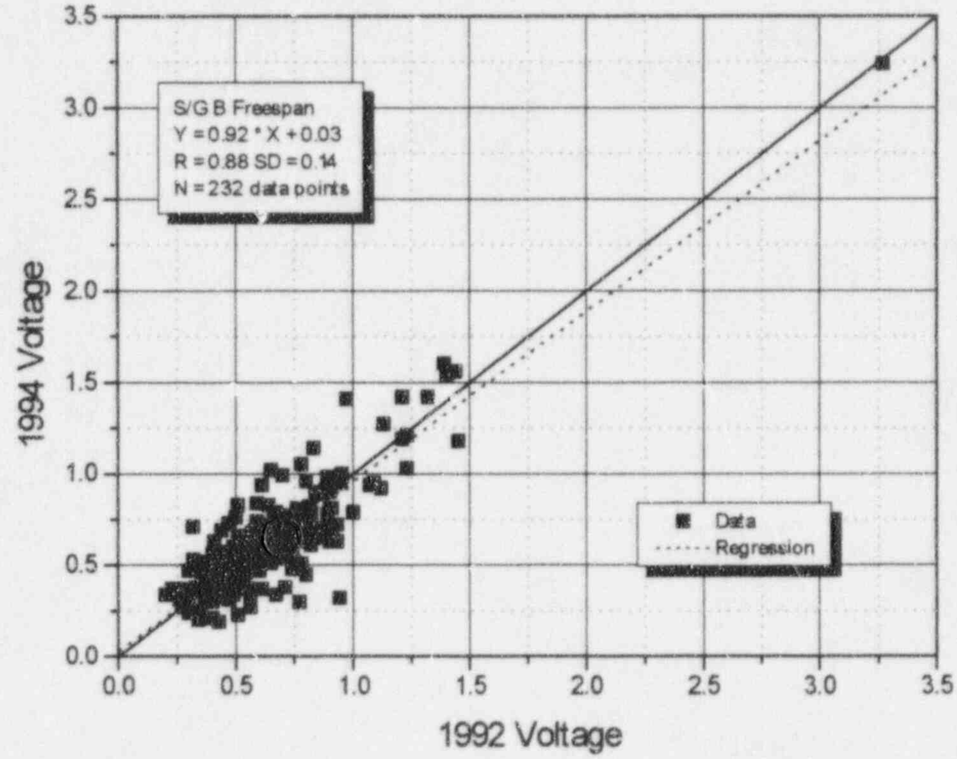
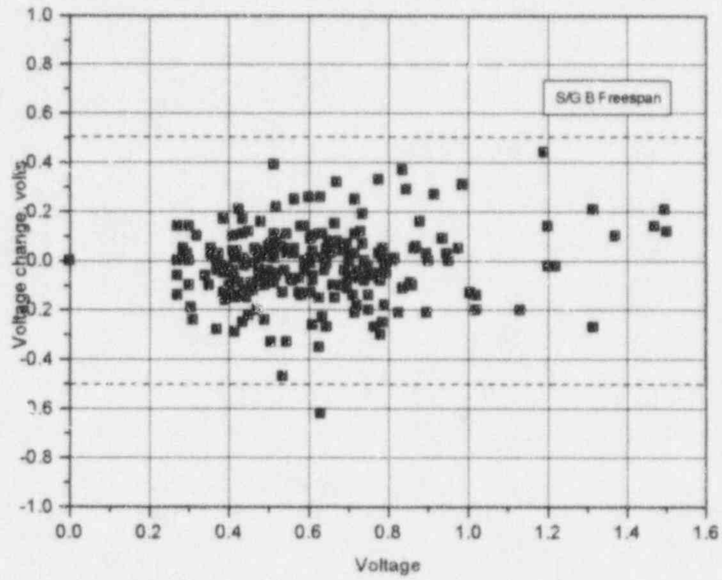
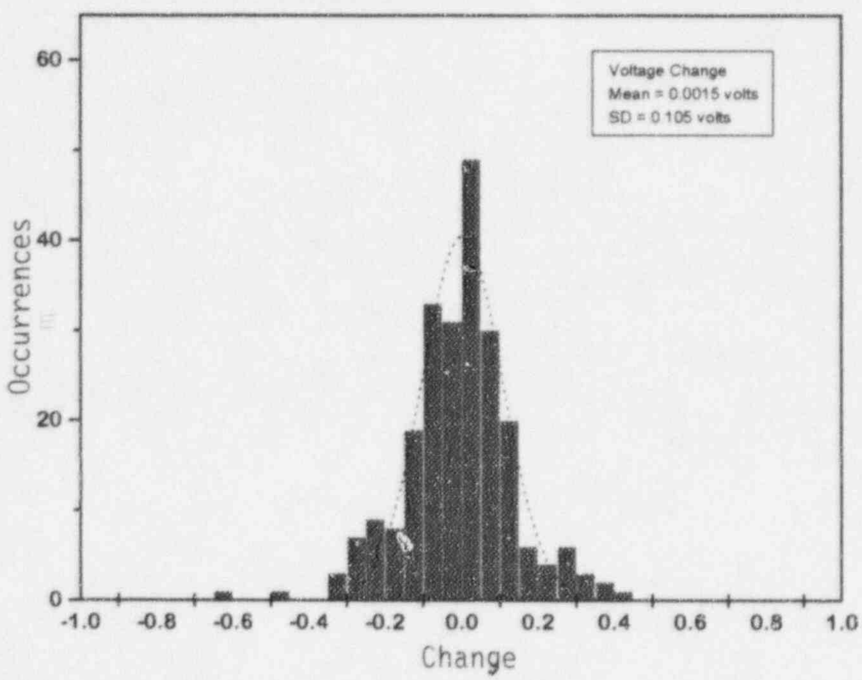


Figure 3. Voltage scatter plot from two consecutive outages for freespan indications attributed to pit-like IGA; CR-3 Steam Generator B.

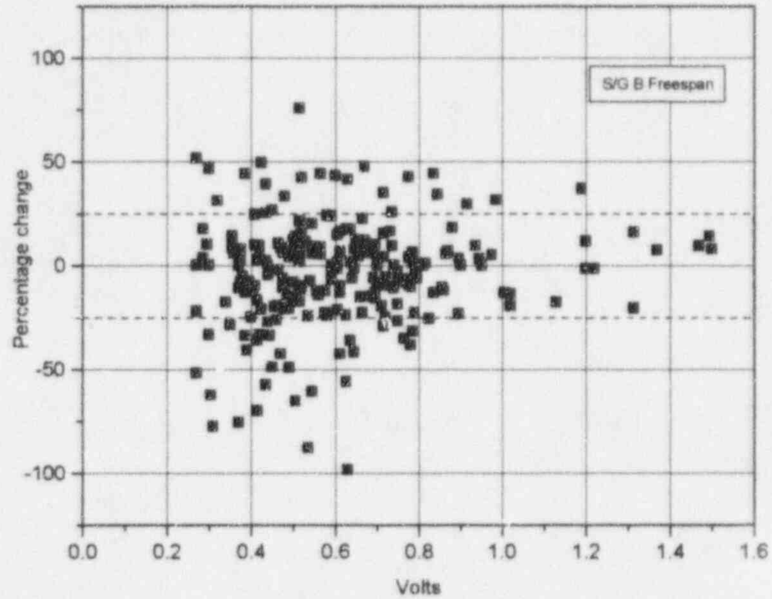


(a) Scatter plot format

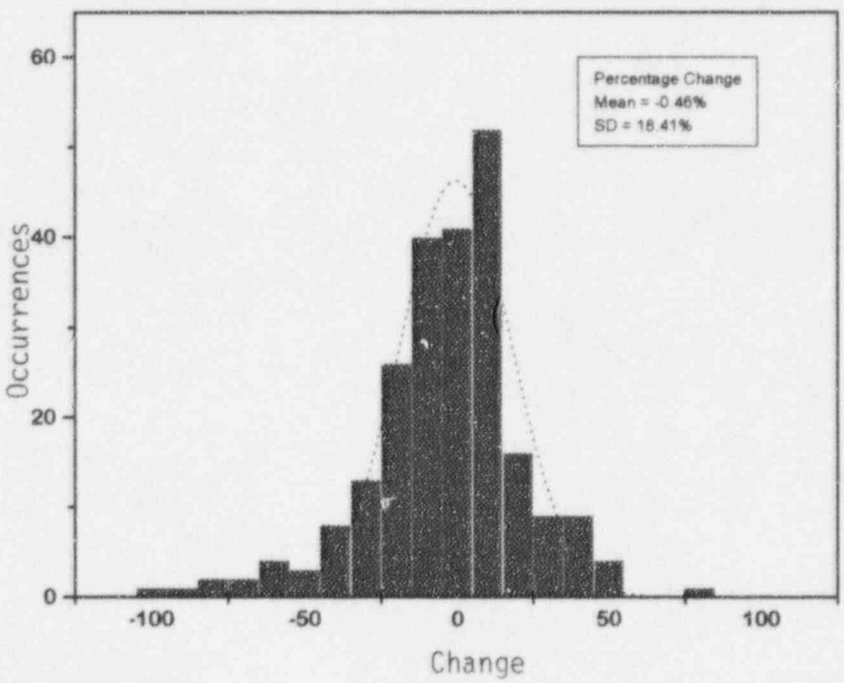


(b) Histogram format

Figure 4. Voltage change for freespan indications attributed to pit-like IGA.



(a) Scatter plot format



(b) Histogram format

Figure 5. Percentage voltage change for freespan indications attributed to pit-like IGA.

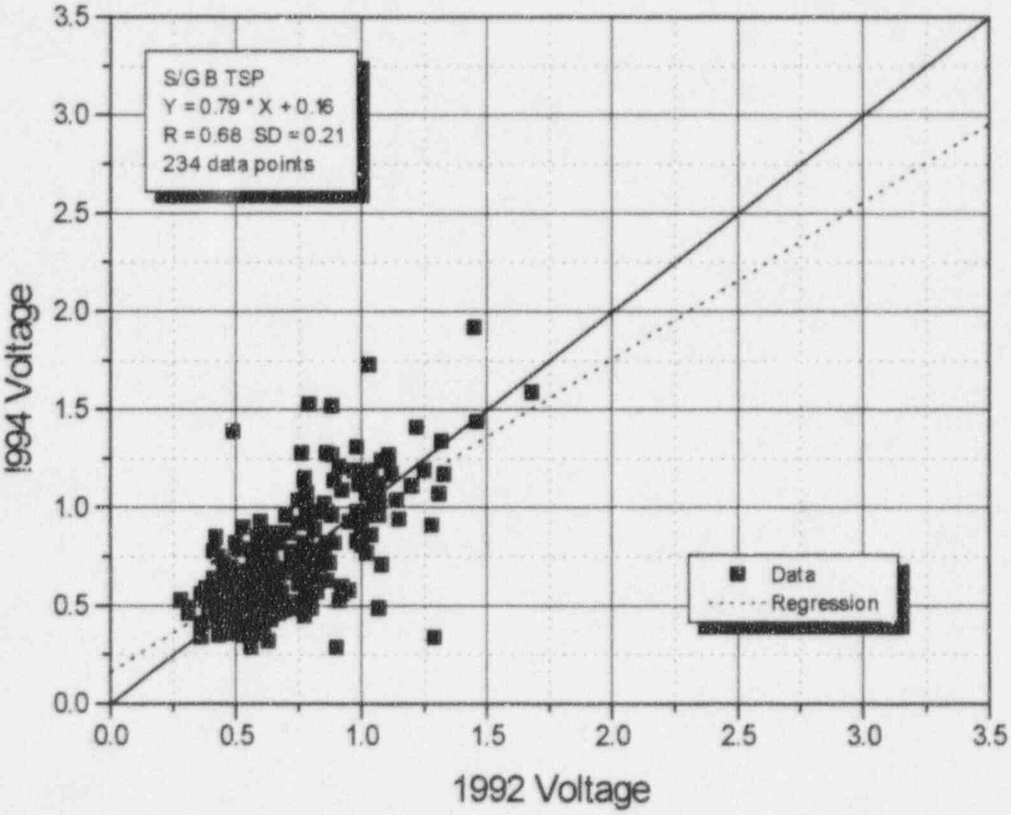
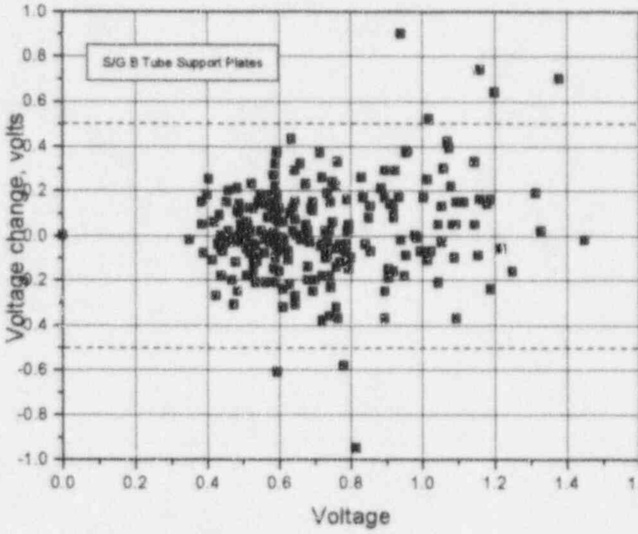
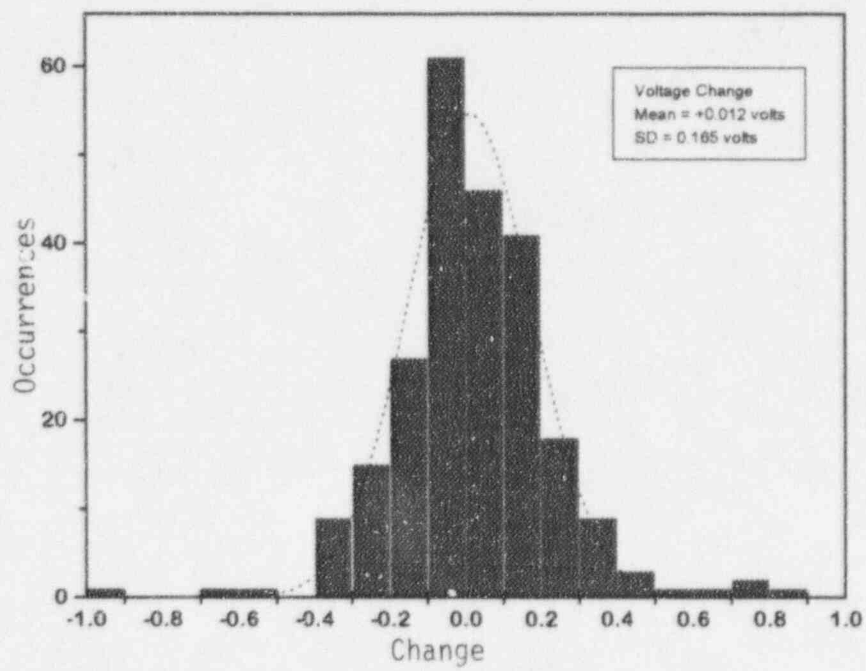


Figure 6. Voltage scatter plot from two consecutive outages for indications at tube support plates attributed to wear. CR-3 Steam Generator B.

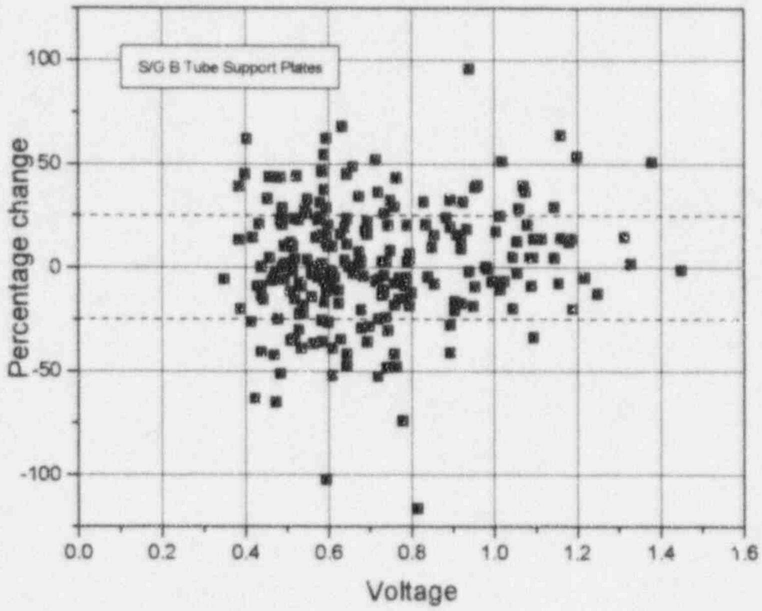


(a) Scatter plot format

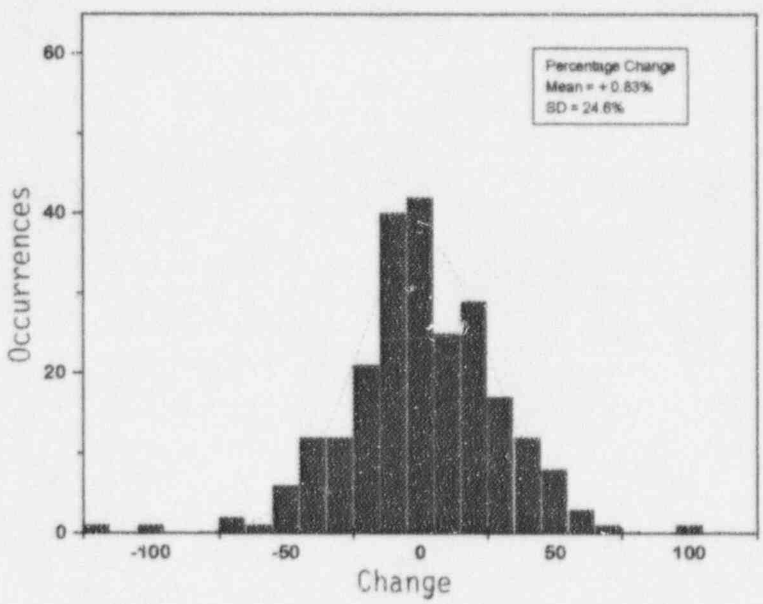


b) Histogram format

Figure 7. Voltage change for indications attributed to wear at tube support plates.



(a) Scatter plot format



(b) Histogram format

Figure 8. Voltage change for indications attributed to wear at tube support plates.

The 1992 and 1994 data were acquired using the same acquisition procedure, using many different probes, with the data analyzed by numerous analysts. The observed scatter in the data simply reflects overall NDE repeatability or NDE system measurement error. The scatter in the tube support plate wear data is greater because of the effects of support plate mix residual. This mix residual acts like a noise vector which perturbs the indication increasing the scatter associated with the measurement of its features, e.g., magnitude and phase angle.

The 0.5 volt threshold originally proposed for establishing change essentially bounds all of the data for pit-like IGA (Figure 4(a)), and most of the data for wear at tube support plates (Figure 7(a)). However, with a two-sigma NDE system repeatability error of 0.21 volts for free-span IGA, a more-conservative threshold of 0.25 volts for growth could be utilized. This increase would be applied using the most recent inspection data.

Essentially, the difference in the 0.25 and 0.5 volts is attributable to the manner in which each was developed. The 0.5 volt value was derived based upon technical judgement and was a criteria which was intended to provide, with some assurance, that growth was occurring. The 0.25 volt value is believed to represent the other end of the spectrum. It is representative of an approach whereby, with some assurance, the earliest signs of growth would be detected. Both approaches have benefits and drawbacks. However, based upon the data included within Figures 3 through 8, it appears both criteria are appropriate for their intended purpose.

In the context of a percentage change in voltage, the absolute voltage level needs to be considered as shown with the data in Figure 5. For amplitudes less than approximately 0.9 volts, the percentage change can be quite large with extremes on the order of 100%. For amplitudes greater than approximately 0.9 volts, a 25 percentage point change bounds the bulk of the data. Clearly, estimates of the NDE system error will be strongly influenced by the voltage ranges of the indications included within the data set and the effects of support plate mix residual. For free-span indications with voltages greater than 0.9 volts, the 24% NDE system measurement error originally estimated agrees reasonably well with the experimental data.

Leakage

16. The basis for the 0.9 volt cutoff for determining when RPC examinations should be performed and the length based limits applied is not clear in light of past inspection data which indicates that voltages of about 0.8 volts can have an axial extent in excess of 0.5 inches (Figure 28 in Reference 5). Has a systematic review of all available CR-3 data as well as any pulled tube data from other plants been performed which supports the assumption that the 0.9 volt criteria will ensure that the proposed dimensional limits will not be exceeded?

Since the 0.9 volt cutoff is presumably based on experience to date, discuss your plans for random RPC sampling below the appropriate voltage threshold (0.9 volts is being proposed).

A systematic review of all CR-3 data has been performed and the results of this review are presented in the technical report which supports the proposed TSCRN (Reference 1).

Inclusion of the particular indication mentioned in the RAI within Figure 28 of Reference 5 was an error. This indication, from RCSG-1B, tube number 70-125 had measured axial and circumferential extents of 0.52 and 0.19 inches, respectively, and is attributed to tapered wear. Since tapered wear is not included within the scope of the proposed TSCRN, it should not have been included within the subject data set.

Other plant data has always been considered for applicability and incorporation into the CR-3 database. Reference 5 included a discussion of some IGA data from the Palisades nuclear plant. Further, industry data used to support Degradation Specific Management efforts has been reviewed throughout the development of the CR-3 disposition strategy technical basis. This data has been utilized where appropriate.

The RAI requests FPC discuss its' plans for random MRPC sampling of indications exhibiting a bobbin coil voltage below the proposed lower voltage cutoff. Presumably, this is proposed as a means of using field data to validate the continued applicability of the voltage cutoff, as was addressed by Confirmatory Action Letter No. 2-94-004, Item # 4 (Reference 8). At the time the CAL was written, the cutoff value was based on a limited database, making the focussed inspection an appropriate action. However, as discussed in the TSCRN 203 topical report, 413 additional data points were added to the database as a result of the 9R MRPC special interest inspection. Given the current amount of data, there is no reason to require additional MRPC for purposes of validating the voltage cutoff. Although not a commitment, FPC does intend to inspect these indications on a time and resource basis during future inspection outages in order to further our understanding of the condition of the CR-3 OTSGs.

17. Independent staff calculations determined that leakage integrity is not assured at a 95% confidence level for indications with a bobbin coil signal of 0.9 volts. Discuss the 0.9 volt lower limit in light of this staff finding. Consider the response to Question 18 below.

FPC calculational results do not agree with the NRC Staff's. For a bobbin coil signal of 0.9 volts, the volume and depth are estimated using Figures 9 and Figure 12. From Figure 12, the volume is estimated at 90×10^{-6} in^3 at the upper 95% prediction interval. Using Figure 9, this volume corresponds to a depth of 80% through-wall at the upper 95% prediction interval. Since this depth is less than 87% through-wall, leakage integrity is maintained.

18. The data in Figures 5-1 through 5-5 in Reference 1 illustrates the relationship between eddy current voltage measurements and the dimensions of S/W indications. However, these relationships are based on nominal correlations without consideration to the scatter in the data. Plot conservative 95% prediction intervals for each of these figures and determine the volume and corresponding bobbin coil voltage associated with an 87% through-wall indication evaluated at the 95% prediction interval.

95% prediction intervals for data presented as Figure 5-1 through 5-5 in (Reference 1) are shown as Figures 9 through 13 herein. Linear scaling of the prediction interval plots as opposed to log-log plots of the original data is used because of software limitations. In addition, for Figure 11, volume has been correlated with the circumferential extent *in mils* rather than *inches* as originally presented in order to be consistent with the axial length correlation.

The 95% prediction intervals shown in the figures are calculated using the equation

$$Y_0 = (a+bX_0) +/- t_{0.25} * s$$

where a and b are the intercept and slope respectively of the least squares fit to the experimental data, s is the residual variance, and $t_{0.25}$ is the Student t-parameter (Reference 9).

Dimensional values calculated in response to specific questions were estimated using the exact equation.

The volume and corresponding bobbin coil voltage associated with an 87% through-wall indication is estimated as follows. From Figure 9, the volume associated with an 87% through-wall indication is approximately 104×10^{-6} in^3 at the upper 95% prediction interval. Figure 12 is used to estimate the corresponding bobbin coil voltage; entering the upper prediction interval at the desired volume gives an amplitude of approximately 1 volt which exceeds the proposed 0.9 volt bobbin coil screening limit.

The conservatism present in the ligament calculation supported using raw data without consideration of the prediction interval. The calculations are based upon tube burst test results where the length of the degradation was one to two inches in length. Volumetric degradation with an axial extent less than the proposed limit of 0.33 inches would represent a much less severe degraded condition. Hence, the depth limit to avoid leakage is conservative. It is expected that the maximum depth of pit-like IGA, which is within the proposed axial and circumferential extent limits, would have to be virtually through-wall to result in leakage during a postulated steam line break.

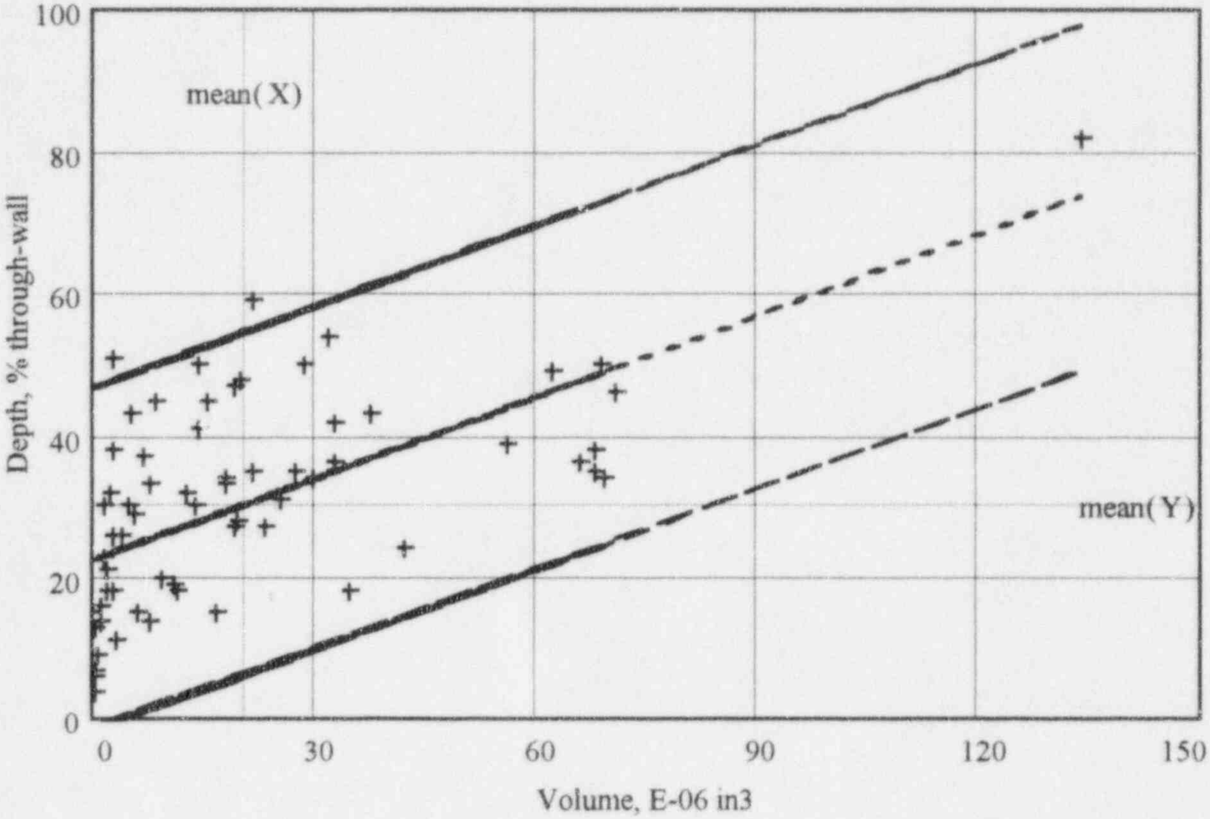


Figure 9. Depth-volume correlation using Crystal River 3 pulled tube metallographic data.

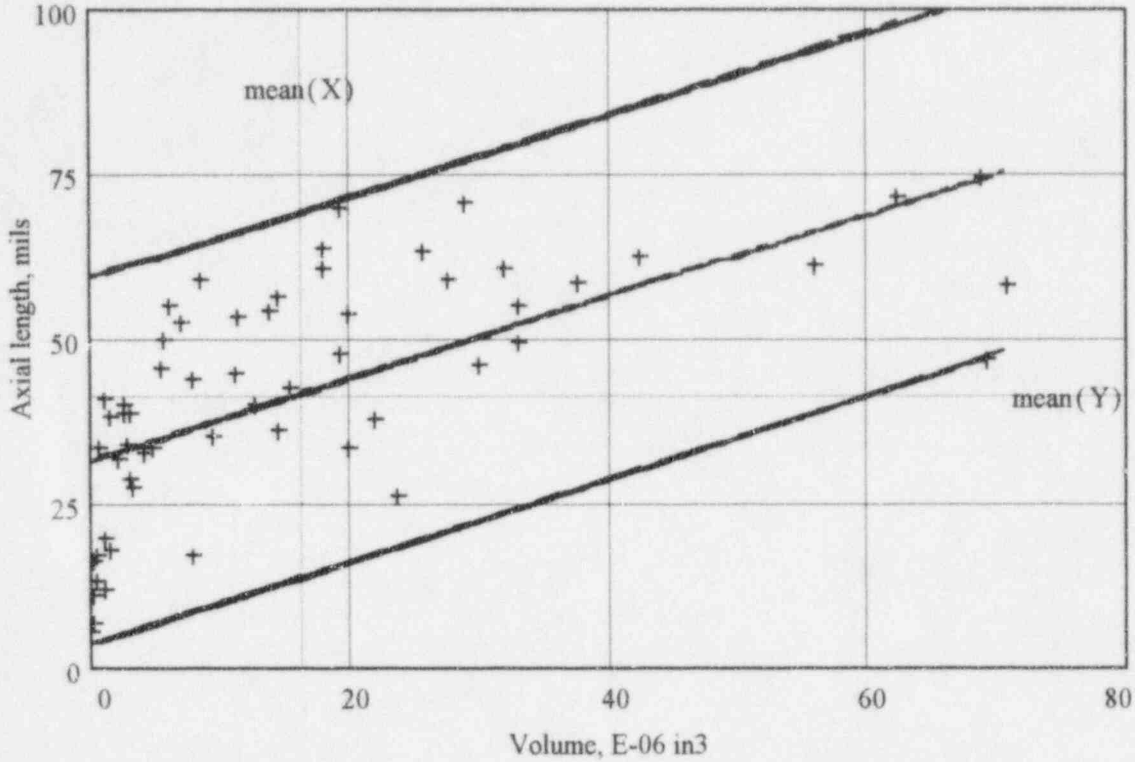


Figure 10. Axial length-volume correlation using Crystal River 3 pulled tube metallographic data.

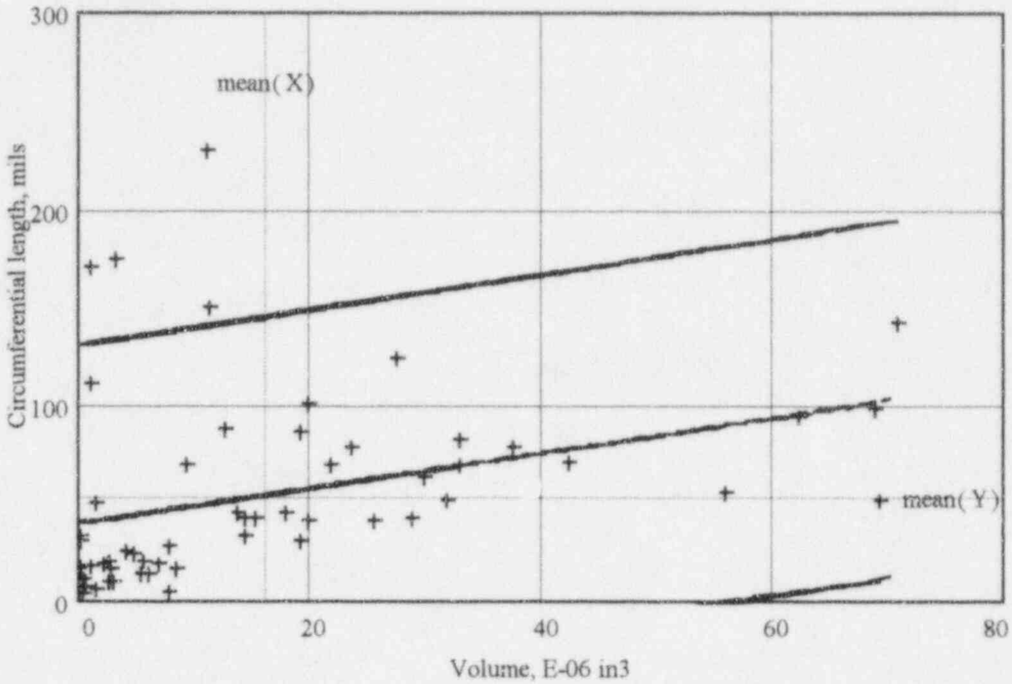


Figure 11. Circumferential length-volume using Crystal River 3 pulled tube metallographic data.

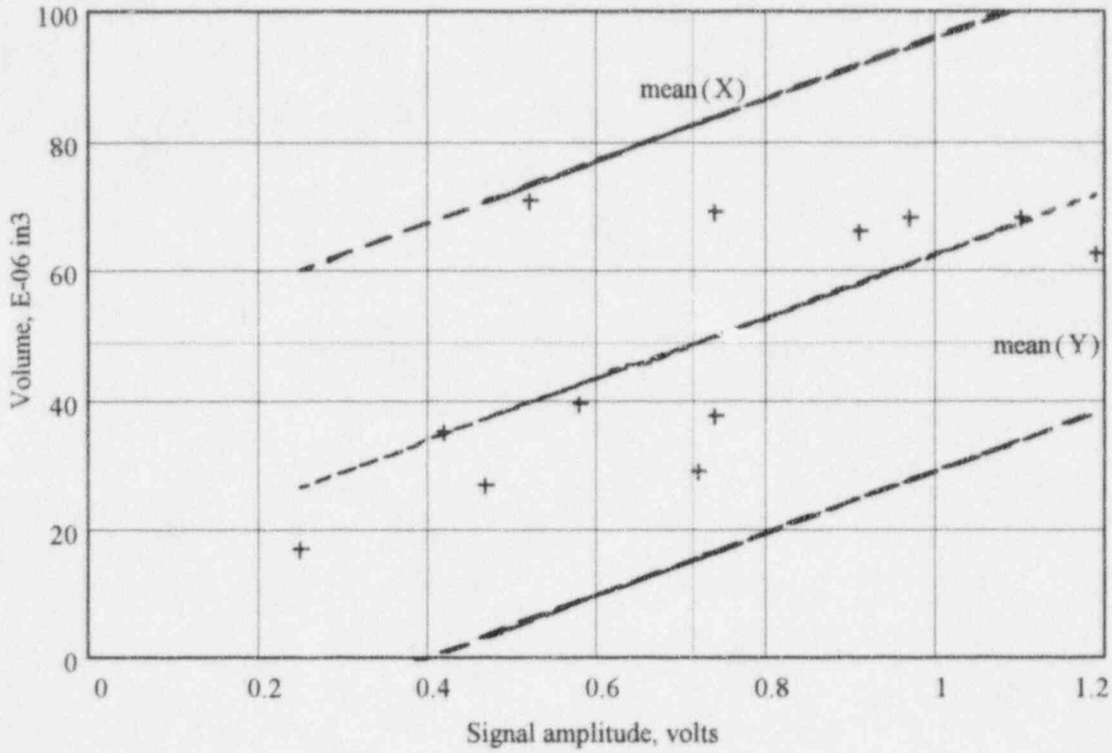


Figure 12. Voltage-volume correlation using Crystal River 3 pulled tube data.

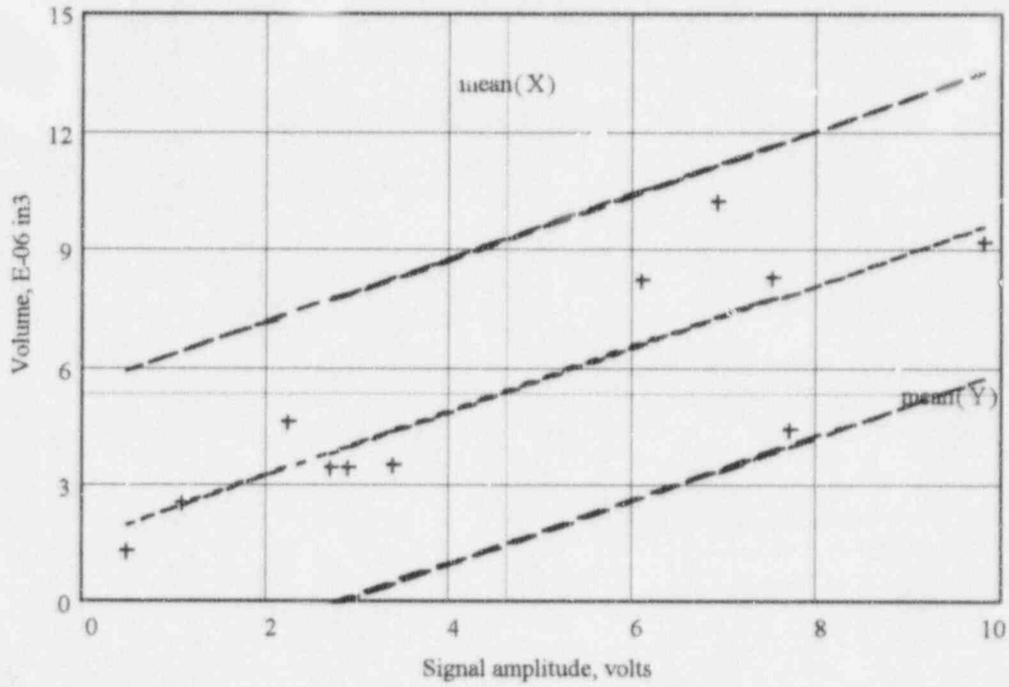


Figure 13. Voltage-volume correlation using BWOG NDE Committee samples.

19. Clarify what material properties were used to determine the proposed dimensional limits. Reference 7 indicates that the "probable" values are the 95% probability/95% confidence values as does page 4-1 of Reference 1. However, the calculations provided in the appendices to Reference 7 indicate both "actual" and "average" values were considered.

The determination of the proposed dimensional limits utilized the "probable" tubing material properties (i.e., established at a 95% probability of occurrence at a 95% confidence level) as an input to the calculation.

20. In Reference 5 (Section 8.2), a correction was made to account for the lower voltage response when using the mix frequency channel for sizing tube support plate indications. Is a similar correction needed with the current approach? Discuss how the proposed depth/volume/bobbin voltage approach accounts for the lower voltages from indications located at the tube support plate intersections. Also, discuss the basis for combining the data from tube support plate and freespan indications given that the voltages may not be comparable.

Freespan indications associated with pit-like IGA are typically reported using Channel 1 (600 Khz) whereas volumetric wear indications at tube support plates are reported using a Mix 1 analysis channel. The voltage scales for the two analysis channels e.g., 600 Khz and Mix 1, are established differently using current Crystal River 3 analysis guidelines. In order to establish a volume-voltage correlation curve for both pit-like IGA and wear, eddy current indications were reanalyzed with the Mix 1 voltage scale set in the same manner as Channel 1. Measured signal amplitudes could then be plotted on the same curve relating volume to voltage.

The original voltages from wear scar indications are smaller because the voltage scale for the Mix 1 analysis channel had been set differently from that of Channel 1 (600 Khz). If the voltage scales for the two analysis channels are initially set in the same manner then voltage readings from both channels are comparable.

Inservice Inspection

21. The proposed dimensional requirements do not specify limits for indications exhibiting geometries with the maximum linear dimension inclined at an intermediate angle with respect to the steam generator tube axis (i.e., neither axial nor circumferential). Staff calculations indicate that consideration of only defect axial or circumferential lengths may be nonconservative for certain defect geometries. Discuss how the proposed dimensional limits will be applied to an S/N indication with its major axis not aligned to either the tube axial or circumferential directions.

FPC calculational results do not agree with the Staff's. The orientation terminology of the proposed dimensional repair criteria as 'axial' and 'circumferential' relates to the limiting Regulatory Guide 1.121 structural analysis and not the actual implementation of the criteria. The analysis which calculated the proposed limits (Reference 7) assumed a planar defect, with no credit taken for ligaments between micro cracks. A crack-like defect oriented strictly in the axial or circumferential plane is bounded by this analysis. Other possible defect configurations which could occur in the secondary side of the CR-3 OTSG tubing are also covered by the structural analysis.

The configuration of the defect can be either symmetrical or non-symmetrical about the tube axis because the primary stress of concern (axial stress due to differential expansion effects during a LOCA) are not affected by the asymmetry of the defects. As indicated in the calculation, all pertinent loads are reacted by either the tube or its support without the need for any bending moment capability of the tube at the defect (i.e., a plastic hinge can be assumed at the defect).

The projected axial and circumferential dimensions of an indication at an intermediate angle to the tube axis provide a good description of length needed to evaluate the structural integrity of a degraded tube. Test data on tubes with volumetric defects and plastic collapse considerations support the above statement.

22. Reference 1 provided limited details of the testing performed to support the nondestructive examination uncertainty allowance of 13.05% (pg 3-17). Discuss how many analysts were used, clarify if 10 different probes were used, discuss the need for considering additional data since the study was based on an examination of only six indications. Discuss the similarities and differences in the morphology between the indications in the NDE study and those in the population of S/N indications examined from pulled tubes at CR-3?

The purpose of the test was to investigate data acquisition repeatability. Three different probes were used including a conventional 510 bobbin probe and two variations of a 540 bobbin probe, e.g., mid-range and high-frequency designs. Ten independent data sets were acquired from six discontinuities using the 510 high-frequency probe while an additional eight data sets were acquired using the two 540 probes. Acquisition voltage repeatability studies were conducted using only the 510 bobbin probe data set. A single analyst was used to analyze the data. The six discontinuities used in the study were subsequently shown by tube pull to be predominantly volumetric wear. Since the morphology of the wear used in the study is three-dimensional or volumetric, comparable results would be expected from free-span pit-like IGA. For volumetric discontinuities, signal amplitude is proportional to the removed metal volume and is not dependent on the particular damage mechanism, e.g., pit-like IGA or volumetric wear. Additional testing using free-span pit-like IGA signals with voltage ranges comparable to those covered in the data acquisition repeatability study would be expected to give comparable results. The important consideration is the range of average voltages that were included in the study which ranged from approximately 0.4 to 1.4 volts covering the expected dynamic range of the voltage-volume correlation curve.

The impact of multiple data analysts is estimated as follows. Detailed EPRI studies in support of TSP ODSCC ARC show that signal amplitudes or voltages can be read to within an +/- 10%. This analysis error is independent of data acquisition error so the two error sources can be combined using RMS methods. The total error budget would increase from 13.05% to approximately 16%.

23. The error allowance for acquisition variability is assumed to be equal to that determined in EPRI report TR-100407, Revision 1, "PWR Steam Generator Tube Repair Limits - Technical Support Document For Outside Diameter Stress Corrosion Cracking at Tube Support Plates," dated August 1993. However, the NDE error quantified in the EPRI report uses different probe sizes, inspection frequencies, and procedures from those used at CR-3. Provide a basis for assuming a 7% error for acquisition variability considering these factors. In addition, acquisition variability is closely related to the amount of probe wear during inspections. Discuss the need to limit the amount of probe wear in future CR-3 inspections to ensure that the probe wear allowance used in the determination of the repair limits is conservative.

Eddy current data acquisition procedures in use at Crystal River 3 are comparable to those listed in EPRI Report TR-100407, Revision 1 "PWR Steam Generator Tube Repair Limits - Technical Support Document For Outside Diameter Stress Corrosion Cracking at Tube Support Plates, " dated August 1993. While the absolute probe sizes and inspection frequencies are different one must take into account differences in tube wall thickness and tube diameter. The normalized essential test variables are phase angle spread (Primary analysis channel) and probe fill factor. Phase angle spread is typically established by measuring the difference in phase angles between the 100% and 20% flat bottom holes in the ASME calibration standard. Probe fill factor in percent is defined as the ratio of the square of the probe outer diameter divided by the tube inner diameter times 100. Values for these variables are listed below in Table 1. Probe fill factors are virtually identical whereas phase angle differences in the primary analysis channels are within approximately 20%. This difference is viewed as insignificant. The use of a higher primary acquisition frequency to achieve a larger phase angle spread in OTSG tubing comparable to RSG phase angle spread is discouraged because of the effects of system noise which are exaggerated at higher test frequencies.

Table 1. Normalized Essential Variables Comparison

RSG Tubing - 0.050" wall/0.875 outer diameter

- 400 KHz - Phase angle spread between 100% through-wall hole and 20% through-wall hole is approximately 113 degrees
- 0.720" diameter probe - Probe fill factor in percent is given by $100 \times (0.720/0.775)^2$ or 86%

OTSG Tubing - 0.034" wall/0.625" outer diameter

- 600 KHz - Phase angle spread between 100% through-wall hole and 20% through-wall hole is approximately 90 degrees
- 0.510" diameter probe - Probe fill factor in percent is given by $100 \times (0.510/0.557)^2$ or 85%

Probe wear effects require further study in OTSGs. Most of the work to date has been in RSGs in which U-bends may exaggerate probe wear dynamics. An allowance of 7% for probe wear has been included in the NDE measurement error budget based on ODSCC at TSP alternate repair criteria studies (Reference 10).

24. Provide a comparison of the sizing error being proposed (Section 3.2 of Reference 1) and that provided in EPRI report NP-6864-L Revision 2, "PWR Steam Generator Tube Repair Limits: Technical Support Document For Expansion Zone PWSCC in Roll Transitions - Rev. 2" dated August 1993. Provide the field procedure for length sizing S/Ns. Describe any differences between the field procedures and the procedures used to support your length sizing uncertainty estimate. Discuss how these procedures compare to those in the EPRI report NP-6864-L.

A comparison of the sizing error proposed in Section 3.2 of Reference 1 and that provided in EPRI report NP-6864-L Revision 2 shows good correlation as follows:

CR-3 data - correlation coefficient = 0.99
standard deviation = 0.45

EPRI data - correlation coefficient = 0.93
standard deviation = 0.83

The field procedure for measuring the length and width of S/N's is currently outlined in the Crystal River Unit #3 Eddy Current Data Analysis Guidelines as follows:

"5.0 <u>INDICATION LENGTH AND WIDTH MEASUREMENTS</u>

5.1 <u>RPC Clip Plot Measurements</u>

RPC clip plot measurements will be performed on all bobbin coil S/N indications examined.

5.1.1 The primary frequency of the 300 kHz pancake coil will be used to size the axial and circumferential extents of the indications.

5.1.2 The setup and calibration requirements for reporting indications are the same as those in Section 2.0 of the data analysis guidelines.

5.2 <u>Clip Plot Setup and Calibration Requirements</u>

5.2.1 After performing the basic setup select the "MRPC/CRKMAP" menu. Go to user select and set the tubing diameter to .551".

5.2.2 Set the axial scale in reference to the EDM calibration standard. Refer to the EDM calibration standard drawing for the standards total length.

5.2.3 Select "MEASFLAW". Plot the 60% O.D. EDM notch at 270. Position the threshold cursor just above tube noise.

5.2.4 Select "CLIP PLOT" function and plot the data at 0 degrees. "BOX ANGLE" must be kept at 0 degrees.

5.2.5 Perform length and width measurements by drawing the box equivalent to the same size of the 60% OD EDM notch signal. After the measurement is performed, move the box just below the signal.

5.2.6 Verify that the total length and width measurement is equivalent or greater than the as-built length and width of the 60% OD EDM notch. If the measurement is not (within +/- 0.10") reset the axial scale.

5.2.7 When plotting data, set the strip chart cursor window to display + .86" to - .86" (+/- .20")."

The field procedure used for length sizing S/N's and the procedure used to support the length sizing uncertainty error are the same.

The procedure used for length sizing S/N's at CR-3 differs from that procedure used in the EPRI report NP-6864-L. The CR-3 procedure makes use of a routine in the Zetec Eddynet software called MEASFLAW or measure flaw while the EPRI report makes use of a routine in the Zetec Eddynet software called CRKMAP or crack map.

The MEASFLAW routine is more applicable to volumetric indications since it allows measurement of a flaws axial and circumferential extents or length and width. The CRKMAP feature is used more for crack-like indications at the top-of-tubesheet since it calculates a flaws length for its major dimension and provides information about the flaws position with respect to the top-of-tubesheet. Both methods apply similar operator input and calibration such as axial and circumferential scale adjustment, threshold adjustment, selection of coil and frequency used for measurement, and both make use of rotating coil data acquired following the same procedure. It is expected that the resolution of the two measurement methods are comparable.

25. In order to demonstrate RPC sizing capability for S/N indications, CR-3 pulled tube data were combined with data from IGA samples obtained from the B&W Owners Group NDE Committee. Discuss the applicability of combining eddy current data obtained from these two sources. Consider the differences in voltage response for the laboratory grown flaws and the sulfur-induced IGA indications found at CR-3.

Dimensional sizing error is not dependent on signal voltage and voltage scales established during eddy current testing are arbitrary. A key factor contributing to sizing error is the length of the discontinuity in relationship to the average coil diameter. For situations where this ratio is small, the absolute error can be large but is always conservative. For small discontinuities, e.g., those with dimensions comparable to or smaller than the average coil diameter, one is essentially measuring the coil field spread or profile which is larger than the discontinuity. This is why the measurement error is always conservative.

Combining dimensional sizing data from CR-3 pulled tube pit-like IGA and lab samples was done to establish the error at two length extremes. The lab samples have dimensions large relative to the average coil diameter whereas the pit samples have dimensions much smaller that the average coil diameter. The fact that different voltage ranges are included is immaterial.

26. In Reference 3 it is stated that the probability of detection (POD) for the RPC was somewhat less than for the bobbin coil (page 1-2). This is supported by Section 3.2 of Reference 6; however, the study documented in Appendix B of Reference 6 (i.e., page B-4 of Appendix B to Reference 6) states that the IGA patches were better detected with the RPC. Please clarify these observations.

The exact basis behind each of these conflicting statements was not retrievable. Reviewing the technical data presented with the discussion of each study indicates both statements/ conclusions to be supportable with the data provided. Section 3.2 referred to Figures 3-4 and 3-5 within the same text. From this data, one could conclude bobbin showed slightly better detectability. The data immediately preceding the relative POD comparison of the two techniques in Appendix B indicates a larger percentage of the total number of defects were detected with MRPC. Again, dependent upon the criteria used within the individual study, it is possible to reach the same conclusion as the text. Based upon the recent re-review of the data, the POD for the two techniques is considered comparable in the defect range of interest.

27. What is the general shape of the free-span IGA? For example, is the shape cone-like or similar to a flat-bottomed hole?

The free-span IGA is three dimensional, generally appearing to be the shape of a half-ellipsoid or as a "thumbnail-shaped" patch. The deepest part of the defect generally occurs at the mid-plane of the defect.

<u>Other Issues</u>

28. It is not apparent from the data presented, what data were used in the various correlations. The staff is having difficulty comparing the results from one section of a report to another and from one report to another. In addition, it appears that some correlations have more data than others although they should apparently be coming from the same database. For example, the number of data points used in Table 3-2 of Reference 6 does not match the number of data points used in Appendix D to Attachment 2 of Reference 4. Another example is the number of specimens cited in Table 3-1 of Reference 1 compared to the number of data points in Appendix B to Reference 6. In order to clarify the data presented in the various correlations, provide the following information.

a. Provide the pulled tube data points (1992 and 1994) used throughout your submittals. Identify the tube number, defect location, defect identification, defect classification (circular wear, IGA, etc.) field bobbin and RPC call, field and laboratory bobbin voltage, field and laboratory RPC voltage, field and laboratory percent through-wall call, laboratory reanalyzed voltages (if applicable), length, width, depth, volume, and other relevant parameters. Since several different probes were used during the inspections, provide the information for the probe

and inspection parameters (frequencies/calibration) to be used during the upcoming inspection, if available, or the "probe of record."

b. Identify which specimens were included in each correlation. For specimens with multiple discontinuities that were too close to be distinguished in the field non-destructive examination (i.e., within the proposed 0.2" band), provide details on what dimensions were used in the various correlations and/or analyses, annotate specimens that were combined, provide the data used for the combined data point, and indicate in which correlation this combined data point was used (e.g., the depth used in the probability of detection study). For example, if an "indication" was missed, was the largest, smallest, or a combination of the defect dimensions used in the POD curve, voltage versus volume correlation, etc. For specimens excluded from any correlation, discuss the reason for excluding them. Discuss if any significant indications were not included in a correlation since they were not destructively examined. For example, in the POD correlation, were any large laboratory detected indications which were not detected in the field not included in the analysis since they were not destructively examined.

c. The above information should specifically identify the data used in the development of Figures 3-4, 3-5, 3-6, and 3-7 of Reference 1.

The information requested by this RAI question is included as Appendix A to this text.

Two general comments are provided with respect to this request. The last sentence in item 'a' appears to be out of context with respect to the balance of the request. It addresses plans for the upcoming outage NDE inspection while the majority of the request deals with providing pulled tube data. For completeness, a response is provided. As discussed in earlier RAI responses, there are no plans to change the probe of record for the upcoming outage from the ones (bobbin coil or MRPC) utilized during the last two CR-3 outages.

The second comment deals with the scope of the request associated with item 'b' above. As written, the request could be interpreted to include the data for every correlation which has ever been provided to the NRC relative to the CR-3 OTSG S/N issue. FPC has chosen to address this request in a much narrower fashion. Much of the older (1992) work has been superseded by more recent efforts as additional tube pull and inspection data has become available. NRC Staff review should focus on the most current, up-to-date information available. To this end, Appendix A provides the following information as part of the response to RAI number 28, sub-item 'b':

1) The data supporting all correlations included as part of Technical Specification Change Request Number 203 (Reference 1).

2) The data supporting the probability of detection (POD) correlations included as part of the final CR-3 9R tube pull examination report (Reference 3).

3) A discussion of the reason for the two differences cited within RAI number 28.

Additional information on other specific correlations can be made available upon request. Unless noted with the 'A-' prefix, page numbers are same as original document.

29. On page 2-5 of Reference 3, it indicates that a small amplitude low S/N indication was observed in the field for the 75% through-wall defect in the lower tubesheet region of tube 68-46; however, in other portions of Reference 3 (e.g., Table 2-3, page 1-4) it appears that the indication was not identified in the field (i.e., called an NDD). Please clarify whether this indication was detected in the field or not. If hindsight was used to identify this indication, discuss any improvements made to the eddy current data analysis guidelines to prevent missing such indications in the future. What is the threshold for reporting S/N indications during eddy current inspections?

The indication in the lower tubesheet region of tube 68-46 was not reported during the field examination. Hindsight was used to identify this indication following destructive examination. This flaw does not produce an indication with the bobbin coil technique which is reportable as a flaw hence no changes were made to the analysis guidelines to prevent missing such an indication in the future.

There is no minimum voltage threshold for reporting S/N indications during eddy current inspections at CR-3.

30. 600 kHz is stated to be the best frequency for sizing S/N indications but correlations of through-wall depth to voltage (Vmax) were developed at 400 kHz (Section 7.1 of Reference 5) justifying a 2.7 volt limit corresponding to a 100% through-wall flaw. Staff calculations using the data in Table B2 of Appendix D to Reference 5 indicate that a reduction in the voltage limit corresponding to a 100% through-wall flaw from approximately 2.7 volts to 2.2 volts is obtained when using the 600 kHz channel (presumably the channel used to size indications in the field). The staff notes that the licensee is not currently proposing this correlation. Discuss the calibration procedure used in the development of Table B2. Discuss whether the voltages measured and recorded in the field are peak-to-peak voltages or Vmax. If peak-to-peak voltages are recorded in the field, provide a correlation based on peak-to-peak voltages developed with the frequency used to size these indications. These correlations should use all of the data (not just the 10 data points to support the 2.7 volt limit).

Voltages measured in the field are peak-to-peak voltages. Table B2 of Appendix D to Reference 5 utilized V_{max} readings. The data presented in the Table was not used in the correlation because of the difference in the way the voltage scales are set.

31. Discuss how the burst pressure of specimen 68-46-3A was adjusted to account for the brass shim. If discussed in the Electric Power Research Institute (EPRI) Burst Testing Guidelines (Reference 2 of Reference 3), submitting a copy per Question 35 below is acceptable.

The method of adjusting the burst pressure of 68-46-3A for the presence of the brass shim is discussed in the EPRI Guidelines for Burst Testing Steam Generator Tubes. The guidelines document is provided, as requested, in response to question number 35 of this RAI.

32. Quantify the level of error associated with the estimation of defect volume from a metallographic analysis.

The metallographic examination of a tube provides the best estimate of the volume of a degradation, and is usually considered to be the real or actual volume. This estimate is normally obtained by measuring the maximum axial and circumferential extents of the degradation from an enlarged planar view, and measuring the depth from an enlarged sectional view through the maximum width of the degradation. For volumetric degradations, the volume is assumed to be half of an ellipsoid, which is a constant times the product of the three semi-axes defined by the three measured dimensions.

The ellipsoid assumption presumes that the planar view of the degradation is described by an ellipse, and the section view is described by half of another ellipse, neglecting the curvature of the tube. If the outline of the cavity is irregular the use of maximum extents will yield a somewhat non-conservative volume. Volumetric degradations generally have the shape of a shallow dish, with deepest penetration at the center, which makes the assumption of an ellipsoid shape most appropriate.

It is estimated that the measured depth and axial and circumferential extents of the cavity may each vary from the true dimensions within a range of plus or minus 0.002 inches. For degradation on the order of 210 $\times 10^{-6}$ in^3, which correlates to a 3.6 volt NDE limit for leakage discussed in Section 5.2.2 of Reference 1, a 0.002 inch error amounts to an approximate $\pm$ 4% error in calculated volume.

33. On page 2-3 of Reference 3, item 3 indicates that tapered wear marks were identified at two adjacent tube support plate lands. However, Table 2-3 does not identify the indications referred to in the text. Was one of the specimens not destructively examined? Please clarify.

Item 3 (Second bullet) on page 2-3 of Reference 3 discusses tapered wear defects located at the top and bottom of adjacent Tube Support Plate (TSP) lands. The text refers the reader to Figure 2-2, which is a photograph of the defects in question. The indications were at the 9th TSP of pulled tube 68-46 (Section 68-46-18). Referring to Table 2-3 under pulled tube

68-46, both of these defects are indeed identified in the table. Thus, the exact nature of the RAI question is not clear.

34. Clarify the reason for the difference in the number of metallurgical indications reported in Appendix B to Reference 6 and the number reported in Table 3-1 of Reference 6. Furthermore, clarify the reason for the discrepancy between the previously cited data and the data (number of indications) reported in Tables B1/B2 of Appendix D to Attachment 2 to Reference 4. If the reasons for these discrepancies are a result of different analysts/analysis criteria, have the eddy current data analysis guidelines been improved to incorporate the best aspects of each analysis criteria?

The data in Table 3-1 is the listing of eddy current distinguishable defects present in the 1992 CR-3 pulled tubes. This information is a grouping of all defects from the destructive examination, by proximity of location, into defects which would be expected to be uniquely differentiable by NDE/ ECT. This grouping was done in order to correlate the destructive examination and NDE results. As indicated in Table 3-1, not all of the distinguishable defects were detected by means of field bobbin coil during the 1992 Outage. This was to be expected, given the probability of detection for this size (particularly volume) of indication.

Appendix B summarizes a review of CR-3 eddy current data from three consecutive outages performed by the EPRI NDE Center. Only those indications which were detected during each of the three Outages were available to be used in the study. Further, it was noted in Appendix B that only three of the six tubes pulled in 1992 were ECT inspected during these three Outages. One of the three tubes, 109-30, was not destructively examined and is thus, not reported in Table 3-1.

The other reference (Appendix D) is to work the EPRI NDE Center performed to correlate eddy current voltage to volume wall loss for certain defects from the destructive examination. The work is based upon laboratory (B1) and field (B2) eddy current data analysis performed with the hindsight of the destructive examination results. This differs from the other work which was more of an objective examination of eddy current capabilities, particularly detection. The analyst performing the work in Appendix D apparently was comfortable assigning voltage values to the flaws as noted in Tables B1 and B2.

35. The numerous documents submitted in support of the proposed Technical Specification (TS) amendment refer to several supporting references. The NRC staff requests that the licensee forward the following references in support of this license amendment application.

A. Reference 2 of Reference 3: Robert F. Keating memo to D. Steininger (EPRI) dated October 25, 1993, "EPRI Guidelines for Leak & Burst Testing of SG Tubes," NSD-EPRI-0545.

B. Reference 15 of Reference 3: S.D. Brown, "Crystal River 3 8R/9R Bobbin Voltage (S/N) Growth Rate Calculations," Packer Engineering Report B51956-R1, Dated May 1995.

C. Reference 14 of Reference 1, Packer Engineering Report B51956-R1-Rev. 0, "Crystal River 3 8R/9R Bobbin Voltage (S/N) Growth Rate Calculations," dated March 1995.

D. Reference 7 of Reference 3: "OTSG Pulled Tube Catalog," B&W Report 1190991, December 1988; and/or Reference 7 of Reference 1, "OTSG Pulled Tube Catalog," Revision 1 BWNT Report 1190991, August 1994

E. Reference 5 of Reference 1: "OTSG Trending Report" 7th Edition, BWNT Report 51-1229259-00, July 1994

F. Reference 10 of Reference 5: BWNT Document 51-1229575-00.

G. Reference 2 of Reference 7: "Determination of Minimum Required Tube Wall Thickness for 177-FA Once Through Steam Generators," Babcock & Wilcox, No. 10146. April 1980.

H. Reference 3 of Reference 7: "Review and Update of OTSG Tube Loads, Task 1 Summary," Babcock & Wilcox No 51-1202303-00, February 28, 1991.

References A, B, and F are attached as Appendix B. Reference C is a draft-for-comment version of Reference B and has not been provided since minimal changes occurred between the two documents. Reference F has yet to be finalized and has thus, been provided in draft form. The remaining references (D, E, G, and H) have minimal direct impact to the proposed TSCRN and have not been provided for this reason. The approach taken in this response has been discussed with the NRC Staff.

36. Section 2.3.1.2 of Reference 3 indicates that the tapered wear scars ranged up to 0.64 inches in length. Table 2-3 indicates that one tapered wear scar was 0.812-inch. Clarify this discrepancy. What was the depth of this indication?

The tapered wear scar present on tube 72-49 at a location corresponding to the lower edge of the 9th Tube Support Plate (TSP) was confirmed to be 0.812 inches in length. Thus, Section 2.3.1.2 of reference 3 is incorrect. This wear scar was considered the lesser of the two tapered wear scars identified during visual and stereovisual examinations of the tube section. Because of this, no further destructive examination was performed (i.e., depth was not determined). Presumably, the depth of the indication was less than that of the wear scar present at the top of TSP location (10%) which was destructively examined.

37. The number of indications identified with the bobbin coil (3) and the RPC (2) in the 0.075-inch to 0.099-inch bin of Figure 2-8 in Reference 3 appears inconsistent. It seems that the number of indications should be the same for both (i.e., either there were 2 or 3 indications from the destructive examination). Please clarify the number of indications identified by destructive examination in the 0.075-inch to 0.099-inch bin in Figure 2-8.

Three discontinuities were identified in the 0.075-inch to 0.099-inch bin found during the destructive examination of the 9R pulled tubes. Each of these defects was identified during the field bobbin coil examination. However, the indication present in tube section 109-71-7 did not receive a field MRPC examination prior to pulling the tube. It is summized that this inspection was not performed due to the very small bobbin coil voltage (0.17 volts) associated with the indication. This explains the difference in the number of indications presented for the two inspection techniques.

38. Confirm the circumferential extent for tube section 109-71-7 listed in Table 3-2 of Reference 1.

The correct circumferential extent for the discontinuity found in tube section 109-71-7 was 0.097 inches.

39. In equation 5-1 of Reference 1, an allowance for NDE uncertainty is made. Was the adjustment made to the beginning of cycle voltage (i.e., the repair limit voltage) or the structural limit (LL) voltage?

This question suggests some confusion with other industry Degradation Specific Management (DSM) efforts. The CR-3 approach does not utilize two separate bobbin voltage limits as do other DSM approaches. Based upon little or no degradation growth rate, the FPC approach utilizes only one limit (2.5 volts). This is the Beginning of Cycle (BOC) and the End of Cycle (EOC) limit. Additionally, this limit is not a structural limit. Ensuring adequate structural integrity is accomplished by proper application of the proposed length and width criteria. The proposed voltage criteria is only explicitly credited for purposes of addressing primary-to-secondary leakage under worst-case differential pressure conditions.

40. The labeling of the vertical axis of Figure 1-4 in Reference 3 states that the data is given "per 100 tubes inspected." Provide graphs showing the voltage distribution of all S/Ns currently in service in steam generator "A" and steam generator "B" (i.e., exclude the tubes repaired in 1994). How many active tubes in each steam generator have S/N indications?

The graphs requested are presented as Figures 14 and 15. Based upon Refuel 9 inspection results, there were 290 active tubes in 'A' and 817 tubes in the 'B' OTSG which contained S/N indications. A review of the CR-3 historical eddy current database indicates 351 active tubes in 'A' and 892 active tubes in 'B' have been assigned an S/N code in at least one outage since 1983. The difference in the two numbers is believed to be principally attributable to certain small amplitude signals "fading" in and out from one outage to another (discussed in the response to RAI #9), as well as a number of S/N indications which have changed designation for one reason or another over the years.

41. The results provided in Table 4-12 of Reference 1 do not correspond to the results given in your letter dated May 25, 1994 (pages 20 and 57 of the Attachment). Specifically, the sample size and number of failures for the second expansion do not match. Please clarify.

The information presented in Reference 1 is correct. There were no subject failures present in the second expansion sample for RCSG-1A. Further, the number of indications inspected as part of the second sample for RCSG-1B was 58 instead of the value of 56 presented on page 57 of the Attachment to the May 25th letter.

Figure 14. Number of S/N Indications in Active Tubes of CR-3 RCSG-1A Following Refuel 9 as a Function of Bobbin Coil Voltage

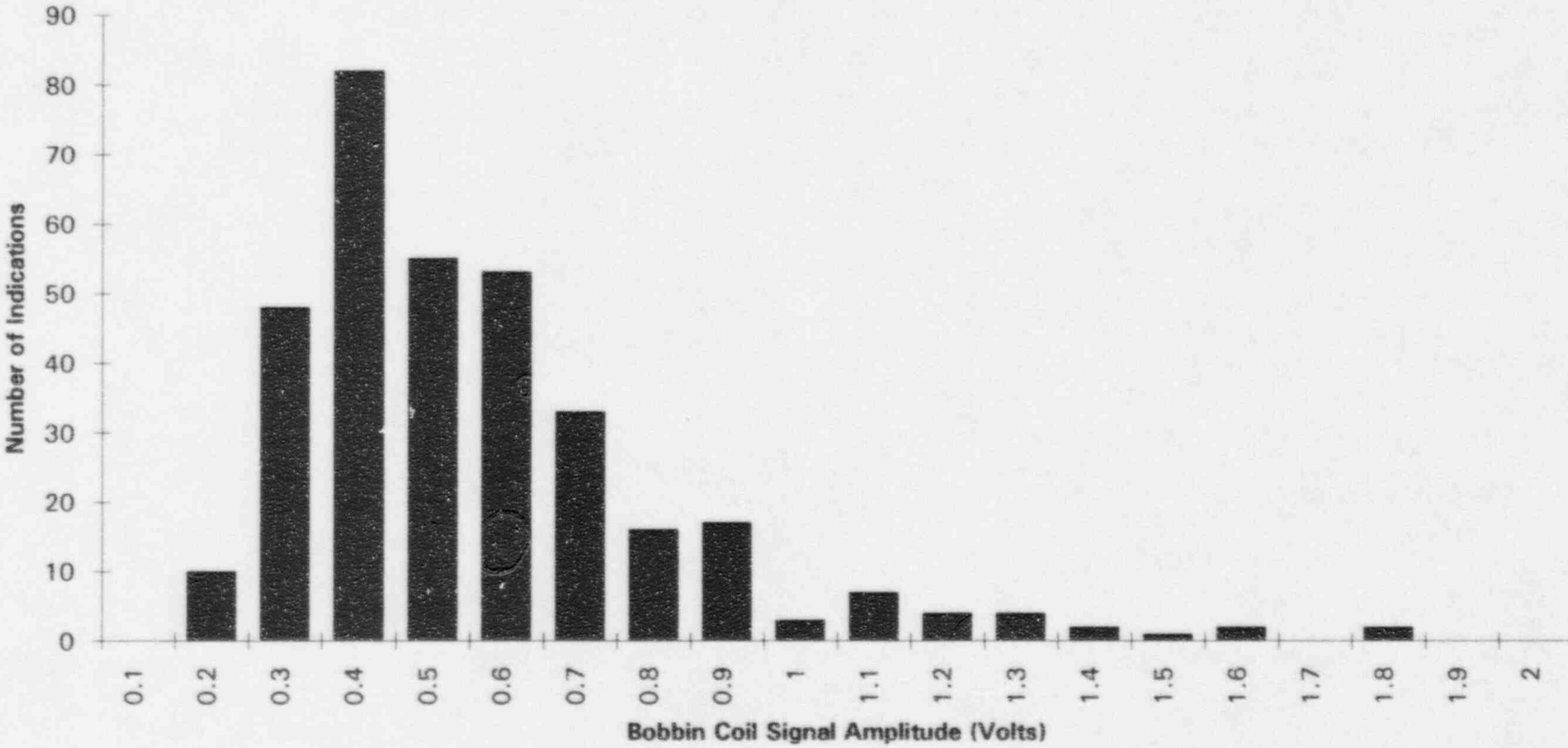
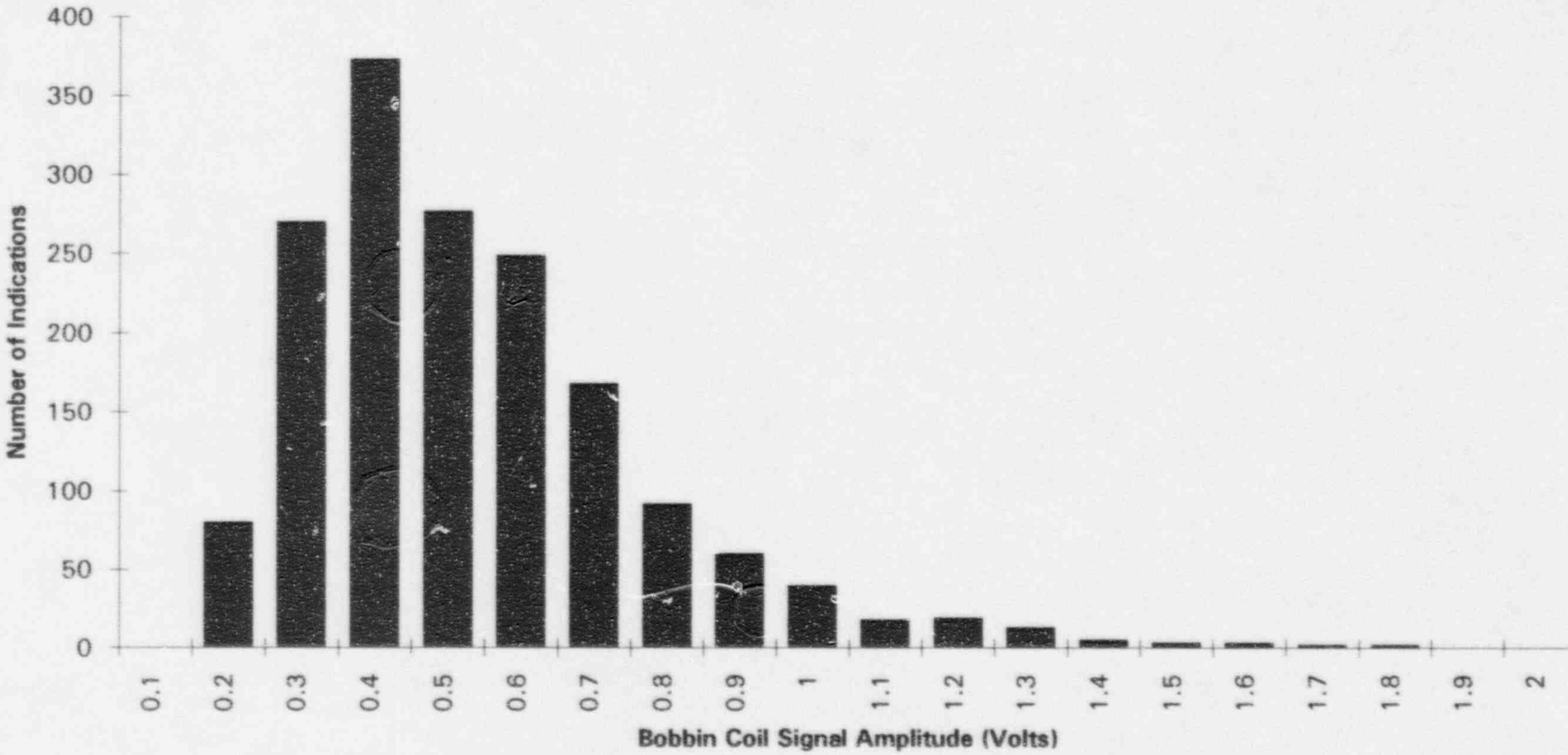


Figure 15. Number of S/N Indications in Active Tubes of CR-3 RCSG-1B Following Refuel 9 as a Function of Bobbin Coil Voltage



References

1. "Alternate Disposition Strategy for Low Volume OTSG Eddy Current Indications," forwarded as Attachment 1 to a Florida Power Corporation (FPC) letter dated May 31, 1995 (3F0595-05).

2. "OTSG Tube Inservice Inspection Refuel Outage 9 12 Month Report," forwarded as an attachment to a FPC letter dated May 31, 1995 (3F0595-07).

3. "Examination of Crystal River-3 Pulled Steam Generator Tubes - Final Report," forwarded as an attachment to a FPC letter dated May 31, 1995 (3F0595-07).

4. "Refuel 9 Inspection Plan for Once Through Steam Generators," submitted by a FPC letter dated April 19, 1994 (3F0494-09).

5. "Crystal River Unit 3 Steam Generator Regulatory Guide 1.121 Evaluation Revision 2," forwarded as Attachment 2 to Reference 4.

6. "Draft EPRI Tube Pull Report," TR-103756, forwarded as Appendix A to Attachment 2 to Reference 4.

7. "MPR Structural Analysis," forwarded as Appendix B to Attachment 2 to Reference 4.

8. "Crystal River Nuclear Generating Plant Unit 3 - Confirmatory Action Letter (CAL) - Regarding Once-Through-Steam-Generator (OTSG) Tube Inspection During Refuel 9," letter NRC to FPC, dated April 26, 1994.

9. Introductory Statistics. Thomas H. Wonnacott and Ronald J. Wonnacott. Fifth Edition, John Wiley and Sons, 1990.

10. "PWR Steam Generator Tube Repair Limits - Technical Support Document for Outside Diameter Stress Corrosion Cracking at Tube Support Plates - Revision 1," EPRI Report TR-100407, August 1993.

Appendix A

Response to RAI Number 28

"Correlation Data"

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I. 1992 and 1994 Pulled Tube Data Points

The following pages of information are intended to satisfy RAI Question Number 28, sub-item 'a'.

In the case of the 1992 pulled tube results, this data has previously been provided to the Staff as part of References 4, 5, and 6. The pertinent pages from the 1992 EPRI report are reproduced herein for completeness sake.

The majority of the 1994 pulled tube data has been previously provided as part of Reference 3. Once again, all requested information is included herein.

1992 Pulled Tube Exam Data

Results on 1st Freespan Regions (52-51-2, 90-28-2, 97-91-2 & 106-32-2)

The majority of defects identified by stereovisual inspection (as well as the type of damage) were confirmed by metallography (see Figure 2-40). Again, tube degradation was primarily in the form of small patches of "thumbnail-shaped" IGA. A total of 108 defects were confirmed, with maximum and minimum depths of 62% and 1% throughwall, respectively, with an overall average depth of 28% and a standard deviation of 16%. Metallography data is summarized in Table 2-9.

Table 2-9
FIRST SPAN METALLOGRAPHY SUMMARY

52-51-2			90-28-2			97-91-2			106-32-2					
ID	Type	Depth	ID	Type	Depth	ID	Type	Depth	ID	Type	Depth	ID	Type	Depth
Z	Pit	NDD	AF	IGA	51%	AA	Pit	NDD	BG	IGA	11%	AG1	IGA	N/A
X	IGA	32%	AD	IGA	24%	Y	Pit	NDD	BF	IGA	17%	AE	IGA	24%
V	IGA	N/A	AD	IGA	49%	W	IGA	54%	BD	IGA	31%	AD	IGA	25%
U	IGA	26%	AB	IGA	30%	U	IGA	48%	BC	IGA	30%	AC2	IGA	22%
S	IGA	33%	Z	IGA	30%	T	IGA	44%	BB	IGA	17%	AC1	IGA	18%
R	IGA	18%	X2	IGA	24%	S	Pit	1%	BA	IGA	20%	AB	IGA	18%
P	IGA	33%	X1	IGA	62%	R1	IGA	4%	AZ	IGA	22%	AA	IGA	17%
N2	IGA	19%	V2	IGA	46%	P	IGA	46%	AY	IGA	36%	Z	IGA	51%
N1	IGA	40%	V1	IGA	49%	**O**	**IGA**	**54%**	AX	IGA	32%	Y	IGA	8%
L	IGA	13%	T2	IGA	53%	M	IGA	16%	AV	IGA	29%	X2	IGA	49%
K2	IGA	19%	T1	IGA	46%	K	IGA	29%	AU	IGA	39%	X1	IGA	27%
K1	IGA	45%	S2	IGA	28%	I	IGA	4%	AT	IGA	31%	V2	IGA	14%
I2	IGA	52%	S1	IGA	23%	G	IGA	5%	AR	IGA	19%	V1	Pit	NDD
I1	IGA	28%	Q	IGA	45%	E2	IGA	5%	AQ2	IGA	46%	T	Pit	NDD
G	IGA	34%	O	IGA	45%	E1	IGA	5%	AQ1	IGA	24%	R	IGA	NDD
F*	IGA	53%	N*	IGA	60%	D	IGA	8%	AP	IGA	42%	---	---	---
D	IGA	34%	M	IGA	27%	B	Pit	6%	AO	IGA	12%	Q	Pit	7%
--	---	---	K	IGA	18%	--	---	---	AN	IGA	36%	O	IGA	3%
B		38%	I	IGA	46%				AM3	IGA	25%	N	IGA	15%
			H	IGA	37%				AM2	IGA	22%	M1	IGA	3%
			G	**IGA**	**53%**				AM1	IGA	12%	L	Pit	14%
			E	IGA	50%				AM1	IGA	16%	K	IGA	17%
			C	IGA	56%				AL2	IGA	16%	J	Pit	5%
			B	IGA	12%				AL1	IGA	10%	I	IGA	31%
			--	---	---				AK	IGA	40%	H	IGA	3%
									AJ	IGA	38%	G1	Pit	4%
									AH	IGA	29%	F	IGA	9%
									AG2	**IGA**	**40%**	E	IGA	23%
												C	Pit	7%

Statistics:

Maximum	F	IGA	53%	X1	IGA	62%	O,W	IGA	53%	Z	IGA	51%
Minimum	L	IGA	13%	B	IGA	12%	S	Pit	1%	O, M1, H	IGA	3%
Average			32%			40%			22%			22%
S. Dev. (σ)			12%			14%			21%			13%

NDD = No Detectable Degradation; N/A = Data not available; Boldface/Shaded = Burst location; --- = LTSF

* Specimens utilized for SEM/EDS & SAM/XPS; depth estimated from SEM of fracture surface.

TABLE 3-1

SUMMARY OF EDDY CURRENT DISTINGUISHABLE DEFECTS

Tube Section No.	Defect No.	Position Axial (inches)	Position Circ. (°)	Defect Extent Axial (mils)	Defect Extent Circ. (°)	Defect Extent Depth (%TW)	Defect Extent Vol. (10^{-6} in^3)	Eddy Current Results Bobbin Coil Field	Eddy Current Results Bobbin Coil Lab	Eddy Current Results MRPC Field	Eddy Current Results MRPC Lab
90-28-2	AF	17.2	150°	28.9	2.0	51%	3.0		S/N		
	AD2/1	16.1	180°/315°	52.4	3.5	37%	6.9				S/N
	AB	15.5	340°	54.4	8.3	30%	13.8				
	Z	15.1	325°	38.2	1.3	30%	1.5		S/N		
	X2/1	14.6	340°/110°	45.6	2.7	43%	5.4		S/N		S/N
	V2/1	14.0	270°/350°	53.7	7.5	48%	19.9				
	T2/1	13.2	110°/330°	36.3	7.8	50%	14.5				
	S2/1	12.9	350°/110°	33.9	3.2	26%	2.9		S/N		
	Q	12.3	340°	59.2	3.1	45%	8.5		S/N		
	O/N/M	11.5	340°/100°/290°	58.5	14.5	43%	37.5		S/N		S/N
	K	10.8	290°	31.8	3.6	18%	2.1		S/N		
	I/H/G	10.2	200°/10°/330°	71.5	17.3	49%	62.3	S/N	S/N	S/N	S/N
	AFC*	9.2								S/N	
	E	7.8	340°	70.9	7.9	50%	28.8	46%	36%	S/N	S/N
	C/B	6.1	20°/315°	56.5	6.1	41%	14.5	S/N	S/N	S/N	S/N
	AFC*	1.0							S/N		
52-51-2	X	16.5	315°	40.3	2.0	32%	2.6				S/N
	U	15.3	315°	32.7	4.8	26%	4.2				
	S	14.7	315°	63.7	8.3	33%	17.9				
	R	14.1	250°	38.9	3.7	18%	2.7		S/N		S/N
	P	13.1	200°	43.9	5.3	33%	7.9				
	N2/1	12.4	180°/260°	33.6	4.6	30%	4.8				
	L	11.4	180°	33.5	1.4	13%	0.6				S/N
	K2/1	11.0	250°/180°	42.7	7.8	45%	15.4				
	I2/1	10.0	350°/270°	49.7	15.2	42%	32.9	S/N		S/N	S/N
	G/F	8.9	315°/350°	69.9	5.7	47%	19.3	S/N	S/N	S/N	
	AFC*	7.9						S/N	S/N	S/N	S/N
	D	6.5	265°	60.9	8.4	34%	17.9	S/N	S/N	S/N	S/N
	B	-1.0	20°	38.6	2.0	38%	3.0				
97-91 2	W	14.1	105°	60.6	9.6	54%	32.0	67%	S/N	S/N	S/N
	AFC*	12.3									S/N
	U/T/S	11.5	245°/90°/95°	58.2	26.0	46%	70.9		S/N	S/N	S/N
	R1	9.3	350°	11.0	6.1	4%	0.3			S/N	S/N
	AFC*	8.6						S/N	S/N	S/N	S/N
	P/O	8.3	90°/15°	74.4	18.0	50%	68.8	67%	S/N		

TABLE 3-1 (Continued)

Tube Section No.	Defect No.	Position		Defect Extent				Eddy Current Results			
		Axial (inches)	Circ. (°)	Axial (mils)	Circ. (°)	Depth (%TW)	Vol. (10^{-6} in³)	Bobbin Coil Field	Bobbin Coil Lab	MRPC Field	MRPC Lab
97-91-2 (cont.)	M	7.1	320°	19.7	3.3	16%	1.1				
	K	6.6	225°	49.8	3.8	29%	5.7				
	I	5.6	355°	6.7	2.4	4%	0.1				
	G	3.3	20°	13.1	0.7	5%	0.0				
	E2/1/D	2.8	20°/285°/350°	13.5	5.7	6%	0.5				
	B	1.1	385°	16.3	2.5	6%	0.2				
	AFC*	-1.7							S/N		
106-32-2	BG/BF	16.6	90°/30°	55.1	7.6	15%	6.2				
	BD/BC	15.6	50°/30°	63.5	12.8	31%	25.5				
	BB/BA/AZ	14.9	90°/35°/45°	35.3	12.9	20%	9.4				
	AY	14.6	220°	55.3	16.1	36%	32.9	S/N	S/N		
	AX	14.3	30°	39.9	9.6	32%	12.6				
	AT/AU/AV	13.2	135°/45°/60°	46.8	42.3	34%	69.2	S/N	S/N	S/N	
	AR	12.3	90°	44.9	12.8	19%	11.2			S/N	
	AQ2/1	11.7	180°/90°	38.1	16.0	35%	21.9			S/N	
	AP/AO	11.2	20°/90°	48.0	14.4	27%	19.2	S/N			
	AN/AM 3/2/1	10.8	240°/0°/50°/45° 125°/180°/170°	26.5	31.9	27%	23.5	S/N	S/N	S/N	
	AL2/1	10.5	25°/80°/75°	27.7	10.2	11%	3.2			S/N	
	AJ/AK	9.9	190°/25°	61.3	22.8	39%	56.0	S/N	S/N	S/N	
	AG2/AH	8.8	100°/60°	59.1	13.0	35%	27.6		S/N	S/N	S/N
	AFC*	8.2								S/N	
	AE/AD/AC2	7.7	225°/60° 220°	62.5	27.5	24%	42.4	S/N	S/N		
	AC1/AB	7.4	60°/70°	53.5	11.5	18%	11.4				
	Z/AA	7.0	180°/200°	46.2	18.6	34%	30.0				
	X2/Y/X1	6.4	65°/85°/50°	33.7	20.4	28%	19.8	S/N	S/N	S/N	S/N
	V2	5.3	125°	40.8	2.1	14%	1.2			S/N	S/N
	Q	-0.6	190°	17.1	3.2	7%	0.4				
	N	-1.8	270°	5.4	1.0	15%	0.1				
	L/K/J I/H	-2.3	280°/310°/105° 40°/120°	17.3	31.3	14%	7.8				
	F	-3.4	160°	12.0	9.3	9%	1.0				
	E	-3.9	145°	18.2	3.4	23%	1.5				
	C	-5.4	350°	6.7	4.9	7%	0.2				

* AFC = Apparent False Call

TABLE 4

BOBBIN

FIELD VS. LABORATORY EDDY CURRENT

SPECIMEN		FIELD RESULTS				LABORATORY RESULTS			
ROW-TUBE-PIECE	AREA OF INTEREST	LOCATION	VOLTS	PHASE	1992 %TW	AXIAL LOCATION++	VOLTS	PHASE	1992 %TW
41-44-2	26.3" TO 45.3"	LTSF + 6.86"	0.89	118	S/N	BTM +11.92"	0.75	120	S/N
		LTSF +12.12"	0.62	117	S/N	BTM +16.76"	0.80	120	S/N
		LTSF +15.53"	0.85	126	S/N	BTM +20.64"	0.72	120	S/N
						BTM + 9.70"*	0.45	124	S/N
						BTM +10.63"*	0.48	118	S/N
						BTM +13.86"*	0.26	119	S/N
						BTM +22.81"*	0.59	140	S/N
52-51-2	25.3" TO 42.3"	LTSF + 5.79"	0.98	148	S/N	BTM + 8.64"	0.97	154	S/N
		LTSF + 8.03"	0.52	78	S/N	BTM +10.91"	0.79	87	S/N
		LTSF + 9.22"	0.95	149	S/N	BTM +12.21"	1.02	130	S/N
		LTSF +10.12"	0.47	75	S/N	BTM +16.97"	0.35	107	S/N
90-28-2	21.3" TO 42.3"	LTSF + 6.38"	1.00	107	S/N	BTM +13.32"	0.91	99	S/N
		LTSF + 7.88"	1.73	121	46	BTM +14.78"	1.66	122	36
		LTSF +10.35"	1.07	119	S/N	BTM +17.21"	1.06	126	S/N
						BTM + 7.98"*	0.44	144	S/N
						BTM +17.65"*	0.46	100	S/N
						BTM +18.61"*	0.46	116	S/N
						BTM +18.99"*	1.07	132	S/N
						BTM +19.72"*	0.66	143	S/N
						BTM +21.39"*	1.12	130	S/N
						BTM +21.92"*	0.65	91	S/N
						BTM +23.66"*	1.08	164	S/N
97-91-2	28.3" TO 43.3"	LTSF + 8.28"	0.88	90	76	BTM +15.54"	0.75	113	44
		LTSF + 8.56"	0.65	110	S/N	BTM +15.82"	0.79	124	S/N
		LTSF +14.28"	0.71	106	63	BTM +19.19"	0.64	91	62
						BTM +21.89"*	0.93	103	52
						BTM + 5.58"*	0.51	161	S/N
106-32-2	25.3" TO 42.3"	LTSF + 5.76"	0.84	135	S/N	BTM + 9.13"	0.50	136	S/N
		LTSF + 8.22"	0.34	138	S/N	BTM +12.89"	0.70	167	S/N
		LTSF + 9.48"	0.55	156	S/N	BTM +14.19"	0.74	144	S/N
		LTSF +10.91"	0.48	147	S/N	BTM +10.80"	0.56	155	S/N
		LTSF +11.24"	0.34	131	S/N	BTM + 8.76"	0.71	122	S/N
		LTSF +12.82"	0.57	162	S/N	BTM + 7.27"	0.67	153	S/N
		LTSF +14.34"	0.30	110	S/N	BTM + 5.90"	0.73	160	S/N
109-30-2	25.3" TO 33.3"	LTSF + 5.66"	0.79	150	S/N	BTM +13.11"	0.80	159	S/N
		LTSF + 7.99"	0.94	133	30	BTM +15.39"	0.94	131	27
		LTSF + 9.22"	0.31	132	S/N	BTM +16.62"	0.35	138	S/N
		LTSF + 9.78"	0.60	150	S/N	BTM +17.17"	0.54	148	S/N
						BTM +25.45"*	0.33	131	S/N

*ADDITIONAL LOCATIONS REPORTED DURING LAB ANALYSIS

++AXIAL LOCATION IS MEASURED FROM THE BOTTOM TUBE END

NOTE: ALL PIECE 4'S FOR EACH TUBE EXHIBITED NO DETECTABLE DEGRADATION (NDD)

TABLE 5

MRPC

FIELD VS. LABORATORY EDDY CURRENT

SPECIMEN		FIELD RESULTS				LABORATORY RESULTS				CIRCUMFERENTIAL LOCATION TOP(NOTCH) = 0 DEGREES++
ROW-TUBE-PIECE	AREA OF INTEREST	LOCATION	VOLTS	PHASE	1992 %TW	AXIAL LOCATION+	VOLTS	PHASE	1992 %TW	
41-44-2	26.3" TO 45.3"	LTSF + 4.99"	1.44	115	S/N				NDD	
		LTSF + 5.93"	2.02	37	S/N				NDD	
		LTSF + 7.20"	2.06	125	S/N	BTM +14.11"	0.77	74	S/N	130 DEG
		LTSF +11.89"	2.59	29	S/N	BTM +19.78"	1.76	39	S/N	0 DEG
		LTSF +13.37"	1.61	72	S/N	BTM +21.62"	0.86	60	S/N	270 DEG
		LTSF +15.50"	1.89	65	S/N	BTM +24.26"	1.23	59	S/N	0 DEG
		LTSF +17.63"	2.04	67	S/N	BTM +26.74"	0.92	111	S/N	270 DEG
52-51-2	25.3" TO 42.3"	LTSF + 5.90"	0.17	108	S/N				NDD	
		LTSF + 6.22"	1.83	108	S/N	BTM + 8.14"	0.88	103	S/N	100 DEG
		LTSF + 8.01"	0.24	57	S/N	BTM +10.68"	1.13	64	S/N	180 DEG
		LTSF + 8.47"	2.42	45	S/N				NDD	
		LTSF + 9.25"	0.12	52	S/N				NDD	
		LTSF + 9.75"	1.61	30	S/N				NDD	
		LTSF +10.00"	0.14	142	S/N	BTM +13.00"	0.35	125	S/N	0 DEG
		LTSF +10.57"	0.90	70	S/N				NDD	
90-23-2	21.3" TO 42.3"	LTSF + 6.21"	0.41	12	S/N				NDD	
		LTSF + 6.33"	2.09	85	S/N	BTM +13.22"	0.96	91	S/N	130 DEG
		LTSF + 7.79"	3.93	15	S/N	BTM +14.89"	0.92	86	S/N	90 DEG
		LTSF + 7.95"	0.23	22	S/N	BTM +17.25"	0.71	70	S/N	210 DEG
		LTSF + 9.12"	0.31	57	S/N	BTM +18.54"	1.47	76	S/N	200 DEG
		LTSF +10.15"	2.70	54	S/N	BTM +21.28"	0.58	52	S/N	220 DEG
						BTM +23.07"*	0.76	45	S/N	290 DEG
97-91-2	28.3" TO 43.3"	LTSF + 8.66"	0.35	82	S/N	BTM +15.82"	1.09	117	S/N	310 DEG
		LTSF + 8.95"	0.17	72	S/N	BTM +15.51"	1.00	114	S/N	310 DEG
		LTSF +12.15"	0.21	43	S/N	BTM +19.17"	1.74	69	S/N	310 DEG
		LTSF +14.84"	0.36	57	S/N	BTM +21.88"	1.41	71	S/N	340 DEG
						BTM +19.27"*	0.51	68	S/N	310 DEG
106-32-2	25.3" TO 42.3"	LTSF + 5.77"	0.32	101	S/N	BTM +12.74"	1.12	133	S/N	180 DEG
		LTSF + 6.35"	0.37	92	S/N	BTM +14.00"	0.94	73	S/N	320 DEG
		LTSF + 8.17"	0.25	101	S/N	BTM +16.12"	0.61	127	S/N	180 DEG
		LTSF + 8.85"	0.19	8	S/N				NDD	
		LTSF + 9.09"	0.20	87	S/N	BTM +16.36"	0.84	97	S/N	160 DEG
		LTSF + 9.81"	0.12	80	S/N				NDD	
		LTSF +10.13"	0.27	93	S/N				NDD	
		LTSF +10.78"	0.13	45	S/N				NDD	
		LTSF +11.88"	0.14	61	S/N				NDD	
		LTSF +12.12"	0.12	41	S/N				NDD	
		LTSF +13.41"	0.13	76	S/N	BTM +18.20"	0.69	88	S/N	350 DEG
						BTM +17.77"*	0.92	132	S/N	170 DEG
109-30-2	25.3" TO 33.3"	LTSF + 8.47"	0.13	67	S/N	BTM +16.59"	0.42	58	S/N	150 DEG
		LTSF + 9.66"	0.28	88	S/N				NDD	

*ADDITIONAL LOCATIONS REPORTED DURING LAB ANALYSIS

+AXIAL LOCATION IS MEASURED FROM THE BOTTOM TUBE END

++CIRCUMFERENTIAL LOCATION IS MEASURED IN DEGREES. THE COPPER PIECE ATTACHED TO THE SPECIMEN IS THE ZERO-DEGREE LOCATION. DEGREES INCREASE IN A POSITIVE MANNER WITH CLOCKWISE ROTATION WHEN VIEWING THE SPECIMEN FROM THE COPPER PIECE.

1994 Pulled Tube Exam Data

Table 4-1
IGA Patches on Tube Section 41-44-2

Defect Location		Defect Extent *		Depth, mils	Volume,** cu.in.
Axial, inches	Circ., degrees	Axial, mils	Circ., mils		
10.43	135	48	68	12	6 x 10^{-6}
10.86	210	49	65	15	7 x 10^{-6}
11.30	90	76	73	16	12 x 10^{-6}
11.43	200	60	81	14	10 x 10^{-6}
12.11	130	26	40	7	1 x 10^{-6}
12.55	290	74	75	15	12 x 10^{-6}
13.18	160	39	82	10	5 x 10^{-6}
13.30	70	24	37	10	1 x 10^{-6}
13.30	340	76	43	7	4 x 10^{-6}
13.36	160	69	30	2	1 x 10^{-6}
13.36	160	26	30	6	1 x 10^{-6}
13.93	80	48	34	8	2 x 10^{-6}
14.24	100	41	83	12	6 x 10^{-6}
14.24	280	36	32	7	1 x 10^{-6}
14.43	150	29	58	11	3 x 10^{-6}
14.61	225	46	72	13	6 x 10^{-6}
14.86	0	38	38	7	1 x 10^{-6}
14.86	0	65	44	11	5 x 10^{-6}
14.93	280	40	63	10	4 x 10^{-6}
15.36	180	50	51	10	4 x 10^{-6}
16.24	225	33	33	7	1 x 10^{-6}
17.24	30	80	86	17	17 x 10^{-6}
17.55	170	69	106	20	22 x 10^{-6}
17.68	0	55	48	10	4 x 10^{-6}
18.05	60	37	53	9	3 x 10^{-6}
18.93	100	52	47	10	4 x 10^{-6}
19.24	315	45	84	11	6 x 10^{-6}
19.74	110	29	41	7	1 x 10^{-6}
21.11	5	66	34	10	3 x 10^{-6}
21.11	170	61	74	14	9 x 10^{-6}
21.99	210	36	66	10	4 x 10^{-6}
22.93	160	41	47	9	3 x 10^{-6}
23.18	80	44	42	9	2 x 10^{-6}

* = measured from stereomicrographs
** = calculated assuming half-ellipsoid defect geometry
Shaded values are defect depth and volume estimated from correlation between depth and defect OD extent

Table 2-3: Field NDE Results vs Destructive Examination Results

Tube Number (Row/Column)	Location inches	Defect Identification	Field Bobbin Call	Defect Dimensions, 10^{-3} inches			
			Volts (%TW)	Maximum Depth (%TW)	Axial Length	Width	Volume (in^3)
68-46	LTSF - 0.60	pit-like IGA	NDD	28.0 (75%)	228	89	$138(10)^{-6}$
	7th TSP - 0.56	"D"-shaped wear	1.36(27%)	12.0 (32%)	90	119	$68(10)^{-6}$
	9th TSP + 0.81	Tapered wear	0.65(S/N)	7.0 (19%)	425	141	$157(10)^{-6}$
	9th TSP - 0.58	Tapered wear	0.38(S/N)	4.9 (13%)	515	148	$135(10)^{-6}$
72-49	Below LTSF	pit-like IGA	NDD	7.0 (19%)	41	29	$2(10)^{-6}$
	7th TSP - 0.69	Oval wear	0.50(39%)	6.0 (16%)	94	134	$35(10)^{-6}$
	9th TSP + 0.82	Tapered wear	0.49(S/N)	3.8 (10%)	640	134	$62(10)^{-6}$
	9th TSP -	Tapered wear	NDD		812	145	
109-71	3rd TSP - 0.67	"D"-shaped wear	0.17 (S/N)	5.0 (14%)	86	97	$17(10)^{-6}$
	7th TSP - 0.68	Circular wear	0.17(40%)	12.2 (33%)	112	101	$66(10)^{-6}$
136-26	LTSF	None	LC1 @ LTS				
	3rd TSP	None	NDD				
	7th TSP - 0.70	"D"-shaped wear	1.29(31%)	13.0 (35%)	112	170	$68(10)^{-6}$

Table 5-2
Correlation of Eddy Current and Destructive Examination Results

TUBE - SAMPLE	LOCATION	DEFECT	FIELD 0.510 BOBBIN	LAB 0.510 BOBBIN	LAB 0.540 BOBBIN	FIELD MRPC	LAB MRPC	FIELD RFEC	LAB RFEC
72-49-2	LTSF	IGA 19% TW	LCB	DING	N/A	N/A	DING	DING	NDD
68-46-3	LTSF -0.6"	IGA 70% TW	LCB	43%, 23%,	N/A	N/A	0.26 x 0.70 0.25 x 0.15	DING	ODI & S/N
68-46-3	LTSF +12.3"	IGA PATCH	S/N	NDD	N/A	PIT	NDD	NDD	NDD
41-44-2B2	LTSF +5"	IGA 40% TW	NDD	NDD	NDD	NDD	VOL 0.15 x 0.11	N/A	NDD
41-44-2B4	LTSF +7.5"	4-IGA 28,27,20, &7% TW	NDD	NDD	S/N	NDD	NDD	N/A	NDD
41-44-2B6	LTSF +8.8"	2-IGA 30, & 35% TW	NDD	S/N 1992 & 1994	S/N	NDD	NDD	N/A	NDD
41-44-2B8	LTSF +11.5"	IGA 55% TW	S/N	S/N	S/N	S/N	VOL 0.19 x 0.25	N/A	S/N
41-44-2B10	LTSF +13.6"	IGA 30% TW	NDD	S/N	NDD	NDD	NDD	N/A	NDD
68-46-14	7th TSP	WEAR 32% TW	27%	28%	N/A	0.80 x 0.20	0.14 x 0.13	S/N	S/N
68-46-18	9th TSP	WEAR 19 & 14%	2-S/N	2-S/N	N/A	0.22 x.0.19 0.21 x 0.17	0.15 x 0.10 0.22 x 0.15	S/N	2-S/N
72-49-13	7th TSP	WEAR 16%TW	39%	32%	N/A	0.11 x 0.22	0.12 x 0.16	S/N	S/N
72-49-17	9th TSP	WEAR 10%TW	S/N	S/N	N/A	0.22 x 0.19 0.22 x 0.19	0.20 x 0.17 0.22 x 0.15	S/N	2-S/N
109-71-7	3rd TSP	WEAR 14%TW	S/N	S/N	N/A	N/A	NDD	S/N	S/N
109-71-14	7th TSP	WEAR 33%TW	40%	13%	N/A	0.20 x 0.19	0.10 x 0.08	S/N	S/N
136-26-15	7th TSP	WEAR 35%TW	31%	32%	N/A	0.17 x 0.23	0.15 x 0.21	S/N	S/N

Bobbin coil indications are listed at percent through-wall when available.

All MRPC indications were Volumetric unless stated otherwise. The axial and circumferential extent of the MPRC indications are given in (axial) x (circumferential) format, in units of inches.

NDD = No Detectable Degradation, N/A = No Data Available, LCB = Localized Banana signal

PULLED TUBE EDDY CURRENT RESULTS - .510 BOBBIN

SPECIMEN	FIELD RESULTS				LABORATORY RESULTS			
ROW-TUBE/ SECTION	LOCATION	VOLTS	PHASE	1994 %TW	AXIAL LOCATION++	VOLTS	PHASE	1994 %TW
68-46/18	09S + 0.81"	0.65	113	S/N	BTM + 5.47"	1.44	144	S/N
	09S - 0.58"	0.38	119	S/N	BTM + 4.11"	0.31	128	S/N
68-46/14	07S - 0.56"	1.36	119	27	BTM + 7.08"	1.65	118	28
68-46/03	LTS +12.32"	0.16	70	S/N				NDD
				NDD	BTM + 5.74"#	2.71	119	43
				NDD	BTM + 5.21"#	1.33	137	23
				NDD	BTM + 4.61"#	0.25	121	S/N
	LTS + 0.00"	7.04	178	LCB				NDD
68-46/01				NDD	BTM + 5.55"#	2.85	141	18
				NDD	BTM + 4.49"#	5.12	127	34
72-49/17	09S + 0.82"	0.49	123	S/N	BTM +11.93"	0.43	102	S/N
72-49/13	07S - 0.69"	0.50	108	39	BTM +14.77"	0.56	115	32
72-49/08				NDD	BTM +23.70"*	0.34	67	S/N
72-49/04				NDD	BTM + 9.50"*	0.23	130	S/N
72-49/02	LTS + 0.00"	7.59	356	LCB	BTM + 10.85"	5.58	0	DNG
109-71/14	07S - 0.68"	1.32	107	40	BTM +12.84"	1.93	128	13
109-71/07	03S - 0.67"	0.17	67	S/N	BTM +10.01"	0.35	120	S/N
136-26/15	07S - 0.70"	1.29	115	31	BTM +16.96"	1.39	115	32
136-26/02	LTS + 0.00"	6.75	350	LC1	BTM + 2.78	7.66	182	DNG

++AXIAL LOCATION IS MEASURED FROM THE BOTTOM TUBE END

#POSSIBLE MECHANICALLY-INDUCED FLAW OCCURRING DURING TUBE PULL

*ADDITIONAL LOCATIONS REPORTED DURING LAB ANALYSIS

ATTACHMENT 10

PULLED TUBE EDDY CURRENT RESULTS - BOBBIN (CONT'D.)

SPECIMEN	FIELD RESULTS				LABORATORY RESULTS			
ROW-TUBE/ SECTION	LOCATION	VOLTS	PHASE	1994 %TW	AXIAL LOCATION++	VOLTS	PHASE	1994 %TW
41-44/02# .510 PROBE					BTM +25.36"	0.96	148	S/N
					BTM +22.82"	0.51	151	S/N
					BTM +22.63"	0.21	101	S/N
					BTM +21.58"	0.25	52	S/N
					BTM +20.66"	0.79	111	S/N
					BTM +18.59"	0.47	48	S/N
					BTM +17.09"	0.79	100	S/N
					BTM +15.97"	0.21	106	S/N
					BTM +14.21"	0.30	117	S/N
					BTM +12.27"	0.66	121	S/N
					BTM +10.98"	0.39	126	S/N
					BTM +10.08"	0.40	132	S/N
41-44/02# .540 PROBE					BTM +25.73"	0.98	146	S/N
					BTM +23.14"	0.42	145	S/N
					BTM +22.93"	0.22	79	S/N
					BTM +21.97"	0.16	80	S/N
					BTM +21.10"	0.66	117	S/N
					BTM +19.37"	0.21	122	S/N
					BTM +19.05"	0.38	95	S/N
					BTM +18.21"	0.23	148	S/N
					BTM +17.50"	0.63	124	S/N
					BTM +16.38"	0.19	49	S/N
					BTM +14.54"	0.19	94	S/N
					BTM +13.27"	0.20	141	S/N
					BTM +12.62"	0.77	131	S/N
					BTM +11.22"	0.39	89	S/N
					BTM +10.38"	0.42	133	S/N

++AXIAL LOCATION IS MEASURED FROM THE BOTTOM TUBE END

#ARCHIVED TUBE - ORIGINALLY ANALYZED 1992 W/.510 BOBBIN - NO 1994 FIELD DATA

ATTACHMENT 10

PULLED TUBE EDDY CURRENT RESULTS - 3-COIL MRPC

SPECIMEN	FIELD RESULTS				DIMENSIONS	LABORATORY RESULTS				CIRCUM-FERENTIAL LOCATION	DIMENSIONS
ROW-TUBE/ SECTION	LOCATION	VOLTS	PHASE	1994 %TW	LGTH X WIDTH L=AXIAL EXT. W=CIRC. EXT.	AXIAL LOCATION++	VOLTS	PHASE	1994 %TW	TOP (NOTCH) =0 DEGREES+	LGTH X WIDTH L=AXIAL EXT. W=CIRC. EXT.
68-46/18	09S + 0.72"	0.34	96	VOL	0.27 X 0.16	BTM + 5.58"	0.77	48	VOL	345 DEG	0.15 X 0.10
	09S - 0.71"	0.31	66	VOL	0.26 X 0.16	BTM + 4.29"	0.81	57	VOL	110 DEG	0.22 X 0.15
68-46/14	07S - 0.79"	0.41	102	VOL	0.18 X 0.20	BTM + 7.12"	0.74	46	VOL	50 DEG	0.14 X 0.13
68-46/03	LTS +12.72"**			PIT	N/A				NDD		
	--	--	--	--	--	BTM + 5.82"*	2.22	61	VOL	60 DEG	0.26 X 0.17
	--	--	--	--	--	BTM + 5.43"*	0.65	77	VOL	340 DEG	0.25 X 0.15
72-49/17	09S + 0.77"	0.61	13	VOL	0.20 X 0.17	BTM +12.06"	0.46	133	VOL	200 DEG	0.20 X 0.17
	09S - 0.61"	0.51	49	VOL	0.24 X 0.24	BTM +10.66"	0.74	26	VOL	340 DEG	0.26 X 0.15
72-49/13	07S - 0.87"	0.29	37	VOL	0.11 X 0.22	BTM +14.62"	0.57	62	VOL	110 DEG	0.12 X 0.16
72-49/02	--	--	--	--	--	BTM +10.94"*	4.25	355	DNG	80 DEG	N/A
109-71/14	0[illegible] - 0.68"	0.53	69	VOL	0.21 X 0.19	BTM +12.93"	1.73	02	DNG	80 DEG	N/A
						BTM +12.89"	0.34	113	VOL	80 DEG	0.11 X 0.10
109-71/07	03S - 0.00"**			PIT	N/A	BTM +10.04"	0.26	98	VOL	90 DEG	0.08 X 0.10
136-26/15	07S - 0.68"	0.70	56	VOL	0.17 X 0.23	BTM +16.96"	0.67	58	VOL	200 DEG	0.13 X 0.20
136-26/02	--	--	--	--	--	BTM + 2.79"*	6.14	19	DNG	300 DEG	N/A

++AXIAL LOCATION IS MEASURED FROM THE BOTTOM TUBE END

+CIRCUMFERENTIAL LOCATION MEASURED IN DEGREES - COPPER PIECE ATTACHED TO SPECIMEN IS ZERO-DEGREE LOCATION. DEGREES INCREASE IN A POSITIVE MANNER WITH CLOCKWISE ROTATION WHEN VIEWING SPECIMEN FROM THE COPPER PIECE.

*ADDITIONAL LOCATIONS REPORTED DURING LAB ANALYSIS

**BOBBIN CALL - NO FIELD MRPC DATA

PULLED TUBE EDDY CURRENT RESULTS - 3-COIL MRPC (CONT'D.)

SPECIMEN	FIELD RESULTS				LABORATORY RESULTS				CIRCUM-FERENTIAL LOCATION	DIMENSIONS LGTH X WIDTH
ROW-TUBE/ SECTION	LOCATION	VOLTS	PHASE	1994 %TW	AXIAL LOCATION++	VOLTS	PHASE	1994 %TW	TOP(NOTCH) =0 DEGREES+	L=AXIAL EXT. W=CIRC. EXT.
41-44/02#					BTM +25.93"	0.72	22	VOL	170 DEG	0.16 X 0.18
					BTM +23.26"	0.42	64	VOL	95 DEG	0.16 X 0.18
					BTM +23.05"	0.29	35	VOL	25 DEG	0.09 X 0.15
					BTM +21.05"	0.45	57	VOL	20 DEG	0.15 X 0.15
					BTM +19.00"	0.26	40	VOL	90 DEG	0.12 X 0.17
					BTM +17.35"	0.65	32	VOL	15 DEG	0.17 X 0.19
					BTM +17.14"	0.28	61	VOL	140 DEG	0.19 X 0.25
					BTM +12.54"	0.29	68	VOL	250 DEG	0.15 X 0.14
					BTM +11.20"	0.42	51	VOL	100 DEG	0.16 X 0.17
					BTM +10.68"	0.22	104	VOL	60 DEG	0.15 X 0.11
					BTM +10.32"	0.34	64	VOL	50 DEG	0.20 X 0.16

++AXIAL LOCATION IS MEASURED FROM THE BOTTOM TUBE END

+CIRCUMFERENTIAL LOCATION MEASURED IN DEGREES - COPPER PIECE ATTACHED TO SPECIMEN IS ZERO-DEGREE LOCATION. DEGREES INCREASE IN A POSITIVE MANNER WITH CLOCKWISE ROTATION WHEN VIEWING SPECIMEN FROM THE COPPER PIECE.

#ARCHIVED TUBE - ORIGINALLY ANALYZED 1992 - NO 1994 FIELD DATA

ARCHIVED TUBE 1992 EDDY CURRENT RESULTS - BOBBIN & MRPC

SPECIMEN	FIELD RESULTS				LABORATORY RESULTS				CIRCUM-FERENTIAL LOCATION
ROW-TUBE/ SECTION	LOCATION	VOLTS	PHASE	%TW	AXIAL LOCATION++	VOLTS	PHASE	%TW	TOP (NOTCH) =0 DEGREES+
41-44/02	LTS + 6.86"	0.89	118	S/N	BTM +11.92"	0.75	120	S/N	
1992	LTS +12.12"	0.62	117	S/N	BTM +16.76"	0.80	120	S/N	
.510	LTS +15.53"	0.85	126	S/N	BTM +20.64"	0.72	120	S/N	
BOBBIN	--	--	--	--	BTM + 9.70"*	0.45	124	S/N	
	--	--	--	--	BTM +10.63"*	0.48	118	S/N	
	--	--	--	--	BTM +13.86"*	0.26	119	S/N	
	--	--	--	--	BTM +22.81"*	0.59	140	S/N	
41-44/02	LTSF + 4.99"	1.44	115	S/N				NDD	
1992	LTSF + 5.93"	2.02	37	S/N				NDD	
MRPC	LTSF + 7.20"	2.06	125	S/N	BTM +14.11"	0.77	74	S/N	130 DEG
	LTSF +11.89"	2.59	29	S/N	BTM +19.78"	1.76	39	S/N	0 DEG
	LTSF +13.37"	1.61	72	S/N	BTM +21.62"	0.86	60	S/N	270 DEG
	LTSF +15.50"	1.89	65	S/N	BTM +24.26"	1.23	59	S/N	0 DEG
	LTSF +17.63"	2.04	67	S/N	BTM +26.74"	0.92	111	S/N	270 DEG

*ADDITIONAL LOCATIONS REPORTED DURING 1992 LAB ANALYSIS

ATTACHMENT 10

II.A Figure 3-1

Figure 3-1 is a plot of a linear regression analysis of eddy current bobbin coil estimates versus metallurgical test results for the 1992 CR-3 pulled tubes. There are 32 data points included within this comparative analysis. This data has previously been provided to the Staff as part of References 4, 5, and 6. The pertinent pages from the 1992 EPRI report are reproduced herein for completeness sake. The plotted points are derived from the 5/14/92 eddy current test results presented in the attached excerpt for those defects with met data.

Attachment B - IGA Detection and Sizing by Eddy Current

52-51 Locations (A)	3/18/89 Volt/Phase/% (B)	4/30/90 Volt/Phase/% (B)	5/14/92 Volt/Phase/% (B)	Met Locations/% (C)
6.38/6.43/6.21	0.89/148/2	0.62/153/0	0.62/148/16	9.06/34
8.66/8.64/8.48	0.47/94/66	0.57/92/68	0.33/79/82	11.37,11.63/53
9.89/9.87/9.66	0.88/139/17	0.75/136/21	0.61/150/13	12.63/52
10.77/10.73/10.59	0.19/80/77	0.24/47/96	0.30/66/89	13.50,13.63/45
NDD				14.0/13%
12.2/12.07/11.91	0.19/66/86	0.22/45/97	0.16/62/91	14.88,15.06/40
12.95/12.86/12.72	0.43/161/0	0.26/162/0	0.32/164/0	15.69/33
NDD				16.69/18
14.53/14.5/14.32	0.33/119/43	0.29/105/57	0.35/152/9	17.25/33
NDD				17.94/26
NDD				19.13/32

109-30 Locations	3/18/89 Volt/Phase/%	4/30/90 Volt/Phase/%	5/14/92 Volt/Phase/%	Met Locations/%
6.04/6.29/6.13	0.67/153/0	0.67/157/0	0.54/153/8	No met
8.34/8.54/8.46	0.75/125/36	0.66/126/35	0.65/137/31	15.88-15.96/50
9.52/9.77/9.66	0.33/131/28	0.27/129/31	0.23/135/33	No met
10.09/11.13/10.16	0.43/141/13	0.50/135/23	0.35/132/37	17.5-17.56/40
10.91/11.13/-	0.18/126/35	0.16/117/45	-	No met
12.72/12.95/12.87	0.13/45/97	0.27/53.93	0.18/26/60	No met
14.84/15.17/15.15	0.32/20/50	0.36/28/70	0.20/32/74	No met

106-32 Locations	3/18/89 Volt/Phase/%	4/30/90 Volt/Phase/%	5/14/92 Volt/Phase/%	Met Locations/%
NDD				12.75/14
6.32/6.32/6.35	0.62/141/13	0.86/147/2	0.58/138/30	13.81,13.94/49
6.87/6.80/6.96	0.83/164/0	0.93/165/0	0.63/176/0	14.38/51
NDD				14.63,14.81/18
7.58/7.57/7.71	0.35/145/6	0.42/132/25	0.40/167/0	15.00-15.19/25
8.01/7.97/8.09	0.39/11/27	0.38/15/37	0.26/22/51	15.44/24
8.69/8.67/8.78	0.33/126/35	0.27/124/35	0.23/138/30	16.18,16.19/40
8.94/8.91/9.01	0.19/74/81	0.21/39/95	0.14/82/80	16.44/29
9.71/9.68/9.73	0.49/150/0	0.60/145/4	0.29/152/9	17.19/38
9.98/9.97/---	0.46/139/16	0.50/146/4	0.34/157/1	17.50/40
NDD				17.94,18.0/16
NDD				18.19,18.25/22
NDD				18.36-18.56/36
11.34/11.33/11.44	0.35/127/34	0.53/146/4	0.32/150/13	18.75/42
11.71/11.71/11.78	0.55/134/24	0.65/134/22	0.24/133/36	19.13,19.25/46
NDD				19.81/19
13.09/13.20/13.34	0.57/133/25	0.58/140/14	0.36/150/13	20.69/31
NDD				20.94,21.06/39
14.63/14.56/14.81	0.22/101/61	0.43/117/44	0.20/110/59	21.81,22.13/36
NDD				22.31-22.50/22
NDD				23.00,23.13/31
NDD				24.00,24.13/17

Attachment B (Cont'd)

90-28 Locations	5/14/92 Volt/Phase/%	Met Locations/%
6.46	0.73/109/59	13.56,13.69/56
7.98	1.26/123/44	15.31/50
10.39	0.75/122/46	17.63,17.69/53
10.65	0.32/124/43	17.88/46
NDD		18.25/18
11.59	0.25/115/53	18.80,19.06/27
11.93	0.79/138/24	19.25/45
NDD		19.75/45
12.76	0.42/144/14	20.31/23
NDD		20.44/28
NDD		20.69/53
14.36	0.90/128/38	21.50,21.56/49
14.84	0.35/112/56	21.88,22.06/62
NDD		22.56/30
15.78	0.09/130/36	23.00/30
NDD		23.56/49
16.50	0.50/158/0	23.63/24
NDD		24.69/51

Notes: (A) Eddy current flaw locations of respective tube from each outage
(B) 600 kHz eddy current data and flaw depth estimates
(C) Actual met locations and met results
NDD - No detectable degradations

II.B Figure 3-2 and Figure 3-3

These Figures are two different presentations of the same data. The Figures illustrate the dimensional sizing accuracy of the MRPC probe for sizing volumetric defects. The data plotted in the Figures is extracted from Table 3-2 and Table 3-3 of the same report. The Tables are included herein.

Table 3-2
CR-3 Pulled Tube Dimensional Sizing

TUBE SECTION	AXIAL POSITION	ID NUMBER	MET. AXIAL EXTENT, IN.	MET. CIRC. EXTENT, IN.	MRPC AXIAL EXTENT, IN.	MRPC CIRC. EXTENT, IN.
52-51-2	LTSF + 9.25	D	0.061	0.041	0.15	0.20
	LTSF + 12.75	I2	0.048	0.037	0.19	0.17
	LTSF + 12.75	I1	0.053	0.037	0.19	0.17
90-28-2	LTSF + 13.6	C	0.053	0.010	0.14	0.19
	LTSF + 13.6	B	0.063	0.020	0.11	0.14
	LTSF + 15.3	E	0.071	0.038	0.16	0.20
	LTSF + 17.7	I	0.063	0.023	0.19	0.19
	LTSF + 17.7	H	0.059	0.022	0.15	0.19
	LTSF + 17.7	G	0.079	0.039	0.15	0.19
97-91-2	LTSF + 15.3	P	0.073	0.074	0.15	0.17
	LTSF + 15.3	O	0.076	0.062	0.15	0.19
	LTSF + 19.0	U	0.054	0.047	0.15	0.25
	LTSF + 19.0	T	0.061	0.066	0.19	0.18
	LTSF + 19.0	S	0.011	0.0005	0.08	0.10
	LTSF + 21.6	W	0.061	0.047	0.16	0.18
106-32-2	LTSF + 13.8	X2	0.071	0.053	0.11	0.14
	LTSF + 13.8	Y	0.015	0.008	0.13	0.11
	LTSF + 13.8	X1	0.016	0.038	0.11	0.19
	LTSF + 16.3	AG2	0.062	0.035	0.11	0.13
	LTSF + 16.3	AH	0.056	0.028	0.12	0.15
	LTSF + 21.0	AT	0.060	0.050	0.15	0.19
	LTSF + 21.0	AU	0.047	0.054	0.11	0.25
68-46-14	07S - 0.79	14B	0.090	0.119	0.18	0.20
72-49-13	07S - 0.87	13B	0.094	0.134	0.11	0.22
109-71-7	03S - 0.00	7BX	0.086	0.097	0.08	0.10
109-71-14	07S - 0.68	14B	0.112	0.101	0.20	0.19
136-26-15	07S - 0.68	15B	0.112	0.170	0.17	0.23

Table 3-3
B&WOG NDE Committee IGA Samples MRPC Sizing Data

Sample No.	Length, in.	Width, in.	M[illegible] Length, in.	MRPC Width, in.
1217423-B	1.508	0.263	1.62	0.524
1217423-C	0.772	0.255	0.88	0.524
1217423-D	1.5	0.236	1.56	0.436
1217424-B	1.49	0.245	1.59	0.436
1217424-C	0.751	0.243	0.85	0.480
1217424-D	1.51	0.246	1.65	0.480
1217425-B	1.506	0.253	1.56	0.393
1217425-C	0.746	0.246	0.99	0.436

Figures 3-4, 3-5, and 3-6

Fifty nine of the data points are from the 1992 CR-3 tube pull originally listed in Table 3-1 of (6). For convenience, these data points are included herein as a Table, listing tube section number, defect number, and associated dimensional data. An additional data point (Defect No. G from tube section number 97-91-2) was not used for correlation since it had a reported volume of 0.0×10^{-6} in^3.

As stated in (6), these sixty data points represent clusters of defects separated with an axial spacing of approximately 0.2 inches. The volume of each defect was estimated by assuming an ellipsoidal shape for the IGA. For defects which were combined to form a composite, axial extent and depths were determined by a weighted average (based on volume) and circumferential extents were summed.

An additional eight data points are from the 1994 CR-3 tube pull and one tube pulled during 1992 but examined in conjunction with the 1994 pulled tubes. Dimensional information was originally tabulated in Table 3-3 of (1). For convenience, these data points and their dimensions are included herein .

Axial and circumferential extents for the additional eight data points were not originally included in the correlations because the dimensional information was not available. This explains why Figures 3-5 and 3-6 from (1) have 8 fewer data points than Figure 3-4 of (1). The dimensional information has since become available. When the additional data is appended to the original volume-axial length, volume-circumferential length data sets the correlation plots shown in the Figures attached. These new plots with the extended data sets compare very well with the original plots.

Table 1
1992 Crystal River 3 Tube Pull
Metallographic Dimensional Data

Tube Section No.	Defect No.	Axial (mils)	Circ. (degrees)	Depth (% TW)	Vol. (10^{-6} in^3)
90-28-2	AF	28.9	2.0	51	3.0
	AD2/1	52.4	3.5	37	6.9
	AB	54.4	8.3	30	13.8
	Z	38.2	1.3	30	1.5
	X2/1	45.6	2.7	43	5.4
	V2/1	53.7	7.5	48	19.9
	T2/1	36.3	7.8	50	14.5
	S2/1	33.9	3.2	26	2.9
	Q	59.2	3.1	45	8.5
	O/M/N	58.5	14.5	43	37.5
	K	31.8	3.6	18	2.1
	I/H/G	71.5	17.3	49	62.3
	E	70.9	7.9	50	28.8
	C/B	56.5	6.1	41	14.5
52-51-2	X	40.3	2.0	32	2.6
	U	32.7	4.8	26	4.2
	S	63.7	8.3	33	17.9
	R	38.9	3.7	18	2.7
	P	43.9	5.3	33	7.9
	N2/1	33.6	4.6	30	4.8
	L	33.5	1.4	13	0.6
	K2/1	42.7	7.8	45	15.4
	I2/1	49.7	15.2	42	32.9
	G/F	69.9	5.7	47	19.3
	D	60.9	8.4	34	17.9
	B	38.6	2.0	38	3.0
97-91-2	W	60.6	9.6	54	32.0
	U/T/S	58.2	26.0	46	70.9
	R1	11.0	6.1	4	0.3

Table 1 (Continued)
1992 Crystal River 3 Tube Pull
Metallographic Dimensional Data

Tube Section No.	Defect No.	Axial (mils)	Circ. (degrees)	Depth (% TW)	Vol. (10^{-6} in^3)
97-91-2	P/O	74.4	18.0	50	68.8
(cont.)	M	19.7	3.3	16	1.1
	K	49.8	3.8	29	5.7
	I	6.7	2.4	4	0.1
	G	13.1	0.7	5	0.0
	E2/1/D	13.5	5.7	6	0.5
	B	16.3	2.5	6	0.2
106-32-2	BG/BF	55.1	7.6	15	6.2
	BD/BC	63.5	12.8	31	25.5
	BB/BA/AZ	35.3	12.9	20	9.4
	AY	55.3	16.1	36	32.9
	AX	39.9	9.6	32	12.6
	AT/AU/AV	46.8	42.3	34	69.2
	AR	44.9	12.8	19	11.2
	AQ2/1	38.1	16.0	35	21.9
	AP/AO	48.0	14.4	27	19.2
	AN/AM 3/2/1	26.5	31.9	27	23.5
	AL2/1	27.7	10.2	11	3.2
	AJ/AK	61.3	22.8	39	56.0
	AG2/AH	59.1	13.0	35	27.6
	AE/AD/AC2	62.5	27.5	24	42.4
	AC1/AB	53.5	11.5	18	11.4
	Z/AA	46.2	18.6	34	30.0
	X2/Y/X1	33.7	20.4	28	19.8
	V2	40.8	2.1	14	1.2
	Q	17.1	3.2	7	0.4
	N	5.4	1.0	15	0.1
	L/K/J/I/H	17.3	31.3	14	7.8
	F	12.0	9.3	9	1.0
	E	18.2	3.4	23	1.5
	C	6.7	4.9	7	0.2

Table 2
Additional Crystal River 3 Tube Pull
Metallographic Dimensional Data

Tube Section No.	Defect No.	Location	Axial (mils)	Circ. (mils)	Depth (% TW)	Vol. (10^{-6} in^3)
1992						
41-44-2B	A	LTS-16.5"	69	106	54	21.7
		(IGA)				
1994						
68-46-3A	B	LTS-0.6"	228	89	76	134
		(IGA)				
68-46-14B	C	7th TSP	90	119	32	68
		(Wear)				
72-49-2B	D	LTS - ?	41	29	20	2.2
		(IGA)				
72-49-13B	E	7th TSP	94	134	16	35
		(Wear)				
109-71-7Bx	F	3rd TSP	86	97	14	17
		(Wear)				
109-71-14B	G	7th TSP	112	101	33	66
		(Wear)				
136-26-15B	H	7th TSP	112	170	35	68
		(Wear)				

Figure 3-7

The twelve CR-3 pulled tube data points used for voltage-volume correlation are listed in Table 3. Voltage values were obtained by reanalyzing 8R and 9R eddy current data for points that could be uniquely associated with discontinuities listed in the tube pull reports. In general, association was based on volume rather than location or depth since this parameter determines signal amplitude. In addition, for multiple discontinuities within the coil field of view, volumes are additive.

Association of particular data points with metallographic data presented in Tables 1 and 2 is shown in the last column of the table. Data for CR-3 1992 pulled tube 109-30 is not included in Table 1. The volume data are listed in Table 2-8 of (6) and represent a composite volume of mulitple pit-like IGA within an axial span of approximately 0.15 inches.

Table 3
Data Used to Establish Voltage-Volume Correlation

Tube	Location	Volume, E-06 cubic in	Voltage[1]	Mechanism	Defect #
1992 Tube Pull					
90-28	LTSF + 6.38"	37.5	0.74	IGA	O/N/M of Table 1
	LTSF + 7.88"	62.3	1.19	IGA	I/H/G of Table 2
	LTSF + 10.35"	28.8	0.72	IGA	E of Table 1
97-91	LTSF + 8.28"	68.8	0.74	IGA	P/O of Table 1
	LTSF + 14.28"	70.9	0.52	IGA	U/T/S of Table 1
109-30	LTSF + 5.66"	26.9[2]	0.47	IGA	-
	LTSF + 7.99"	39.2[2]	0.58	IGA	-
1994 Tube Pull					
68-46	7H - 0.56"	68	1.1	Wear	C of Table 2
72-49	7H - 0.69"	35	0.42	Wear	E of Table 2
109-71	3H - 0.67"	17	0.25	Wear	F of Table 2
	7H - 0.70"	66	0.91	Wear	G of Table 2
136-26	7H - 0.70"	68	0.87	Wear	H of Table 2

Notes:
[1] CR-3 voltage normalization using Channel P1
[2] Total volume of multiple discontinuities

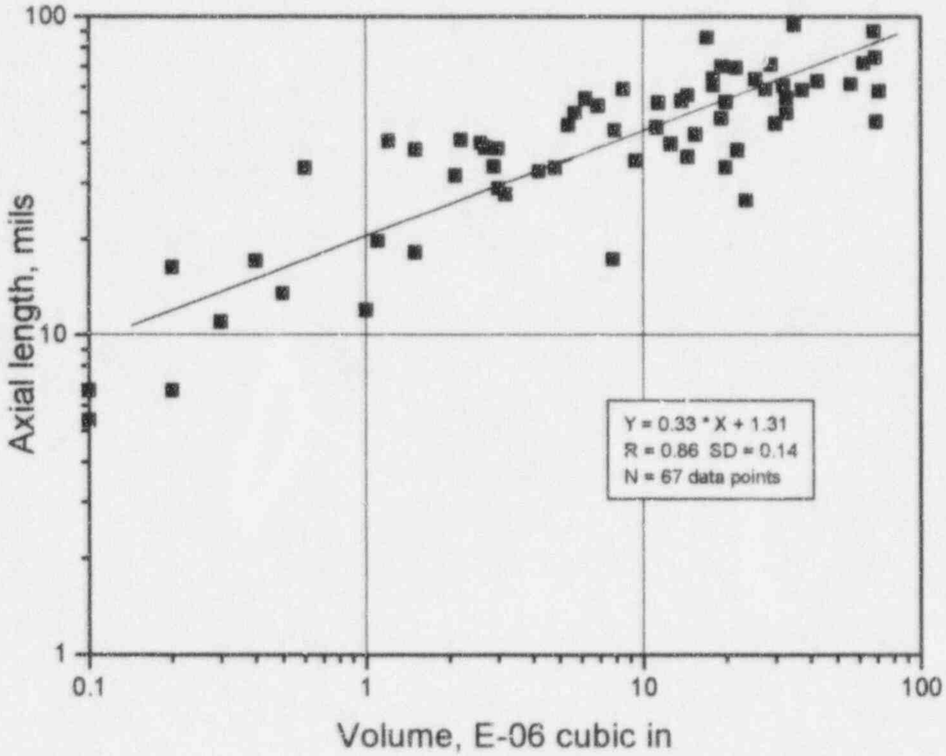

Figure of Volume-Axial length correlation using additional 8 data points.

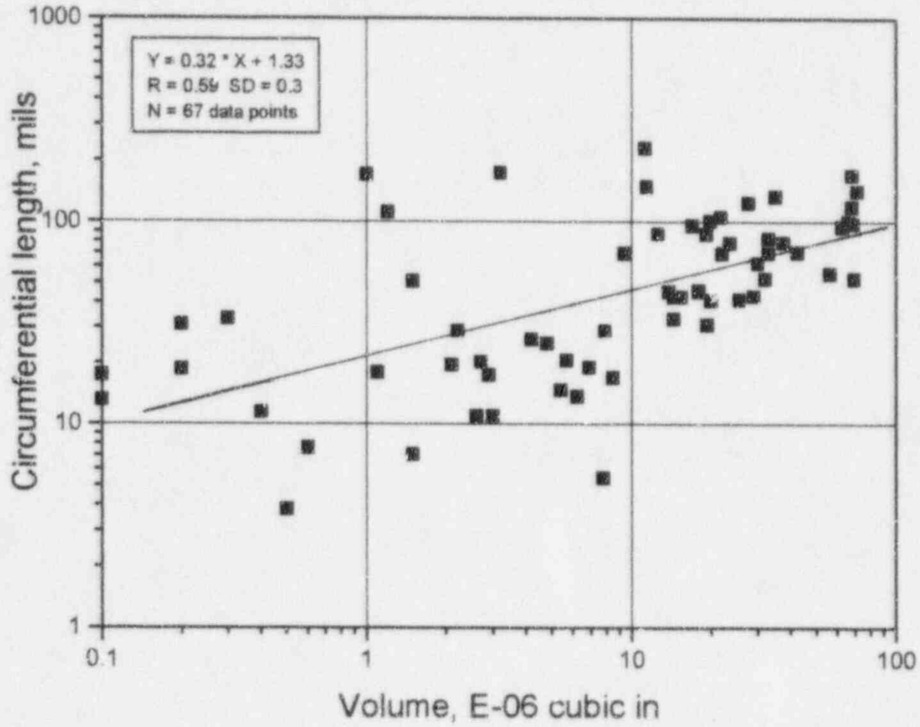

Figure of Volume-Circumferential length correlation using additional 8 data points.

II.D Figure 3-8

Figure 8 shows a scatter plot of bobbin coil voltage versus discontinuity volume for the B&WOG NDE Committee IGA sample data. The data supporting this plot was previously provided to the NRC Staff as Table 3-5 of the same report. This Table is included below.

Table 3-5
B&WOG NDE Committee IGA Samples Voltage vs. Volume Data

Sample Number	Maximum %TW[2]	Axial, in.[1,2]	Circum., in.[1,2]	Bobbin Coil Voltage	Approx. Volume, $in.^3$
1217423-A	55	0.75	0.245	2.7	0.0034
1217423-B	72	1.5	0.245	7.5	0.0083
1217423-D	67	1.5	0.245	6.1	0.0082
1217423-E	55	0.75	0.245	2.9	0.0034
1217424-A	56	0.75	0.245	3.4	0.0035
1217424-B	79	1.5	0.245	9.8	0.0092
1217424-D	80	1.5	0.245	6.9	0.0102
1217424-E	71	0.75	0.245	7.7	0.0044
1217425-A	22	0.75	0.245	0.5	0.0013
1217425-B	42	1.5	0.245	2.25	0.0046
1217425-E	41	0.75	0.245	1.1	0.0025

1 Nominal dimensions
2 Dimensions not used in calculation of volume

II.F Figure 4-1 and Figure 4-2

These bar graphs illustrate the measured axial and circumferential extent distribution of volumetric indications which underwent an MRPC inspection during the 9R refueling outage. All MRPC calls of a volumetric or pit-like morphology were included within this plot. Raw data is attached.

BWNT TUBAN II (Version 2.1) 04/27/1994 07:12:56

Crystal River Unit 3

S/G A

94/04 RFO

SPECIAL INTEREST 20%

SPECIAL INTEREST - PIT

SPEC. INT. 20% - PIT LISTS

ROW	TUBE	VOLTS	CHN	DEG	[illegible]	LOCATION	EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
2	8	0.71	P 1	0	VOL	12S +0.67	12S	12S	520	H8259	71	PIT
					MSG	L x W 0.16 x 0.17 PIT			520	H8259	71	
31	32	0.38	P 1	60	VOL	10S +0.72	10S	10S	520	C9318	71	PIT
			P 1		MSG	L x W 0.15 x 0.21 PIT			520	H8259	71	
47	69	0.32	1	131	VOL	LTS +42.52	01S	LTS	520	R6452	80	PIT
			1		MSG	L x W 0.11 x 0.18 PIT			520	R6452	80	
55	96	0.49	P 1	266	VOL	03S +0.77	03S	03S	520	B0690	80	PIT
					MSG	L x W 0.16 x 0.16 PIT			520	B0690	80	
61	124	0.20	P 1	44	VOL	10S -0.69	10S	10S	520	R6452	80	PIT
			P 1		MSG	L x W 0.12 x 0.18 PIT			520	R6452	80	
149	19	0.22	P 1	95	VOL	12S -0.81	12S	12S	520	B0690	80	PIT
					MSG	L x W 0.14 x 0.12 PIT			520	R6452	80	
					MSG	L x W 0.37 x 0.19 WAR			520	B0690	80	

Total Indications Found = 13

Total Tubes Found = 6

Total Tubes in Input File = 6

SPECIAL INTEREST - VOL

SPEC. INT. 20% - VOL LISTS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION		EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
7	27	0.36	P 1	0	VOL		08S	+0.63	08S	08S	520	H8259	71	VOL
					MSG		L x W	0.24 x 0.20 VOL			520	H8259	71	
18	74	0.32	P 1	66	VOL		06S	+0.60	06S	06S	520	P2204	71	VOL
					MSG		L x W	0.16 x 0.15 VOL			520	P2204	71	
28	92	0.47	P 1	95	VOL		08S	+0.67	08S	08S	520	L7871	71	VOL
					MSG		L x W	0.27 x 0.23 VOL			520	H8259	71	
37	113	0.52	P 1	0	VOL		11S	-0.66	11S	11S	520	B0690	78	VOL
					MSG		L x W	0.18 x 0.18 VOL			520	R6452	78	
41	116	0.24	P 1	0	VOL		11S	-0.82	11S	11S	520	R6452	78	VOL
					MSG		L x W	0.19 x 0.20 VOL			520	R6452	78	
67	62	0.46	P 1	102	VOL		10S	-0.73	10S	10S	520	H8259	81	VOL
					MSG		L x W	0.20 x 0.20 VOL			520	H8259	81	

Total Indications Found = 12
Total Tubes Found = 6
Total Tubes in Input File = 6

SPECIAL INTEREST - PIT

SPEC. INT. 20% - PIT LISTS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION		EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
27	94	0.35	P 1	62	VOL		09S	+0.78	09S	09S	520	H8259	77	PIT
					MSG		L x W	0.12 x 0.19 PIT			520	S2680	77	
					MSG		L x W	0.40 x 0.16 WAR			520	S2680	77	
35	20	0.19	P 1	61	VOL		04S	-0.67	04S	04S	520	H8259	77	PIT
					MSG		L x W	0.19 x 0.15 PIT			520	S2680	77	
35	42	0.34	P 1	55	VOL		09S	-0.74	09S	09S	520	H8259	77	PIT
					MSG		L x W	0.13 x 0.21 PIT			520	S2680	77	
36	40	0.17	1	68	VOL		LTS	+23.42	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.10 x 0.12 PIT			520	S2680	77	
37	40	0.23	1	61	VOL		LTS	+27.32	LTS	LTS	520	P2204	83	PIT
					MSG		L x W	0.17 x 0.17 PIT			520	P2204	83	
		0.19	1	93	VOL		LTS	+27.21	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.11 x 0.16 PIT			520	S2680	77	
37	41	0.15	1	72	VOL		LTS	+6.58	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.18 x 0.14 PIT			520	S2680	77	
38	38	0.52	P 1	59	VOL		09S	-0.75	09S	09S	520	H8259	77	PIT
					MSG		L x W	0.14 x 0.21 PIT			520	S2680	77	
39	41	0.21	1	77	VOL		LTS	+9.72	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.15 x 0.17 PIT			520	S2680	77	
41	47	0.23	1	26	VOL		LTS	+14.18	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.09 x 0.12 PIT			520	S2680	77	
41	56	0.16	P 1	42	VOL		03S	-0.62	03S	03S	520	H8259	77	PIT
					MSG		L x W	0.12 x 0.11 PIT			520	S2680	77	
43	42	0.13	1	80	VOL		LTS	+8.97	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.16 x 0.14 PIT			520	S2680	77	
43	80	0.86	P 1	35	VOL		12S	+6.41	12S	12S	520	H8259	77	PIT
					MSG		L x W	0.16 x 0.14 PIT			520	S2680	77	
45	35	0.40	P 1	36	VOL		07S	-0.78	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.16 x 0.38 PIT			520	S2680	77	
46	37	0.23	1	74	VOL		LTS	+10.39	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.08 x 0.19 PIT			520	S2680	77	
46	44	0.24	1	86	VOL		LTS	+5.60	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.12 x 0.14 PIT			520	S2680	77	
47	48	0.22	1	108	VOL		LTS	+11.30	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.08 x 0.10 PIT			520	S2680	77	
48	38	0.18	1	82	VOL		LTS	+10.92	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.19 x 0.16 PIT			520	S2680	77	
48	47	0.19	1	76	VOL		LTS	+7.52	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.19 x 0.16 PIT			520	S2680	77	
49	35	0.13	P 1	88	VOL		LTS	+7.24	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.18 x 0.14 PIT			520	S2680	77	
49	48	0.21	1	62	VOL		LTS	+13.74	LTS	LTS	520	R6452	77	PIT
					MSG		L x W	0.13 x 0.16 PIT			520	S2680	77	
49	50	0.31	1	84	VOL		LTS	+10.69	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.17 x 0.12 PIT			520	S2680	77	
51	48	0.22	P 1	44	VOL		07S	-0.69	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.15 x 0.15 PIT			520	S2680	77	
52	36	0.24	1	81	VOL		LTS	+6.48	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.16 x 0.16 PIT			520	S2680	77	
53	39	0.28	1	131	VOL		LTS	+12.43	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.11 x 0.16 PIT			520	S2680	77	
54	98	1.33	P 1	66	VOL		05S	-0.14	05S	05S	520	H8259	77	PIT
					MSG		L x W	0.35 x 0.27 PIT			520	S2680	77	
57	38	0.16	1	90	VOL		LTS	+11.95	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.09 x 0.14 PIT			520	S2680	77	
57	44	0.15	1	95	VOL		LTS	+9.46	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.13 x 0.15 PIT			520	S2680	77	
57	52	0.16	1	45	VOL		LTS	+6.76	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.11 x 0.16 PIT			520	S2680	77	
58	38				MSG		L x W	0.18 x 0.17 PIT			520	S2680	77	
		0.33	1	59	VOL		LTS	+9.06	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.14 x 0.18 PIT			520	S2680	77	
		0.31	1	100	VOL		LTS	+11.71	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.08 x 0.19 PIT			520	S2680	77	
		0.29	1	15	VOL		LTS	+7.05	LTS	LTS	520	H8259	77	PIT

SPECIAL INTEREST - PIT
SPEC. INT. 20% - PIT LISTS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION		EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
59	122	0.61	P 1	82	VOL		09S	-0.66	09S	09S	520	H8259	77	PIT
					MSG		L x W	0.11 x 0.20 PIT			520	S2680	77	
60	119	0.90	P 1	72	VOL		07S	-0.67	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.14 x 0.24 PIT			520	S2680	77	
61	42	0.33	P 1	52	VOL		07S	-0.75	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.12 x 0.11 PIT			520	S2680	77	
63	34	0.34	P 1	48	VOL		07S	-0.73	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.14 x 0.16 PIT			520	S2680	77	
65	122	0.32	P 2	80	VOL		05S	+0.75	05S	05S	520	H8259	77	PIT
					MSG		L x W	0.11 x 0.16 PIT			520	S2680	77	
66	37	0.29	P 1	73	VOL		09S	-0.71	09S	09S	520	H8259	77	PIT
					MSG		L x W	0.18 x 0.19 PIT			520	S2680	77	
67	33	0.28	P 1	9	VOL		07S	-0.60	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.10 x 0.21 PIT			520	S2680	77	
67	52	0.46	P 1	55	VOL		07S	-0.63	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.14 x 0.25 PIT			520	S2680	77	
69	56	0.19	P 1	65	VOL		03S	-0.64	03S	03S	520	P2204	86	VOL
					MSG		L x W	0.08 x 0.06 VOL			520	P2204	86	
		0.43	P 1	255	VOL		09S	-0.65	09S	09S	520	H8259	77	PIT
					MSG		L x W	0.18 x 0.20 PIT			520	S2680	77	
		0.65	P 1	68	VOL		07S	-0.71	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.14 x 0.24 PIT			520	S2680	77	
80	127	0.30	P 1	81	VOL		07S	-0.61	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.23 x 0.19 PIT			520	S2680	77	
81	64	0.27	P 1	71	VOL		10S	-0.77	10S	10S	520	S2680	80	PIT
					MSG		L x W	0.14 x 0.19 PIT			520	S2680	80	
81	122	0.38	P 1	73	VOL		07S	-0.70	07S	07S	520	S1848	81	PIT
					MSG		L x W	0.24 x 0.21 PIT			520	H8259	81	
83	56	0.26	1	92	VOL		02S	-6.40	02S	02S	520	S1848	81	PIT
					MSG		L x W	0.21 x 0.23 PIT			520	H8259	81	
85	124	0.66	P 1	80	VOL		08S	+0.58	08S	08S	520	S1848	81	PIT
					MSG		L x W	0.34 x 0.18 PIT			520	H8259	81	
88	12	0.27	P 1	63	VOL		07S	-0.69	07S	07S	520	S1848	82	PIT
					MSG		L x W	0.13 x 0.19 PIT			520	S1848	82	
89	34	0.11	1	88	VOL		LTS	+14.69	LTS	LTS	520	P2204	82	PIT
					MSG		L x W	0.18 x 0.21 PIT			520	P2204	82	
		0.25	1	72	VOL		LTS	+5.25	LTS	LTS	520	P2204	82	PIT
					MSG		L x W	0.16 x 0.21 PIT			520	P2204	82	
90	43	0.26	1	80	VOL		LTS	+6.00	LTS	LTS	520	M6664	81	PIT
					MSG		L x W	0.11 x 0.12 PIT			520	H8259	81	
90	60	0.32	P 1	47	VOL		07S	-0.39	07S	07S	520	S1848	81	PIT
					MSG		L x W	0.10 x 0.11 PIT			520	H8259	81	
92	28				MSG		L x W	0.15 x 0.17 PIT			520	P2204	82	
		0.35	1	83	VOL		LTS	+7.94	LTS	LTS	520	P2204	82	PIT
93	27	0.27	1	28	VOL		LTS	+7.76	LTS	LTS	520	P2204	82	PIT
					MSG		L x W	0.14 x 0.17 PIT			520	P2204	82	
93	36	0.61	P 1	76	VOL		09S	-0.76	09S	09S	520	S1848	81	PIT
					MSG		L x W	0.24 x 0.20 PIT			520	H8259	81	
94	43	0.43	P 1	67	VOL		09S	-0.74	09S	09S	520	S1848	81	PIT
					MSG		L x W	0.13 x 0.22 PIT			520	H8259	81	
		0.13	P 1	91	VOL		09S	+0.71	09S	09S	520	H8259	81	PIT
			P 1		MSG		L x W	0.06 x 0.19 PIT			520	H8259	81	
96	66	0.50	P 1	71	VOL		07S	-0.75	07S	07S	520	S1848	81	PIT
					MSG		L x W	0.18 x 0.23 PIT			520	H8259	81	
96	70	0.49	P 1	66	VOL		07S	-0.74	07S	07S	520	S1848	81	PIT
					MSG		L x W	0.13 x 0.19 PIT			520	H8259	81	
97	27	0.17	1	68	VOL		LTS	+11.12	LTS	LTS	520	P2204	82	PIT
					MSG		L x W	0.14 x 0.17 PIT			520	P2204	82	
98	95	0.14	1	84	VOL		LTS	+7.00	LTS	LTS	520	P2204	82	PIT
					MSG		L x W	0.13 x 0.17 PIT			520	P2204	82	
100	32	0.24	P 1	76	VOL		LTS	+8.35	LTS	LTS	520	M6664	81	PIT
					MSG		L x W	0.14 x 0.14 PIT			520	H8259	81	
101	41	0.17	1	55	VOL		LTS	+15.92	LTS	LTS	520	S1848	81	PIT
					MSG		L x W	0.14 x 0.14 PIT			520	H8259	81	
101	91	0.18	1	63	VOL		LTS	+8.98	LTS	LTS	520	P2204	82	PIT

SPECIAL INTEREST - PIT
SPEC. INT. 20% - PIT LISTS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION	EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
					MSG		L x W 0.11 x 0.18 PIT			520	P2204	82	
102	46	0.61	P 1	71	VOL		07S -0.76	07S	07S	520	S1848	81	PIT
					MSG		L x W 0.17 x 0.32 PIT			520	H8259	81	
102	95	0.37	P 1	69	VOL		07S -0.65	07S	07S	520	R6452	82	PIT
					MSG		L x W 0.16 x 0.20 PIT			520	R6452	82	
103	44	0.28	1	70	VOL		LTS +11.10	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.19 x 0.17 PIT			520	H8259	81	
103	90	0.21	1	89	VOL		LTS +7.96	LTS	LTS	520	M6664	81	PIT
					MSG		L x W 0.15 x 0.15 PIT			520	R6452	81	
104	31	0.12	1	64	VOL		LTS +9.77	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.16 x 0.16 PIT			520	H8259	81	
105	32	0.17	1	95	VOL		LTS +7.91	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.13 x 0.17 PIT			520	H8259	81	
105	42	0.35	P 1	51	VOL		07S -0.79	07S	07S	520	S1848	81	PIT
					MSG		L x W 0.17 x 0.20 PIT			520	H8259	81	
105	113	0.47	P 1	73	VOL		07S -0.86	07S	07S	520	R6452	81	PIT
					MSG		L x W 0.19 x 0.24 PIT			520	R6452	81	
106	38	0.48	P 1	55	VOL		07S -0.70	07S	07S	520	H8259	81	PIT
					MSG		L x W 0.15 x 0.17 PIT			520	H8259	81	
107	50	0.23	1	82	VOL		LTS +9.31	LTS	LTS	520	P2204	83	PIT
					MSG		L x W 0.17 x 0.15 PIT			520	P2204	83	
108	33	0.23	1	80	VOL		LTS +11.96	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.10 x 0.15 PIT			520	H8259	81	
		0.12	1	49	VOL		LTS +10.01	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.14 x 0.15 PIT			520	H8259	81	
		0.28	1	74	VOL		[illegible] +6.95	LTS	LTS	520	R6452	81	PIT
					MSG		L x W 0.12 x 0.19 PIT			520	H8259	81	
109	32	0.12	1	68	VOL		LTS +9.11	LTS	LTS	520	M6664	81	PIT
					MSG		L x W 0.11 x 0.12			520	M6664	81	
109	45	0.15	.	81	VOL		LTS +14.66	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.10 x 0.17 PIT			520	H8259	81	
109	52	0.34	P 1	65	VOL		07S -0.71	07S	07S	520	R6452	81	PIT
					MSG		L x W 0.22 x 0.21 PIT			520	R6452	81	
116	49	0.50	P 1	57	VOL		07S -0.75	07S	07S	520	S1848	81	PIT
					MSG		L x W 0.20 x 0.15 PIT			520	R6452	81	
117	44	0.34	1	66	VOL		LTS +7.31	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.14 x 0.18 PIT			520	H8259	81	
118	40	0.14	1	115	VOL		LTS +23.83	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.11 x 0.10 PIT			520	H8259	81	
		0.10	1	82	VOL		LTS +8.11	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.17 x 0.10 PIT			520	H8259	81	
119	48	0.34	P 1	61	VOL		07S -0.63	07S	07S	520	H8259	81	PIT
					MSG		L x W 0.20 x 0.20 PIT			520	H8259	81	
119	63	0.28	P 1	77	VOL		07S -0.78	07S	07S	520	H8259	81	PIT
			P 1		MSG		L x W 0.25 x 0.22 PIT			520	R6452	81	
125	89	0.76	P 1	57	VOL		07S -0.59	07S	07S	520	H8259	81	PIT
					MSG		L x W 0.17 x 0.17 PIT			520	H8259	81	
127	58	0.35	P 1	78	VOL		07S -0.81	07S	07S	520	S1848	81	PIT
					MSG		L x W 0.14 x 0.21 PIT			520	R6452	81	
128	53	0.25	P 1	69	VOL		13S -0.72	13S	13S	520	R6452	81	PIT
					MSG		L x W 0.14 x 0.17 PIT			520	R6452	81	
132	63	0.35	P 1	78	VOL		07S -0.77	07S	07S	520	S1848	81	PIT
					MSG		L x W 0.17 x 0.20 PIT			520	R6452	81	
136	32	0.29	P 1	66	VOL		07S -0.70	07S	07S	520	R6452	81	PIT
					MSG		L x W 0.15 x 0.20 PIT			520	R6452	81	
139	74	0.22	P 1	100	VOL		07S -0.80	07S	07S	520	R6452	81	PIT
					MSG		L x W 0.14 x 0.16 PIT			520	R6452	81	
146	14	0.38	P 1	72	VOL		07S -0.69	07S	07S	520	R6452	82	PIT
					MSG		L x W 0.18 x 0.17 PIT			520	R6452	82	
146	26	0.17	P 1	88	VOL		09S -0.59	09S	09S	520	R6452	82	WAR
			P 1		MSG		L x W 0.22 x 0.14 WAR			520	R6452	82	
		0.30	P 1	71	VOL		09S +0.71	09S	09S	520	R6452	82	WAR
			P 1		MSG		L x W 0.30 x 0.22 WAR			520	R6452	82	
		0.21	P 1	87	VOL		08S -0.58	08S	08S	520	S1848	82	PIT
					MSG		L x W 0.18 x 0.17 PIT			520	R6452	82	

SPECIAL INTEREST - VOL
SPEC. INT. 20% - VOL LISTS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION		EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
41	53	0.53	P 1	66	VOL		03S	-0.66	03S	03S	520	R6452	83	VOL
			P 1		MSG		L x W	0.11 x 0.15 VOL			520	R6452	83	
59	1	0.18	P 1	52	VOL		09S	-0.68	09S	09S	520	S1848	83	VOL
					MSG		L x W	0.07 x 0.14 VOL			520	S1848	83	
69	56	0.19	P 1	65	VOL		03S	-0.64	03S	03S	520	P2204	86	VOL
					MSG		L x W	0.08 x 0.06 VOL			520	P2204	86	
		0.43	P 1	255	VOL		09S	-0.65	09S	09S	520	H8259	77	PIT
					MSG		L x W	0.18 x 0.20 PIT			520	S2680	77	
		0.65	P 1	68	VOL		07S	-0.71	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.14 x 0.24 PIT			520	S2680	77	
72	67	0.34	P 1	95	VOL		03S	-0.75	03S	03S	520	S2680	80	VOL
					MSG		L x W	0.12 x 0.11 VOL			520	S2680	80	
79	39	0.31	P 1	66	VOL		12S	-0.68	12S	12S	520	P2204	82	VOL
					MSG		L x W	0.17 x 0.23 VOL			520	P2204	82	
92	17	0.38	P 1	72	VOL		09S	-0.65	09S	09S	520	P2204	82	VOL
					MSG		L x W	0.14 x 0.20 VOL			520	P2204	82	
93	17	0.49	P 1	71	VOL		09S	-0.59	09S	09S	520	P2204	82	VOL
					MSG		L x W	0.16 x 0.24 VOL			520	P2204	82	
96	28	0.68	P 1	64	VOL		09S	-0.66	09S	09S	520	P2204	82	VOL
					MSG		L x W	0.13 x 0.23 VOL			520	P2204	82	
140	21	0.37	P 1	62	VOL		07S	-0.74	07S	07S	520	R6452	82	VOL
			P 1		MSG		L x W	0.17 x 0.23 VOL			520	R6452	82	
144	12	0.29	P 1	79	VOL		07S	-0.62	07S	07S	520	P2204	82	VOL
					MSG		L x W	0.17 x 0.21 VOL			520	P2204	82	
145	8	0.23	P 1	36	VOL		07S	-0.68	07S	07S	520	P2204	82	VOL
					MSG		L x W	0.14 x 0.14 VOL			520	P2204	82	
151	13	0.61	P 1	81	VOL		10S	-0.56	10S	10S	520	P2204	82	VOL
					MSG		L x W	0.24 x 0.21 VOL			520	P2204	82	

Total Indications Found = 28
Total Tubes Found = 12
Total Tubes in Input File = 12

SPECIAL INTEREST - VOL

SPEC. INT. 10% #1 - VOL LISTS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION	EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
8	21				MSG		L x W 0.11 x 0.11 VOL			520	H8259	72	
		0.42	P 1	85	VOL		07S +0.75	07S	07S	520	M6664	72	VOL
19	3				MSG		L x W 0.20 x 0.17 VOL			520	H8259	72	
		1.30	P 1	115	VOL		12S +0.70	12S	12S	520	M6664	72	VOL
27	91	0.54	1	17	VOL		13S +13.36	13S	13S	520	R6452	74	VOL
					MSG		L x W 0.12 x 0.12 VOL			520	M6664	74	
			P 1		MSG		L x W 0.29 x 0.19 WAR			520	R6452	74	
			P 1		MSG		L x W 0.44 x 0.20 WAR			520	R6452	74	
28	93	0.92	P 1	123	VOL		08S +0.56	08S	08S	520	M6664	72	VOL
					MSG		L x W 0.30 x 0.18 VOL			520	H8259	72	
34	72	0.57	1	84	VOL		02S +15.67	02S	02S	520	M6664	72	VOL
					MSG		L x W 0.19 x 0.18 VOL			520	H8259	72	
41	116	0.97	P 1	127	VOL		12S +0.70	12S	12S	520	M6664	72	VOL
					MSG		L x W 0.19 x 0.19 VOL			520	H8259	72	
65	87	0.31	P 1	75	VOL		04S +0.73	04S	04S	520	M6664	74	VOL
					MSG		L x W 0.10 x 0.17 VOL			520	H8259	74	
75	29	0.65	P 1	123	VOL		07S -0.68	07S	07S	520	M6664	72	VOL
					MSG		L x W 0.15 x 0.19 VOL			520	M6664	72	
77	17	0.57	P 1	124	VOL		07S -0.73	07S	07S	520	M6664	72	VOL
					MSG		L x W 0.13 x 0.15 VOL			520	H8259	72	
79	128	0.20	P 1	105	VOL		10S +0.70	10S	10S	520	M6664	74	VOL
			1		MSG		L x W 0.18 x 0.19 VOL			520	M6664	74	

Total Indications Found = 22
Total Tubes Found = 10
Total Tubes in Input File = 10

SPECIAL INTEREST - PIT
SPEC. INT. 10% #1 - PIT LISTS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION	EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
14	34	0.21	P 1	98	VOL		07S -0.78	07S	07S	520	C9318	84	PIT
					MSG		L x W 0.14 x 0.14 PIT			520	C9318	84	
37	48	0.29	P 1	70	VOL		07S -0.62	07S	07S	520	C9318	84	PIT
					MSG		L x W 0.14 x 0.10 PIT			520	C9318	84	
39	42	0.30	1	113	VOL		LTS +28.85	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.15 x 0.15 PIT			520	C9318	84	
46	37	0.26	1	60	VOL		LTS +7.61	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.18 x 0.21 PIT			520	C9318	84	
46	44	0.18	1	90	VOL		LTS +9.68	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.14 x 0.14 PIT			520	C9318	84	
47	48	0.19	1	30	VOL		LTS +9.78	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.16 x 0.15 PIT			520	C9318	84	
49	49	0.11	1	79	VOL		LTS +12.91	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.17 x 0.16 PIT			520	C9318	84	
50	35	0.20	1	54	VOL		LTS +8.73	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.23 x 0.19 PIT			520	C9318	84	
51	48	0.15	1	49	VOL		LTS +6.48	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.14 x 0.19 PIT			520	C9318	84	
54	51	0.41	1	94	VOL		LTS +11.70	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.15 x 0.18 PIT			520	C9318	84	
55	32	0.30	1	68	VOL		LTS +7.51	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.11 x 0.16 PIT			520	C9318	84	
55	81	0.19	1	98	VOL		LTS +6.72	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.19 x 0.18 PIT			520	C9318	84	
56	44	0.19	1	110	VOL		LTS +9.06	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.11 x 0.16 PIT			520	C9318	84	
56	51	0.22	1	155	VOL		LTS +7.31	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.14 x 0.19 PIT			520	C9318	84	
80	22	0.06	P 1	75	VOL		LTS +30.86	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.15 x 0.15 PIT			520	C9318	84	
89	34	0.22	1	39	VOL		LTS +8.54	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.17 x 0.17 PIT			520	C9318	84	
89	43	0.27	1	69	VOL		LTS +6.66	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.17 x 0.22 PIT			520	C9318	84	
90	96	0.12	1	82	VOL		LTS +9.34	LTS	LTS	520	C9318	84	PIT
			1		MSG		L x W 0.16 x 0.14 PIT			520	C9318	84	
95	92	0.11	1	86	VOL		LTS +12.19	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.12 x 0.16 PIT			520	C9318	84	
101	31	0.15	1	54	VOL		LTS +11.71	LTS	LTS	520	C9318	85	PIT
					MSG		L x W 0.19 x 0.17 PIT			520	C9318	85	
103	34	0.07	1	48	VOL		LTS +15.99	LTS	LTS	520	C9318	85	PIT
					MSG		L x W 0.19 x 0.17 PIT			520	C9318	85	
103	35	0.12	1	45	VOL		LTS +9.31	LTS	LTS	520	C9318	85	PIT
					MSG		L x W 0.20 x 0.19 PIT			520	C9318	85	
104	33	0.10	1	56	VOL		LTS +8.22	LTS	LTS	520	C9318	85	PIT
				0	MSG		L x W 0.20 x 0.19 PIT			520	C9318	85	
		0.05	1	85	VOL		LTS +6.43	LTS	LTS	520	C9318	85	PIT
					MSG		L x W 0.17 x 0.16 PIT			520	C9318	85	
110	41	0.26	1	55	VOL		LTS +8.70	LTS	LTS	520	C9318	85	PIT
					MSG		L x W 0.18 x 0.18 PIT			520	C9318	85	

Total Indications Found = 50
Total Tubes Found = 24
Total Tubes in Input File = 24

SPECIAL INTEREST - VOL
SPEC. INT. 10% #1 - VOL LISTS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION		EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
40	52	0.16	P 1	97	VOL		07S	-0.78	07S	07S	520	R6452	84	VOL
					MSG		L x W	0.12 x 0.12 VOL			520	R6452	84	
80	58	0.12	P 1	64	VOL		09S	-0.85	09S	09S	520	C9318	84	VOL
					MSG		L x W	0.14 x 0.14 VOL			520	C9318	84	
134	38	0.18	P 1	0	VOL		07S	-0.80	07S	07S	520	R6452	85	VOL
					MSG		L x W	0.15 x 0.14 VOL			520	R6452	85	
150	15	0.23	P 1	0	VOL		07S	-0.77	07S	07S	520	R6452	85	VOL
					MSG		L x W	0.15 x 0.15 VOL			520	R6452	85	

Total Indications Found = 8
Total Tubes Found = 4
Total Tubes in Input File = 4

SPECIAL INTEREST - VOL
SPEC. INT. 10% #2 - VOL LISTS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION		EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
10	6	0.41	P 1	75	VOL		12S	+0.70	12S	12S	520	M6664	76	VOL
					MSG		L x W	0.17 x 0.19 VOL			520	M6664	76	
31	11	0.38	P 1	75	VOL		09S	+0.51	09S	09S	520	M6664	76	VOL
					MSG		L x W	0.17 x 0.19 VOL			520	R6452	76	

Total Indications Found = 4
Total Tubes Found = 2
Total Tubes in Input File = 2

SPECIAL INTEREST - PIT
SPEC. INT. 10% #2 - PIT LISTS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION	EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
37	40	0.27	1	70	VOL		LTS +9.20	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.13 x 0.20 PIT			520	P2204	88	
		0.24	1	55	VOL		LTS +5.87	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.17 x 0.20 PIT			520	P2204	88	
39	42	0.24	1	216	VOL		LTS +14.27	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.13 x 0.18 PIT			520	P2204	88	
39	45	0.21	1	82	VOL		LTS +8.04	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.13 x 0.19 PIT			520	P2204	88	
44	46	0.18	1	59	VOL		LTS +11.72	LTS	LTS	520	P1790	89	PIT
					MSG		L x W 0.14 x 0.16 PIT			520	P1790	89	
45	46	0.13	1	42	VOL		LTS +14.68	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.14 x 0.13 PIT			520	P2204	88	
46	44	0.15	1	42	VOL		LTS +13.89	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.16 x 0.17 PIT			520	P2204	88	
47	48	0.15	1	43	VOL		LTS +14.84	LTS	LTS	520	R6452	89	PIT
			1		MSG		L x W 0.16 x 0.15 PIT			520	R6452	89	
49	47	0.15	1	6	VOL		LTS +13.07	LTS	LTS	520	B0690	88	PIT
					MSG		L x W 0.15 x 0.14 PIT			520	B0690	88	
50	33	0.23	1	83	VOL		LTS +7.24	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.13 x 0.16 PIT			520	P2204	88	
51	49	0.26	P 1	271	VOL		LTS +13.77	LTS	LTS	520	M6664	92	PIT
			1		MSG		L x W 0.06 x 0.12 PIT			520	M6664	92	
52	40	0.27	1	70	VOL		LTS +12.25	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.16 x 0.16 PIT			520	P2204	88	
58	38	0.37	1	98	VOL		LTS +11.42	LTS	LTS	520	R6452	89	PIT
			1		MSG		L x W 0.13 x 0.16 PIT			520	R6452	89	
65	28	0.09	1	72	VOL		LTS +11.03	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.16 x 0.14 PIT			520	P2204	88	
68	35	0.12	1	40	VOL		LTS +12.40	LTS	LTS	520	B0690	88	PIT
					MSG		L x W 0.14 x 0.16 PIT			520	R6452	88	
84	99	0.34	3	90	VOL		LTS +8.67	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.17 x 0.15 PIT			520	P2204	88	
85	99	0.10	1	78	VOL		LTS +10.26	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.17 x 0.17 PIT			520	P2204	88	
89	34	0.14	1	69	VOL		LTS +15.78	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.11 x 0.15 PIT			520	P2204	88	
90	44	0.20	1	85	VOL		LTS +7.79	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.13 x 0.15 PIT			520	P2204	88	
94	43	0.28	1	116	VOL		LTS +8.10	LTS	LTS	520	B0690	88	PIT
					MSG		L x W 0.16 x 0.14 PIT			520	B0690	88	
97	27	0.18	1	66	VOL		LTS +11.31	LTS	LTS	520	P2204	89	PIT
					MSG		L x W 0.13 x 0.17 PIT			520	P2204	89	
100	91	0.16	1	75	VOL		LTS +12.07	LTS	LTS	520	R6452	88	PIT
					MSG		L x W 0.13 x 0.17 PIT			520	P2204	88	
101	93	0.26	1	75	VOL		LTS +5.01	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.16 x 0.15 PIT			520	P2204	88	
		0.28	1	60	VOL		LTS +7.07	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.12 x 0.12 PIT			520	P2204	88	
104	51	0.13	1	34	VOL		LTS +9.51	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.16 x 0.16 PIT			520	P2204	88	
105	36	0.22	1	45	VOL		LTS +9.73	LTS	LTS	520	P1790	89	PIT
					MSG		L x W 0.16 x 0.13 PIT			520	P1790	89	
107	48	0.31	1	67	VOL		LTS +11.66	LTS	LTS	520	P2204	88	PIT
					MSG		L x W 0.10 x 0.12 PIT			520	P2204	88	
113	39	0.21	1	114	VOL		LTS +13.79	LTS	LTS	520	P2204	89	PIT
					MSG		L x W 0.13 x 0.16			520	P2204	89	

Total Indications Found = 56
Total Tubes Found = 26
Total Tubes in Input File = 26

SPECIAL INTEREST - VOL
SPEC. INT. 10% #2 - VOL LISTS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION		EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
7	10	0.37	P 1	60	VOL		08S	+0.60	08S	08S	520	P2204	88	VOL
					MSG		L x W	0.23 x 0.20 VOL			520	P2204	88	
10	12	0.22	P 1	92	VOL		09S	-0.82	09S	09S	520	P2204	88	VOL
					MSG		L x W	0.15 x 0.15 VOL			520	P2204	88	
32	71	0.33	1	149	VOL		06S	-0.97	06S	06S	520	B0690	88	VOL
					MSG		L x W	0.26 x 0.29 VOL			520	B0690	88	
40	49	0.28	P 1	71	VOL		07S	-0.65	07S	07S	520	P2204	88	VOL
					MSG		L x W	0.07 x 0.14 VOL			520	P2204	88	
65	115	0.51	P 1	61	VOL		04S	+0.55	04S	04S	520	R6452	89	VOL
			P 1		MSG		L x W	0.10 x 0.21 VOL			520	R6452	89	
73	51	0.17	P 1	63	VOL		03S	-0.69	03S	03S	520	P2204	88	VOL
					MSG		L x W	0.14 x 0.14 VOL			520	P2204	88	
75	123	0.09	P 1	49	VOL		04S	+0.72	04S	04S	520	P2204	88	VOL
					MSG		L x W	0.11 x 0.17 VOL			520	P2204	88	
88	31	0.21	P 1	89	VOL		09S	-0.72	09S	09S	520	P2204	88	VOL
					MSG		L x W	0.13 x 0.16 VOL			520	P2204	88	
92	36	0.34	P 1	77	VOL		07S	-0.59	07S	07S	520	P2204	89	VOL
					MSG		L x W	0.10 x 0.13 VOL			520	P2204	89	
104	46	0.20	P 1	63	VOL		07S	-0.66	07S	07S	520	P2204	88	VOL
					MSG		L x W	0.15 x 0.25 VOL			520	R6452	88	
118	66	0.24	P 1	81	VOL		07S	-0.77	07S	07S	520	P2204	88	VOL
					MSG		L x W	0.13 x 0.20 VOL			520	P2204	88	
119	12	0.19	P 1	98	VOL		07S	-0.76	07S	07S	520	P2204	88	VOL
					MSG		L x W	0.16 x 0.18 VOL			520	P2204	88	
120	63	0.30	P 1	74	VOL		07S	-0.74	07S	07S	520	P2204	88	VOL
					MSG		L x W	0.16 x 0.21 VOL			520	P2204	88	
127	96	0.21	P 1	64	VOL		10S	+0.69	10S	10S	520	R6452	89	VOL
			P 1		MSG		L x W	0.17 x 0.17 VOL			520	R6452	89	
130	23	0.48	P 1	87	VOL		07S	-0.80	07S	07S	520	R6452	88	VOL
			P 1		MSG		L x W	0.18 x 0.17 VOL			520	R6452	88	
131	50	0.30	P 1	68	VOL		07S	-0.75	07S	07S	520	P2204	88	VOL
					MSG		L x W	0.19 x 0.16 VOL			520	P2204	88	
132	45	0.15	P 1	92	VOL		07S	-0.70	07S	07S	520	P2204	88	VOL
					MSG		L x W	0.13 x 0.16 VOL			520	R6452	88	
134	63	0.43	P 1	84	VOL		07S	-0.64	07S	07S	520	P2204	88	VOL
					MSG		L x W	0.16 x 0.20 VOL			520	P2204	88	

Total Indications Found = 36
Total Tubes Found = 18
Total Tubes in Input File = 18

SPECIAL INTEREST - VOL
SPEC. INT. 10% #3 - VOL LISTS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION	EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
7	27	0.35	P 1	92	VOL		07S +0.56	07S	07S	520	L7871	86	VOL
					MSG		L x W 0.23 x 0.17 VOL			520	L7871	86	
		0.24	P 1	91	VOL		07S -0.58	07S	07S	520	L7871	86	VOL
					MSG		L x W 0.08 x 0.06 VOL			520	L7871	86	
		0.27	P 1	123	VOL		07S +0.65	07S	07S	520	L7871	86	VOL
					MSG		L x W 0.08 x 0.11			520	L7871	86	
22	59	0.18	P 1	72	VOL		10S +0.62	10S	10S	520	L7871	86	VOL
					MSG		L x W 0.15 x 0.13 VOL			520	L7871	86	
82	130	0.20	P 1	52	VOL		LTS +24.67	LTS	LTS	520	L7871	86	VOL
					MSG		L x W 0.23 x 0.16 VOL			520	L7871	86	
90	9	0.41	P 1	65	VOL		08S -0.64	08S	08S	520	L7871	86	VOL
					MSG		L x W 0.13 x 0.13 VOL			520	L7871	86	
107	15	0.33	P 1	91	VOL		14S -0.92	14S	14S	520	L7871	86	VOL
					MSG		L x W 0.16 x 0.13 VOL			520	L7871	86	
148	36				MSG		L x W 0.68 x 0.12 WAR			520	L7871	86	
		0.23	P 1	91	VOL		10S +0.79	10S	10S	520	L7871	86	VOL
					MSG		L x W 0.20 x 0.13 VOL			520	L7871	86	
150	7	0.39	P 1	52	VOL		10S -0.80	10S	10S	520	L7871	86	VOL
					MSG		L x W 0.14 x 0.09 VOL			520	L7871	86	

Total Indications Found = 19
Total Tubes Found = 7
Total Tubes in Input File = 7

******************************** BWNT TUBAN II (Version 2.1) 04/27/1994 13:16:16 ********************************

Crystal River Unit 3

S/G B

94/04 RFO

SPEC. INT. 10% EXP 3

SPECIAL INTEREST - PIT

SPEC. INT. 10% #3 - PIT LISTS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION		EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
15	35	0.33	P 1	63	VOL		09S	-0.91	09S	09S	520	C9318	90	PIT
					MSG		L x W	0.18 x 0.14 PIT			520	C9318	90	
35	38	0.15	1	49	VOL		LTS	+27.05	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.10 x 0.17 PIT			520	S1848	90	
36	40	0.13	1	94	VOL		LTS	+28.83	LTS	LTS	520	S1848	91	PIT
					MSG		L x W	0.13 x 0.13 PIT			520	S1848	91	
39	42	0.13	1	50	VOL		LTS	+8.77	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.17 x 0.14 PIT			520	S1848	90	
41	47	0.21	1	61	VOL		LTS	+9.51	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.10 x 0.17 PIT			520	S1848	90	
43	42	0.23	1	82	VOL		LTS	+9.53	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.10 x 0.17 PIT			520	S1848	90	
44	46	0.17	1	121	VOL		LTS	+8.46	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.13 x 0.13 PIT			520	S1848	90	
47	48	0.19	1	75	VOL		LTS	+5.86	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.17 x 0.17 PIT			520	S1848	90	
57	51	0.19	1	49	VOL		LTS	+9.90	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.13 x 0.15 PIT			520	S1848	90	
60	38	0.29	1	98	VOL		LTS	+9.56	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.17 x 0.15 PIT			520	S1848	90	
63	27	0.09	P 1	55	VOL		LTS	+8.38	LTS	LTS	520	M6664	90	PIT
					MSG		L x W	0.07 x 0.08 PIT			520	M6664	90	
63	29	0.18	1	98	VOL		LTS	+6.20	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.13 x 0.17 PIT			520	S1848	90	
66	28	0.25	1	55	VOL		LTS	+8.16	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.07 x 0.13 PIT			520	S1848	90	
84	98	0.07	P 1	79	VOL		LTS	+12.05	LTS	LTS	520	M6664	90	PIT
					MSG		L x W	0.13 x 0.13 PIT			520	M6664	90	
92	93	0.20	1	68	VOL		LTS	+6.12	LTS	LTS	520	S2680	90	PIT
					MSG		L x W	0.17 x 0.17 PIT			520	S2680	90	
96	29	0.09	1	50	VOL		LTS	+26.59	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.09 x 0.15 PIT			520	S1848	90	
96	116	0.09	1	70	VOL		15S	+21.39	15S	15S	520	S1848	90	PIT
					MSG		L x W	0.10 x 0.17 PIT			520	S1848	90	
99	94	0.12	1	87	VOL		LTS	+5.79	LTS	LTS	520	M6664	90	PIT
					MSG		L x W	0.13 x 0.14 PIT			520	M6664	90	
110	45	0.12	1		VOL		LTS	+11.65	LTS	LTS	520	S1848	91	PIT
					MSG		L x W	0.07 x 0.20 PIT			520	S1848	91	
112	40	0.21	1	36	VOL		LTS	+6.31	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.10 x 0.15 PIT			520	S1848	90	
117	44	0.22	1	95	VOL		LTS	+10.76	LTS	LTS	520	S1848	91	PIT
					MSG		L x W	0.16 x 0.13 PIT			520	S1848	91	
		0.21	1	74	VOL		LTS	+8.68	LTS	LTS	520	S1848	91	PIT
					MSG		L x W	0.10 x 0.17 PIT			520	S1848	91	

Total Indications Found = 44

Total Tubes Found = 21

Total Tubes in Input File = 21

SPECIAL INTEREST - VOL
SPEC. INT. 10% #3 - VOL LISTS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION		EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
5	38	0.58	P 1	83	VOL		09S	-0.85	09S	09S	520	S2680	90	VOL
					MSG		L x W	0.21 x 0.21 VOL			520	S2680	90	
27	94	0.27	P 1	71	VOL		11S	+0.84	11S	11S	520	S2680	91	VOL
			P 1		MSG		L x W	0.20 x 0.18 VOL			520	S2680	91	
36	47	0.26	P 1	73	VOL		07S	-0.73	07S	07S	520	S1848	90	VOL
					MSG		L x W	0.10 x 0.15 VOL			520	S1848	90	
49	47	0.08	P 1	25	VOL		LTS	+13.54	LTS	LTS	520	M6664	90	VOL
					MSG		L x W	0.13 x 0.13 VOL			520	M6664	90	
49	48	0.36	P 1	111	VOL		09S	-0.73	09S	09S	520	S1848	90	VOL
					MSG		L x W	0.13 x 0.19 VOL			520	S1848	90	
51	37	0.22	P 1	78	VOL		09S	-0.59	09S	09S	520	M6664	90	VOL
					MSG		L x W	0.13 x 0.14 VOL			520	M6664	90	
61	26	0.11	P 1	62	VOL		06S	-0.67	06S	06S	520	M6664	90	VOL
					MSG		L x W	0.08 x 0.17 VOL			520	M6664	90	
64	68	0.35	P 1	51	VOL		07S	-0.69	07S	07S	520	M6664	90	VOL
					MSG		L x W	0.16 x 0.16 VOL			520	M6664	90	
64	121	0.34	P 1	63	VOL		04S	+0.98	04S	04S	520	M6664	90	VOL
					MSG		L x W	0.08 x 0.11 VOL			520	M6664	90	
68	102	0.15	P 1	69	VOL		07S	-0.64	07S	07S	520	M6664	90	VOL
					MSG		L x W	0.11 x 0.11 VOL			520	M6664	90	
69	45	0.28	P 1	101	VOL		09S	+0.68	09S	09S	520	S2680	90	VOL
			P 1		MSG		L x W	0.21 x 0.18 VOL			520	S2680	90	
79	40	0.23	P 1	96	VOL		11S	-0.73	11S	11S	520	S1848	90	VOL
					MSG		L x W	0.13 x 0.24 VOL			520	S1848	90	
92	126	0.40	P 1	85	VOL		07S	-0.72	07S	07S	520	M6664	90	VOL
					MSG		L x W	0.11 x 0.15 VOL			520	M6664	90	
117	71	0.35	P 1	98	VOL		07S	-0.73	07S	07S	520	M6664	91	VOL
					MSG		L x W	0.08 x 0.12 VOL			520	M6664	91	
117	73	0.27	P 1	110	VOL		07S	-0.69	07S	07S	520	S1848	91	VOL
					MSG		L x W	0.10 x 0.18 VOL			520	S1848	91	
124	48	0.32	P 1	71	VOL		07S	-0.74	07S	07S	520	M6664	91	VOL
					MSG		L x W	0.12 x 0.16 VOL			520	M6664	91	
126	53	0.30	P 1	89	VOL		07S	-0.73	07S	07S	520	M6664	91	VOL
					MSG		L x W	0.18 x 0.20 VOL			520	M6664	91	
129	52	0.21	P 1	61	VOL		07S	-0.76	07S	07S	520	M6664	91	VOL
					MSG		L x W	0.13 x 0.20 VOL			520	M6664	91	
130	47	0.28	P 1	78	VOL		07S	-0.68	07S	07S	520	M6664	91	VOL
					MSG		L x W	0.15 x 0.15 VOL			520	M6664	91	
147	23	0.28	P 1	62	VOL		03S	-0.67	03S	03S	520	M6664	91	VOL
					MSG		L x W	0.23 x 0.20 VOL			520	M6664	91	

Total Indications Found = 40
Total Tubes Found = 20
Total Tubes in Input File = 20

II.G Figure 4-3

The data points on this Figure are contained within the following Tables from the same report. Calculated pressures are based on the BHK equation.

Table 4-3 for laboratory grown IGA
Table 4-6 for the pulled tube IGA
Table 4-8 for the pulled tube wear

The Tables from Reference 1 are included herein for completeness sake.

Table 4-3

Laboratory IGA Samples

(Calculations Based on Maximum Degradation Depth)

Tube Section	Degradation Width (in.)	Degradation Length (in.)	Maximum Degradation Depth (% TW)	Measured Burst Pressure (psi)	Calculated Burst Pressure (psi) (Framatome Equation)	Calculated Burst Pressure (psi) (BHK Equation)	Calculated Burst Pressure (psi) (Uniform Thinness Equation)	Calculated Burst Pressure (psi) (PNL Slot Equation)
23-B	0.263	1.508	73.4	6850	4363	6210	5378	5530
23-D	0.236	1.500	66.6	6300	5056	6847	6502	6233
24-B	0.245	1.490	78.7	5800	4019	6128	4727	5401
24-D	0.246	1.510	80.4	5250	3874	6027	4419	5285
25-B	0.253	1.506	41.5	9750	7044	8006	8465	7623
25-D	0.239	1.534	68.8	8400	4861	6704	6215	6070

Table 4-6

Burst Pressure of Tubes with IGA Degradation

Tube Section	Degradation Width (in.)	Degradation Length (in.)	Maximum Degradation Depth (% TW)	Measured Burst Pressure (psi)	Calculated Burst Pressure (psi) (Framatome Equation)	Calculated Burst Pressure (psi) (BHK Equation)	Calculated Burst Pressure (psi) (Uniform Thinness Equation)	Calculated Burst Pressure (psi) (PNL Slot Equation)
41-44-2[1]	0.106	0.069	54	9800	7155	8746	8705	8410
68-46-3	0.089	0.228	75	7000	4548	6705	5654	5996
97-91-2[1]	0.098	0.076	54	10300[2]	7305	9022	8968	8636
106-32-2[1]	0.070	0.062	40	10900[2]	8417	9568	9643	9305
72-49-2	0.029	0.041	19	10650	9638	9945	9998	9848

Notes:
1. Tube pulled in 1992.
2. 1992 burst pressure adjusted per Appendix A of Reference 3.

TABLE 4-8

Burst Pressure of Tubes with Wear Degradation

Tube Section	Degradation Width (in.)	Degradation Length (in.)	Maximum Degradation Depth (% TW)[1]	Measured Burst Pressure (psi)	Calculated Burst Pressure (psi) (Framatome Equation)	Calculated Burst Pressure (psi) (BHK Equation)	Calculated Burst Pressure (psi) (Uniform Thinness Equation)	Calculated Burst Pressure (psi) (PNL Slot Equation)
68-46-14	0.119	0.090	32	10850	8806	9802	9979	9544
68-46-18	0.141	0.425	19	10700	9005	9106	9534	8915
72-49-7	0	0	0	10650	10380	10120	10120	10120
72-49-13	0.134	0.094	16	10550	9416	9769	9903	6442

1. Based on tube wall thickness of 0.037 inches.

II.H EPRI Growth Rate Study

The data utilized in this study was previously provided to the NRC Staff as part of References 4, 5, and 6. It is contained within the 1992 EPRI pulled tube report as Attachment A to Appendix B. Excerpt from the EPRI report is provided herein for completeness.

Attachment A - Comparative Analysis of Eddy Current Signals

52-51 Locations(A)	3/18/89 Volt/Phase/%(B)	4/30/90 Volt/Phase/%(B)	5/14/92 Volt/Phase/%(B)	Met Locations/%(C)
6.38/6.43/6.21	0.89/148/2	0.62/153/0	0.62/148/16	9.12-9.34/34
8.66/8.64/8.48	0.47/94/66	0.57/92/68	0.33/79/82	11.39-11.57/53(2)
9.89/9.87/9.66	0.88/139/17	0.75/136/21	0.61/150/13	12.57-12.78/52(2)
10.77/10.73/10.59	0.19/80/77	0.24/47/96	0.30/66/89	13.50-13.68/45(2)
12.2/12.07/11.91	0.19/66/86	0.22/45/97	0.16/62/91	14.82-15.11/40(2)
12.95/12.86/12.72	0.43/161/0	0.26/162/0	0.32/164/0	15.63-15.86/33(2)
14.53/14.5/14.32	0.33/119/43	0.29/105/57	0.35/152/9	17.23-17.44/33

109-30 Locations	3/18/89 Volt/Phase/%	4/30/90 Volt/Phase/%	5/14/92 Volt/Phase/%	Met Locations/%
6.04/6.29/6.13	0.67/153/0	0.67/157/0	0.54/153/8	No met
8.34/8.54/8.46	0.75/125/36	0.66/126/35	0.65/137/31	15.75-15.95/50
9.52/9.77/9.66	0.33/131/28	0.27/129/31	0.23/135/33	No met
10.09/11.13/10.16	0.43/141/13	0.50/135/23	0.35/132/37	17.5-18.54/40
10.91/11.13/-	0.18/126/35	0.16/117/45	-	No met
12.72/12.95/12.87	0.13/45/97	0.27/53.93	0.18/26/60	No met
14.84/15.17/15.15	0.32/20/50	0.36/28/70	0.20/32/74	No met

106-32 Locations	3/18/89 Volt/Phase/%	4/30/90 Volt/Phase/%	5/14/92 Volt/Phase/%	Met Locations/%
6.32/6.32/6.35	0.62/141/13	0.86/147/2	0.58/138/30	13.73-13.76/49(3)
6.87/6.80/6.96	0.83/164/0	0.93/165/0	0.63/176/0	14.21-14.37/51(2)
7.58/7.57/7.71	0.35/145/6	0.42/132/25	0.40/167/0	14.98-15.12/25(4)
8.01/7.97/8.09	0.39/11/27	0.38/15/37	0.26/22/51	15.38-15.50/24
8.69/8.67/8.78	0.33/126/35	0.27/124/35	0.23/138/30	16.08-16.19/40(2)
8.94/8.91/9.01	0.19/74/81	0.21/39/95	0.14/82/80	16.32-16.42/29
9.71/9.68/9.73	0.49/150/0	0.60/145/4	0.29/152/9	17.09-17.14/38
9.98/9.97/---	0.46/139/16	0.50/146/4	0.34/157/1	17.38-17.39/40
11.34/11.33/11.44	0.35/127/34	0.53/146/4	0.32/150/13	18.74-18.85/42(2)
11.71/11.71/11.78	0.55/134/24	0.65/134/22	0.24/133/36	19.12-19.19/46(2)
13.09/13.20/13.34	0.57/133/25	0.58/140/14	0.36/150/13	20.5-20.75/39(3)
14.63/14.56/14.81	0.22/101/61	0.43/117/44	0.20/110/59	21.97-22.22/36(3)

Notes: (A) Eddy current flaw locations of respective tube from each outage
(B) 600 kHz eddy current data and flaw depth estimates
(C) Adjusted locations and associated met results, (X) indicates multiple # of indications

	3/18/89	4/30/90	5/14/92	Difference
Average Peak-to-Peak Volt	0.472	0.499	0.366	-23%
Average Phase Angle	120	117	127	+6%
Average Percent Wall Loss	30	33	33	+9%

II.I B&W Growth Rate Study

The data utilized within this study was previously provided to the NRC Staff as part of References 4 and 5. It is included herein for completeness.

TABLE 4: S/N Growth Study (Sheet 1 of 4)

CR-3 GROWTH EVALUATION OF FREESPAN INDICATIONS

	ROW	COL	LOCATION	1989 VOLTS	1990 VOLTS	1992 VOLTS	DELTA VOLTS	RATIO VOLTS
S/G B	83	56	001 + 31.46		0.60	0.71	0.11	1.18
S/G B	73	26	001 + 34.79		0.59	0.62	0.03	1.06
S/G A	48	111	002 + 24.73	0.47	0.39		-0.08	0.83
S/G B	74	26	002 + 25.96		0.31	0.36	0.05	1.16
S/G B	74	25	002 + 29.56		0.36	0.36	0.01	1.03
S/G B	93	22	002 + 35.20		0.61	0.68	0.07	1.11
S/G B	74	25	003 + 36.25		0.49	0.45	-0.04	0.92
S/G A	4	18	003 + 9.86	1.19	0.96	0.64	-0.55	0.54
S/G A	29	73	003 + 11.90		0.87	1.03	0.16	1.18
S/G A	61	86	004 + 9.63	0.54	0.42		-0.12	0.78
S/G A	26	81	006 + 1.46	0.83	0.75		-0.08	0.90
S/G A	27	93	008 + 3.34	0.15	0.14		-0.01	0.93
S/G A	27	93	008 + 12.40	0.71	0.64		-0.07	0.90
S/G A	27	93	008 + 22.54	0.51	0.52		0.01	1.02
S/G A	27	93	008 + 31.29	0.36	0.36		0.00	1.00
S/G A	61	86	010 + 8.79	0.72	0.65		-0.07	0.90
S/G A	16	41	011 + 16.07		0.57	0.70	0.13	1.23
S/G A	67	73	012 + 23.62		0.54	0.54	0.00	1.00
S/G B	121	1	013 + 16.97	0.42	0.44		0.02	1.05
S/G B	34	70	013 + 18.89		0.37	0.49	0.12	1.32
S/G B	80	41	014 + 11.86		0.65	0.61	-0.04	0.94
S/G B	62	7	015 + 1.67	0.68	0.79	0.54	-0.14	0.79
S/G B	63	5	015 + 6.99		0.82	1.01	0.19	1.23
S/G B	62	7	015 + 9.86	0.57	0.52	0.59	0.02	1.04
S/G B	62	7	015 + 21.19	0.51	0.56	0.70	0.19	1.37
S/G B	27	92	015 + 22.41		0.58	0.61	0.03	1.06
S/G B	27	92	015 + 22.70		0.81	0.78	-0.03	0.96
S/G B	62	7	015 + 24.75	0.73	0.81	0.86	0.13	1.18
S/G A	27	93	015 + 43.29	0.36	0.38		0.02	1.06
S/G A	27	93	015 + 43.66	0.85	0.81		-0.04	0.96
S/G B	89	43	LTS + 5.37		0.34	0.38	0.04	1.12
S/G B	46	44	LTS + 6.03		0.64	0.63	-0.01	0.98
S/G B	90	43	LTS + 6.42		0.82	0.74	-0.08	0.90
S/G B	58	83	LTS + 6.52		0.39	0.50	0.11	1.28
S/G B	64	39	LTS + 6.90		0.37	0.33	-0.04	0.89
S/G B	89	43	LTS + 7.00		0.68	0.78	0.10	1.15

TABLE 4: S/N Growth Study (Sheet 2 of 4)

CR-3 GROWTH EVALUATION OF FREESPAN INDICATIONS

	ROW	COL	LOCATION	1989 VOLTS	1990 VOLTS	1992 VOLTS	DELTA VOLTS	RATIO VOLTS
S/G B	46	47	LTS + 7.28		0.53	0.62	0.09	1.17
S/G B	49	35	LTS + 7.40		0.81	0.97	0.16	1.20
S/G B	46	44	LTS + 7.42		0.54	0.64	0.10	1.19
S/G B	117	44	LTS + 7.47		0.48	0.46	-0.02	0.96
S/G B	48	47	LTS + 7.80		0.60	0.64	0.04	1.07
S/G B	90	44	LTS + 8.22		0.54	0.59	0.06	1.09
S/G B	63	29	LTS + 8.29		0.50	0.59	0.09	1.18
S/G B	46	46	LTS + 8.71		0.64	0.68	0.04	1.06
S/G B	61	38	LTS + 9.36		0.60	0.71	0.11	1.18
S/G B	104	51	LTS + 9.56		0.72	0.76	0.04	1.06
S/G B	104	31	LTS + 9.97		0.81	0.81	0.00	1.00
S/G B	106	36	LTS + 10.11		0.66	0.56	-0.09	0.86
S/G B	66	99	LTS + 11.09	0.52		0.43	-0.09	0.83
S/G B	110	46	LTS + 11.22		0.62	0.51	-0.11	0.82
S/G B	63	29	LTS + 11.49		0.60	0.62	0.02	1.03
S/G B	97	27	LTS + 11.55		0.83	0.78	-0.06	0.94
S/G B	103	44	LTS + 11.66		0.71	0.60	-0.11	0.86
S/G B	64	39	LTS + 12.33		0.38	0.39	0.01	1.03
S/G B	103	44	LTS + 12.36		0.67	0.54	-0.13	0.81
S/G B	63	29	LTS + 12.37		0.39	0.46	0.07	1.18
S/G B	96	43	LTS + 12.54		0.57	0.44	-0.13	0.77
S/G B	52	81	LTS + 12.86	0.54	0.42	0.47	-0.07	0.87
S/G B	46	44	LTS + 13.26		0.48	0.58	0.10	1.20
S/G B	49	49	LTS + 13.61		0.42	0.55	0.13	1.31
S/G B	67	43	LTS + 14.64		0.56	0.57	0.02	1.04
S/G B	70	42	LTS + 14.71		0.76	0.76	0.00	1.00
S/G B	63	39	LTS + 15.42		0.37	0.46	0.09	1.24
S/G B	70	42	LTS + 15.67		0.52	0.55	0.03	1.06
S/G B	46	44	LTS + 24.60		0.52	0.51	-0.01	0.98
	AVG. DEV.						0.01	1.03
	STD. DEV.						0.11	0.16

TABLE 4: S/N Growth Study (Sheet 3 of 4)
CR-3 GROWTH EVALUATION OF SUPPORT PLATE INDICATION

	ROW	COL	LOCATION	1989 VOLTS	1990 VOLTS	1992 VOLTS	DELTA VOLTS	RATIO VOLTS
S/G A	28	93	007 + 0.00	0.86	1.27	0.69	-0.16	0.81
S/G B	59	113	007 - 0.66	0.83	0.77		-0.06	0.93
S/G B	67	52	007 - 0.69	0.90	0.84	0.93	0.03	1.03
S/G B	68	58	007 - 0.72	0.72	0.70		-0.02	0.97
S/G B	88	12	007 - 0.72	0.91	0.74		-0.17	0.81
S/G B	92	38	007 - 0.73		0.80	0.68	-0.12	0.85
S/G B	142	11	007 - 0.73		0.38	0.35	-0.03	0.92
S/G A	114	109	007 - 0.74		0.39	0.28	-0.11	0.72
S/G B	119	63	007 - 0.75	0.68	0.68	0.81	0.13	1.19
S/G B	142	12	007 - 0.75		0.35	0.28	-0.07	0.80
S/G B	130	23	007 - 0.76		0.82	0.58	-0.24	0.71
S/G B	136	32	007 - 0.76		1.24	0.62	-0.62	0.50
S/G B	17	74	007 - 0.77		1.43	0.69	-0.74	0.48
S/G B	109	52	007 - 0.78		0.80	0.53	-0.27	0.66
S/G B	145	34	007 - 0.78		0.51	0.61	0.10	1.20
S/G B	146	14	007 - 0.78		1.05	0.64	-0.41	0.61
S/G A	14	8	007 - 0.79		0.41	0.52	0.11	1.27
S/G B	132	30	007 - 0.79		1.06	0.24	-0.82	0.23
S/G B	132	36	007 - 0.79		0.96	0.31	-0.65	0.32
S/G B	133	36	007 - 0.79		1.41	0.26	-1.15	0.18
S/G B	141	29	007 - 0.79		0.41	0.16	-0.25	0.39
S/G B	128	43	007 - 0.80		0.51	0.34	-0.17	0.67
S/G B	144	16	007 - 0.80		0.76	0.71	-0.05	0.93
S/G B	144	22	007 - 0.81		0.41	0.31	-0.10	0.76
S/G B	144	26	007 - 0.81		0.37	0.14	-0.23	0.38
S/G B	117	73	007 - 0.84		0.51	0.47	-0.04	0.92
S/G B	144	12	007 - 0.84		0.67	0.58	-0.09	0.87
S/G B	57	38	007 - 0.86		0.71	0.52	-0.19	0.73
S/G B	147	24	007 - 0.86		0.53	0.39	-0.14	0.74
S/G B	180	15	007 - 0.87		0.64	0.65	0.01	1.02
S/G B	144	56	007 - 0.90		0.35	0.40	0.05	1.14
S/G B	117	71	007 - 0.95		0.39	0.33	-0.06	0.85
S/G A	73	128	008 + 0.00		0.51	0.53	0.02	1.04
S/G A	28	93	008 + 0.64	0.67	0.44	0.61	-0.06	0.91
S/G B	58	125	008 - 0.73	0.44	0.58		0.14	1.32

TABLE 4: S/N Growth Study (Sheet 4 of 4)

CR-3 GROWTH EVALUATION OF SUPPORT PLATE INDICATION

	ROW	COL	LOCATION	1989 VOLTS	1990 VOLTS	1992 VOLTS	DELTA VOLTS	RATIO VOLTS
S/G A	94	129	008 - 0.74	0.75	0.58	0.66	-0.10	0.87
S/G A	62	128	008 - 0.77		0.40	0.46	0.06	1.13
S/G B	6	46	008 - 0.77		1.44	0.50	-0.94	0.35
S/G B	146	26	008 - 0.81	?????	0.82	0.14	-0.68	0.17
S/G B	59	120	008 - 0.83	0.56	0.76		0.20	1.36
S/G B	31	7	008 - 0.84		0.43	0.57	0.14	1.33
S/G A	61	1	009 + 0.69	1.16	0.83	0.66	-0.47	0.59
S/G B	4	19	009 + 0.66		0.60	0.46	-0.06	0.90
S/G A	88	53	009 + 0.75	0.60	0.62		-0.08	0.87
S/G B	86	6	009 + 0.78	0.60	0.56	0.50	-0.10	0.83
S/G B	54	124	009 - 0.68		0.33	0.23	-0.10	0.70
S/G B	82	6	009 - 0.72		0.58	0.62	0.04	1.07
S/G B	82	38	009 - 0.72		0.69	0.42	-0.27	0.61
S/G B	6	49	009 - 0.78	1.26	1.22	0.46	-0.80	0.37
S/G B	14	7	009 - 0.78		0.91	0.40	-0.51	0.44
S/G B	4	24	009 - 0.81	1.27	1.10	0.46	-0.81	0.36
S/G B	10	12	009 - 0.85	0.86	1.10	0.44	-0.42	0.51
S/G B	146	28	009 - 0.86		0.59	0.09	-0.50	0.15
S/G A	22	69	010 + 0.66		0.46	0.31	-0.15	0.67
S/G B	149	30	010 + 0.66		0.53	0.40	-0.13	0.75
S/G A	56	3	010 + 0.73		0.44	0.60	0.16	1.36
S/G B	151	3	010 - 0.69		0.42	0.28	-0.14	0.67
S/G B	127	96	010 - 0.73	0.49		0.56	0.07	1.14
S/G B	151	13	010 - 0.75		0.76	0.63	-0.13	0.83
S/G A	149	20	010 - 0.77		0.44	0.50	0.06	1.14
S/G A	146	38	010 - 0.78		0.42	0.47	0.05	1.12
S/G A	146	50	010 - 0.79		0.54	0.51	-0.03	0.94
	AVG. DEV.						-0.19	0.79
	STD. DEV.						0.30	0.31

II.J Figures 4-5, 4-6, 4-7, and 4-8

These scatter plots present the results of the Packer Engineering growth rate study. The indications utilized within this study, including the 1992 and 1994 field bobbin coil voltage readings, are provided.

Data Utilized In Figure 4-5

Tube Identification		Location			1992 Volts		1994 Volts
4	18	"03S	9.58		0.76		0.88
8	30	"09S	4.71		0.57		0.62
8	30	"LTS	21.33		0.46		0.67
8	30	"06S	20.14		0.6		0.97
13	57	"02S	22.27		0.51		0.74
16	47	"01S	20.31		0.39		0.41
16	41	"11S	16.24		0.55		0.47
24	88	"10S	13.59		0.75		0.63
24	86	"08S	31.07		0.98		0.66
24	89	"13S	31.53		0.75		0.92
26	90	"15S	40.2		0.78		0.83
26	90	"15S	21.3		0.63		0.97
27	91	"09S	31.07		0.56		0.63
27	91	"02S	20.24		0.63		0.77
27	91	"11S	21.45		0.66		0.8
27	91	"07S	25.06		0.66		0.8
27	93	"08S	12		0.74		0.81
27	91	"LTS	38.36		0.75		1.19
28	92	"08S	15.64		0.4		0.6
29	73	"03S	12.16		1.04		1.06
33	52	"11S	35.22		0.48		0.55
34	72	"02S	15.67		0.85		1.35
35	59	"12S	12.36		1.43		1.47
39	1	"LTS	23.46		1.13		1.17
40	69	"10S	28.65		0.28		0.32
40	117	"13S	28.69		0.66		0.6
42	68	"11S	3.79		1.19		0.66
42	69	"09S	23.93		0.49		0.69
47	58	"05S	22.5		1.83		1.78
57	122	"08S	31.21		0.5		1.12
58	123	"09S	14.11		1.22		1.16
58	125	"13S	25.6		1.09		1.34
60	65	"12S	8.7		0.27		0.31
61	88	"10S	8.81		0.45		0.45
63	128	"LTS	17.54		0.32		0.47
67	73	"12S	23.93		0.34		0.38
71	47	"11S	25.82		2.01		1.62
71	90	"11S	8.47		1.36		1.65
73	85	"05S	13.59		2.09		2.1
82	130	"LTS	24.67		0.7		1.02
86	74	"11S	20.1		0.29		0.24
86	74	"11S	16.06		0.57		0.66
90	72	"12S	15.38		0.91		1.11
91	37	"01S	27.75		0.68		0.6
96	83	"06S	3.05		0.48		0.44
96	83	"06S	27.24		0.78		0.61
108	86	"05S	3.47		0.32		0.27

Data Utilized In Figure 4-5

Tube Identification		Location			1992 Volts		1994 Volts
108	68	"LTS	40.45		0.41		0.41
108	86	"10S	27.99		0.46		0.41
108	70	"11S	32.12		0.52		0.63
109	72	"03S	18.66		0.74		0.73
111	68	"15S	10.16		0.47		0.67
113	112	"14S	9.73		0.49		0.56
120	77	"04S	2.36		0.64		0.89
129	69	"04S	23.49		0.47		0.47
131	89	"15S	5.49		0.89		0.65
135	63	"03S	34.01		0.58		0.6
135	63	"05S	12.96		0.98		0.89
136	49	"10S	33.09		0.43		0.69
147	45	"12S	18.88		0.53		0.48
147	45	"12S	12.43		0.37		0.62
147	45	"11S	32.56		0.49		0.79

Data Utilized in Figure 4-6

Tube Identification		Location			1992 Volts		1994 Volts
2	8	"12S	0.6		1.62		1.17
9	34	"12S	0.67		0.39		0.47
10	6	"12S	0.58		0.75		0.48
11	7	"12S	0.62		1.16		1.11
12	7	"07S	-0.73		0.55		0.63
14	8	"07S	-0.62		0.71		0.73
15	30	"06S	0.76		1.11		1.06
18	25	"09S	0.63		0.64		0.52
18	74	"06S	0.66		0.9		0.68
19	3	"12S	0.66		0.89		0.96
22	59	"10S	0.77		0.72		0.66
22	79	"11S	0.61		2.71		2.58
23	91	"08S	-0.87		0.66		0.7
24	7	"12S	0.63		0.6		0.53
26	95	"08S	-0.72		0.72		0.61
27	93	"08S	0.59		0.91		0.72
27	91	"08S	13.36		0.87		0.78
27	89	"04S	-0.58		1.26		1.4
28	93	"08S	0.61		0.83		0.72
31	11	"09S	0.45		0.77		0.89
31	32	"10S	0.7		1.17		1.21
37	113	"11S	0.72		1.4		1.45
41	116	"12S	0.67		0.82		0.87
41	116	"11S	-0.75		1.15		1.05
52	11	"03S	0.69		0.54		0.47
56	5	"09S	0.59		0.58		0.7
56	3	"10S	0.71		0.55		0.85
57	2	"08S	0.67		0.51		0.89
59	2	"08S	0.61		0.65		0.67
60	1	"10S	0.67		0.51		0.58
60	103	"04S	0.68		0.61		0.92
61	124	"08S	-0.8		0.35		0.62
61	1	"09S	0.59		0.93		0.83
62	5	"09S	0.56		0.41		0.39
62	4	"07S	-0.72		0.68		0.59
65	87	"04S	0.66		0.82		0.82
67	62	"10S	0.68		1.14		0.59
68	130	"11S	-0.81		0.38		0.65
68	22	"12S	0.67		0.57		0.8
73	41	"12S	0.82		0.5		1.13
75	29	"07S	-0.69		0.89		0.84
77	17	"07S	-0.86		0.8		0.65
78	123	"08S	-0.74		0.67		0.69
79	19	"04S	0.79		0.45		0.5
79	128	"10S	0.48		0.83		1.13
82	40	"08S	-0.77		0.42		0.27
82	130	"11S	-0.66		0.57		0.41

Data Utilized in Figure 4-6

Tube Identification		Location			1992 Volts		1994 Volts
82	58	"10S	0.68		0.35		0.64
82	53	"10S	0.62		0.45		0.74
85	9	"08S	-0.79		0.57		0.47
90	9	"08S	-0.74		0.7		0.96
94	129	"08S	-0.7		0.85		1.06
96	70	"04S	0.71		0.66		0.81
107	31	"03S	0.51		0.57		0.6
107	31	"09S	0.68		0.44		0.62
114	109	"07S	-0.92		0.4		0.45
121	32	"05S	-0.7		0.51		0.53
125	80	"04S	0.67		0.57		0.89
125	63	"08S	0.7		0.55		0.96
127	60	"09S	0.71		0.59		0.84
134	3	"12S	0.68		1.4		1.21
135	71	"09S	-0.86		1.64		2.09
136	80	"08S	-0.67		0.68		0.68
143	48	"07S	-0.81		0.46		0.51
146	26	"07S	-0.97		0.49		0.64
146	7	"08S	-0.8		0.41		0.71
146	7	"08S	0.68		0.52		0.75
146	22	"07S	-0.86		0.82		0.75
148	3	"11S	0.56		0.65		0.81
149	19	"12S	-0.79		0.97		0.54
149	11	"08S	-0.77		0.91		0.56
150	18	"10S	-0.57		0.72		0.51
150	7	"10S	-0.74		0.72		0.85

Data Utilized in Figure 4-7

Tube Identification		Location			1992 Volts		1994 Volts
7	11	"""12S"	27.9		1.41		0.97
15	2	"""10S"	26.32		0.57		0.46
25	4	"""LTS"	24.58		0.62		0.72
25	10	"""15S"	23.46		1.19		1.21
25	10	"""15S"	24.76		1.21		1.23
27	92	"""15S"	21.99		0.6		0.61
27	94	"""11S"	9.56		0.7		0.74
27	71	"""LTS"	2.91		1.42		1.21
31	52	"""14S"	13.4		0.35		0.39
34	70	"""13S"	18.91		0.37		0.41
35	38	"""LTS"	14.35		0.39		0.43
35	38	"""LTS"	27.53		0.7		0.7
36	44	"""LTS"	7.75		0.57		0.52
36	40	"""LTS"	10.68		0.44		0.54
37	40	"""LTS"	6.64		0.27		0.56
37	40	"""LTS"	9.39		0.77		0.66
37	41	"""LTS"	7.11		0.74		0.74
37	44	"""LTS"	5.86		0.64		0.78
38	41	"""LTS"	6.53		0.64		0.75
39	41	"""LTS"	12.56		0.37		0.37
39	41	"""LTS"	22.1		0.44		0.43
39	41	"""LTS"	30.2		0.46		0.47
39	41	"""LTS"	26.22		0.49		0.55
39	42	"""LTS"	9.15		0.72		0.65
39	41	"""LTS"	11.23		0.52		0.75
39	45	"""LTS"	8.31		0.78		0.89
39	41	"""LTS"	9.62		1.27		1.13
40	47	"""LTS"	13.22		0.53		0.48
40	47	"""LTS"	8.72		0.56		0.5
41	47	"""LTS"	14.27		0.38		0.43
41	47	"""LTS"	9.36		0.7		0.65
42	41	"""LTS"	8.52		0.49		0.38
42	39	"""LTS"	7.82		0.32		0.45
42	48	"""LTS"	9.16		0.49		0.54
43	80	"""12S"	6.7		0.69		[illegible]
43	42	"""LTS"	9.34		0.71		0.63
44	46	"""LTS"	12.09		0.73		0.66
45	37	"""LTS"	10.98		0.38		0.37
45	46	"""LTS"	12.29		0.59		0.6
45	77	"""01S"	30.29		0.77		0.7
46	44	"""LTS"	7.25		0.47		0.6
46	46	"""LTS"	8.4		0.54		0.61
46	44	"""LTS"	13.07		0.58		0.64
46	37	"""LTS"	6.47		0.74		0.79
47	31	"""13S"	9.55		1.03		1.23
48	38	"""LTS"	10.88		0.34		0.67
49	42	"""LTS"	9.48		0.49		0.46

Data Utilized in Figure 4-7

Tube Identification		Location			1992 Volts		1994 Volts
49	48	"""LTS"	10.51		0.35		0.49
49	41	"""LTS"	12.39		0.42		0.51
49	42	"""LTS"	8.87		0.66		0.52
49	49	"""LTS"	13.52		0.84		0.59
49	38	"""LTS"	10.35		0.61		0.6
49	47	"""LTS"	10.34		0.68		0.63
49	48	"""LTS"	7.42		0.69		0.65
49	50	"""LTS"	10.71		1.02		0.65
49	48	"""LTS"	14.18		0.9		0.84
49	35	"""LTS"	7.35		0.96		0.93
50	35	"""LTS"	12.26		0.23		0.51
50	33	"""LTS"	7.64		0.79		0.78
51	48	"""LTS"	9.29		0.65		0.64
51	48	"""LTS"	6.76		0.89		0.84
52	81	"""LTS"	12.9		0.51		0.39
52	41	"""LTS"	7.59		0.35		0.45
52	43	"""LTS"	8.22		0.62		0.66
52	36	"""LTS"	10.1		0.67		0.73
52	40	"""LTS"	12.78		0.79		0.76
53	81	"""LTS"	15.58		0.52		0.51
53	81	"""LTS"	16.47		0.57		0.65
54	37	"""LTS"	8.35		0.51		0.64
55	41	"""LTS"	15.36		0.3		0.3
55	41	"""LTS"	10.85		0.49		0.44
55	81	"""LTS"	6.81		0.83		0.64
56	80	"""05S"	22.92		0.31		0.26
56	82	"""LTS"	6.91		0.51		0.65
56	44	"""LTS"	8.33		0.82		0.81
56	51	"""LTS"	8.07		0.81		0.81
56	53	"""13S"	15.99		0.74		0.81
56	50	"""LTS"	11.93		0.61		0.82
57	40	"""LTS"	6.47		0.38		0.47
57	44	"""LTS"	9.56		0.53		0.48
57	96	"""LTS"	10.05		0.63		0.59
57	52	"""LTS"	7.28		0.74		0.82
57	38	"""LTS"	12.17		1.14		0.83
58	44	"""LTS"	8.12		0.56		0.4
58	83	"""LTS"	6.4		0.3		0.4
58	41	"""LTS"	11.63		0.63		0.41
58	27	"""LTS"	10.43		0.57		0.52
58	45	"""LTS"	9.35		0.46		0.54
58	38	"""LTS"	7.51		1.56		1.44
59	25	"""LTS"	10.58		0.2		0.34
59	49	"""LTS"	7.66		0.21		0.4
59	39	"""LTS"	11.11		0.5		0.47
59	26	"""LTS"	8.54		0.46		0.49
59	39	"""LTS"	12.57		0.58		0.55

Data Utilized in Figure 4-7

Tube Identification		Location			1992 Volts		1994 Volts
61	26	"""LTS"	12.61		0.43		0.45
61	26	"""LTS"	15.07		0.46		0.53
61	29	"""LTS"	10.36		0.37		0.57
62	27	"""LTS"	7.34		0.52		0.59
62	33	"""LTS"	13.23		0.38		0.71
63	29	"""LTS"	11.41		0.52		0.35
63	39	"""LTS"	15.12		0.36		0.39
63	29	"""LTS"	8.14		0.49		0.44
63	29	"""LTS"	10.11		0.37		0.52
63	27	"""LTS"	7.56		0.65		0.85
64	39	"""LTS"	11.94		0.24		0.3
64	39	"""LTS"	6.59		0.37		0.34
64	46	"""LTS"	11.53		0.38		0.41
64	46	"""LTS"	9.39		0.45		0.52
65	28	"""LTS"	9.27		0.3		0.77
65	28	"""LTS"	6.39		0.66		0.91
66	28	"""LTS"	8.47		0.72		0.78
67	36	"""08S"	19.87		0.56		0.48
67	43	"""LTS"	14.53		0.52		0.6
68	35	"""LTS"	11.88		0.78		0.8
69	99	"""LTS"	10.96		0.49		0.45
70	42	"""LTS"	15.41		0.47		0.56
70	42	"""LTS"	14.41		0.68		0.57
72	29	"""09S"	3.11		0.54		0.67
73	26	"""01S"	12.73		0.38		0.33
73	74	"""03S"	27.68		0.37		0.39
73	39	"""LTS"	13.94		0.44		0.44
74	24	"""09S"	10.57		0.37		0.23
74	25	"""02S"	36.06		0.39		0.36
80	41	"""14S"	11.86		0.39		0.36
84	95	"""LTS"	8.19		0.44		0.4
84	95	"""LTS"	9.27		0.38		0.47
84	99	"""LTS"	9.93		0.32		0.94
86	32	"""LTS"	10.02		0.56		0.53
86	94	"""LTS"	7.74		0.59		0.59
89	43	"""LTS"	5.37		0.31		0.28
89	95	"""LTS"	12.99		0.55		0.48
89	95	"""LTS"	14.59		0.65		0.51
89	96	"""LTS"	8.34		0.4		0.52
89	96	"""LTS"	13.51		0.66		0.56
89	43	"""LTS"	7		0.81		0.91
89	34	"""LTS"	12.45		1.54		1.4
90	94	"""LTS"	14.49		0.36		0.41
90	43	"""LTS"	10.46		0.66		0.56
90	43	"""LTS"	8.03		0.64		0.65
90	44	"""LTS"	7.65		0.77		0.82
90	43	"""LTS"	6.32		1		0.95

Tube Identification		Location			1992 Volts		1994 Volts
92	93	"""LTS"	10.13		0.53		0.32
92	45	"""LTS"	6.53		0.54		0.49
92	44	"""LTS"	10.2		0.67		0.71
92	44	"""LTS"	9.01		0.63		0.81
92	96	"""LTS"	9.61		0.68		0.82
92	28	"""LTS"	8.1		0.79		1
92	28	"""LTS"	6.73		1.42		1.32
92	28	"""LTS"	10.93		1.6		1.39
92	28	"""LTS"	8.79		1.18		1.45
93	22	"""02S"	35.09		0.46		0.36
94	81	"""10S"	18.39		0.72		0.93
96	28	"""LTS"	7.27		0.42		0.41
96	116	"""15S"	23.65		0.69		0.76
97	94	"""03S"	5.65		0.68		0.64
97	27	"""LTS"	11.2		0.98		0.89
97	43	"""LTS"	17.95		3.24		3.27
98	93	"""LTS"	7.01		0.19		0.43
98	43	"""LTS"	12.48		0.69		0.44
98	95	"""LTS"	7		0.95		0.95
99	94	"""LTS"	6		0.7		0.88
100	94	"""LTS"	7.54		0.47		0.3
100	27	"""LTS"	5.9		0.34		0.56
100	37	"""12S"	31		0.59		0.74
100	32	"""LTS"	8.35		0.96		0.8
100	91	"""LTS"	11.73		0.78		0.81
101	41	"""LTS"	16.24		0.43		0.41
101	31	"""LTS"	12.5		0.68		0.63
101	93	"""LTS"	5.24		0.79		0.67
101	31	"""LTS"	11.35		0.61		0.71
101	93	"""LTS"	7.44		0.74		0.76
101	41	"""LTS"	15.02		0.81		0.9
101	91	"""LTS"	8.98		0.95		1.09
103	37	"""LTS"	15.4		0.37		0.27
103	37	"""LTS"	9.99		0.53		0.5
103	44	"""LTS"	13.82		0.45		0.5
103	81	"""03S"	11.67		0.52		0.5
103	35	"""LTS"	9.63		0.83		0.51
103	44	"""LTS"	12.25		0.69		0.58
103	44	"""LTS"	11.57		0.99		0.7
103	90	"""LTS"	8.14		1.05		0.78
103	34	"""LTS"	9.83		0.45		0.8
103	90	"""LTS"	11.71		0.63		0.93
104	51	"""LTS"	10.17		0.34		0.2
104	51	"""LTS"	9.75		0.76		0.5
104	36	"""LTS"	6.94		0.48		0.52
104	33	"""LTS"	5.51		0.55		0.7
104	33	"""LTS"	6.52		0.81		0.76

Data Utilized in Figure 4-7

Tube Identification		Location			1992 Volts		1994 Volts
104	31	"""LTS"	10.12		0.91		0.88
105	43	"""LTS"	11.8		0.27		0.27
105	36	"""LTS"	10.01		0.73		0.47
105	43	"""LTS"	16.58		0.31		0.47
105	43	"""LTS"	18.01		0.54		0.47
105	43	"""LTS"	12.22		0.34		0.49
105	32	"""LTS"	9.4		0.48		0.74
106	35	"""LTS"	8.7		0.37		0.61
106	47	"""LTS"	9.62		0.57		0.61
107	50	"""LTS"	5.71		0.25		0.35
107	50	"""LTS"	10.94		0.41		0.5
108	33	"""LTS"	13.01		0.29		0.28
108	33	"""LTS"	12.65		0.53		0.47
108	33	"""LTS"	6.36		0.74		0.59
109	32	"""LTS"	9.52		0.94		0.61
110	45	"""LTS"	11.16		0.71		0.32
110	70	"""03S"	26.41		0.5		0.47
111	41	"""LTS"	9.14		0.58		0.6
112	40	"""LTS"	9.31		0.52		0.56
112	40	"""LTS"	9.99		0.65		0.56
112	40	"""LTS"	13.33		0.51		0.78
112	40	"""LTS"	6.65		0.7		0.78
113	48	"""LTS"	16.97		0.43		0.53
113	48	"""LTS"	14.1		0.59		0.54
113	39	"""LTS"	10.41		0.64		0.63
113	39	"""LTS"	12.05		0.73		0.7
113	39	"""LTS"	15.42		0.65		0.74
113	39	"""LTS"	11.23		0.63		0.9
117	44	"""LTS"	7.48		0.92		1.12
118	40	"""LTS"	6.35		0.31		0.37
118	40	"""LTS"	8.67		0.57		0.53
118	40	"""LTS"	24.57		0.31		0.56
123	10	"""07S"	6.55		0.9		0.9
123	10	"""07S"	5.59		0.94		1.07
124	8	"""09S"	12.33		0.67		0.64
127	8	"""06S"	8.28		0.43		0.39
127	8	"""04S"	17.31		0.5		0.48
127	8	"""05S"	24.94		0.6		0.49
127	8	"""06S"	17.03		0.67		0.62
127	8	"""02S"	19.16		0.67		0.64
127	8	"""12S"	14.71		0.71		0.67
130	57	"""07S"	28.76		0.38		0.5
134	44	"""08S"	16.5		0.38		0.45
142	42	"""10S"	22.32		0.37		0.35

Tube Identification		Location			1992 Volts		1994 Volts
2	21	"""10S"	-0.68		0.75		0.79
4	16	"""08S"	-0.78		0.46		0.31
4	19	"""09S"	0.62		0.67		0.7
4	24	"""09S"	-0.85		0.49		0.73
5	38	"""09S"	-0.82		0.71		1.08
6	46	"""08S"	-0.77		0.68		0.61
6	44	"""09S"	-0.81		0.69		0.83
6	49	"""09S"	-0.82		0.29		0.9
7	26	"""12S"	-0.86		0.29		0.56
7	20	"""07S"	0.56		0.98		0.81
10	27	"""09S"	-0.83		0.61		0.53
10	12	"""09S"	-0.81		0.79		0.56
13	27	"""03S"	-0.72		0.41		0.45
13	9	"""08S"	-0.83		0.45		0.77
14	34	"""07S"	-0.86		0.82		0.89
14	7	"""09S"	-0.95		0.53		0.91
15	5	"""08S"	-0.87		0.64		0.46
15	3	"""09S"	-0.81		0.56		0.63
15	35	"""09S"	-0.85		0.72		0.87
16	38	"""07S"	-0.72		0.45		0.48
17	74	"""07S"	-0.79		1.53		0.79
19	6	"""09S"	-0.9		0.48		0.69
19	30	"""07S"	-0.86		0.63		0.86
21	40	"""07S"	-0.77		0.42		0.46
21	40	"""09S"	-0.82		0.69		0.78
22	35	"""07S"	-0.81		0.6		0.61
23	36	"""03S"	-0.72		0.66		0.54
23	12	"""08S"	-0.84		0.32		0.63
27	5	"""09S"	-0.79		0.52		0.6
28	6	"""09S"	-0.85		0.54		0.49
29	42	"""03S"	-0.69		0.52		0.47
30	14	"""09S"	-0.84		0.43		0.64
31	7	"""08S"	-0.81		0.61		0.75
32	71	"""06S"	-1.04		0.75		0.43
33	8	"""07S"	0.67		0.75		0.85
34	8	"""09S"	-0.93		0.34		1.29
35	42	"""09S"	-0.82		0.87		0.65
35	20	"""04S"	-0.69		0.93		0.95
36	47	"""07S"	-0.83		0.72		0.45
37	12	"""09S"	-0.72		0.59		0.38
37	48	"""07S"	-0.68		0.81		0.78
39	61	"""09S"	-0.79		0.56		0.56
39	49	"""03S"	-0.67		0.69		0.74
39	8	"""07S"	0.65		0.8		0.78
40	52	"""07S"	-0.79		0.85		0.42
40	8	"""07S"	0.77		0.44		0.44
40	49	"""07S"	-0.77		0.75		0.64

Data Utilized in Figure 4-8

Tube Identification		Location			1992 Volts		1994 Volts
41	56	"""03S"	-0.81		0.54		0.44
41	53	"""03S"	-0.73		1.27		0.88
42	69	"""03S"	-0.79		0.63		0.56
45	7	"""07S"	0.77		0.99		0.78
47	7	"""07S"	0.67		0.82		0.67
48	7	"""07S"	0.53		0.82		0.77
52	30	"""10S"	-0.85		0.83		0.98
54	124	"""09S"	-0.77		0.53		0.28
54	6	"""07S"	0.71		0.59		0.58
54	51	"""07S"	-0.62		0.68		0.78
54	98	"""05S"	-0.28		0.98		0.98
58	125	"""08S"	-0.79		0.45		0.39
59	1	"""09S"	-0.78		0.93		0.6
59	113	"""07S"	-0.8		0.75		0.63
59	122	"""09S"	-0.74		1.19		1.04
60	117	"""07S"	-0.77		0.48		0.56
60	119	"""07S"	-0.8		1.12		0.99
62	13	"""03S"	-0.67		0.68		0.51
63	34	"""07S"	-0.68		1.17		1.33
63	69	"""07S"	-0.74		1.44		1.46
64	68	"""07S"	-0.8		0.7		0.48
64	121	"""04S"	0.65		0.71		0.83
65	115	"""04S"	0.71		0.73		0.85
65	122	"""05S"	0.65		1.02		0.85
65	121	"""05S"	0.62		0.96		1.03
65	119	"""05S"	0.59		1.59		1.68
66	111	"""05S"	0.71		0.58		0.95
66	126	"""04S"	0.68		1.04		1.14
67	112	"""05S"	0.65		0.58		0.63
67	33	"""07S"	-0.65		1.07		0.78
68	56	"""09S"	0.56		0.42		0.6
68	125	"""05S"	-0.59		0.65		0.67
68	49	"""09S"	0.73		0.52		0.74
68	48	"""09S"	0.68		0.65		0.83
68	42	"""09S"	0.65		0.6		0.92
68	21	"""08S"	-0.9		1.41		1.22
69	56	"""09S"	-0.63		1.14		0.77
69	56	"""07S"	-0.68		1.31		0.98
69	47	"""09S"	0.78		0.49		1.07
70	58	"""09S"	0.68		0.37		0.57
70	61	"""09S"	0.68		0.59		0.62
70	125	"""12S"	0.3		0.63		0.81
70	68	"""07S"	-0.82		0.86		1.04
71	43	"""09S"	0.71		0.56		0.92
72	64	"""10S"	-0.7		0.48		0.6
73	66	"""05S"	-0.64		0.59		0.66
73	56	"""07S"	-0.72		0.57		0.68

Data Utilized in Figure 4-8

Tube Identification		Location			1992 Volts		1994 Volts
73	66	"""06S"	-0.67		0.99		1.06
76	68	"""07S"	-0.76		0.63		0.54
79	126	"""07S"	-0.76		0.64		0.41
79	66	"""07S"	-0.68		0.51		0.55
79	123	"""06S"	-0.81		0.36		0.61
79	21	"""07S"	-0.69		0.82		0.86
79	39	"""12S"	-0.64		0.96		0.88
79	22	"""11S"	-0.46		0.84		1
80	65	"""10S"	-0.71		0.35		0.43
80	127	"""07S"	-0.79		0.98		0.86
80	58	"""07S"	-0.8		1.11		1.2
81	122	"""07S"	-0.85		1.09		0.92
81	65	"""10S"	-0.71		1.04		1.07
81	64	"""10S"	-0.79		1.34		1.32
82	38	"""09S"	-0.74		0.56		0.42
82	6	"""09S"	-0.82		0.82		0.5
83	131	"""09S"	-0.77		0.56		0.59
84	75	"""07S"	-0.73		0.59		0.61
84	39	"""07S"	-0.81		1.07		1.02
85	72	"""06S"	-0.78		0.49		0.49
85	38	"""03S"	-0.89		0.64		0.51
86	108	"""06S"	-0.82		0.36		0.47
86	6	"""09S"	0.51		0.85		0.59
86	53	"""07S"	-0.78		0.87		0.71
87	112	"""07S"	0.55		0.52		0.6
88	12	"""07S"	-0.79		1.28		0.76
92	126	"""07S"	-0.85		0.72		0.57
92	60	"""07S"	-0.77		0.87		0.63
92	36	"""07S"	-0.78		0.73		0.79
93	17	"""09S"	-0.79		0.92		0.79
96	70	"""07S"	-0.78		0.96		0.7
96	66	"""0[illegible]S"	-0.75		1.24		1.08
96	28	"""09S"	-0.79		1.07		1.31
102	46	"""07S"	-0.81		1.52		0.88
102	95	"""07S"	-0.79		1.17		1.02
103	5	"""09S"	0.62		1.17		1.12
104	46	"""07S"	-0.78		0.78		0.41
105	113	"""07S"	-0.79		0.9		0.53
105	42	"""07S"	-0.73		1.73		1.03
106	38	"""07S"	-0.83		1.39		0.49
106	61	"""07S"	-0.86		1.21		0.91
109	84	"""07S"	-0.76		0.7		0.74
111	71	"""03S"	-0.77		0.48		0.54
111	66	"""07S"	-0.79		0.6		0.8
112	82	"""07S"	-0.8		0.6		0.63
114	70	"""07S"	-0.8		0.69		0.78
115	100	"""07S"	-0.77		0.47		0.48

Data Utilized in Figure 4-8

Tube Identification		Location			1992 Volts		1994 Volts
115	43	"""07S"	-0.83		0.65		0.51
116	61	"""07S"	-0.8		0.35		0.53
116	80	"""07S"	-0.83		0.42		0.54
116	49	"""07S"	-0.79		1.28		0.86
117	71	"""07S"	-0.76		0.7		0.65
118	99	"""07S"	-0.76		0.54		0.43
118	66	"""03S"	-0.75		0.54		0.48
118	66	"""07S"	-0.75		0.77		0.81
119	66	"""07S"	-0.81		0.53		0.38
119	12	"""07S"	-0.84		0.77		0.62
119	48	"""07S"	-0.81		1.15		0.77
119	63	"""07S"	-0.79		0.97		1.04
120	102	"""07S"	-0.77		0.67		0.49
120	97	"""07S"	-0.78		0.68		0.58
120	63	"""07S"	-0.83		0.78		0.72
121	78	"""03S"	-0.76		0.56		0.36
121	48	"""07S"	-0.73		0.48		0.39
122	102	"""07S"	-0.93		0.6		0.62
123	74	"""07S"	-0.82		0.63		0.57
125	98	"""10S"	-0.71		0.51		0.56
125	89	"""07S"	-0.79		0.92		0.75
126	53	"""07S"	-0.8		0.7		0.65
126	43	"""07S"	-0.85		0.46		0.67
127	96	"""10S"	-0.68		0.75		0.73
127	58	"""07S"	-0.8		0.94		1.15
128	53	"""13S"	-0.84		0.91		1.28
129	52	"""03S"	-0.75		0.49		0.31
129	52	"""07S"	-0.75		0.7		0.58
129	34	"""07S"	-0.81		1.19		0.97
130	40	"""07S"	-0.81		0.56		0.58
130	14	"""09S"	-0.82		0.65		0.63
130	47	"""07S"	-0.78		0.72		0.75
130	23	"""07S"	-0.81		0.75		0.82
131	50	"""07S"	-0.81		0.74		0.72
132	36	"""07S"	-0.8		0.55		0.43
132	45	"""07S"	-0.81		0.79		0.5
132	58	"""07S"	-0.78		0.64		0.58
132	63	"""07S"	-0.76		1.14		0.89
132	48	"""07S"	-0.8		1.12		1.07
133	35	"""07S"	-0.76		0.62		0.48
134	78	"""07S"	-0.8		0.48		0.51
134	29	"""07S"	-0.78		0.64		0.55
134	63	"""07S"	-0.76		0.76		0.63
134	39	"""07S"	-0.81		0.51		0.78
135	47	"""07S"	-0.83		0.46		0.48
135	43	"""09S"	-0.89		0.52		0.68
136	49	"""07S"	-0.79		0.62		0.47

Data Utilized in Figure 4-8

Tube Identification		Location			1992 Volts		1994 Volts
136	32	"""07S"	-0.74		1.04		0.75
137	3	"""10S"	0.66		0.58		0.62
138	20	"""07S"	-0.8		0.37		0.57
138	30	"""07S"	-0.8		0.89		0.81
139	33	"""07S"	-0.77		0.34		0.36
139	21	"""07S"	-0.76		0.59		0.47
139	74	"""07S"	-0.88		1.19		1.25
140	32	"""07S"	-0.82		0.49		0.59
140	21	"""07S"	-0.69		0.98		0.84
140	15	"""07S"	-0.77		1.92		1.45
141	57	"""07S"	-0.85		0.58		0.78
142	57	"""07S"	-0.85		0.41		0.36
142	38	"""03S"	-0.82		0.41		0.47
142	38	"""07S"	-0.82		0.5		0.49
142	24	"""07S"	-0.77		0.53		0.51
142	11	"""07S"	-0.75		0.43		0.61
142	12	"""07S"	-0.78		0.57		0.63
142	14	"""07S"	-0.8		0.83		0.64
143	31	"""07S"	-0.79		0.52		0.51
144	24	"""07S"	-0.77		0.47		0.45
144	56	"""07S"	-0.84		0.58		0.46
144	22	"""07S"	-0.79		0.55		0.57
144	13	"""07S"	-0.74		0.57		0.61
144	12	"""07S"	-0.89		0.98		0.99
144	57	"""07S"	-0.84		0.91		1
144	15	"""07S"	-0.78		0.77		1.02
144	49	"""07S"	-0.81		0.96		1.07
145	28	"""07S"	-0.8		0.54		0.64
145	8	"""07S"	-0.83		0.68		0.67
145	34	"""07S"	-0.8		0.69		0.77
146	30	"""07S"	-0.86		0.45		0.61
146	47	"""07S"	-0.88		0.51		0.66
146	14	"""07S"	-0.89		1.25		1.11
147	23	"""07S"	-0.79		0.47		0.59
147	12	"""07S"	-0.77		0.69		0.67
147	24	"""07S"	-0.77		0.49		0.8
147	44	"""07S"	-0.86		0.57		0.82
148	38	"""07S"	1.02		1.27		1.11
149	32	"""10S"	0.66		0.41		0.48
149	30	"""10S"	0.63		0.51		0.52
149	11	"""07S"	-0.74		0.65		0.65
149	13	"""10S"	0.55		1.17		1.33
150	15	"""07S"	-0.83		0.81		1
151	3	"""10S"	-0.79		0.53		0.48
151	13	"""10S"	0.61		0.56		0.54
151	13	"""10S"	-0.75		1.11		1.06

II.K Refuel Outage 9 Special Interest MRPC Inspection Results

This inspection was performed to satisfy NRC Confirmatory Action Letter 2-94-004, Item No. 4. The results have been provided to the NRC in previous correspondence, but the raw MRPC data from the inspection has not. This information, in conjunction with the bobbin voltage data provided in Reference 2 defines the scope of data adressed by the correlations using this data.

LIST OF ALL SPECIAL INTEREST 20% MRPC CALLS
LIST OF ALL S.I. 20% CALLS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION	EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
2	8	0.71	P 1	0	VOL		12S +0.67	12S	12S	520	H8259	71	PIT
					MSG		L x W 0.16 x 0.17 PIT			520	H8259	71	
7	27	0.36	P 1	0	VOL		08S +0.63	08S	08S	520	H8259	71	VOL
					MSG		L x W 0.24 x 0.20 VOL			520	H8259	71	
8	30				NDF		LTS +1.17	LTS	LTS	520	C9318	71	
18	74	0.32	P 1	66	VOL		06S +0.60	06S	06S	520	P2204	71	VOL
					MSG		L x W 0.16 x 0.15 VOL			520	P2204	71	
21	39	0.34	1	103	VOL		03S -3.37	03S	03S	520	C9318	71	MBM
					MSG		L x W 0.32 x 0.32 MBM			520	C9318	71	
24	86	0.64	1	69	VOL		09S -7.09	09S	09S	520	C9318	71	MBM
					MSG		L x W 0.46 x 0.37 MBM			520	C9318	71	
24	88				NDF		11S +24.27	11S	11S	520	C9318	71	
24	89				NDF		14S +5.76	14S	14S	520	C9318	71	
27	89				NDF		15S +33.90	15S	15S	520	P1790	82	
					NDF		15S +34.33	15S	15S	520	P1790	82	
					NDF		15S +34.79	15S	15S	520	P1790	82	
					NDF		04S -0.58	04S	04S	520	C9318	71	
					NDF		LTE +6.51	LTS	LTE	520	L7871	85	
					NDF		LTS +6.51	LTS	LTS	520	C9318	71	
27	91				NDF		13S -6.68	13S	13S	520	L7871	85	
					NDF		07S +6.61	07S	07S	520	L7871	85	
					MSG		L x W 0.37 x 0.17 WAR			520	L7871	85	
		0.26	P 1	0	WAR	14	07S +0.56	07S	07S	520	L7871	85	WAR
		0.32	P 1	84	WAR	16	07S -0.67	07S	07S	520	L7871	85	WAR
					NDF		15S +24.93	15S	15S	520	C9318	81	
					MSG		L x W 0.37 x 0.15 WAR			520	L7871	85	
					NDF		01S -8.06	01S	01S	520	L7871	85	
					NDF		13S +12.98	13S	13S	520	C9318	71	
					NDF		13S -5.00	13S	13S	520	C9318	71	
		0.46	1	125	VOL		LTE +14.97	LTE	LTE	520	P2204	71	MBM
					MSG		L x W 0.14 x 0.24 MBM			520	P2204	71	
		0.38	P 1	0	WAR	12	07S -0.68	07S	07S	520	P2204	71	WAR
					MSG		L x W 0.34 x 0.24 WAR			520	P2204	71	
					RIC		LTS +37.94			520	L7871	71	
27	93	0.31	P 1	0	WAR	16	08S +0.77	08S	08S	520	L7871	85	WAR
					MSG		L x W 0.58 x 0.15 WAR			520	L7871	85	
		0.18	P 1	98	WAR	10	08S -0.76	08S	08S	520	L7871	85	WAR
					MSG		L x W 0.24 x 0.12 WAR			520	L7871	85	
28	92	0.47	P 1	95	VOL		08S +0.67	08S	08S	520	L7871	71	VOL
					MSG		L x W 0.27 x 0.23 VOL			520	H8259	71	
29	73	0.48	1	49	VOL		03S +10.92	03S	03S	520	P2204	71	MBM
					MSG		L x W 0.41 x 0.31 MBM			520	P2204	71	
31	32	0.38	P 1	60	VOL		10S +0.72	10S	10S	520	C9318	71	PIT
			P 1		MSG		L x W 0.15 x 0.21 PIT			520	H8259	71	
35	59	1.09	1	12	VOL		12S +12.11	12S	12S	520	L7871	85	MBM
					MSG		L x W 0.29 x 0.17 MBM			520	L7871	85	
					RIC		12S +12.36			520	L7871	71	
37	113	0.52	P 1	0	VOL		11S -0.66	11S	11S	520	B0690	78	VOL
					MSG		L x W 0.18 x 0.18 VOL			520	R6452	78	
39	1	1.70	1	151	VOL		LTS +24.55	LTS	LTS	520	H8259	81	MBM
					MSG		L x W 0.81 x 0.17 MBM			520	H8259	81	
		2.40	1	352	DNG		LTS +23.84	LTS	LTS	520	P1790	81	
41	116	0.24	P 1	0	VOL		11S -0.82	11S	11S	520	R6452	78	VOL
					MSG		L x W 0.19 x 0.20 VOL			520	R6452	78	
42	68	0.44	1	279	VOL		11S +4.29	11S	11S	520	B0690	80	MBM
					MSG		L x W 0.33 x 0.29 MBM			520	R6452	80	
47	58	1.73	1	102	VOL		05S +23.12	05S	05S	520	P1790	80	MBM
					MSG		L x W 0.48 x 0.34 MBM			520	P1790	80	
47	69	0.32	1	131	VOL		LTS +42.52	01S	LTS	520	R6452	80	PIT
			1		MSG		L x W 0.11 x 0.18 PIT			520	R6452	80	
55	96	0.49	P 1	266	VOL		03S +0.77	03S	03S	520	B0690	80	PIT
					MSG		L x W 0.16 x 0.16 PIT			520	B0690	80	
58	123				NDF		09S +14.11	09S	09S	520	P1790	80	
58	125	0.80	1	42	VOL		13S +26.06	13S	13S	520	P1790	80	MBM
					MSG		L x W 0.59 x 0.34 MBM			520	P1790	80	

LIST OF ALL SPECIAL INTEREST 20% MRPC CALLS
LIST OF ALL S.I. 20% CALLS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION	EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
61	1	0.38	P 1	0	WAR	12	09S -0.61	09S	09S	520	P1790	78	WAR
					MSG		L x W 0.17 x 0.16 WAR			520	P1790	78	
61	124	0.20	P 1	44	VOL		10S -0.69	10S	10S	520	R6452	80	PIT
			P 1		MSG		L x W 0.12 x 0.18 PIT			520	R6452	80	
62	128	0.64	P 1	241	WAR	22	10S +0.08	10S	10S	520	B0690	78	WAR
					MSG		L x W 1.38 x 0.18 WAR			520	B0690	78	
63	128				NDF		LTS +16.57	LTS	LTS	520	P1790	80	
67	62	0.46	P 1	102	VOL		10S -0.73	10S	10S	520	H8259	81	VOL
					MSG		L x W 0.20 x 0.20 VOL			520	H8259	81	
71	90	0.39	1	77	VOL		11S +9.27	11S	11S	520	C9318	81	MBM
					MSG		L x W 0.39 x 0.30 MBM			520	C9318	81	
71	128	0.28	P 1	0	WAR	6	10S -0.68	10S	10S	520	P1790	80	WAR
					MSG		L x W 0.65 x 0.18 WAR			520	P1790	80	
					MSG		L x W 0.57 x 0.11 WAR			520	P1790	80	
71	129	0.30	P 1	0	WAR	7	10S +0.00	10S	10S	520	P1790	80	WAR
					MSG		L x W 1.56 x 0.16 WAR			520	P1790	80	
73	128	0.36	P 1	0	WAR	9	08S -0.57	08S	08S	520	P1790	80	WAR
					MSG		L x W 0.53 x 0.17 WAR			520	P1790	80	
90	72	0.52	1	38	VOL		12S +15.57	12S	12S	520	B0690	82	MBM
					MSG		L x W 0.27 x 0.23 MBM			520	B0690	82	
135	63	0.87	1	111	VOL		05S +12.54	05S	05S	520	P1790	80	MBM
					MSG		L x W 0.48 x 0.37 MBM			520	R6452	80	
135	71	0.43	P 1	0	WAR	11	09S -0.79	09S	09S	520	P1790	80	WAR
					MSG		L x W 0.26 x 0.19 WAR			520	P1790	80	
149	11	0.38	P 1	0	WAR	10	08S -0.62	08S	08S	520	P1790	80	WAR
					MSG		L x W 0.19 x 0.20 WAR			520	P1790	80	
149	19	0.22	P 1	95	VOL		12S -0.81	12S	12S	520	B0690	80	PIT
					MSG		L x W 0.14 x 0.12 PIT			520	R6452	80	
		0.53	P 1	0	WAR	15	10S -0.62	10S	10S	520	B0690	80	WAR
					MSG		L x W 0.37 x 0.19 WAR			520	B0690	80	
149	28				MSG		L x W 0.67 x 0.19 WAR			520	B0690	80	
		0.47	P 1	0	WAR	14	10S -0.37	10S	10S	520	B0690	80	WAR
150	16	0.60	P 1	0	WAR	17	10S -0.55	10S	10S	520	B0690	80	WAR
					MSG		L x W 0.82 x 0.21 WAR			520	R6452	80	

Total Indications Found = 99
Total Tubes Found = 40

LIST OF ALL SPECIAL INTEREST 20% MRPC CALLS
LIST OF ALL S.I. 20% CALLS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION		EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
7	11				NDF		12S	+27.90	13S	12S	520	P1790	76	
7	20	0.16	P 1	96	VOL		07S	+0.78	07S	07S	520	P1790	76	
					MSG		L x W	0.12 x 0.15			520	P1790	76	
7	30	0.30	P 1	86	VOL		08S	+0.59	08S	08S	520	P1790	76	WAR
					MSG		L x W	0.38 x 0.18			520	P1790	76	
		0.55	P 1	67	VOL		09S	-0.79	09S	09S	520	P1790	76	WAR
					MSG		L x W	0.41 x 0.21			520	P1790	76	
13	9	0.18	P 1	79	VOL		08S	-0.81	08S	08S	520	P1790	76	
					MSG		L x W	0.19 x 0.14			520	P1790	76	
13	43	0.18	P 1	54	VOL		09S	-0.79	09S	09S	520	P1790	76	
					MSG		L x W	0.16 x 0.17			520	P1790	76	
15	69	0.24	P 1	121	VOL		07S	+0.62	07S	07S	520	H7791	76	
					MSG		L x W	0.20 x 0.15			520	H7791	76	
16	30	0.40	P 1	67	VOL		09S	-0.71	09S	09S	520	P1790	76	
					MSG		L x W	0.11 x 0.19			520	P1790	76	
17	74	0.19	P 1	57	VOL		07S	+0.69	07S	07S	520	P1790	76	
					MSG		L x W	0.20 x 0.17			520	P1790	76	
		0.35	P 1	72	VOL		07S	-0.80	07S	07S	520	P1790	76	
					MSG		L x W	0.16 x 0.17			520	P1790	76	
25	10				NDF		15S	+23.46	15S	15S	520	P2204	83	
					NDF		15S	+24.76	15S	15S	520	P2204	83	
		0.55	P 1	0	WAR	17	09S	+0.57	09S	09S	520	P2204	83	WAR
					MSG		L x W	0.50 x 0.22 WAR			520	P2204	83	
					NDF		LTS	-3.20	LTS	LTS	520	P2204	83	
					NDF		LTS	-2.22	LTS	LTS	520	P2204	83	
					NDF		LTS	-3.86	LTS	LTS	520	P2204	83	
27	71				MSG		L x W	0.28 x 0.43 MBM			520	S2680	77	
		0.24	1	62	VOL		LTS	+2.78	LTS	LTS	520	P2204	77	MBM
27	94	0.35	P 1	62	VOL		09S	+0.78	09S	09S	520	H8259	77	PIT
					MSG		L x W	0.12 x 0.19 PIT			520	S2680	77	
		0.65	P 1	0	WAR	20	08S	+0.53	08S	08S	520	R6452	77	WAR
					MSG		L x W	0.40 x 0.16 WAR			520	S2680	77	
35	20	0.19	P 1	61	VOL		04S	-0.67	04S	04S	520	H8259	77	PIT
					MSG		L x W	0.19 x 0.15 PIT			520	S2680	77	
35	42	0.34	P 1	55	VOL		09S	-0.74	09S	09S	520	H8259	77	PIT
					MSG		L x W	0.13 x 0.21 PIT			520	S2680	77	
36	40				NDF		09S	-0.90	09S	09S	520	C9318	77	
		0.17	1	68	VOL		LTS	+23.42	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.10 x 0.12 PIT			520	S2680	77	
37	12				NDF		LTS	+27.32	LTS	LTS	520	P2204	83	
37	40	0.23	1	61	VOL		LTS	+27.32	LTS	LTS	520	P2204	83	PIT
					MSG		L x W	0.17 x 0.17 PIT			520	P2204	83	
		0.19	1	93	VOL		LTS	+27.21	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.11 x 0.16 PIT			520	S2680	77	
37	41	0.15	1	72	VOL		LTS	+6.58	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.18 x 0.14 PIT			520	S2680	77	
38	38	0.52	P 1	59	VOL		09S	-0.75	09S	09S	520	H8259	77	PIT
					MSG		L x W	0.14 x 0.21 PIT			520	S2680	77	
39	41	0.21	1	77	VOL		LTS	+9.72	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.15 x 0.17 PIT			520	S2680	77	
41	47	0.23	1	26	VOL		LTS	+14.18	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.09 x 0.12 PIT			520	S2680	77	
41	53	0.53	P 1	66	VOL		03S	-0.66	03S	03S	520	R6452	83	VOL
			P 1		MSG		L x W	0.11 x 0.15 VOL			520	R6452	83	
41	56	0.16	P 1	42	VOL		03S	-0.62	03S	03S	520	H8259	77	PIT
					MSG		L x W	0.12 x 0.11 PIT			520	S2680	77	
43	42	0.13	1	80	VOL		LTS	+8.97	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.16 x 0.14 PIT			520	S2680	77	
43	80	0.86	P 1	35	VOL		12S	+6.41	12S	12S	520	H8259	77	PIT
					MSG		L x W	0.16 x 0.14 PIT			520	S2680	77	
45	7	0.43	P 1	74	WAR	14	07S	+0.68	07S	07S	520	R6452	83	WAR
			P 1		MSG		L x W	0.43 x 0.20 WAR			520	R6452	83	
45	35	0.40	P 1	36	VOL		07S	-0.78	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.16 x 0.38 PIT			520	S2680	77	
46	37	0.23	1	74	VOL		LTS	+10.39	LTS	LTS	520	H8259	77	PIT

LIST OF ALL SPECIAL INTEREST 20% MRPC CALLS
LIST OF ALL S.I. 20% CALLS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION		EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
					MSG		L x W	0.08 x 0.19 PIT			520	S2680	77	
46	44	0.24	1	86	VOL		LTS	+5.60	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.12 x 0.14 PIT			520	S2680	77	
47	31	0.61	1	67	VOL		13S	+9.23	13S	13S	520	H8259	77	MBM
					MSG		L x W	0.35 x 0.25 MBM			520	S2680	77	
47	48	0.22	1	108	VOL		LTS	+11.30	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.08 x 0.10 PIT			520	S2680	77	
48	38	0.18	1	82	VOL		LTS	+10.92	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.19 x 0.16 PIT			520	S2680	77	
48	47	0.19	1	76	VOL		LTS	+7.52	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.19 x 0.16 PIT			520	S2680	77	
49	35	0.13	P 1	88	VOL		LTS	+7.24	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.18 x 0.14 PIT			520	S2680	77	
49	48	0.21	1	62	VOL		LTS	+13.74	LTS	LTS	520	R6452	77	PIT
					MSG		L x W	0.13 x 0.16 PIT			520	S2680	77	
49	50	0.31	1	84	VOL		LTS	+10.69	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.17 x 0.12 PIT			520	S2680	77	
51	48	0.22	P 1	44	VOL		07S	-0.69	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.15 x 0.15 PIT			520	S2680	77	
52	36	0.24	1	81	VOL		LTS	+6.48	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.16 x 0.16 PIT			520	S2680	77	
53	39	0.28	1	131	VOL		LTS	+12.43	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.11 x 0.16 PIT			520	S2680	77	
54	98	1.33	P 1	66	VOL		05S	-0.14	05S	05S	520	H8259	77	PIT
					MSG		L x W	0.35 x 0.27 PIT			520	S2680	77	
57	38	0.16	1	90	VOL		LTS	+11.95	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.09 x 0.14 PIT			520	S2680	77	
57	44	0.15	1	95	VOL		LTS	+9.46	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.13 x 0.15 PIT			520	S2680	77	
57	52	0.16	1	45	VOL		LTS	+6.76	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.11 x 0.16 PIT			520	S2680	77	
58	38				MSG		L x W	0.18 x 0.17 PIT			520	S2680	77	
		0.33	1	59	VOL		LTS	+9.06	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.14 x 0.18 PIT			520	S2680	77	
					NDF		LTS	+9.59	LTS	LTS	520	P2204	77	
		0.31	1	100	VOL		LTS	+11.71	LTS	LTS	520	H8259	77	PIT
					MSG		L x W	0.08 x 0.19 PIT			520	S2680	77	
					NDF		LTS	+12.34	LTS	LTS	520	P2204	77	
		0.29	1	15	VOL		LTS	+7.05	LTS	LTS	520	H8259	77	PIT
59	1	0.18	P 1	52	VOL		09S	-0.68	09S	09S	520	S1848	83	VOL
					MSG		L x W	0.07 x 0.14 VOL			520	S1848	83	
59	122	0.61	P 1	82	VOL		09S	-0.66	09S	09S	520	H8259	77	PIT
					MSG		L x W	0.11 x 0.20 PIT			520	S2680	77	
60	119	0.90	P 1	72	VOL		07S	-0.67	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.14 x 0.24 PIT			520	S2680	77	
61	42	0.33	P 1	52	VOL		07S	-0.75	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.12 x 0.11 PIT			520	S2680	77	
63	34	0.34	P 1	48	VOL		07S	-0.73	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.14 x 0.16 PIT			520	S2680	77	
64	3				NDF		15S	-0.87	15S	15S	520	P2204	82	
65	122	0.32	P 2	80	VOL		05S	+0.75	05S	05S	520	H8259	77	PIT
					MSG		L x W	0.11 x 0.16 PIT			520	S2680	77	
66	37	0.29	P 1	73	VOL		09S	-0.71	09S	09S	520	H8259	77	PIT
					MSG		L x W	0.18 x 0.19 PIT			520	S2680	77	
67	33	0.28	P 1	9	VOL		07S	-0.60	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.10 x 0.21 PIT			520	S2680	77	
67	52	0.46	P 1	55	VOL		07S	-0.63	07S	07S	520	H8259	77	PIT
					MSG		L x W	0.14 x 0.25 PIT			520	S2680	77	
68	21				NDF		08S	-0.90	08S	08S	520	P2204	77	
69	56				NDF		10S	+0.00	10S	10S	520	P2204	86	
					NDF		08S	+0.00	08S	08S	520	P2204	86	
					NDF		06S	+0.00	06S	06S	520	P2204	86	
					NDF		05S	+0.00	05S	05S	520	P2204	86	
					NDF		04S	+0.00	04S	04S	520	P2204	86	
		0.19	P 1	65	VOL		03S	-0.64	03S	03S	520	P2204	86	VOL

LIST OF ALL SPECIAL INTEREST 20% MRPC CALLS
LIST OF ALL S.I. 20% CALLS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION	EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
					MSG		L x W 0.08 x 0.06 VOL			520	P2204	86	
		0.43	P 1	255	VOL		09S -0.65	09S	09S	520	H8259	77	PIT
					MSG		L x W 0.18 x 0.20 PIT			520	S2680	77	
		0.65	P 1	68	VOL		07S -0.71	07S	07S	520	H8259	77	PIT
					MSG		L x W 0.14 x 0.24 PIT			520	S2680	77	
72	67	0.34	P 1	95	VOL		03S -0.75	03S	03S	520	S2680	80	VOL
					MSG		L x W 0.12 x 0.11 VOL			520	S2680	80	
73	66				MSG		L x W 0.50 x 0.17 WAR			520	S2680	80	
		0.75	P 1	0	WAR	26	06S -0.68	06S	06S	520	P2204	80	WAR
77	125	0.33	P 1	70	WAR	11	11S -0.67	11S	11S	520	H8259	77	WAR
					MSG		L x W 0.38 x 0.20 WAR			520	S2680	77	
79	39	0.31	P 1	66	VOL		12S -0.68	12S	12S	520	P2204	82	VOL
					MSG		L x W 0.17 x 0.23 VOL			520	P2204	82	
80	58				NDF		07S -0.81	07S	07S	520	M6664	81	
80	127	0.30	P 1	81	VOL		07S -0.61	07S	07S	520	H8259	77	PIT
					MSG		L x W 0.23 x 0.19 PIT			520	S2680	77	
81	64	0.27	P 1	71	VOL		10S -0.77	10S	10S	520	S2680	80	PIT
					MSG		L x W 0.14 x 0.19 PIT			520	S2680	80	
81	122	0.38	P 1	73	VOL		07S -0.70	07S	07S	520	S1848	81	PIT
					MSG		L x W 0.24 x 0.21 PIT			520	H8259	81	
81	126	0.55	P 1	0	WAR	22	08S +0.72	08S	08S	520	M6664	81	WAR
			P 1		MSG		L x W 0.18 x 0.14			520	M6664	81	
82	6	0.38	P 1	0	WAR	12	09S -0.61	09S	09S	520	S1848	82	WAR
					MSG		L x W 0.29 x 0.22 WAR			520	R6452	82	
83	56	0.26	1	92	VOL		02S -6.40	02S	02S	520	S1848	81	PIT
					MSG		L x W 0.21 x 0.23 PIT			520	H8259	81	
84	39				NDF		07S -0.81	07S	07S	520	P2204	86	
85	124	0.66	P 1	80	VOL		08S +0.58	08S	08S	520	S1848	81	PIT
					MSG		L x W 0.34 x 0.18 PIT			520	H8259	81	
88	12	0.27	P 1	63	VOL		07S -0.69	07S	07S	520	S1848	82	PIT
					MSG		L x W 0.13 x 0.19 PIT			520	S1848	82	
88	47				NDF		09S -0.72	09S	09S	520	M6664	81	
89	34	0.11	1	88	VOL		LTS +14.69	LTS	LTS	520	P2204	82	PIT
					MSG		L x W 0.18 x 0.21 PIT			520	P2204	82	
		0.25	1	72	VOL		LTS +5.25	LTS	LTS	520	P2204	82	PIT
					MSG		L x W 0.16 x 0.21 PIT			520	P2204	82	
90	43	0.26	1	80	VOL		LTS +6.00	LTS	LTS	520	M6664	81	PIT
					MSG		L x W 0.11 x 0.12 PIT			520	H8259	81	
90	60	0.32	P 1	47	VOL		07S -0.39	07S	07S	520	S1848	81	PIT
					MSG		L x W 0.10 x 0.11 PIT			520	H8259	81	
92	17	0.38	P 1	72	VOL		09S -0.65	09S	09S	520	P2204	82	VOL
					MSG		L x W 0.14 x 0.20 VOL			520	P2204	82	
92	28				MSG		L x W 0.15 x 0.17 PIT			520	P2204	82	
		0.35	1	83	VOL		LTS +7.94	LTS	LTS	520	P2204	82	PIT
93	17	0.49	P 1	71	VOL		09S -0.59	09S	09S	520	P2204	82	VOL
					MSG		L x W 0.16 x 0.24 VOL			520	P2204	82	
93	27	0.27	1	28	VOL		LTS +7.76	LTS	LTS	520	P2204	82	PIT
					MSG		L x W 0.14 x 0.17 PIT			520	P2204	82	
93	36	0.61	P 1	76	VOL		09S -0.76	09S	09S	520	S1848	81	PIT
					MSG		L x W 0.24 x 0.20 PIT			520	H8259	81	
93	42				NDF		03S -6.77	03S	03S	520	M6664	81	
94	43	0.43	P 1	67	VOL		09S -0.74	09S	09S	520	S1848	81	PIT
					MSG		L x W 0.13 x 0.22 PIT			520	H8259	81	
		0.13	P 1	91	VOL		09S +0.71	09S	09S	520	H8259	81	PIT
			P 1		MSG		L x W 0.06 x 0.19 PIT			520	H8259	81	
96	28	0.68	P 1	64	VOL		09S -0.66	09S	09S	520	P2204	82	VOL
					MSG		L x W 0.13 x 0.23 VOL			520	P2204	82	
96	66	0.50	P 1	71	VOL		07S -0.75	07S	07S	520	S1848	81	PIT
					MSG		L x W 0.18 x 0.23 PIT			520	H8259	81	
96	70	0.49	P 1	66	VOL		07S -0.74	07S	07S	520	S1848	81	PIT
					MSG		L x W 0.13 x 0.19 PIT			520	H8259	81	
97	27	0.17	1	68	VOL		LTS +11.12	LTS	LTS	520	P2204	82	PIT
					MSG		L x W 0.14 x 0.17 PIT			520	P2204	82	
97	48	1.46	1	199	VOL		15S +27.50	15S	15S	520	M6664	81	MBM
					MSG		L x W 0.37 x 0.33 MBM			520	H8259	81	

LIST OF ALL SPECIAL INTEREST 20% MRPC CALLS
LIST OF ALL S.I. 20% CALLS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION	EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
98	95	0.14	1	84	VOL		LTS +7.00	LTS	LTS	520	P2204	82	PIT
					MSG		L x W 0.13 x 0.17 PIT			520	P2204	82	
100	32	0.24	P 1	76	VOL		LTS +8.35	LTS	LTS	520	M6664	81	PIT
					MSG		L x W 0.14 x 0.14 PIT			520	H8259	81	
100	98				NDF		UTS +12.97	UTS	UTS	520	M6664	81	
101	41	0.17	1	55	VOL		LTS +15.92	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.14 x 0.14 PIT			520	H8259	81	
101	91	0.18	1	63	VOL		LTS +8.98	LTS	LTS	520	P2204	82	PIT
					MSG		L x W 0.11 x 0.13 PIT			520	P2204	82	
102	46	0.61	P 1	71	VOL		07S -0.76	07S	07S	520	S1848	81	PIT
					MSG		L x W 0.17 x 0.32 PIT			520	H8259	81	
102	95	0.37	P 1	69	VOL		07S -0.65	07S	07S	520	R6452	82	PIT
					MSG		L x W 0.16 x 0.20 PIT			520	R6452	82	
103	5	0.49	P 1	78	VOL		09S +0.62	09S	09S	520	R6452	82	WAR
			P 1		MSG		L x W 0.27 x 0.19 WAR			520	R6452	82	
103	44	0.28	1	70	VOL		LTS +11.10	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.19 x 0.17 PIT			520	H8259	81	
103	90	0.21	1	89	VOL		LTS +7.96	LTS	LTS	520	M6664	81	PIT
					MSG		L x W 0.15 x 0.15 PIT			520	R6452	81	
104	31	0.12	1	64	VOL		LTS +9.77	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.16 x 0.16 PIT			520	H8259	81	
105	32	0.17	1	95	VOL		LTS +7.91	LTS	LTS		S1848	81	PIT
					MSG		L x W 0.13 x 0.17 PIT				H8259	81	
105	42	0.35	P 1	51	VOL		07S -0.79	07S	07S	[illegible]	S1848	81	PIT
					MSG		L x W 0.17 x 0.20 PIT			520	H8259	81	
105	113	0.47	P 1	73	VOL		07S -0.86	07S	07S	520	R6452	81	PIT
					MSG		L x W 0.19 x 0.24 PIT			520	R6452	81	
106	38	0.48	P 1	55	VOL		07S -0.70	07S	07S	520	H8259	81	PIT
					MSG		L x W 0.15 x 0.17 PIT			520	H8259	81	
107	50	0.23	1	82	VOL		LTS +9.31	LTS	LTS	520	P2204	83	PIT
					MSG		L x W 0.17 x 0.15 PIT			520	P2204	83	
					RIC		LTS +9.31			520	H8259	81	
108	33	0.23	1	80	VOL		LTS +11.96	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.10 x 0.15 PIT			520	H8259	81	
		0.12	1	49	VOL		LTS +10.01	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.14 x 0.15 PIT			520	H8259	81	
		0.28	1	74	VOL		LTS +6.95	LTS	LTS	520	R6452	81	PIT
					MSG		L x W 0.12 x 0.19 PIT			520	H8259	81	
109	32	0.12	1	68	VOL		LTS +9.11	LTS	LTS	520	M6664	81	PIT
					MSG		L x W 0.11 x 0.12			520	M6664	81	
109	45	0.15	1	81	VOL		LTS +14.66	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.10 x 0.17 PIT			520	H8259	81	
109	52	0.34	P 1	65	VOL		07S -0.71	07S	07S	520	R6452	81	PIT
					MSG		L x W 0.22 x 0.21 PIT			520	R6452	81	
116	49	0.50	P 1	57	VOL		07S -0.75	07S	07S	520	S1848	81	PIT
					MSG		L x W 0.20 x 0.15 PIT			520	R6452	81	
117	44	0.34	1	66	VOL		LTS +7.31	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.14 x 0.18 PIT			520	H8259	81	
118	40	0.14	1	115	VOL		LTS +23.83	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.11 x 0.10 PIT			520	H8259	81	
		0.10	1	82	VOL		LTS +8.11	LTS	LTS	520	S1848	81	PIT
					MSG		L x W 0.17 x 0.10 PIT			520	H8259	81	
119	48	0.34	P 1	61	VOL		07S -0.63	07S	07S	520	H8259	81	PIT
					MSG		L x W 0.20 x 0.20 PIT			520	H8259	81	
119	63	0.28	P 1	77	VOL		07S -0.78	07S	07S	520	H8259	81	PIT
			P 1		MSG		L x W 0.25 x 0.22 PIT			520	R6452	81	
123	10				NDF		07S +5.59	07S	07S	520	P2204	82	
					NDF		07S +6.55	07S	07S	520	P2204	82	
125	89	0.76	P 1	57	VOL		07S -0.59	07S	07S	520	H8259	81	PIT
					MSG		L x W 0.17 x 0.17 PIT			520	H8259	81	
127	8				NDF		LTE +3.11	LTE	LTE	520	P2204	82	
127	58	0.35	P 1	78	VOL		07S -0.81	07S	07S	520	S1848	81	PIT
					MSG		L x W 0.14 x 0.21 PIT			520	R6452	81	
128	53	0.25	P 1	69	VOL		13S -0.72	13S	13S	520	R6452	81	PIT
					MSG		L x W 0.14 x 0.17 PIT			520	R6452	81	

LIST OF ALL SPECIAL INTEREST 20% MRPC CALLS
LIST OF ALL S.I. 20% CALLS

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION	EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
132	63	0.35	P 1	78	VOL		07S -0.77	07S	07S	520	S1848	81	PIT
					MSG		L x W 0.17 x 0.20 PIT			520	R6452	81	
136	32	0.29	P 1	66	VOL		07S -0.70	07S	07S	520	R6452	81	PIT
					MSG		L x W 0.15 x 0.20 PIT			520	R6452	81	
139	74	0.22	P 1	100	VOL		07S -0.80	07S	07S	520	R6452	81	PIT
					MSG		L x W 0.14 x 0.16 PIT			520	R6452	81	
140	21	0.37	P 1	62	VOL		07S -0.74	07S	07S	520	R6452	82	VOL
			P 1		MSG		L x W 0.17 x 0.23 VOL			520	R6452	82	
144	12	0.29	P 1	79	VOL		07S -0.62	07S	07S	520	P2204	82	VOL
					MSG		L x W 0.17 x 0.21 VOL			520	P2204	82	
145	8	0.23	P 1	36	VOL		07S -0.68	07S	07S	520	P2204	82	VOL
					MSG		L x W 0.14 x 0.14 VOL			520	P2204	82	
146	14	0.38	P 1	72	VOL		07S -0.69	07S	07S	520	R6452	82	PIT
					MSG		L x W 0.18 x 0.17 PIT			520	R6452	82	
146	26	0.17	P 1	88	VOL		09S -0.59	09S	09S	520	R6452	82	WAR
			P 1		MSG		L x W 0.22 x 0.14 WAR			520	R6452	82	
		0.30	P 1	71	VOL		09S +0.71	09S	09S	520	R6452	82	WAR
			P 1		MSG		L x W 0.30 x 0.22 WAR			520	R6452	82	
		0.21	P 1	87	VOL		08S -0.58	08S	08S	520	S1848	82	PIT
					MSG		L x W 0.18 x 0.17 PIT			520	R6452	82	
149	13	0.81	P 1	70	VOL		10S +0.59	10S	10S	520	R6452	82	WAR
					MSG		L x W 0.26 x 0.22 WAR			520	R6452	82	
151	13	0.61	P 1	81	VOL		10S -0.56	10S	10S	520	P2204	82	VOL
					MSG		L x W 0.24 x 0.21 VOL			520	P2204	82	

Total Indications Found = 284
Total Tubes Found = 125

LIST OF ALL SPECIAL INTEREST 10% MRPC EXPANSION #1 CALLS
LIST OF ALL S.I. 10% CALLS - 1

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION	EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
8	21				MSG		L x W 0.11 x 0.11 VOL			520	H8259	72	
		0.42	P 1	85	VOL		07S +0.75	07S	07S	520	M6664	72	VOL
19	3				MSG		L x W 0.20 x 0.17 VOL			520	H8259	72	
		1.30	P 1	115	VOL		12S +0.70	12S	12S	520	M6664	72	VOL
24	88				NDF		11S +14.74	11S	11S	520	M6664	72	
27	89				NDF		15S +22.54	15S	15S	520	L7871	83	
					NDF		15S +25.59	15S	15S	520	M6664	72	
27	91				NDF		07S -3.14	07S	07S	520	L7871	83	
		0.54	1	17	VOL		13S +13.36	13S	13S	520	R6452	74	VOL
					MSG		L x W 0.12 x 0.12 VOL			520	M6664	74	
					NDF		LTE +14.33	LTE	LTE	520	R6452	74	
					RIC		13S +12.58			520	M6664	72	
					NDF		11S +2.15	11S	11S	520	M6664	72	
					NDF		08S +13.37	08S	08S	520	M6664	72	
					RBD		07S -3.14			520	H8259	72	
					RBD		LTE +14.33			520	L7871	72	
		0.24	P 1	0	WAR	8	10S +0.62	10S	10S	520	R6452	74	WAR
			P 1		MSG		L x W 0.29 x 0.19 WAR			520	R6452	74	
		0.30	P 1	0	WAR	10	10S -0.61	10S	10S	520	R6452	74	WAR
			P 1		MSG		L x W 0.44 x 0.20 WAR			520	R6452	74	
28	92				NDF		11S +13.48	11S	11S	520	M6664	72	
28	93	0.92	P 1	123	VOL		08S +0.56	08S	08S	520	M6664	72	VOL
					MSG		L x W 0.30 x 0.18 VOL			520	H8259	72	
34	72	0.57	1	84	VOL		02S +15.67	02S	02S	520	M6664	72	VOL
					MSG		L x W 0.19 x 0.18 VOL			520	H8259	72	
41	116	0.97	P 1	127	VOL		12S +0.70	12S	12S	520	M6664	72	VOL
					MSG		L x W 0.19 x 0.19 VOL			520	H8259	72	
65	87	0.31	P 1	75	VOL		04S +0.73	04S	04S	520	M6664	74	VOL
					MSG		L x W 0.10 x 0.17 VOL			520	H8259	74	
					RBD		04S +0.00			520	M6664	72	
72	127	0.55	P 1	0	WAR	18	10S -0.59	10S	10S	520	R6452	74	WAR
			P 1		MSG		L x W 0.33 x 0.17 WAR			520	R6452	74	
		0.19	P 1	0	WAR	6	10S -0.53	10S	10S	520	R6452	74	WAR
			P 1		MSG		L x W 0.29 x 0.19 WAR			520	R6452	74	
75	29	0.65	P 1	123	VOL		07S -0.68	07S	07S	520	M6664	72	VOL
					MSG		L x W 0.15 x 0.19 VOL			520	M6664	72	
76	122	0.52	P 1	0	WAR	19	09S +0.44	09S	09S	520	L7871	74	WAR
					MSG		L x W 0.45 x 0.20 WAR			520	R6452	74	
77	17	0.57	P 1	124	VOL		07S -0.73	07S	07S	520	M6664	72	VOL
					MSG		L x W 0.13 x 0.15 VOL			520	H8259	72	
79	128	0.20	P 1	105	VOL		10S +0.70	10S	10S	520	M6664	74	VOL
			1		MSG		L x W 0.18 x 0.19 VOL			520	M6664	74	
94	129	0.61	P 1	0	WAR	20	08S -0.68	08S	08S	520	R6452	74	WAR
			P 1		MSG		L x W 0.37 x 0.18 WAR			520	R6452	74	
131	89	0.24	1	18	MBM		15S +5.24	15S	15S	520	M6664	74	MBM
					MSG		L x W 0.27 x 0.25 MBM			520	R6452	74	
132	30				NDF		LTE +16.95	LTE	LTE	520	L7871	74	
146	22	0.32	P 1	0	WAR	11	07S -0.71	07S	07S	520	R6452	74	WAR
					MSG		L x W 0.28 x 0.23 WAR			520	R6452	74	
149	21	0.44	P 1	108	WAR	18	10S -0.64	10S	10S	520	L7871	74	WAR
					MSG		L x W 0.41 x 0.21 WAR			520	R6452	74	

Total Indications Found = 51
Total Tubes Found = 20

LIST OF ALL SPECIAL INTEREST 10% MRPC EXPANSION #1 CALLS
LIST OF ALL S.I. 10% CALLS - 1

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION	EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
12	1	0.17	P 1	0	WAR	10	08S -0.77	08S	08S	520	C9318	84	WAR
					MSG		L x W 0.21 x 0.14 WAR			520	C9318	84	
14	34	0.21	P 1	98	VOL		07S -0.78	07S	07S	520	C9318	84	PIT
					MSG		L x W 0.14 x 0.14 PIT			520	C9318	84	
25	10				NDF		LTE +4.20	LTE	LTE	520	L7871	87	
		0.14	1	154	VOL		LTS +4.01	LTS	LTS	520	C9318	84	MBM
					MSG		L x W 0.24 x 0.16 MBM			520	C9318	84	
37	48	0.29	P 1	70	VOL		07S -0.62	07S	07S	520	C9318	84	PIT
					MSG		L x W 0.14 x 0.10 PIT			520	C9318	84	
39	8	0.24	P 1	0	WAR	7	07S +0.75	07S	07S	520	R6452	84	WAR
					MSG		L x W 0.17 x 0.16 WAR			520	C9318	84	
39	42	0.30	1	113	VOL		LTS +26.85	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.15 x 0.15 PIT			520	C9318	84	
40	52	0.16	P 1	97	VOL		07S -0.78	07S	07S	520	R6452	84	VOL
					MSG		L x W 0.12 x 0.12 VOL			520	R6452	84	
46	37	0.26	1	60	VOL		LTS +7.61	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.18 x 0.21 PIT			520	C9318	84	
46	44	0.18	1	90	VOL		LTS +9.68	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.14 x 0.14 PIT			520	C9318	84	
47	7	0.38	P 1	0	WAR	21	07S +0.77	07S	07S	520	C9318	84	WAR
					MSG		L x W 0.20 x 0.17 WAR			520	C9318	84	
47	48	0.19	1	30	VOL		LTS +9.78	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.16 x 0.15 PIT			520	C9318	84	
48	7	0.30	P 1	0	WAR	17	07S +0.60	07S	07S	520	H7791	84	WAR
					MSG		L x W 0.22 x 0.18 WAR			520	H7791	84	
49	49	0.11	1	79	VOL		LTS +12.91	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.17 x 0.16 PIT			520	C9318	84	
50	35	0.20	1	54	VOL		LTS +8.73	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.23 x 0.19 PIT			520	C9318	84	
51	48	0.15	1	49	VOL		LTS +6.48	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.14 x 0.19 PIT			520	C9318	84	
52	30				NDF		10S -0.85	10S	10S	520	C9318	84	
54	51	0.41	1	94	VOL		LTS +11.70	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.15 x 0.18 PIT			520	C9318	84	
55	32	0.30	1	68	VOL		LTS +7.51	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.11 x 0.16 PIT			520	C9318	84	
55	81	0.19	1	98	VOL		LTS +6.72	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.19 x 0.18 PIT			520	C9318	84	
56	44	0.19	1	110	VOL		LTS +9.06	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.11 x 0.16 PIT			520	C9318	84	
56	51	0.22	1	155	VOL		LTS +7.31	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.14 x 0.19 PIT			520	C9318	84	
66	106	0.18	P 1	0	WAR	11	07S -0.60	07S	07S	520	C9318	84	WAR
					MSG		L x W 0.05 x 0.13 WAR			520	C9318	84	
68	35	0.28	P 1	0	WAR	16	07S -0.77	07S	07S	520	C9318	84	WAR
					MSG		L x W 0.19 x 0.13 WAR			520	C9318	84	
68	50	0.27	P 1	127	WAR	10	09S +0.68	09S	09S	520	R6452	84	WAR
					MSG		L x W 0.20 x 0.20 WAR			520	C9318	84	
69	46	0.23	P 1	0	WAR	14	09S +0.81	09S	09S	520	C9318	84	WAR
					MSG		L x W 0.39 x 0.18 WAR			520	C9318	84	
70	68	0.20	P 1	0	VOL		07S -0.70	07S	07S	520	R6452	85	WAR
			P 1		MSG		L x W 0.18 x 0.14 WAR			520	R6452	85	
79	21	0.10	P 1	0	WAR	6	07S -0.70	07S	07S	520	C9318	84	WAR
					MSG		L x W 0.09 x 0.12 WAR			520	C9318	84	
80	22	0.06	P 1	75	VOL		LTS +30.86	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.15 x 0.15 PIT			520	C9318	84	
80	58	0.12	P 1	64	VOL		09S -0.85	09S	09S	520	C9318	84	VOL
					MSG		L x W 0.14 x 0.14 VOL			520	C9318	84	
86	6	0.35	P 1	0	WAR	19	09S +0.52	09S	09S	520	H7791	84	WAR
					MSG		L x W 0.37 x 0.21 WAR			520	H7791	84	
86	53	0.26	P 1	0	WAR	15	07S -0.66	07S	07S	520	H7791	84	WAR
					MSG		L x W 0.18 x 0.17 WAR			520	H7791	84	
87	49	0.25	P 1	0	WAR	15	06S -0.82	06S	06S	520	C9318	84	WAR
					MSG		L x W 0.19 x 0.18 WAR			520	C9318	84	
89	34	0.22	1	39	VOL		LTS +8.54	LTS	LTS	520	C9318	84	PIT

LIST OF ALL SPECIAL INTEREST 10% MRPC EXPANSION #1 CALLS
LIST OF ALL S.I. 10% CALLS - 1

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION	EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
					MSG		L x W 0.17 x 0.17 PIT			520	C9318	84	
89	43	0.27	1	69	VOL		LTS +6.66	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.17 x 0.22 PIT			520	C9318	84	
90	96	0.12	1	82	VOL		LTS +9.34	LTS	LTS	520	C9318	84	PIT
			1		MSG		L x W 0.16 x 0.14 PIT			520	C9318	84	
92	60	0.22	P 1	0	WAR	13	07S -0.66	07S	07S	520	C9318	84	WAR
					MSG		L x W 0.20 x 0.19 WAR			520	C9318	84	
95	92	0.11	1	86	VOL		LTS +12.19	LTS	LTS	520	C9318	84	PIT
					MSG		L x W 0.12 x 0.16 PIT			520	C9318	84	
99	41				NDF		03S -0.76	03S	03S	520	C9318	84	
100	27	0.25	P 1	0	WAR	15	07S -0.69	07S	07S	520	C9318	85	WAR
					MSG		L x W 0.13 x 0.11 WAR			520	C9318	85	
101	31	0.15	1	54	VOL		LTS +11.71	LTS	LTS	520	C9318	85	PIT
					MSG		L x W 0.19 x 0.17 PIT			520	C9318	85	
103	34	0.07	1	48	VOL		LTS +15.99	LTS	LTS	520	C9318	85	PIT
					MSG		L x W 0.19 x 0.17 PIT			520	C9318	85	
103	35	0.12	1	45	VOL		LTS +9.31	LTS	LTS	520	C9318	85	PIT
					MSG		L x W 0.20 x 0.19 PIT			520	C9318	85	
104	33	0.10	1	56	VOL		LTS +8.22	LTS	LTS	520	C9318	85	PIT
				0	MSG		L x W 0.20 x 0.19 PIT			520	C9318	85	
		0.05	1	85	VOL		LTS +6.43	LTS	LTS	520	C9318	85	PIT
					MSG		L x W 0.17 x 0.16 PIT			520	C9318	85	
109	45	0.14	P 1	0	WAR	9	07S -0.67	07S	07S	520	C9318	85	WAR
					MSG		L x W 0.14 x 0.12 WAR			520	C9318	85	
110	41	0.26	1	55	VOL		LTS +8.70	LTS	LTS	520	C9318	85	PIT
					MSG		L x W 0.18 x 0.18 PIT			520	C9318	85	
124	8				NDF		09S +22.53	09S	09S	520	C9318	85	
134	38	0.18	P 1	0	VOL		07S -0.80	07S	07S	520	R6452	85	VOL
					MSG		L x W 0.15 x 0.14 VOL			520	R6452	85	
135	29	0.15	P 1	0	WAR	9	07S -0.75	07S	07S	520	C9318	85	WAR
					MSG		L x W 0.18 x 0.16 WAR			520	C9318	85	
138	2	0.24	P 1	0	WAR	10	10S +0.61	10S	10S	520	R6452	85	WAR
					MSG		L x W 0.28 x 0.15 WAR			520	R6452	85	
138	30	0.25	P 1	0	WAR	12	07S -0.74	07S	07S	520	H7791	85	WAR
					MSG		L x W 0.19 x 0.16 WAR			520	H7791	85	
141	29	0.11		0	WAR	5	13S -0.77	13S	13S	520	H7791	85	WAR
					MSG		L x W 0.15 x 0.15 WAR			520	H7791	85	
		0.10	P 1	0	WAR	5	13S -0.79	13S	13S	520	H7791	85	WAR
					MSG		L x W 0.09 x 0.20 WAR			520	R6452	85	
142	14	0.24	P 1	0	WAR	14	07S -0.77	07S	07S	520	C9318	85	WAR
			P 1		MSG		L x W 0.18 x 0.16 WAR			520	C9318	85	
150	15	0.23	P 1	0	VOL		07S -0.77	07S	07S	520	R6452	85	VOL
					MSG		L x W 0.15 x 0.15 VOL			520	R6452	85	

Total Indications Found = 108
Total Tubes Found = 53

LIST OF ALL SPECIAL INTEREST 10% MRPC EXPANSION #2 CALLS

LIST OF ALL S.I. 10% CALLS - 2

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION	EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
4	18	0.42	P 1	47	VOL		03S +9.14	03S	03S	520	M6664	76	MBM
					MSG		L x W 0.28 x 0.22 MBM			520	R6452	76	
8	30				NDF		07S +18.48	07S	07S	520	L7871	84	
		0.37	P 1	87	WAR	19	07S +0.66	07S	07S	520	L7871	84	WAR
					MSG		L x W 0.51 x 0.13 WAR			520	L7871	84	
		0.38	P 1	90	WAR	19	07S -0.61	07S	07S	520	L7871	84	WAR
					MSG		L x W 0.42 x 0.12 WAR			520	H8259	84	
					NDF		LTS +20.40	LTS	LTS	520	R6452	76	
		0.29	P 1	0	WAR	10	07S +0.66	07S	07S	520	R6452	76	WAR
			P 1		MSG		L x W 0.36 x 0.14 WAR			520	R6452	76	
		0.32	P 1	0	WAR	11	07S -0.75	07S	07S	520	R6452	76	WAR
			P 1		MSG		L x W 0.29 x 0.11 WAR			520	R6452	76	
10	6	0.41	P 1	75	VOL		12S +0.70	12S	12S	520	M6664	76	VOL
					MSG		L x W 0.17 x 0.19 VOL			520	M6664	76	
12	70	0.37	P 1	0	WAR	13	10S +0.68	10S	10S	520	R6452	76	WAR
			P 1		MSG		L x W 0.65 x 0.21 WAR			520	R6452	76	
24	88				NDF		10S +13.59	10S	10S	520	R6452	76	
24	89				NDF		14S -4.47	14S	14S	520	R6452	76	
26	90				NDF		UTS -5.66	UTS	UTS	520	R6452	76	
27	91				NDF		08S +3.47	08S	08S	520	L7871	84	
		0.33	P 1	70	WAR	17	08S +0.61	08S	08S	520	L7871	84	WAR
					MSG		L x W 1.13 x 0.19 WAR			520	L7871	84	
					NDF		07S +15.21	07S	07S	520	L7871	84	
		0.24	P 1	86	WAR	13	07S +0.60	07S	07S	520	L7871	84	WAR
		0.32	P 1	0	WAR	12	08S +0.57	08S	08S	520	R6452	76	WAR
					MSG		L x W 0.30 x 0.13 WAR			520	L7871	84	
			P 1		MSG		L x W 0.27 x 0.12 WAR			520	R6452	76	
		0.22	P 1	108	WAR	12	07S -0.73	07S	07S	520	L7871	84	WAR
		0.25	P 1	0	WAR	9	07S +0.61	07S	07S	520	R6452	76	WAR
					MSG		L x W 0.36 x 0.15 WAR			520	L7871	84	
			P 1		MSG		L x W 0.28 x 0.12 WAR			520	R6452	76	
		0.33	P 1	0	WAR	12	07S -0.68	07S	07S	520	R6452	76	WAR
			P 1		MSG		L x W 0.41 x 0.15 WAR			520	R6452	76	
					NDF		LTS +38.36	LTS	LTS	520	R6452	76	
27	93	0.29	P 1	0	WAR	10	08S +0.62	08S	08S	520	R6452	76	WAR
			P 1		MSG		L x W 0.46 x 0.16 WAR			520	R6452	76	
		0.15	P 1	0	WAR	5	08S -0.69	08S	08S	520	R6452	76	WAR
			P 1		MSG		L x W 0.31 x 0.15 WAR			520	R6452	76	
					NDF		08S +12.00	08S	08S	520	L7871	84	
28	3				NDF		01S +19.20 to +27.10	01S	01S	520	L7871	84	
					RIC		03S +25.92			520	M6664	76	
28	93	0.24	P 1	0	WAR	8	07S +0.74	07S	07S	520	R6452	76	WAR
			P 1		MSG		L x W 0.41 x 0.15 WAR			520	R6452	76	
		0.35	P 1	0	WAR	13	07S -0.56	07S	07S	520	R6452	76	WAR
			P 1		MSG		L x W 0.49 x 0.15 WAR			520	R6452	76	
31	11	0.38	P 1	75	VOL		09S +0.51	09S	09S	520	M6664	76	VOL
					MSG		L x W 0.17 x 0.19 VOL			520	R6452	76	
31	59	0.65	1	37	VOL		11S +17.62	11S	11S	520	R6452	76	MBM
					MSG		L x W 0.58 x 0.20 MBM			520	R6452	76	
73	128	0.49	P 1	0	WAR	18	09S +0.61	09S	09S	520	P1790	79	WAR
					MSG		L x W 0.53 x 0.18 WAR			520	P1790	79	
76	123	0.36	P 1	0	WAR	13	10S +0.75	10S	10S	520	P1790	79	WAR
					MSG		L x W 0.31 x 0.18 WAR			520	P1790	79	
88	53	0.41	P 1	0	WAR	15	09S +0.77	09S	09S	520	P1790	79	WAR
					MSG		L x W 0.16 x 0.20 WAR			520	P1790	79	
96	83	0.19	1	38	VOL		06S +3.06	06S	06S	520	P1790	79	MBM
					MSG		L x W 0.23 x 0.24 MBM			520	P1790	79	
					NDF		06S +27.24	06S	06S	520	P1790	79	
109	72	0.91	1	67	VOL		03S +19.29	03S	03S	520	R6452	79	MBM
					MSG		L x W 0.35 x 0.13 MBM			520	R6452	79	
149	20	0.22	P 1	0	WAR	5	10S +0.77	10S	10S	520	P1790	79	WAR
					MSG		L x W 0.13 x 0.09 WAR			520	P1790	79	
		0.48	P 1	0	WAR	18	10S -0.69	10S	10S	520	P1790	79	WAR
					MSG		L x W 0.28 x 0.15 WAR			520	P1790	79	
150	15	0.38	P 1	0	WAR	13	10S -0.78	10S	10S	520	P1790	79	WAR

LIST OF ALL SPECIAL INTEREST 10% MRPC EXPANSION #2 CALLS
LIST OF ALL S.I. 10% CALLS - 2

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION	EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
					MSG		L x W 0.43 x 0.16 WAR			520	P1790	79	

Total Indications Found = 66
Total Tubes Found = 20

******************************* BWNT TUBAN II (Version 2.1) 04/28/1994 10:01:25 *******************************
******************************* Crystal River Unit 3 *******************************
******************************* S/G B *******************************
******************************* 94/04 RFO *******************************
******************************* SPEC. INT. 10% EXP 2 *******************************

LIST OF ALL SPECIAL INTEREST 10% MRPC EXPANSION #2 CALLS
LIST OF ALL S.I. 10% CALLS - 2

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION		EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
2	21	0.55	P 1	0	WAR	18	10S	-0.67	10S	10S	520	P2204	88	WAR
					MSG		L x W	0.59 x 0.19 WAR			520	P2204	88	
7	10	0.37	P 1	60	VOL		08S	+0.60	08S	08S	520	P2204	88	VOL
					MSG		L x W	0.23 x 0.20 VOL			520	P2204	88	
10	12	0.22	P 1	92	VOL		09S	-0.82	09S	09S	520	P2204	88	VOL
					MSG		L x W	0.15 x 0.15 VOL			520	P2204	88	
25	8				NDF		UTS	-4.44	UTS	UTS	520	S1848	92	
					NDF		UTS	-4.89	UTS	UTS	520	S1848	92	
					RIC		15S	+41.94	15S	15S	520	R6452	88	
					RIC		15S	+41.49	15S	15S	520	R6452	88	
					NDF		15S	+22.01	15S	15S	520	B0690	88	
27	94				NDF		11S	+29.24	11S	11S	520	P1790	89	
32	71	0.33	1	149	VOL		06S	-0.97	06S	06S	520	B0690	88	VOL
					MSG		L x W	0.26 x 0.29 VOL			520	B0690	88	
33	8	0.31	P 1	84	WAR	11	07S	+0.64	07S	07S	520	R6452	88	WAR
					MSG		L x W	0.17 x 0.15 WAR			520	R6452	88	
37	40	0.27	1	70	VOL		LTS	+9.20	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.13 x 0.20 PIT			520	P2204	88	
		0.24	1	55	VOL		LTS	+5.87	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.17 x 0.20 PIT			520	P2204	88	
39	42	0.24	1	216	VOL		LTS	+14.27	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.13 x 0.18 PIT			520	P2204	88	
39	45	0.21	1	82	VOL		LTS	+8.04	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.13 x 0.19 PIT			520	P2204	88	
40	49	0.28	P 1	71	VOL		07S	-0.65	07S	07S	520	P2204	88	VOL
					MSG		L x W	0.07 x 0.14 VOL			520	P2204	88	
44	46	0.18	1	59	VOL		LTS	+11.72	LTS	LTS	520	P1790	89	PIT
					MSG		L x W	0.14 x 0.16 PIT			520	P1790	89	
45	46	0.13	1	42	VOL		LTS	+14.68	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.14 x 0.13 PIT			520	P2204	88	
45	77	0.58	1	95	VOL		02S	-7.18	02S	02S	520	P2204	88	MBM
					MSG		L x W	0.50 x 0.30 MBM			520	R6452	88	
46	44	0.15	1	42	VOL		LTS	+13.89	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.16 x 0.17 PIT			520	P2204	88	
47	48	0.15	1	43	VOL		LTS	+14.84	LTS	LTS	520	R6452	89	PIT
			1		MSG		L x W	0.16 x 0.15 PIT			520	R6452	89	
49	47	0.15	1	6	VOL		LTS	+13.07	LTS	LTS	520	B0690	88	PIT
					MSG		L x W	0.15 x 0.14 PIT			520	B0690	88	
50	33	0.23	1	83	VOL		LTS	+7.24	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.13 x 0.16 PIT			520	P2204	88	
51	49	0.26	P 1	271	VOL		LTS	+13.77	LTS	LTS	520	M6664	92	PIT
			1		MSG		L x W	0.06 x 0.12 PIT			520	M6664	92	
					RIC		LTS	+14.18			520	R6452	88	
52	40	0.27	1	70	VOL		LTS	+12.25	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.16 x 0.16 PIT			520	P2204	88	
56	53	0.38	1	44	VOL		13S	+15.43	13S	13S	520	P2204	88	MBM
					MSG		L x W	0.36 x 0.24 MBM			520	P2204	88	
58	38	0.37	1	98	VOL		LTS	+11.42	LTS	LTS	520	R6452	89	PIT
			1		MSG		L x W	0.13 x 0.16 PIT			520	R6452	89	
58	45				NDF		LTS	+11.79	LTS	LTS	520	P1790	89	
59	113				NDF		07S	-0.80	07S	07S	520	P2204	88	
65	28	0.09	1	72	VOL		LTS	+11.03	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.16 x 0.14 PIT			520	P2204	88	
65	115	0.51	P 1	61	VOL		04S	+0.55	04S	04S	520	R6452	89	VOL
			P 1		MSG		L x W	0.10 x 0.21 VOL			520	R6452	89	
68	35	0.12	1	40	VOL		LTS	+12.40	LTS	LTS	520	B0690	88	PIT
					MSG		L x W	0.14 x 0.16 PIT			520	R6452	88	
73	51	0.17	P 1	63	VOL		03S	-0.69	03S	03S	520	P2204	88	VOL
					MSG		L x W	0.14 x 0.14 VOL			520	P2204	88	
75	123	0.09	P 1	49	VOL		04S	+0.72	04S	04S	520	P2204	88	VOL
					MSG		L x W	0.11 x 0.17 VOL			520	P2204	88	
84	99	0.34	3	90	VOL		LTS	+8.67	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.17 x 0.15 PIT			520	P2204	88	
85	99	0.10	1	78	VOL		LTS	+10.26	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.17 x 0.17 PIT			520	P2204	88	

LIST OF ALL SPECIAL INTEREST 10% MRPC EXPANSION #2 CALLS
LIST OF ALL S.I. 10% CALLS - 2

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION		EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
88	31	0.21	P 1	89	VOL		09S	-0.72	09S	09S	520	P2204	88	VOL
					MSG		L x W	0.13 x 0.16 VOL			520	P2204	88	
89	34	0.14	1	69	VOL		LTS	+15.78	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.11 x 0.15 PIT			520	P2204	88	
90	44	0.20	1	85	VOL		LTS	+7.79	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.13 x 0.15 PIT			520	P2204	88	
92	36	0.34	P 1	77	VOL		07S	-0.59	07S	07S	520	P2204	89	VOL
					MSG		L x W	0.10 x 0.13 VOL			520	P2204	89	
94	43	0.28	1	116	VOL		LTS	+8.10	LTS	LTS	520	B0690	88	PIT
					MSG		L x W	0.16 x 0.14 PIT			520	B0690	88	
97	27	0.18	1	66	VOL		LTS	+11.31	LTS	LTS	520	P2204	89	PIT
					MSG		L x W	0.13 x 0.17 PIT			520	P2204	89	
100	91	0.16	1	75	VOL		LTS	+12.07	LTS	LTS	520	R6452	88	PIT
					MSG		L x W	0.13 x 0.17 PIT			520	P2204	88	
101	93	0.26	1	75	VOL		LTS	+5.01	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.16 x 0.15 PIT			520	P2204	88	
		0.28	1	60	VOL		LTS	+7.07	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.12 x 0.12 PIT			520	P2204	88	
104	46	0.20	P 1	63	VOL		07S	-0.66	07S	07S	520	P2204	88	VOL
					MSG		L x W	0.15 x 0.25 VOL			520	R6452	88	
104	51	0.13	1	34	VOL		LTS	+9.51	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.16 x 0.16 PIT			520	P2204	88	
105	36	0.22	1	45	VOL		LTS	+9.73	LTS	LTS	520	P1790	89	PIT
					MSG		L x W	0.16 x 0.13 PIT			520	P1790	89	
107	48	0.31	1	67	VOL		LTS	+11.66	LTS	LTS	520	P2204	88	PIT
					MSG		L x W	0.10 x 0.12 PIT			520	P2204	88	
113	39	0.21	1	114	VOL		LTS	+11.79	LTS	LTS	520	P2204	89	PIT
					MSG		L x W	0.13 x 0.16			520	P2204	89	
118	66	0.24	P 1	81	VOL		07S	-0.77	07S	07S	520	P2204	88	VOL
					MSG		L x W	0.13 x 0.20 VOL			520	P2204	88	
119	12	0.19	P 1	98	VOL		07S	-0.76	07S	07S	520	P2204	88	VOL
					MSG		L x W	0.16 x 0.18 VOL			520	P2204	88	
120	63	0.30	P 1	74	VOL		07S	-0.74	07S	07S	520	P2204	88	VOL
					MSG		L x W	0.16 x 0.21 VOL			520	P2204	88	
127	96	0.21	P 1	64	VOL		10S	+0.69	10S	10S	520	R6452	89	VOL
			P 1		MSG		L x W	0.17 x 0.17 VOL			520	R6452	89	
130	23	0.48	P 1	87	VOL		07S	-0.80	07S	07S	520	R6452	88	VOL
			P 1		MSG		L x W	0.18 x 0.17 VOL			520	R6452	88	
131	50	0.30	P 1	68	VOL		07S	-0.75	07S	07S	520	P2204	88	VOL
					MSG		L x W	0.19 x 0.16 VOL			520	P2204	88	
132	45	0.15	P 1	92	VOL		07S	-0.70	07S	07S	520	P2204	88	VOL
					MSG		L x W	0.13 x 0.16 VOL			520	R6452	88	
134	63	0.43	P 1	84	VOL		07S	-0.64	07S	07S	520	P2204	88	VOL
					MSG		L x W	0.16 x 0.20 VOL			520	P2204	88	
144	15	0.47	P 1	0	WAR	13	07S	-0.78	07S	07S	520	B0690	88	WAR
					MSG		L x W	0.30 x 0.22 WAR			520	B0690	88	

Total Indications Found = 111
Total Tubes Found = 53

****************************** BWNT TUBAN II (Version 2.1) 04/28/1994 09:41:44 ******************************
Crystal River Unit 3
S/G A
94/04 RFO
SPEC. INT. 10% EXP 3

LIST OF ALL SPECIAL INTEREST 10% MRPC EXPANSION #3 CALLS
LIST OF ALL S.I. 10% CALLS - 3

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION		EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
7	27	0.35	P 1	92	VOL		07S	+0.56	07S	07S	520	L7871	86	VOL
					MSG		L x W	0.23 x 0.17 VOL			520	L7871	86	
		0.24	P 1	91	VOL		07S	-0.58	07S	07S	520	L7871	86	VOL
					MSG		L x W	0.08 x 0.06 VOL			520	L7871	86	
		0.27	P 1	123	VOL		07S	+0.65	07S	07S	520	L7871	86	VOL
					MSG		L x W	0.08 x 0.11			520	L7871	86	
8	30				NDF		08S	+25.37	09S	08S	520	H8259	86	
					NDF		08S	+25.37	09S	08S	520	H8259	86	
		0.28	P 1	0	WAR	14	08S	+0.60	09S	08S	520	H8259	86	WAR
			P 1		MSG		L x W	0.24 x 0.18 WAR			520	L7871	86	
		0.33	P 1	0	WAR	15	08S	-0.50	09S	08S	520	H8259	86	WAR
					MSG		L x W	0.29 x 0.14 WAR			520	L7871	86	
		0.35	P 1	0	WAR	16	07S	+0.70	07S	07S	520	L7871	86	WAR
					MSG		L x W	0.26 x 0.14 WAR			520	L7871	86	
		0.40	P 1	0	WAR	18	07S	-0.55	07S	07S	520	L7871	86	WAR
					MSG		L x W	0.39 x 0.15 WAR			520	L7871	86	
14	8	0.29	P 1	0	ODI	14	07S	-0.71	07S	07S	520	L7871	86	VOL
					MSG		L x W	0.20 x 0.17 VOL			520	L7871	86	
22	59	0.18	P 1	72	VOL		10S	+0.62	10S	10S	520	L7871	86	VOL
					MSG		L x W	0.15 x 0.13 VOL			520	L7871	86	
26	95	0.47	P 1	0	WAR	21	08S	-0.68	08S	08S	520	L7871	86	WAR
					MSG		L x W	0.44 x 0.13 WAR			520	L7871	86	
27	91				NDF		LTS	+19.54	LTS	LTS	520	L7871	86	
63	128	0.37	P 1	0	WAR	17	10S	+0.00	10S	10S	520	L7871	86	WAR
					MSG		L x W	1.52 x 0.18 WAR			520	L7871	86	
65	129	0.71	P 1	0	WAR	29	10S	+0.00	10S	10S	520	L7871	86	WAR
					MSG		L x W	1.22 x 0.17 WAR			520	L7871	86	
81	130	0.30	P 1	59	WAR	S/N	10S	-0.89	10S	10S	520	L7871	86	WAR
					MSG		L x W	0.45 x 0.13 WAR			520	L7871	86	
82	130	0.20	P 1	52	VOL		LTS	+24.67	LTS	LTS	520	L7871	86	VOL
					MSG		L x W	0.23 x 0.16 VOL			520	L7871	86	
90	9	0.41	P 1	65	VOL		08S	-0.64	08S	08S	520	L7871	86	VOL
					MSG		L x W	0.13 x 0.13 VOL			520	L7871	86	
107	15	0.33	P 1	91	VOL		14S	-0.92	14S	14S	520	L7871	86	VOL
					MSG		L x W	0.16 x 0.13 VOL			520	L7871	86	
140	55	0.24	1	145	DNG		11S	+19.96	11S	11S	520	H8259	86	
148	36	0.37	P 1	0	WAR	17	10S	-0.68	10S	10S	520	L7871	86	WAR
					MSG		L x W	0.68 x 0.12 WAR			520	L7871	86	
		0.23	P 1	91	VOL		10S	+0.79	10S	10S	520	L7871	86	VOL
					MSG		L x W	0.20 x 0.13 VOL			520	L7871	86	
150	7	0.39	P 1	52	VOL		10S	-0.80	10S	10S	520	L7871	86	VOL
					MSG		L x W	0.14 x 0.09 VOL			520	L7871	86	
150	16	0.67	P 1	0	WAR	28	10S	-0.00	10S	10S	520	L7871	86	WAR
					MSG		L x W	1.52 x 0.33 WAR			520	L7871	86	

Total Indications Found = 44
Total Tubes Found = 16

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******************************    BWNT TUBAN II (Version 2.1)    04/28/1994 10:01:51    ******************************
******************************    Crystal River Unit 3    ******************************
******************************    S/G B    ******************************
******************************    94/04 RFO    ******************************
******************************    SPEC. INT. 10% EXP 3    ******************************
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LIST OF ALL SPECIAL INTEREST 10% MRPC EXPANSION #3 CALLS
LIST OF ALL S.I. 10% CALLS - 3

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION		EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
5	38	0.58	P 1	83	VOL		09S	-0.85	09S	09S	520	S2680	90	VOL
					MSG		L x W	0.21 x 0.21 VOL			520	S2680	90	
15	35	0.33	P 1	63	VOL		09S	-0.91	09S	09S	520	C9318	90	PIT
					MSG		L x W	0.18 x 0.14 PIT			520	C9318	90	
25	8				NDF		08S	+5.30	08S	08S	520	S1848	90	
27	94	0.27	P 1	71	VOL		11S	+0.84	11S	11S	520	S2680	91	VOL
			P 1		MSG		L x W	0.20 x 0.18 VOL			520	S2680	91	
					NDF		11S	+9.56	11S	11S	520	S2680	91	
					RIC		11S	+9.56			520	S1848	90	
35	38	0.15	1	49	VOL		LTS	+27.05	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.10 x 0.17 PIT			520	S1848	90	
36	40	0.13	1	94	VOL		LTS	+28.83	LTS	LTS	520	S1848	91	PIT
					MSG		L x W	0.13 x 0.13 PIT			520	S1848	91	
					RIC		LTS	+27.95			520	M6664	90	
36	47	0.26	P 1	73	VOL		07S	-0.73	07S	07S	520	S1848	90	VOL
					MSG		L x W	0.10 x 0.15 VOL			520	S1848	90	
39	42	0.13	1	50	VOL		LTS	+8.77	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.17 x 0.14 PIT			520	S1848	90	
41	47	0.21	1	61	VOL		LTS	+9.51	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.10 x 0.17 PIT			520	S1848	90	
43	42	0.23	1	82	VOL		LTS	+9.53	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.10 x 0.17 PIT			520	S1848	90	
43	76	0.25	P 1	43	VOL		12S	-5.87	12S	12S	520	M6664	90	MBM
					MSG		L x W	0.47 x 0.27 MBM			520	M6664	90	
44	46	0.17	1	121	VOL		LTS	+8.46	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.13 x 0.13 PIT			520	S1848	90	
47	48	0.19	1	75	VOL		LTS	+5.86	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.17 x 0.17 PIT			520	S1848	90	
49	47	0.08	P 1	25	VOL		LTS	+13.54	LTS	LTS	520	M6664	90	VOL
					MSG		L x W	0.13 x 0.13 VOL			520	M6664	90	
49	48	0.36	P 1	111	VOL		09S	-0.73	09S	09S	520	S1848	90	VOL
					MSG		L x W	0.13 x 0.19 VOL			520	S1848	90	
51	37	0.22	P 1	78	VOL		09S	-0.59	09S	09S	520	M6664	90	VOL
					MSG		L x W	0.13 x 0.14 VOL			520	M6664	90	
57	51	0.19	1	49	VOL		LTS	+9.90	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.13 x 0.15 PIT			520	S1848	90	
60	38	0.29	1	98	VOL		LTS	+9.56	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.17 x 0.15 PIT			520	S1848	90	
61	26	0.11	P 1	62	VOL		06S	-0.67	06S	06S	520	M6664	90	VOL
					MSG		L x W	0.08 x 0.17 VOL			520	M6664	90	
63	27	0.09	P 1	55	VOL		LTS	+8.38	LTS	LTS	520	M6664	90	PIT
					MSG		L x W	0.07 x 0.08 PIT			520	M6664	90	
63	29	0.18	1	98	VOL		LTS	+6.20	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.13 x 0.17 PIT			520	S1848	90	
64	68	0.35	P 1	51	VOL		07S	-0.69	07S	07S	520	M6664	90	VOL
					MSG		L x W	0.16 x 0.16 VOL			520	M6664	90	
64	121	0.34	P 1	63	VOL		04S	+0.98	04S	04S	520	M6664	90	VOL
					MSG		L x W	0.08 x 0.11 VOL			520	M6664	90	
66	28	0.25	1	55	VOL		LTS	+8.16	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.07 x 0.13 PIT			520	S1848	90	
68	102	0.15	P 1	69	VOL		07S	-0.64	07S	07S	520	M6664	90	VOL
					MSG		L x W	0.11 x 0.11 VOL			520	M6664	90	
69	45	0.28	P 1	101	VOL		09S	+0.68	09S	09S	520	S2680	90	VOL
			P 1		MSG		L x W	0.21 x 0.18 VOL			520	S2680	90	
79	40	0.23	P 1	96	VOL		11S	-0.73	11S	11S	520	S1848	90	VOL
					MSG		L x W	0.13 x 0.24 VOL			520	S1848	90	
84	98	0.07	P 1	79	VOL		LTS	+12.05	LTS	LTS	520	M6664	90	PIT
					MSG		L x W	0.13 x 0.13 PIT			520	M6664	90	
92	93	0.20	1	68	VOL		LTS	+6.12	LTS	LTS	520	S2680	90	PIT
					MSG		L x W	0.17 x 0.17 PIT			520	S2680	90	
92	126	0.40	P 1	85	VOL		07S	-0.72	07S	07S	520	M6664	90	VOL
					MSG		L x W	0.11 x 0.15 VOL			520	M6664	90	
94	81	0.77	1	77	VOL		10S	+18.09	10S	10S	520	M6664	91	MBM
					MSG		L x W	0.41 x 0.26 MBM			520	M6664	91	
96	29	0.09	1	50	VOL		LTS	+26.59	LTS	LTS	520	S1848	90	PIT

LIST OF ALL SPECIAL INTEREST 10% MRPC EXPANSION #3 CALLS
LIST OF ALL S.I. 10% CALLS - 3

ROW	TUBE	VOLTS	CHN	DEG	IND	%TW	LOCATION		EXTENT1	EXTENT2	PROBE	ANLST	CAL#	COMMENTS
					MSG		L x W	0.09 x 0.15 PIT			520	S1848	90	
96	116	0.09	1	70	VOL		15S	+21.39	15S	15S	520	S1848	90	PIT
					MSG		L x W	0.10 x 0.17 PIT			520	S1848	90	
99	94	0.12	1	87	VOL		LTS	+5.79	LTS	LTS	520	M6664	90	PIT
					MSG		L x W	0.13 x 0.14 PIT			520	M6664	90	
110	45	0.12	1	106	VOL		LTS	+11.65	LTS	LTS	520	S1848	91	PIT
					MSG		L x W	0.07 x 0.20 PIT			520	S1848	91	
					RIC		LTS	+11.16			520	S1848	90	
112	40	0.21	1	36	VOL		LTS	+6.31	LTS	LTS	520	S1848	90	PIT
					MSG		L x W	0.10 x 0.15 PIT			520	S1848	90	
117	44	0.22	1	95	VOL		LTS	+10.76	LTS	LTS	520	S1848	91	PIT
					MSG		L x W	0.16 x 0.13 PIT			520	S1848	91	
		0.21	1	74	VOL		LTS	+8.68	LTS	LTS	520	S1848	91	PIT
					MSG		L x W	0.10 x 0.17 PIT			520	S1848	91	
117	71	0.35	P 1	98	VOL		07S	-0.73	07S	07S	520	M6664	91	VOL
					MSG		L x W	0.08 x 0.12 VOL			520	M6664	91	
117	73	0.27	P 1	110	VOL		07S	-0.69	07S	07S	520	S1848	91	VOL
					MSG		L x W	0.10 x 0.18 VOL			520	S1848	91	
124	48	0.32	P 1	71	VOL		07S	-0.74	07S	07S	520	M6664	91	VOL
					MSG		L x W	0.12 x 0.16 VOL			520	M6664	91	
126	53	0.30	P 1	89	VOL		07S	-0.73	07S	07S	520	M6664	91	VOL
					MSG		L x W	0.18 x 0.20 VOL			520	M6664	91	
127	8				NDF		12S	+14.71	12S	12S	520	S1848	91	
129	52	0.21	P 1	61	VOL		07S	-0.76	07S	07S	520	M6664	91	VOL
					MSG		L x W	0.13 x 0.20 VOL			520	M6664	91	
130	47	0.28	P 1	78	VOL		07S	-0.68	07S	07S	520	M6664	91	VOL
					MSG		L x W	0.15 x 0.15 VOL			520	M6664	91	
147	23	0.28	P 1	62	VOL		03S	-0.67	03S	03S	520	M6664	91	VOL
					MSG		L x W	0.23 x 0.20 VOL			520	M6664	91	

Total Indications Found = 94
Total Tubes Found = 45

Tube/ Defect	Axial Extent, In.	Circumferential Extent, In.	Depth, % TW
52-51-2-D	0.061	0.041	34
52-51-2-I2	0.048	0.037	52
52-51-2-I1	0.053	0.037	28
52-51-2-X	0.0403	0.011	32
52-51-2-U	0.0327	0.026	26
52-51-2-S	0.0637	0.045	33
52-51-2-R	0.0389	0.02	18
52-51-2-P	0.0439	0.029	33
52-51-2-N2/1	0.0336	0.025	30
52-51-2-L	0.0335	0.007	13
52-51-2-K2/1	0.0427	0.043	45
52-51-2-G/F	0.0699	0.031	47
52-51-2-B	0.0386	0.011	38
90-28-2-C	0.053	0.01	56
90-28-2-AF	0.0289	0.011	51
90-28-2-AD2/1	0.0524	0.019	37
90-28-2-AB	0.0544	0.045	30
90-28-2-Z	0.0382	0.007	30
90-28-2-X2/1	0.0456	0.015	43
90-28-2-V2/1	0.0537	0.041	48
90-28-2-T2/1	0.0363	0.043	50
90-28-2-S2/1	0.0339	0.017	26
90-28-2-Q	0.0592	0.017	45
90-28-2-O/N/M	0.0585	0.079	43
90-28-2-K	0.0318	0.02	18
90-28-2-B	0.063	0.02	12
90-28-2-E	0.071	0.038	50
90-28-2-I	0.063	0.023	46
90-28-2-H	0.059	0.022	37
90-28-2-G	0.079	0.039	53
97-91-2-P	0.073	0.074	46
97-91-2-O	0.076	0.062	54
97-91-2-U	0.054	0.047	48
97-91-2-T	0.061	0.066	44
97-91-2-S	0.011	0.001	1
97-91-2-W	0.061	0.047	54
97-91-2-R1	0.011	0.033	4
97-91-2-M	0.0197	0.018	16
97-91-2-K	0.0498	0.021	29
97-91-2-I	0.0067	0.013	4
97-91-2-G	0.0131	0.004	5
97-91-2-E2/1/D	0.0135	0.031	6
97-91-2-B	0.0163	0.014	6
106-32-2-X2	0.071	0.053	49
106-32-2-Y	0.015	0.008	8
106-32-2-X1	0.016	0.038	27
106-32-2-AG2	0.062	0.035	40

Tube/ Defect	Axial Extent, In.	Circumferential Extent, In.	Depth, % TW
106-32-2-AH	0.056	0.028	29
106-32-2-AT	0.06	0.05	31
106-32-2-AU	0.047	0.054	39
106-32-2-BG/BF	0.0551	0.041	15
106-32-2-BD/BC	0.0635	0.07	31
106-32-2-BB/BA/AZ	0.0353	0.07	20
106-32-2-AY	0.0553	0.088	36
106-32-2-AX	0.0399	0.052	32
106-32-2-AR	0.0449	0.07	19
106-32-2-AQ2/1	0.0381	0.087	35
106-32-2-AF/AO	0.048	0.078	27
106-32-2-AN/AM3/2/1	0.0265	0.174	27
106-32-2-AL2/1	0.0277	0.056	11
106-32-2-AJ/AK	0.0613	0.124	39
106-32-2-AE/AD/AC2	0.0625	0.15	24
106-32-2-AC1/AB	0.0535	0.063	18
106-32-2-Z/AA	0.0462	0.101	34
106-32-2-V2	0.0408	0.011	14
106-32-2-Q	0.0171	0.017	7
106-32-2-N	0.0054	0.005	15
106-32-2-L/K/J/I/H	0.0173	0.171	14
106-32-2-F	0.012	0.051	9
106-32-2-E	0.0182	0.019	23
106-32-2-C	0.0067	0.027	7
68-46-14B	0.09	0.119	30
68-46-3A	0.228	0.089	75
72-49-13B	0.094	0.134	18
109-71-7BX	0.086	0.097	15
109-71-14B	0.112	0.101	36
136-26-15B	0.112	0.17	38
41-44-2-B2	0.049	0.065	44
41-44-2-B4A	0.039	0.082	29
41-44-2-B4B	0.024	0.037	29
41-44-2-B4C	0.076	0.043	20
41-44-2-B4D	0.069	0.03	6
41-44-2-B6A	0.029	0.058	32
41-44-2-B6B	0.046	0.072	38
41-44-2-B8D	0.069	0.106	59
41-44-2-B10	0.045	0.084	32

Data Utilized in Figure 5-6

Discontinuity ID	Depth (%TW)
90-28-2-AF	51
90-28-2-AD2/1	37
90-28-2-AB	30
90-28-2-Z	30
90-28-2-X2/1	43
90-28-2-V2/1	48
90-28-2-T2/1	50
90-28-2-S2/1	26
90-28-2-Q	45
90-28-2-K	18
90-28-2-C/B	41
90-28-2-O/N/M	43
90-28-2-E	50
90-28-2-I/H/G	49
52-51-2-X	32
52-51-2-U	26
52-51-2-S	33
52-51-2-R	18
52-51-2-P	33
52-51-2-N2/1	30
52-51-2-L	13
52-51-2-K2/1	45
52-51-2-G/F	47
52-51-2-D	34
52-51-2-I2/1	42
52-51-2-B	38
97-91-2-R1	4
97-91-2-M	16
97-91-2-K	29
97-91-2-I	4
97-91-2-G	5
97-91-2-E2/1/D	6
97-91-2-B	6
97-91-2-W	54
97-91-2-U/T/S	46
97-91-2-P/O	50
106-32-2-BG/BF	15
106-32-2-BB/BA/AZ	20
106-32-2-AX	32
106-32-2-AR	19
106-32-2-AQ2/1	35
106-32-2-AP/AO	27
106-32-2-AN/AM3/2/1	27
106-32-2-AL2/1	11
106-32-2-AC1/AB	18
106-32-2-X2/Y/X1	28
106-32-2-V2	14

Data Utilized in Figure 5-6

Discontinuity ID			Depth (%TW)
106-32-2-BD/BC			31
106-32-2-AY			36
106-32-2-AG2/AH			35
106-32-2-AE/AD/AC2			24
106-32-2-Z/AA			34
106-32-2-AT/AU/AV			34
106-32-2-AJ/AK			39
106-32-2-Q			7
106-32-2-N			15
106-32-2-L/K/J/I/H			14
106-32-2-F			9
106-32-2-E			23
106-32-2-C			7
41-44-2-B1			35
41-44-2-B2			44
41-44-2-B3A			44
41-44-2-B3B			29
41-44-2-B3C			20
41-44-2-B3D			44
41-44-2-B4A			29
41-44-2-B4B			29
41-44-2-B4C			20
41-44-2-B4D			6
41-44-2-B5A1			24
41-44-2-B5B1			35
41-44-2-B5B2			20
41-44-2-B6A			32
41-44-2-B6B			38
41-44-2-B7A			32
41-44-2-B7B			29
41-44-2-B7C			29
41-44-2-B7D			20
41-44-2-B7E			18
41-44-2-B8A			50
41-44-2-B8D			59
41-44-2-B9A			29
41-44-2-B9B			26
41-44-2-B9C			20
41-44-2-B9D			29
41-44-2-B10			32
41-44-2-B11A			20
41-44-2-B11B			29
41-44-2-B11C			41
41-44-2-B11D			29
41-44-2-B11E			26
41-44-2-B11F			26

Axial Extent Range 0-0.024 Inches (0-24 Mils)			
Discontinuity ID	Axial Extent (Mils)	Detection (Y or N)	
		Bobbin	MRPC
97-91-2-I	6.7	N	N
97-91-2-R1	11	N	Y
97-91-2-M	19.7	N	N
97-91-2-G	13.1	N	N
97-91-2-E2/1/D	13.5	N	N
97-91-2-B	16.3	N	N
Axial Extent Range 0.025-0.049 Inches (25-49 Mils)			
Discontinuity ID	Axial Extent (Mils)	Detection (Y or N)	
		Bobbin	MRPC
41-44-2-B4B	25	N	N
106-32-2-AN/AM/3/2/1	26.5	Y	Y
106-32-2-AL2/1	27.7	N	Y
90-28-2-AF	28.9	N	N
41-44-2-B6A	29	N	N
41-44-2-B4A	39	N	N
90-28-2-Z	38.2	N	N
90-28-2-T2/1	36.3	N	N
90-28-2-S2/1	33.9	N	N
90-28-2-K	31.8	N	N
52-51-2-U	32.7	N	N
52-51-2-R	38.9	N	N
52-51-2-N2/1	33.6	N	N
52-51-2-L	33.5	N	N
106-32-2-BB/BA/AZ	35.3	N	N
106-32-2-AX	39.9	N	N
106-32-2-AQ2/1	38.1	N	Y
106-32-2-X2/Y/X1	33.7	Y	Y
106-32-2-V2	40.8	N	Y
41-44-2-B10	45	N	N
41-44-2-B6B	46	N	N
90-28-2-X2/1	45.6	N	N
52-51-2-X	40.3	N	N
52-51-2-P	43.9	N	N
52-51-2-K2/1	42.7	N	N
52-51-2-I2/1	49.7	Y	Y
97-91-2-K	49.8	N	N
106-32-2-AT/AU/AV	46.8	Y	Y
106-32-2-AR	44.9	N	Y
106-32-2-AP/AO	48	Y	N
106-32-2-Z/AA	46.2	N	N
41-44-2-B2	49	N	N

Data Utilized in the Development of Figures 2-8 and 2-10

	Axial Extent Range 0.050-0.074 Inches (50-74 Mils)		
Discontinuity ID	Axial Extent (Mils)	Detection (Y or N)	
		Bobbin	MRPC
90-28-2-AD2/1	52.4	N	N
90-28-2-AB	54.4	N	N
90-28-2-V2/1	53.7	N	N
90-28-2-Q	59.2	N	N
90-28-2-O/N/M	58.5	N	N
90-28-2-C/B	56.5	Y	Y
97-91-2-U/T/S	58.2	N	Y
97-91-2-W	60.6	Y	Y
106-32-2-BG/BF	55.1	N	N
106-32-2-AY	55.3	Y	N
106-32-2-AG2/AH	59.1	N	Y
106-32-2-AC1/AB	53.5	N	N
52-51-2-S	63.7	N	N
52-51-2-G/F	69.9	Y	Y
52-51-2-D	60.9	Y	Y
106-32-2-BD/BC	63.5	N	N
106-32-2-AJ/AK	61.3	Y	Y
106-32-AE/AD/AC2	62.5	Y	N
41-44-2-B4D	69	Y	Y
41-44-2-B8	69	N	N
90-28-2-I/H/G	71.5	Y	Y
90-28-2-E	70.9	Y	Y
97-91-2-P/O	74.4	Y	N
41-44-2-B4C	76	N	N
	Axial Extent Range 0.075-0.099 Inches (75-99 Mils)		
Discontinuity ID	Axial Extent (Mils)	Detection (Y or N)	
		Bobbin	MRPC
68-46-14	90	Y	Y
72-49-13	94	Y	Y
109-71-7	86	Y	N/A-Note
	Axial Extent Range 0.100-0.124 Inches (100-124 Mils)		
Discontinuity ID	Axial Extent (Mils)	Detection (Y or N)	
		Bobbin	MRPC
109-71-14	112	Y	Y
136-26-15	112	Y	Y

Data Utilized in the Development of Figure 2-9

		Volume Range 0-24E-6 Inches			
Discontinuity ID		Volume (E-6 cubic inches)		Detection (Y or N)	
				Bobbin	MRPC
90-28-2-AF		3		N	N
90-28-2-AD2/1		6.9		N	N
90-28-2-AB		13.8		N	N
90-28-2-Z		1.5		N	N
90-28-2-X2/1		5.4		N	N
90-28-2-V2/1		19.9		N	N
90-28-2-T2/1		14.5		N	N
90-28-2-S2/1		2.9		N	N
90-28-2-Q		8.5		N	N
90-28-2-K		2.1		N	N
90-28-2-C/B		14.5		Y	Y
52-51-2-X		2.6		N	N
52-51-2-U		4.2		N	N
52-51-2-S		17.9		N	N
52-51-2-R		2.7		N	N
52-51-2-P		7.9		N	N
52-51-2-N2/1		4.8		N	N
52-51-2-L		0.6		N	N
52-51-2-K2/1		15.4		N	N
52-51-2-G/F		19.3		Y	Y
52-51-2-D		17.9		Y	Y
97-91-2-R1		0.3		N	Y
97-91-2-M		1.1		N	N
97-91-2-K		5.7		N	N
97-91-2-I		0.1		N	N
97-91-2-G		0		N	N
97-91-2-E2/1/D		0.5		N	N
97-91-2-B		0.2		N	N
106-32-2-BG/BF		6.2		N	N
106-32-2-BB/BA/AZ		9.4		N	N
106-32-2-AX		12.6		N	N
106-32-2-AR		11.2		N	Y
106-32-2-AQ2/1		21.9		N	Y
106-32-2-AP/AO		19.2		Y	N
106-32-2-AN/AM3/2/1		23.5		Y	Y
106-32-2-AL2/1		3.2		N	Y
106-32-2-AC1/AB		11.4		N	N
106-32-2-X2/Y/X1		19.8		Y	Y
106-32-2-V2		1.2		N	Y
109-71-7Bx		17		Y	N/A
41-44-2B		7		N	N
41-44-2-B4A		5		N	N
41-44-2-B4B		1		N	N
41-44-2-B4C		4		N	N
41-44-2-B4D		1		N	N
41-44-2-B6A		3		N	N

Volume Range 0-24E-6 Inches (Continued)			
Discontinuity ID	Volume (E-6 cubic inches)	Detection (Y or N)	
41-44-2-B6B	6	N	N
41-44-2-B8	22	Y	Y
41-44-2-B10	6	N	N
Volume Range 25-49 E-6 Inches			
Discontinuity ID	Volume (E-6 cubic inches)	Detection (Y or N)	
		Bobbin	MRPC
90-28-2-O/N/M	37.5	N	N
90-28-2-E	28.8	Y	Y
52-51-2-I2/1	32.9	Y	Y
97-91-2-W	32	Y	Y
106-32-2-BD/BC	25.5	N	N
106-32-2-AY	32.9	Y	N
106-32-2-AG2/AH	27.6	N	Y
106-32-2-AE/AD/AC2	42.4	Y	N
106-32-2-Z/AA	30	N	N
72-49-13	35	Y	Y
Volume Range 50-74 E-6 Inches			
Discontinuity ID	Volume (E-6 cubic inches)	Detection (Y or N)	
		Bobbin	MRPC
90-28-2-I/H/G	62.3	Y	Y
97-91-2-U/T/S	70.9	N	Y
97-91-2-P/O	68.8	Y	N
106-32-2-AT/AU/AV	69.2	Y	Y
106-32-2-AJ/AK	56	Y	Y
68-46-14B	68	Y	Y
109-71-14B	66	Y	Y
136-26-15B	68	Y	Y

Tube	Location	L1 (8R)	L2 (9R)	w1 (8R)	w2 (9R)		
13-9	08S-0.80	0.14	0.19	0.19	0.14		
35-42	09S-0.63	0.16	0.13	0.22	0.21		
37-41	LTSF+6.78	0.14	0.18	0.14	0.14		
37-48	07S-0.79	0.11	0.14	0.17	0.1		
41-47	LTSF+14.00	0.15	0.09	0.17	0.12		
43-42	LTSF+8.85	0.14	0.16	0.18	0.14		
43-80	12S+6.84	0.16	0.16	0.05	0.14		
48-38	LTSF+10.86	0.15	0.19	0.21	0.16		
53-39	LTSF+12.44	0.18	0.11	0.16	0.16		
57-38	LTSF+12.00	0.07	0.09	0.13	0.14		
57-44	LTSF+9.64	0.14	0.13	0.13	0.15		
57-52	LTSF+6.74	0.14	0.11	0.18	0.16		
60-119	07S-0.69	0.14	0.14	0.19	0.24		
67-52	07S-0.77	0.12	0.14	0.21	0.25		
69-45	09S+0.67	0.12	0.21	0.18	0.18		
72-67	03S-0.62	0.14	0.12	0.18	0.11		
96-70	07S-0.75	0.05	0.13	0.09	0.19		
101-41	LTSF+16.23	0.17	0.14	0.18	0.14		
104-33	LTSF+5.33	0.08	0.17	0.14	0.16		
107-50	LTSF+8.80	0.12	0.17	0.16	0.15		
108-33	LTSF+12.15	0.14	0.1	0.19	0.15		
108-33	LTSF+10.00	0.14	0.14	0.2	0.15		
108-33	LTSF+5.82	0.11	0.12	0.2	0.19		
110-45	LTSF+11.64	0.05	0.07	0.17	0.2		
116-49	07S-0.87	0.13	0.2	0.21	0.15		
117-44	LTSF+7.43	0.17	0.14	0.22	0.18		
118-40	LTSF+7.97	0.14	0.17	0.12	0.1		
118-40	LTSF+23.05	0.22	0.11	0.15	0.1		
118-66	07S-0.78	0.1	0.13	0.14	0.2		
144-12	07S-0.92	0.16	0.17	0.18	0.21		
145-8	07S-0.85	0.14	0.14	0.15	0.14		
34-72A	02S+14.64	0.29	0.19	0.23	0.18		
79-128A	10S+0.54	0.1	0.18	0.13	0.19		

IV.B RAI Question Number 28 - Introductory Paragraph Discussion

The introductory paragraph refers to two instances where the NRC Staff felt there was an apparent discrepancy between data sets presented. Each of these is discussed below.

Table 3-2 is a compilation of the detectability information presented in Table 3-1 "Summary of Eddy Current Distinguishable Defects." As discussed in the response to RAI Question Number 34, the difference between the data presented in Appendix D to Attachment 2 of Reference 4 resides in the intended purpose of the respective evaluation.

The second example cited compares 1992 pulled tube data with the population of pulled tube data following the 1994 tube pull. Presumably, the RAI is referring to the number of indications detected by MRPC since this is the subject of Table 3-1. In this case, Appendix B contained a number of detected indications based upon combined eddy current results and total defect count. This approach was not utilized in later disposition strategy development efforts.

Appendix B

Response to RAI Number 35
"References"

1. SCOPE.

The purpose of this guide is to describe recommended practices for the measurement of fluid leak rate(s) from tubes with through-wall degradation, that are either pulled from steam generators (SG's) or produced under laboratory conditions.

Since acceptable leak rate testing may be performed utilizing a variety of test facility and measuring equipment, a specific delineation of such equipment and its' configuration is not specified herein.

2. TEST SPECIMEN(S).

The test specimens should consist of tube sections approximately 10" (250 mm) long, with the degraded area located as close as practicable to the mid-length position of the specimen. In specific cases lengths as short as 6" (150 mm) may be justified.

If the degradation is visible at the tube outside diameter (OD) surface, a good quality (preferably color) photograph should be taken of the degraded area.

3. PROCEDURE RECOMMENDATIONS.

Testing shall be performed in accordance with a written test procedure. The test procedure shall be aimed at providing a direct or adjusted evaluation of the leak rate to be expected under the specified environmental conditions, e.g., the internal and external pressure, temperature and fluid conditions, of interest.

Note: Usually the desired leak rate is for faulted conditions, with the water pressure and temperature specified on the primary side, and an essentially zero (ambient) pressure vapor phase on the secondary side.

The leak rate measurement(s) shall be performed at a differential pressure closely matching the actual SG conditions (as specified).

It is further desirable, but, not mandatory, that the testing conditions fully duplicate the specified environment, including the SG operating temperatures.

Adjustments to the measured leak rates are required when the absolute pressures (both sides of the tube) and/or the temperatures are not prototypic.

This is always the case for room temperature testing. While such an adjustment procedure involves some additional uncertainty, the latter is usually considered to be much smaller than the scatter of leak rates from nominally similar crack morphologies, i.e., as characterized by standard non-destructive examination (NDE) techniques.

Even if the test is performed at the specific differential pressure, it is desirable, but, not mandatory, to gain some knowledge about the rate of change of leak rate with pressure. This addresses a sensitivity concern, and may provide a basis for the possible extrapolation or interpolation of the results to other faulted conditions that might be further considered by plant safety evaluations.

It is recommended that additional leak rate measurements, preferably three or four, be performed at selected pressure difference levels ranging from not lower than the normal operation condition to not higher than 110% of the specified faulted condition.

The leak test duration, i.e., time at each pressure level, should be determined based on the required measurement accuracy and the measuring equipment being used. Replicate tests for each configuration are recommended. Due to plasticity effects, crack opening areas are path dependent. Therefore, leak rate measurements at a low pressure difference will increase markedly after exposure to a higher pressure difference. Transient pressure fluctuations during the approach to steady state test conditions should thus be controlled to avoid unwanted crack opening deformation.

The measurement system should be capable of providing reliable leak rate results in the range from 0.01 to 100 1/h, with an accuracy of plus or minus 10%.

4. TEST EQUIPMENT

Test equipment may vary widely, depending on the selected testing conditions and method. In general terms, the following may be required:

1) a supply system, delivering the high pressure, and possibly high temperature, water into the primary side of the test specimen,

2) a secondary side enclosure, in the case of high temperature testing, with possible provisions for:

a. pressure confinement,

b. leakage collection,

3) a measurement syst of either the injected flow rate or collected leak rate,

4) adequate control and instrumentation to establish and maintain the applicable testing conditions, such as pressure(s) and temperature(s), for the duration of the test.

The integrated testing facility should be qualified. Such qualification should consist of demonstrating its' functional capability over the full range of specified leak rates, pressures, and temperatures.

Attention should be paid to functional limitations that might impair the nominal measuring ranges, e.g., when the order of magnitude of the flow resistance of piping connections becomes comparable to that of the cracked specimen.

4. DOCUMENTATION

Leak rate testing should comply with all relevant quality assurance (QA) requirements in effect at the testing laboratory organization. As a minimum the following documentation shall be available:

(1) a description and qualification of the leak rate measurement system, including the accuracy of the measurements,

(2) the adjustment procedure to accident conditions (if applicable),

(3) a written test procedure,

(4) a test report including:

(a) full specimen identification,

(b) a sketch, schematic diagram or written description of the test equipment and instrumentation, and the configuration of same,

(c) full description of test parameters,

(d) test equipment serial numbers,

(e) (reference to) instrument calibration data,

(f) measured leak rates (for each selected pressure level),

(g) adjusted leak rates (if applicable),

(h) appended photographs of the degraded area, before and after testing (optional).

1. SCOPE.

The purpose of this guide is to define the configuration of test specimens, equipment and setup, and the procedure to be used for the burst testing of degraded tubes that are either: 1) removed from steam generators (SG), 2) produced in a laboratory under simulated field conditions, or 3) produced by suitable artificial simulation, e.g., EDM slots (with widths not exceeding 0.01" or 0.3 mm).

2. TEST SPECIMEN(S).

The test specimen will be a tube section approximately 10 inches (250 mm) long, with the degraded area located at mid-length (as close as practicable). In specific cases lengths as short as ~6" (150 mm) may be justified.

In order to prevent leakage before burst, an unreinforced plastic bladder, 0.08" to 0.125" (2 to 4 mm) thick, will be inserted in the specimen. The bladder OD is to be matched as close as practicable to the tube ID, and is to be mechanically sealed at both ends of the specimen.

NOTE: The total bladder thickness may be achieved by the use of multiple concentric bladders. The use of more than two (2) concentric bladders to achieve the desired thickness is not recommended.

If the degradation is through or nearly through, and/or the specimen is technically valuable, e.g., a pulled tube section or a unique prototype, it is recommended that the bladder be reinforced with a thin metal foil shim inserted between the tube defect and bladder.

In case of a premature bladder failure (extrusion through the defect opening before tube burst) in a prior pressurization test (of the actual specimen or of other similar specimens), (re)pressurization shall be achieved utilizing a reinforcing foil as described in the following paragraph.

If reinforcing foil is used, it shall be of brass or copper, 4 to 8 mils (0.1 to 0.2 mm) thick, about 0.4" to 0.5" (~10 to 12 mm) wide and with a length not exceeding the ends of the defect by more than 0.25" (6 mm). Alternatively, the foil may be stainless steel, 2 to 4 mils (0.05 to 0.1 mm) thick. The foil should be centered on the degradation. Proper angular positioning of the foil may require information about the (largest) defect from a dye penetrant, RPC and/or UT inspection relative to a known reference point on the specimen.

The use of a reinforcing shim may result in a measured burst pressure greater than the actual value; therefore a corrected, or adjusted, burst pressure shall be obtained by applying a 5% reduction to the measured burst pressure.

The specimen shall be connected to the test rig by Swagelok® or equivalent type fittings; this may include a "union" connection to a tube extension if required for proper simulation of environmental constraints, e.g., for a circumferential crack with lateral motion of the tube constrained by a tube support plate.

Considering the defect to be oriented at the 0° azimuth, the tube outside diameter (OD) shall be measured at the 0° and 90° azimuth locations, at the defect axial location, at both ends of the specimen, and at the level of any external constraint(s) of the specimen or the tube extension. For specimens in which the defect is a machined slit, the OD measurement at the 0° azimuth should be performed before the machining process.

The tube thickness shall be measured at both ends of the specimen at the same azimuth orientations. It is also recommended that the thickness be measured at each end of the specimen at the 180° and 270° azimuth locations. The thickness measurements should be direct if practicable, e.g., pin micrometer. If direct measurement of the thickness cannot be effected, inside diameter (ID) and outside diameter measurements may be made and the thickness calculated.

If the defect is visible at the tube OD surface, a good quality (preferably color) photograph shall be taken of the degraded area. Inclusion of a scale in the photograph is recommended but not mandatory.

A virgin control specimen with known or tested material properties shall be prepared for testing with each series (defined as requiring a separate test equipment setup) of test specimens.

3. <u>TEST RIG</u>.

If required to obtain a representative burst pressure, the test specimen will be placed in a test rig simulating the geometrical constraints acting under actual steam generator conditions. The tube support conditions above and below the tube degradation location in the steam generator should be simulated for the burst test. For example, if the failure mode implies significant bending as could be the case for circumferentially oriented defects at the top of the tubesheet, an assembly of a split collar (no gap) as a tubesheet simulant and ring collar(s), with controlled gap, to simulate the tube support plate(s), linked together by a rigid axial frame, would be required to simulate the restraining effect of the tube support plates.

4. TEST EQUIPMENT.

The test equipment consists mainly of pressurizing devices and measuring instruments.

(1) Pressurizing is achieved by a cold incompressible medium such as water or oil. The pressurizing system consists of a pump, an air-driven pressure multiplier and/or ancillary devices, allowing a controlled pressure rise (with minimum pressure fluctuations) up to a pressure on the order of 13000 psi (900 bar).

NOTE: A system capability of 15000 psi (1034 bar) may be necessary for burst testing of U-bend specimens. The capacity of the equipment must exceed the strength of the specimen.

(2) The measuring/recording system shall include at least:

(a) a pressure transducer (two are recommended for pulled tube tests to avoid loss of data in the event of a malfunction)

(b) a recording device, e.g., tape or pen plotter, etc. (two are recommended for pulled tube tests to avoid loss of data in the event of a malfunction)

Additional features are recommended to provide redundancy to compensate for the potential malfunctioning of any part (with proper attention paid to such common failure modes as associated with power supply).

All instruments, gauges and test equipment shall be calibrated prior to testing (unless valid calibration certificates are already available) and recalibrated after testing in case of disagreement between the independent measurement channels, if present, or if there is any reason to suspect the validity of the observed results. Calibrations shall be traceable to the appropriate national standards institute for the country in which the tests are preformed.

5. TEST PROCEDURE.

(1) Prepare specimens as defined under §2. Note that the control specimen is to be tested first.

(2) Take dimensional measurements and defect photographs, if not previously obtained.

(3) Attach the specimen to the test rig (extension tube, if applicable) and pressurizing system; over torquing of the sealing fittings is permitted if leakage is observed during test.

(4) Check the availability of the measurement equipment and its' calibration data (as defined under §4).

(5) Verification of the settings of the instrumentation shall be based on the results to be obtained from the control specimen.

(6) Fill and bleed the hydraulic system.

(7) Turn-on the recorder(s) just before pressurizing the system.

(8) Increase the primary side pressure at a rate between 200 and 2000 psi/second (15 to 150 bar/sec). Pressurization rates in the upper half of the specified range are recommended when no reinforcing foil is being used because rates in the lower half of the range, e.g., less than 1000 psi/sec (70 bar/sec), may affect the integrity of the bladder seal.

(9) Turn-off the recorders and the pressurizing system after burst of the specimen (or seal failure) has occurred.

(10) Disassemble and examine the test specimen. If the defect has not extended by tearing beyond its initial length and/or does not exhibit significant bulging/fishmouth opening, premature bladder failure has occurred, and the recorded pressure is but a lower bound for the actual burst pressure.

In such a case, it is recommended that repressurizing be performed after reinforcing the bladder arrangement, as indicated under §2. If premature bladder failure is suspected, such shall be documented in the test record.

(11) Take good quality (preferably color) photographs of the burst opening.

(12) Measure the defect dimensions (final length and opening width) and any other noticeable change of the degraded area. Diametral measurements should be made at the bulge location, including the maximum diameter to the lip of the burst opening and at 90° to that location, and at locations remote from the burst opening

NOTE: Additional measurements may be specified as required depending on the planned end usage of the data.

6. <u>QUALITY ASSURANCE</u>.

Burst pressure testing should comply will all relevant QA requirements in effect at the testing laboratory organization.

As a minimum, documentation shall include:

(1) a written test procedure

(2) a test report with

(a) full specimen identification

(b) a sketch/schematic or written description of the test setup

(c) a sketch of support details with pertinent dimensions, if special support of the specimen is employed

(d) test equipment serial numbers

(e) (reference to) instrument calibration data

(f) description (with dimensions) of the specimen sealing system

(g) maximum recorded pressure (with a statement of qualification as valid burst pressure). If a reinforcing foil has been used, both the measured and corrected values are to be reported.

(h) dimensional measurements before and after test

(i) appended pressure plot(s)

Note: These are considered optional for distributed copies of the test report. The plots shall be retained with the master file report.

(j) appended photographs before and after test.

Note: These are considered optional for distributed copies of the test report. The photographs shall be retained with the master file report.