#3

From: WJ Shack <wjshack@anl.gov>
To: Joe Muscara <JXM8@nrc.gov>, Stephanie Coffin <SMC1...
Date: Thu, Jun 22, 2000 11:26 AM
Subject: Inidan Point 2

Enclosed is a pdf version (read with Acrobat) of the memo that Sasan and Dave mentioned on the phone which contains a reanalysis of the IP-2 NDE data using conventional multifrequency techniques. Comparison of 1997 and 2000 ISI results shows an increase in signal voltage (and to some extent length) for flaw indications from tubes 2-69, 2-72 and 2-87. These changes make it more likely that a flaw would be identified in the 2000 exam, although examination of 1997 data leads to the conclusion that significant flaws were present and could be identified if the signals were analyzed carefully.

It is also interesting to note that the analysis suggests that, based on phase analysis, there was no discernible change of flaw depth between the two successive outages, a somewhat surprising result for U bend cracking. Because of the limitations of using phase information from a single frequency to determine depth, we cannot be confident that this is a real result or an artifact of this technique when significant copper is present.

CC: Dave Kupperman <dsk@anl.gov>, Sasan Bakhtiari <bak...

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March 27, 2000

From: S. Bakhtiari, Energy Technology Division, Argonne National Laboratory

To: J. Muscara, USNRC

Subject: Reanalysis of Indian Point 2 NDE results

Analyses of the eddy current ISI results for five tubes from 1997 and 2000 inspections at Indian Point 2 are presented. The MRPC readings that were acquired with a single-coil +Point™ probe are all from the U-bend section of steam generator tubing. Both 1997 and 2000 data are available for three tubes R02C72, R02C69, and R02C87. No significant degradation was detected in these tubes in 1997, but flaws were detected/called in these tubes in the 2000 inspection. Only 1997 data are available for tubes R02C67 and R02C05. Degradation in R02C67 was apparently detected back in 1997 and it was presumably plugged. R02C05 is the tube that failed recently and obviously cannot now be inspected.

The NDE results that were originally stored in ANSER™ (Westinghouse) format were converted to Eddynet™ (Zetec) format for the reanalysis at Argonne. All readings were calibrated using a procedure similar to what is currently implemented in the field for the examination of rotating probe data. Due to unavailability of exact dimensions of simulated flaws and potential differences between the set of standards used in 1997 and 2000 inspections it is expected that some variation will exist between the calibration done here and those done in the field. However, this should not significantly affect the outcomes.

Figures 1–8 display the results of conventional multiple frequency analysis of data from Indian Point 2 for all the available tubes. All final calls were made from a single channel at 300 kHz. In general, all indications with 1997 and 2000 ISI results suggest an increase in the signal voltage and no discernible change of flaw depth between the two successive outages. NDE results also suggest that the flaws are mainly axial primary side (ID) cracking located within a small zone near the center of the U-bend. However, R02C05 indication seems to extend out much farther. A rough estimate would be that it spans more than one fourth of the length of U-bend between the two AVBs, extending approximately from the center toward one of the support structures.

Most tubes have significant amount of OD deposit which complicates the analysis. The ovalization of all small-radius U-bend tubes also produces a rather large baseline fluctuation due e.g. to probe wobble. Such artifacts can not currently be effectively suppressed by standard probe designs or conventional data analysis software. The long length of R02C05 may have been an additional complicating factor in the detection of the indication. Also, with only +Point™ eddy current readings available, any artificial signal complexities (false indications) that might be due to the coil configuration can not readily be resolved.

Phase angle information from a conventional single frequency analysis was used to estimate depths. Such estimates of depth for ID indications can be unreliable in presence of noise mainly due to intrinsically small ID to TW phase angle separations. However, our best–estimate based on the available data is that most of the indications are >60% TW. A better estimate of flaw size and growth would only be possible through examination of plant history ISI data that is not available to us at this point. Our recent results indicate that when conventional RPC data are available, multifrequency phase analysis algorithms can give more accurate depth estimates, but we have not attempted such analyses with +Point™ data.

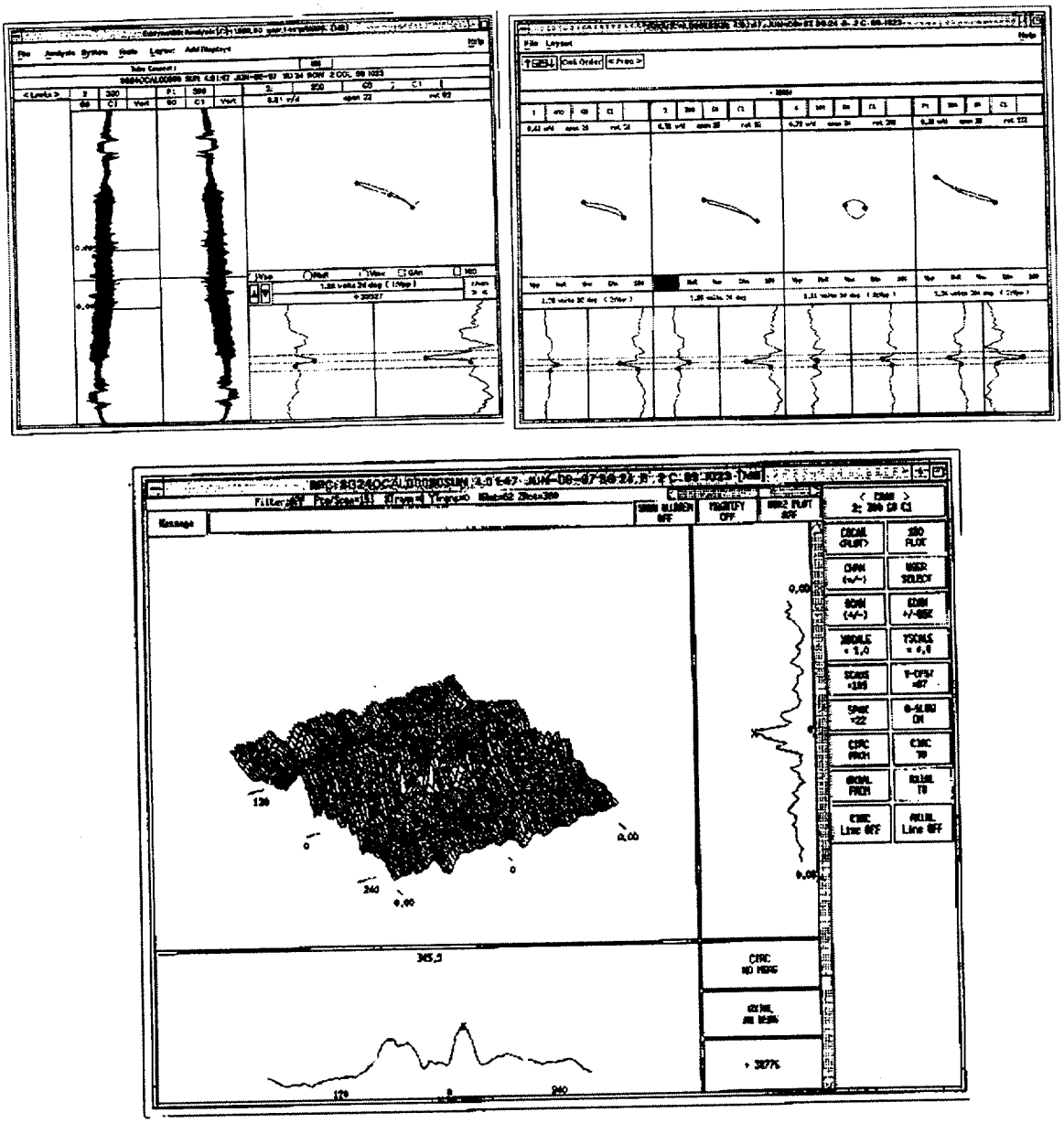

Figure 1: Reanalysis of 1997 ISI MRPC/+Point™ data for U-bend section of R02C69 tube. Stripchart, multiple lissajous, and isometric plots of the data are displayed. Analysis of inspection results suggests presence of ≈1.25v (call made at 300 kHz) primary side indication. The phase angle information suggests >60% TW degradation.

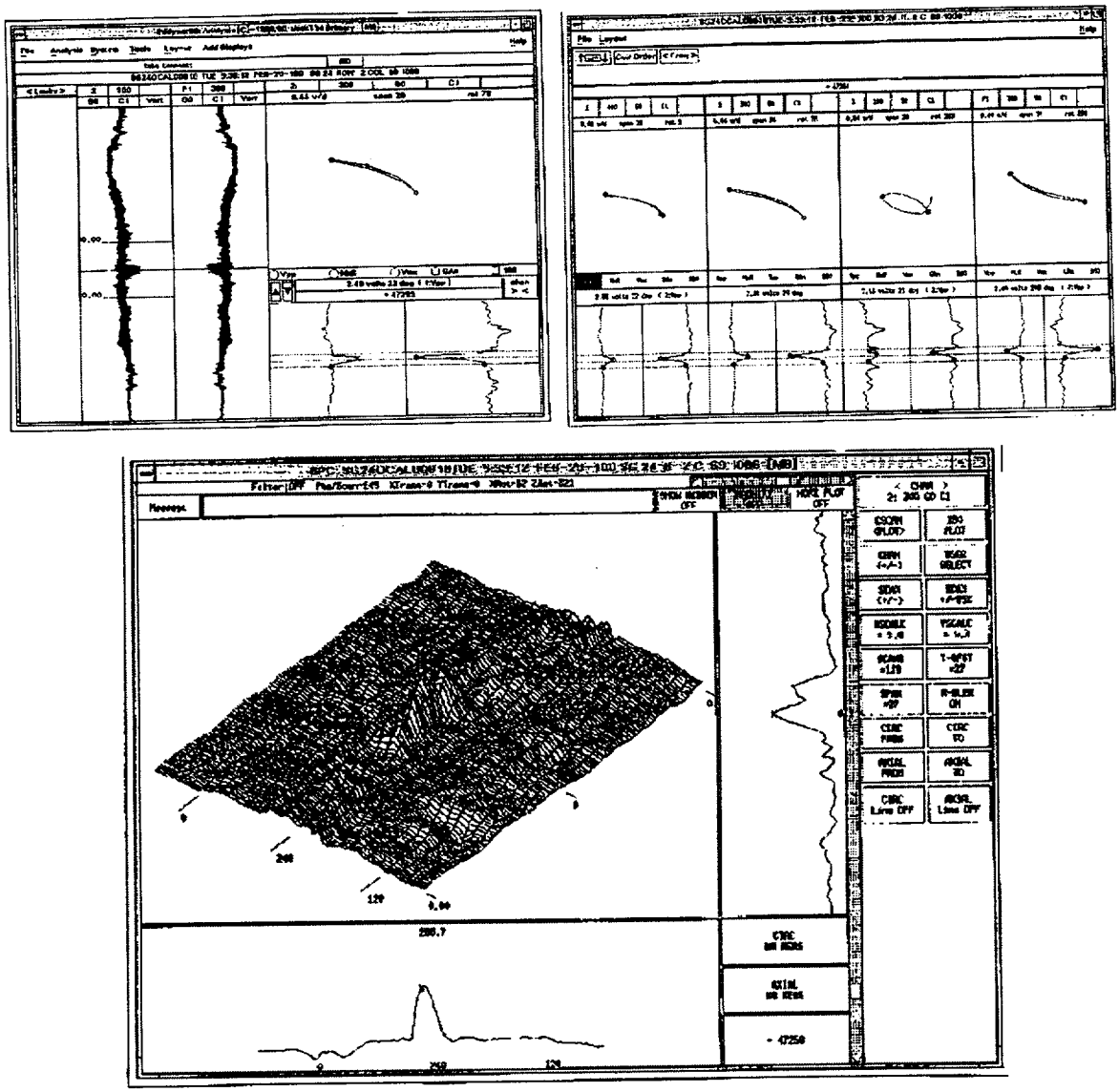

Figure 2: Reanalysis of 2000 ISI MRPC/+Point™ data for U-bend section of R02C69 tube. Stripchart, multiple lissajous, and isometric plots of the data are displayed. Analysis of inspection results suggests presence of ≈2.5v (call made at 300 kHz) primary side indication. The phase angle information suggests >60% TW degradation.

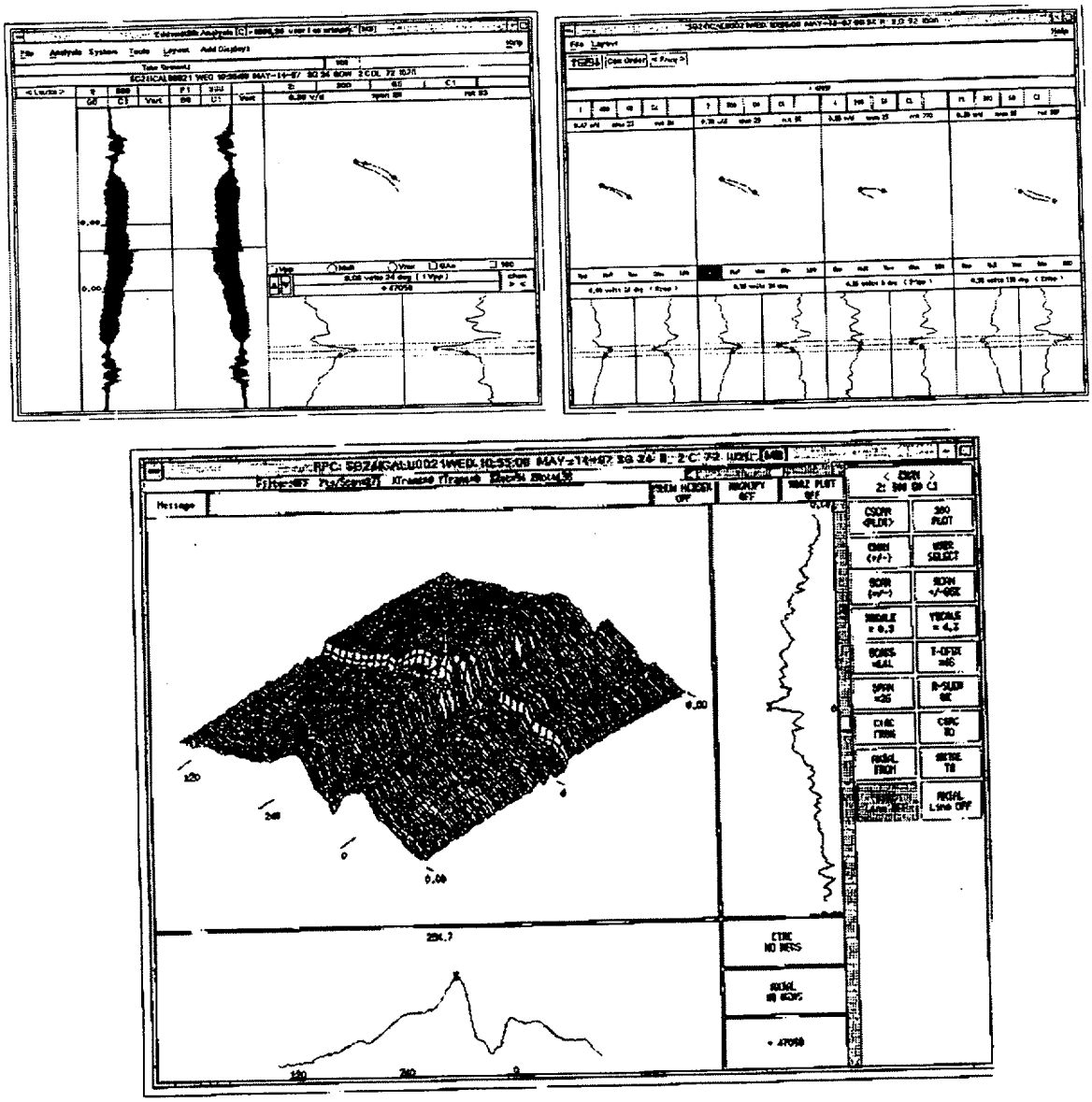

Figure 3: Reanalysis of 1997 ISI MRPC/+Point™ data for U-bend section of R02C72 tube. Stripchart, multiple lissajous, and isometric plots of the data are displayed. Analysis of inspection results suggests presence of ≈1.0v (call made at 300 kHz) primary side indication. The phase angle information suggests >60% TW degradation.

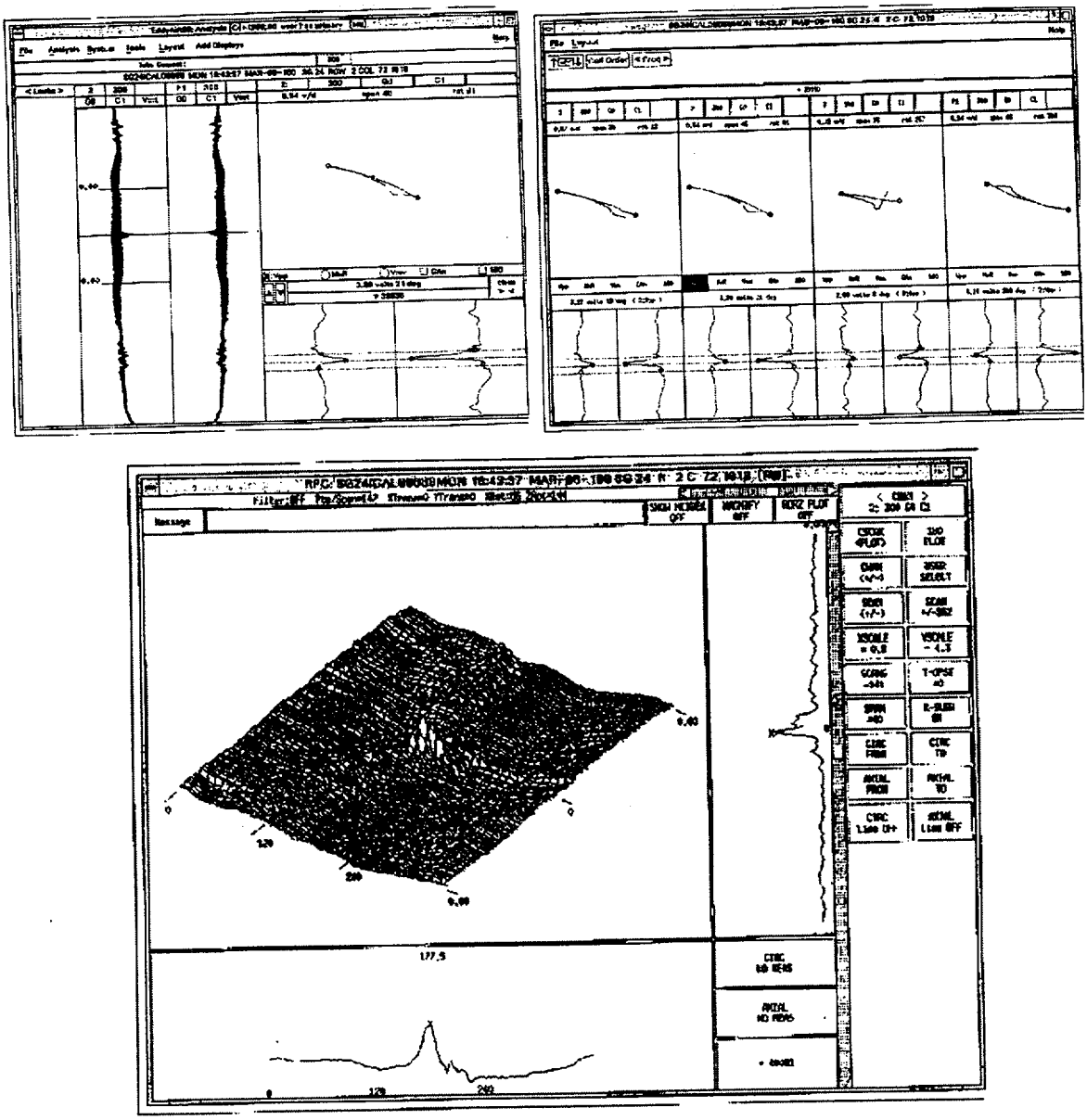

Figure 4: Reanalysis of 2000 ISI MRPC/+Point™ data for U-bend section of R02C72 tube. Stripchart, multiple lissajous, and isometric plots of the data are displayed. Analysis of inspection results suggests presence of ≈3.2v (call made at 300 kHz) primary side indication. The phase angle information suggests >60% TW degradation.

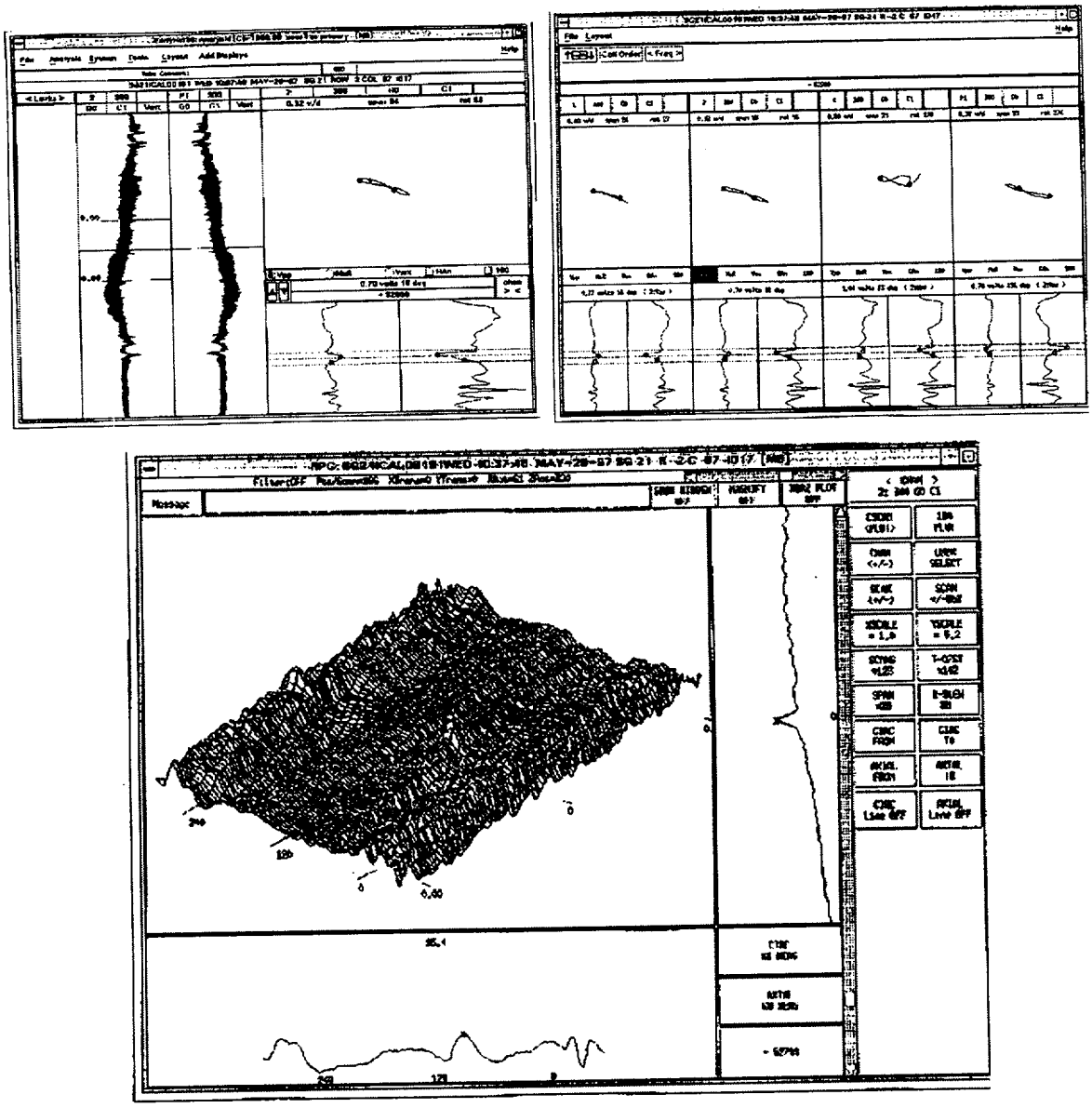

Figure 5: Reanalysis of 1997 ISI MRPC/+Point™ data for U-bend section of R02C87 tube. Stripchart, multiple lissajous, and isometric plots of the data are displayed. Analysis of inspection results suggests presence of ≈0.70v (call made at 300 kHz) primary side indication. The phase angle information suggests >40% TW degradation.

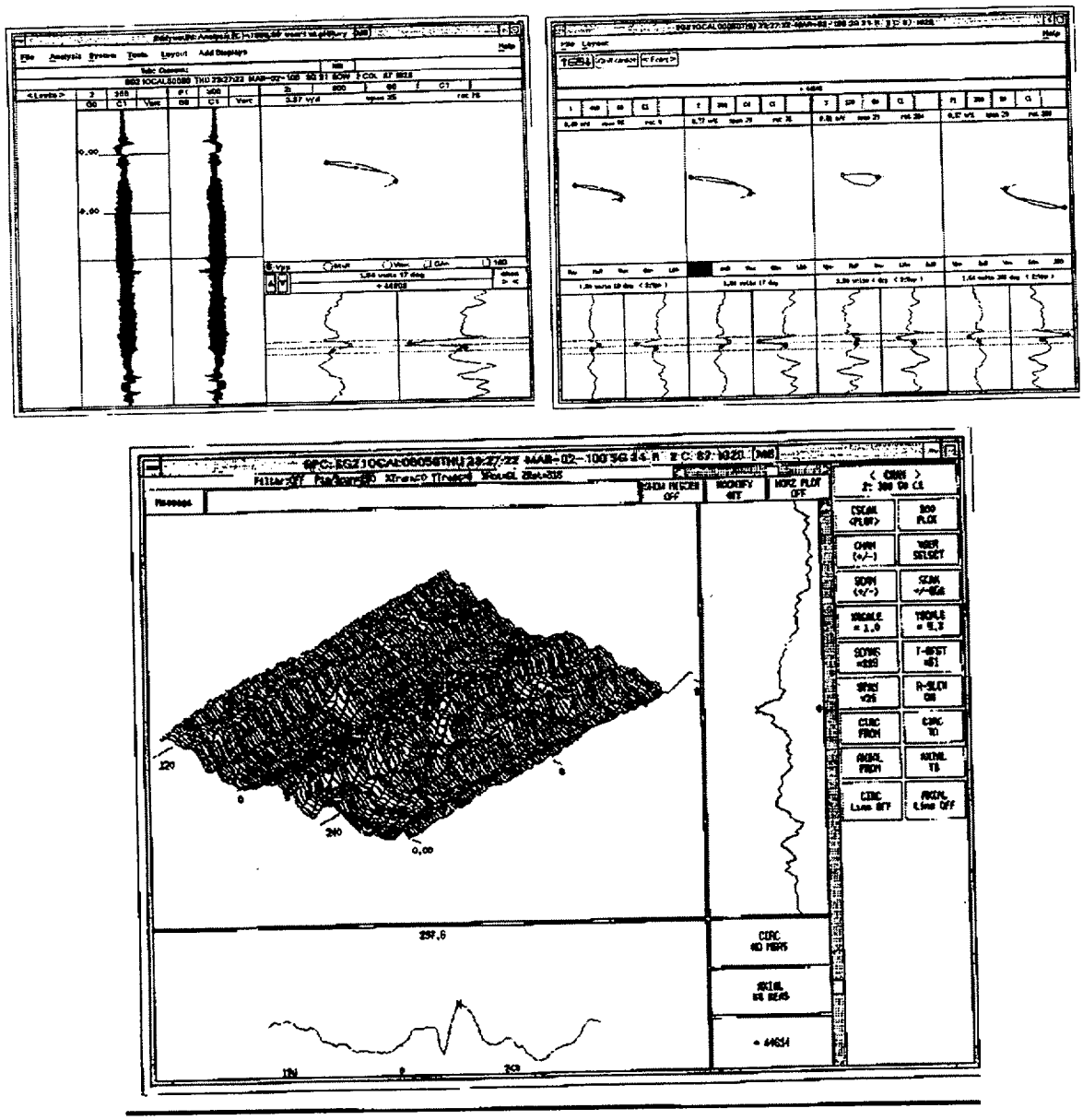

Figure 6: Reanalysis of 2000 ISI MRPC/+Point™ data for U-bend section of R02C87 tube. Stripchart, multiple lissajous, and isometric plots of the data are displayed. Analysis of inspection results suggests presence of ≈1.6v (call made at 300 kHz) primary side indication. The phase angle information suggests >40% TW degradation.

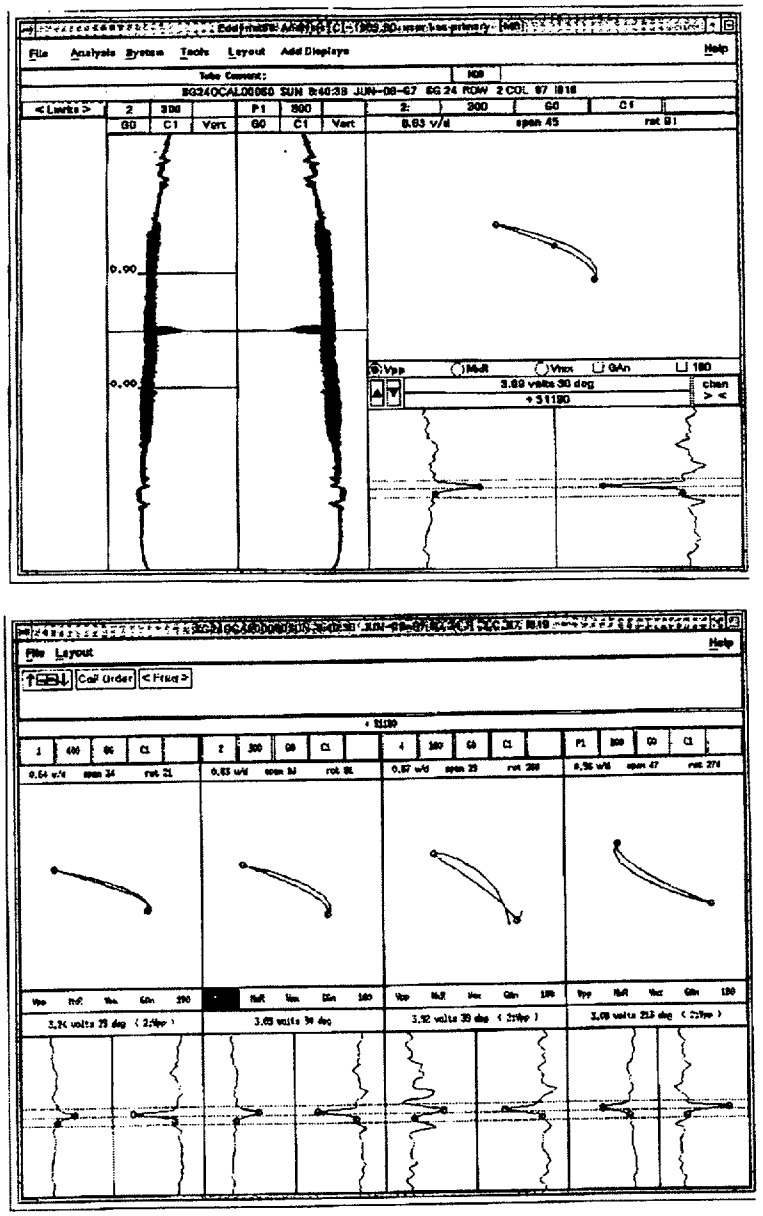

Figure 7: Reanalysis of 1997 ISI MRPC/+Point™ data for U-bend section of R02C67 tube. Stripchart and multiple lissajous figures are displayed. Analysis of inspection results suggests presence of ≈3v (call made at 300 kHz) primary side indication. The phase angle information suggests >80% TW degradation.

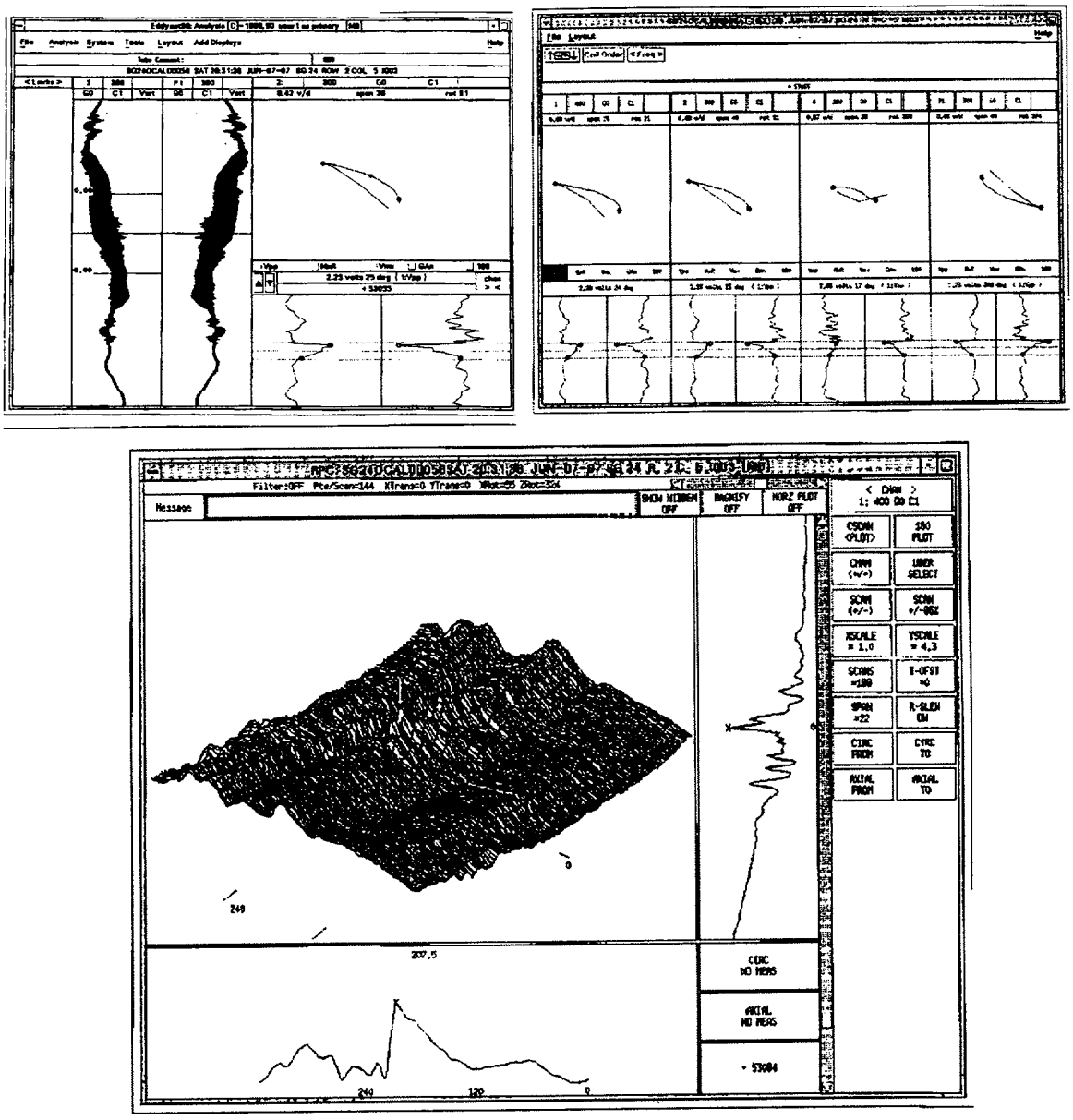

Figure 8: Reanalysis of 1997 ISI MRPC/+Point™ data for U-bend section of R02C05 tube. Stripchart, multiple lissajous, and isometric plots of the data are displayed. Analysis of inspection results suggests presence of ≈1.8v (call made at 300 kHz) primary side indication. The phase angle information suggests >60% TW degradation..