Nuclear Services Division

STANDARD INTERNAL REVIEW SHEET

DOCUMENT NUMBER DAT-IP2-001 REVISION NUMBER 0

TITLE DATA ANALYSIS TECHNIQUE PROCEDURE

☐ GENERIC

☒ PLANT SPECIFIC (Plant identification should be included in title)

☐ OTHER (Specify) ____________

	MANDATORY REVIEWS	SIGNATURE	DATE	COMMENTS
1.	ORIGINATOR JAMES C. HAGOOD, JR.	James C. Hagood Jr.	4/28/97	
2.	ENGINEERING A. R. VAIA	A R Vaia	4-24-97	
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	OTHER REVIEWS			
5.	OTHER DIVISION APPROVAL REQUIRED ☐ YES Division ______ ☒ NO Engr. Concurrence			
6.				
7.				
8.				

(1) Approval of the cognizant manager signifies that all reviews have been obtained and all comments resolved.

ORIGINAL SIGNED COPY WITH ATTACHED PROCEDURE TO BE FORWARDED TO: NSD INFORMATION & RECORDS SERVICES

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1.0 SCOPE AND PURPOSE

1.1 The purpose of this procedure is to establish specific instructions pertaining to analysis of Steam Generator Eddy Current data at Indian Point Unit 2. The guidelines provide instructions for calibration, evaluation, and documentation techniques.

1.2 The basic instructions are written for manual analysis; however, all analysis systems, automated or otherwise will follow the same guidelines. Specific set-ups may be unique to manual and/or automated analysis systems but setup parameters, evaluation, and recording criteria are to remain consistent.

1.3 The basic contents of this document will be divided into separate sections. Sections 6 through 8 will address the basic reporting, evaluating, and resolution guidelines which are generic to all probe types.

1.4 Section 9 will address the setups, reporting criteria and graphics requirements specific to the bobbin probe.

1.5 Since the rotating probe has evolved into several different types of probe heads, only the general setups, evaluation, and reporting criteria for rotating pancake coils will be addressed in Section 10 of this document. Section 11 addresses the setups, reporting criteria and graphics requirements for the 115/+Pt/80HF probe.

1.6 Section 12 addresses the setups, reporting criteria and graphics requirements for the Cecco-5/Bobbin probe.

1.7 Section 13 addresses the setups, reporting criteria and graphics requirements for the RPC/Bobbin probe.

1.8 Section 14 addresses the setups, reporting criteria and graphics requirements for the bobbin probe for the purposes of tube diameter profiling.

2.0 SUPPORTING REFERENCES

2.1 Westinghouse Eddy Current Data Acquisition Procedure No. MRS 2.4.2 GEN 35, Latest Revision.

2.2 ASME Boiler and Pressure Vessel Code 1989, Sections V and XI.

2.3 American Society of Non-Destructive Testing Recommended Practice, SNT-TC-1A, 1980 Edition.

2.4 Westinghouse Procedure for Training, Qualification, and Certification of Personnel in Nondestructive Examination ESBU QA 9.0.

2.5 EPRI Steam Generator Examination Guidelines NP-6201, Rev. 4.

2.6 Westinghouse Data Management Guidelines, DAT-MGT-001.

2.7 Indian Point Unit 2 Plant Technical Specification, DPR-26 Docket 50-247.

2.8 Westinghouse Field Procedure for Additional Roll Expansion of Steam Generator Tubes at Indian Point Unit 2, STD-FP-1997-7944.

3.0 STEAM GENERATOR OPERATING HISTORY

The purpose of this section of the program document is to provide a summary of significant steam generator operating history. This information is useful for planning the tube inspection, repair limits, repair methods and for performing the conditional monitoring and operational assessments. It is intended that this section of the program will be revised on an as needed basis.

Indian Point 2 steam generators are Westinghouse Model 44's, with a nominal 44,430 square feet of heat transfer area. Each steam generator contains 3260, 7/8 inch outside diameter, 0.050 inch average wall thickness, high temperature mill annealed Alloy 600 tubes, fabricated by Huntington Tube. Each tube is hard rolled for the bottom 2 1/4 inches of the 22 inch thick carbon steel tube sheet. The tubes are supported by six, 3/4 inch thick carbon steel, drilled hole support plates. Each support plate is spaced at 52 5/8 inches. The U-bend portion of the tubing is supported by two sets of carbon steel antivibration bars (AVB's).

3.1 Summary of Experience

Since 1975, the principal concern with determining the remaining service life of the Indian Point 2 steam generators has been the corrosion of the support plates and the denting of tubes caused by the accumulation of corrosion products in the annuli between the tubes and the support plates. Since 1984, eddy current indications detected in the tubes, within and immediately above the tubesheet, have also become a concern. After the 1991 Refueling Outage, full stretch rating operation was implemented. The 1993 eddy current examination initially revealed tube deterioration in the form of roll transition cracking and tube wear at Anti-Vibration Bar (AVB) locations. In the 1995 examination, degradation by cracking at roll transitions increased significantly with the majority of cracks found in the SG 23 roll transitions.

The principal reason for tube plugging from the start of operations in 1973 to 1984 was denting. Recently, more tubes were plugged for eddy current indications than for denting. The most recent tube examinations conducted in the 1991-1995 period suggest that the denting effect on the tubes appears to have been arrested.

The Chronology Highlights in the operation of the plant as related to the steam generators is shown in Table 1.

3.2 Tube Plugging History

Table 2 summarizes the plugging history and the current status of each steam generator.

Table 3 shows the plugging history since 1984 when the eddy current inspection methodology changed from a single frequency to multi-frequency analysis.

As a result of a structural review for operating at stretch, based on the North Anna 1 event, one tube in SG 23 was preventively plugged in 1991.

3.3 History of Tube Leakage/Tube Rupture Events

Indian Point has had 9 tube leak events. Four of these resulted in forced outages and the remaining five occurred during testing in refueling outages. Table 4 summarizes these events.

3.4 Degradation Mechanisms

PWSCC and/or secondary side Intergranular Attack (IGA), as well as Stress Corrosion Cracking (SCC), of Alloy 600 steam generator tubes have been the main cause of tube degradation in the industry. These modes of tube degradation have been found predominantly at the tubesheet and tube/support plate intersections. Primary water side degradation modes have been found at tube to tubesheet roll transitions and U-bend regions. Secondary side SCC has been found mainly in the sludge pile and crevice region located at the top of the tubesheet and at support plate intersections. The eddy current rotating coil techniques have been a major nondestructive method used by the industry to characterize these SCC forms of tube degradation.

There are four known degradation mechanisms that have been detected in the steam generators. These are:

- Denting at support plates.
- OD pitting in the sludge pile region.

- Wear caused by AVBs
- PWSCC at roll transition

During the 1995 Indian Point 2 examination, the AVB fretting wear and roll transition cracking modes of tube degradation were again observed. One tube was plugged due to AVB wear in 1995. The most recent examination revealed cracking on 594 tubes in the tube-to-tubesheet roll transition. Since the first application of the rotating coil technology in 1989 at Indian Point 2, secondary side IGA or SCC has not been detected.

The remaining life of the steam generators, based on tubing condition, has been estimated by projecting the number of tubes that will be required to be plugged to prevent inservice tube leaks, assuming a) the continued appearance of new eddy current indications, and b) that the only tube repair technique is plugging of the affected tubes. The effects of possible extreme severe events requiring massive tube plugging have also been considered. For this projection, we assumed that flow slot closure and tube denting have been essentially arrested, and that cracking at roll transitions can be repaired by rerolling. We project for all four steam generators that a total of less than 25% or 3260 tubes would be plugged at the expiration of the current operating license in the year 2013. A current analysis by Westinghouse permits the plugging of up to 25% of the tubes for continued operation.

3.5 Possible Degradation Modes based on Industry Operating Experiences

A review was performed of similar steam generator designs and operating characteristics. In addition to the active modes of degradation discussed above, the following modes of degradation have been reported:

- PWSCC and ODSCC/IGA at tube support plates.
- Freespan ODSCC/IGA

The SCC at support plates may occur in the steam generators. Free span degradation is not expected since dryout and the subsequent build up of impurities that would lead to SCC has not been predicted by computer modeling.

3.6 Chemistry Transients

The chemistry transients experienced have been the result of condenser leaks. Industry guidelines were followed to recover from these incidents. The Indian Point 2 condenser has been modularly replaced with titanium units over the 1991, 1993, and 1995 refueling outages.

3.7 Summary of In-situ Pressure Test Results

No in-situ tube pressure tests have been performed. Secondary side pressure tests were performed when the steam generator shells were weld repaired and heat treated. Pressure tests for structural integrity of individual tubes will be performed when a circumferential crack on the tube exceeds 222 degrees or an axial crack in the tube free span exceeds 0.4 in.

3.8 Summary of Pulled Tube Test Results

Tube, support plate ligament, and corrosion product samples were removed in 1979 to characterize denting. These were examined by Battelle Columbus Laboratories. The corrosion product was characterized and scattered intergranular corrosion was observed on the tube OD surface within the support plate area. The deepest penetration observed was 0.003 inches. Eddy current examinations of tubes within the support plate areas has not identified this type of defect, i.e., past eddy current testing has not suggested intergranular corrosion.

4.0 RESPONSIBILITIES

4.1 <u>Primary Analyst</u>

4.1.1 A primary analyst is responsible for reviewing and evaluating all recorded inspection data for reportable indications of degraded tubing and anomalies defined in this document.

The Primary Analyst is responsible for verifying that messages regarding position verification are included in the Data Set per Reference 2.1. An edited final report is generated and all applicable evaluation documents, i.e., graphics, data disc (if used), identified as PRIMARY, etc., are to be turned over to Data Management.

4.1.2 The Primary Analyst stores a complete and accurate final report to the media of record along with the setup.

4.2 <u>Secondary Analyst</u>

4.2.1 A Secondary Analyst is responsible for the same duties as the Primary Analyst as defined in Section 4.1, except that the Secondary Analyst is not required to report anomalies.

4.3 **<u>Third Party Analysts</u>**

Third party analysts are those analysts for whom ConEd has separately contracted for an independent analysis. The scope of the third party analyst(s) responsibilities is defined by the ConEd.

4.4 **<u>Overall Lead Analyst</u> (OLA)**

4.4.1 The Overall Lead Analyst is responsible for providing direction and coordination of the entire data analysis effort. The OLA is knowledgeable of the analysis procedure and is responsible for the correct interpretation of the Primary/Secondary responsibilities.

4.4.2 The Overall Lead Analyst is also responsible for obtaining the authorized probe list from ConEd and assuring that the correct Acquisition Technique Specification Sheets (ACTS) are used.

4.4.3 The Overall Lead Analyst is responsible for the direct interfacing with ConEd relating to any technical discussions concerning the analysis effort. All inquiries pertaining to the data analysis shall be directed to the Overall Lead or the designated Shift Lead Analysts.

4.4.4 The Overall Lead Analyst is responsible for designating the Shift Leads and Resolution Analysts for the job and providing guidance to them. The OLA will resolve discrepancies presented by the Resolution Analyst(s) in the form of a Lead Analysts Review (LAR).

4.4.5 Before the start of, or during the course of the inspection, the Overall Lead Analyst may make a recommendation to ConEd which he or she feels should be documented, such as, a recommendation to perform RPC on selected tubes, other additional testing besides RPC, etc.

In this case, a recommendation form with a place for the ConEd representative's signature and comment such as the one shown in Appendix D should be used. The form should contain the topic or area of concern, the recommended course of action, the Overall Lead Analyst's signature and the Westinghouse Coordinator's signatures. ConEd shall sign this form upon completion and a copy shall then be included in the job report at the end of the inspection. The completed form(s) should also be included in daily logs, status reports, etc.

The overall Lead Analyst is responsible for communication with Data Management to satisfy the requirements in accordance with Reference 2.6.

4.5 Shift Lead Analyst

4.5.1 A Shift Lead Analyst is responsible for providing direction and coordination of data acquisition and analysis on their particular work shift as defined by the overall Lead Analyst.

4.6 Resolution Analyst

4.6.1 A Resolution analyst is responsible for resolving the differences noted between the Primary, Secondary, and if necessary, Tertiary reports.

4.6.2 If the Resolution Analyst is unable to provide final resolution, the discrepancy may then be presented to the Overall Lead Analyst for his review.

4.6.3 The Resolution Analyst may perform Primary or Secondary analysis of Data Sets as time permits, and in accordance with the responsibilities noted above.

4.6.4 Resolution Analysts **shall not** perform resolutions on Data Sets on which they have performed primary or secondary analysis.

5.0 PERSONNEL QUALIFICATIONS

5.1 Data Analyst personnel performing the data analysis shall be certified to at least Level II in accordance with the guidelines of ASNT-TC-1A. In addition, the analyst shall have received specified training in the evaluation of nonferromagnetic tubing data and will therefore be designated at least a Level IIA in accordance with Reference 2.4.

5.2 Westinghouse Level II personnel, with appropriate training and supervision by a Level IIA or higher, may perform analysis for conditions that are not related to tube wall degradation.

5.3 Non-Westinghouse personnel performing analysis shall be qualified and certified to a written practice that meets the requirements of ASME XI and the guidelines of SNT-TC-1A.

5.4 Personnel performing the data analysis shall also successfully complete a site specific performance demonstration prior to analyzing any data from the current inspection.

5.5 Personnel performing the data analysis shall also be Qualified Data Analyst (QDA) per Reference 2.5.

6.0 SUMMARY QA AND REPORTING FORMAT

6.1 Summary Verification

6.1.1 The recording media shall contain the following:

a. Owner
b. Plant site
c. Heat exchanger identity
d. Recording media identification (e.g., Data Set number)
e. Date of examination
f. Serial number of the calibration standard
g. Operator's identification and certification level
h. Nominal operating frequency
i. Lengths of probe and probe extension cables
j. Probe extension cable type
k. Size and type of probes
l. Probe manufacturer's name and probe description

6.1.2 The analyst shall verify that all of this information is contained in the summary and is correct.

6.1.3 If any of this information is incorrect or missing, the analyst shall inform the Data Collector of any changes or additions to be made.

6.1.4 In the case that the Data Collector is unable to make changes or additions to the summary, the Data Collector may enter the change or addition in a message on the Data Set.

6.2 Final Report Documentation

6.2.1 Figure 1 shows the standard Westinghouse report headers.

6.2.2 When using the Westinghouse report format, a separate header must be entered for every analyst or operator change.

6.2.3 It is important for the analyst to verify that the correct cal times are entered into the report.

6.2.4 The analyst shall make sure there are no other calibrations on the Data Set other than begin and end of Data Set per Reference 2.1.

6.2.5 Analysts shall QA their report to make sure there are no administrative errors on it such as missed tubes, improper extents, improper locations, double entries, and that the probe descriptions and three letter analysis codes are in accordance with this document or any supplements that may have been issued by the Overall Lead Analyst for this outage.

6.3 Storage of Variables and Reports

6.3.1 The analysts shall store the setup and final report to their media of record.

6.3.2 Recording of evaluated data is to include the following:

6.3.3 All tube degradation, noting the VOLTS, DEG, IND, CH#, and LOC.

6.3.4 Any non-quantifiable indication.

6.3.5 Anomalies as defined in the sections addressing each specific probe type.

6.3.6 The begin and end test extent for each tube inspected.

6.3.7 Any restricted tubes identified by the data collector.

6.3.8 Any retests required due to the quality of the recorded data.

6.3.9 Any plugged tube location, as identified by the data collector.

7.0 GENERAL EVALUATION AND REPORTING PRACTICES

7.1 Evaluation

7.1.1 The evaluation shall consist of reviewing lissajous, strip chart and terrain plot displays (where applicable) to the extent that all tube wall degradation and anomalies defined by this document are detected, sized and recorded in accordance with this document.

7.1.2 All data recorded shall be evaluated regardless of the extent tested.

7.1.3 Probe speed shall be verified at least once per Data Set, not to exceed the governing E/C inspection procedure requirements for probe speed. If the Probe Speed is found to exceed the criteria cited in the ACTS, the affected data shall be rejected and the data collector shall be notified to implement corrective action.

7.2 Reporting Criteria - Phase Angle/Amplitude

7.2.1 All indications of tube wall degradation shall be reported either as a % thru-wall, if a qualified sizing technique is available, or a proper three letter code as defined by this document.

7.2.2 There shall be no minimum signal amplitude requirement for reporting degradation.

7.2.3 Phase angles must lie in the flaw plane region on the calling channel to report an indication of tube degradation in accordance with the technique qualification. The flaw plane region is defined as the region between a phase angle which reads a percent value greater than 0% in the OD plane and a phase angle which lies above the probe wobble in the ID plane.

7.2.4 All other indications which are considered to be distorted, non-quantifiable, undefined, and/or possible loose parts shall be recorded. These calls shall use the letter codes as defined by this document.

7.2.5 Calls not related to tube degradation (CUD, DNT, PVN, etc.) shall be recorded as specified in the reporting criteria for each specific probe type.

7.3 Reporting Practices

7.3.1 All locations shall be recorded with a positive offset from the center of the nearest structure. Extents tested shall be reported as last inspected intersection. Only tube end, top of tubesheet, and supports shall be used for extents tested. Anti-Vibration Bars (AVB's) are only to be used as extents tested in cases where degradation is seen in the region between top support hot leg and top support cold leg and the test ends somewhere in that area.

7.3.2 All location and/or length measurements shall be recorded in one-hundredths (0.00) of an inch.

7.3.3 Those indications at a structure or TTS, within a +/- 2 inch band, shall be recorded from the centerline of the structure or from the TTS in the positive (+) or negative (-) direction as applicable.

7.3.4 An indication between the top supports of the HL and CL (except for wear exactly at an AVB location) shall be measured from the lowest (closest to the HL) structure. AVB's are considered structures in this case. No U-bend indications shall be measured positively beyond the top support CL except as allowed in 7.3.3 above.

7.3.5 AVB's are numbered 1 through 4, with the AVB closest to the hot leg being number 1.

7.3.6 A tubesheet minus measurement > 2.00" may be performed in cases where no tube end was recorded.

7.3.7 Extent tested shall be recorded as actual begin test and actual end test. In the case of only one intersection being tested, the begin and the end test will be that intersection. The actual extents recorded will determine whether the tube is complete according to the inspection plan.

7.3.8 Extent tested for a restricted tube (RST) shall be reported as the furthest complete support structure, tubesheet, or tube end. A message from the data collector is needed to call an RST.

7.3.9 Any tube on the T-list that has no eddy current data collected for it shall be addressed as No Test (NT) with no begin/end test extent.

7.3.10 All indications should be listed on the Final Report in the order of probe withdrawal.

7.3.11 Positive ID of tubes shall be recorded with PID in the % field of the report at a location supporting the original call. In the case of multiple indications, only one need be identified to PID the tube.

7.3.12 Analysts may call a tube which is being tested for PID a Lead Analyst Resolution (LAR) if the analyst feels that the tube is either NDD or the tube is not the same tube as originally tested.

7.3.13 A tube which the analyst feels cannot be evaluated properly shall be called a BDA (Bad Data) with the begin/end test extent. Retest will be then performed over the required extent.

7.4 Previous Degradation History

All previous tube degradation history must be addressed with either an Indication Not Reported (INR), Indication Not Found (INF), % thru-wall, or any other non-quantifiable indication as applicable. Locations must correlate within ± 0.50 inches.

7.5 Graphics

7.5.1 All graphics shall be produced by the resolution analysts.

7.5.2 Graphics are required for all "I" Code indications (Repairable or Pluggable Indication) and tube wall degradation which measures 40% or greater. Graphics are also required for all PID calls.

7.5.3 Graphics plots shall display the proper lissajous figure(s) as defined by the Overall Lead Analyst. Graphics should be taken at the lowest possible span (greater displayed gain) without saturation and show only the complete indication and any surrounding data needed to depict the most complete description of the call.

7.6 Turnover Package To Data Management

7.6.1 The turnover package to Data Management consists of all required graphics in a folder for each Data Set with Site, S/G, leg, Data Set #, probe type, and date identified, along with the final resolution report.

7.6.2 All final reports must be stored to hard disk for retrieval by Data Management and also to a permanent storage media. Only the Resolution Analyst is required to print a copy of the resolution report and include it in the folder.

7.6.3 Compare sheets used in resolutions shall be included in the folder (Figure 3).

7.6.4 When Data Management and the Resolution Analysts are at site and the production analysts (PRI, SEC, TER) are remotely analyzing the data, the production analysts are required to print to site at least the last page of their final reports identifying their analysis host number and analyst type.

7.6.5 Discrepancy sheets, disposition sheets, a final report with the resolution section and all graphics are to be placed into their corresponding folder and turned over to Data Management upon completion of the resolutions. Refer to Figure 2 for a typical disposition sheet.

8.0 RESOLUTIONS

8.1 Processing Sequence

8.1.1 After completion of both the PRImary and SECondary analysis, either Data Management or the resolution analyst will compare the results via a computerized compare program.

8.1.2 A hardcopy compare report showing the discrepancies between the two analysts shall be generated by either Data Management or the Resolution Analyst.

8.1.3 The Resolution Analyst(s) will review the discrepancies and provide the resolutions either using the PRImary analyst's media of record or by creating a separate RES report.

The Resolution Analyst shall be responsible for the correct graphics relative to the final resolution call.

8.1.4 After resolution, the data folder containing one copy of a final report and all associated, marked-up or retaken graphics will be returned to Data Management for final entry. The resolution report will be transferred via Ethernet from the hard disk by Data Management.

8.2 Calls Requiring Resolution

The following discrepancies require resolution.

If no resolutions are required on a Data Set, "No P/S Resolutions" shall be entered at the end of the resolution report.

8.2.1 If either the Primary or Secondary Analyst calls a % or any non-quantifiable indication and the other does not;

8.2.2 Percent calls that vary by more than 10%;
8.2.3 Where the location varies by more than 0.50 inches;

8.2.4 If percent calls by both parties addresses opposite sides of 20%, then the call must be resolved, and the 10% variation and 0.50 inch guidelines do not apply;

8.2.5 If one call should exceed the plugging limit and the other does not then these calls must be resolved and the 10% variation and 0.50 inch guidelines do not apply;

8.2.6 Disagreeing non-quantifiable calls that reflect tube wall degradation;

8.2.7 Differences of extent of test;

8.2.8 Differences of probe size and type;

8.2.9 Tube entry on the final report by one analyst and the not by the other(This includes NT's);

8.2.10 Calibration times varying by 10 minutes or more (Resolution analyst must enter the correct cal time on the resolution report); or

8.2.11 Calibration times exceeding 4 hours, or a malfunction occurring where an end of Data Set calibration standard pull is not possible (the last tube on that Data Set before the malfunction shall be retested on the next Data Set and the analyst shall determine, by comparison, if the data in the prior Data Set is acceptable);

8.2.12 If an operator and/or analyst change occurs during the Data Set, then a separate "start resolutions" header must be made for the tubes acquired by each operator or tubes analyzed by each analyst on the Data Set.

8.2.13 If both Primary or Secondary Analyst call a pluggable/repairable indication (> or = plugging limit or an I-code call), the compare sheet shall show that indication even though no resolution is required.

8.2.14 In the event that either Primary or Secondary Analyst or both call a pluggable indication, the Resolution Analyst shall not nullify such a call without concurrence of another Resolution Analyst. A disposition sheet, Figure 2, detailing the basis for nullification, signed by both Resolution Analysts, shall be prepared and included in the resolution folder for that Data Set. In the case of this type of report resolution, the Overall Lead Analyst must be notified of the change.

8.3 Discrepancy Resolution Report Editing

The following is a description of how Westinghouse will resolve discrepancies that are identified during the “Compare” process. The report of record is the Primary Analysis report, and the examples presented are based on this.

8.3.1 In general, a resolution section is identified using the standard header and placed at the bottom of the Primary final report. Resolution lines that affect the main body of the report will be identified in the S/G ID column. Absolutely no change is to be made to the original information provided by the analyst.

8.3.2 The Resolution Analyst will retrieve the Primary report and place a header at the bottom of the report. The header is the standard analyst or operator change header with an additional last line stating "Start P/S Resolutions". The Resolution Analyst must also change the word "PRI" in the first line of the start Data Set header to "RES". This report now becomes the resolution final report with the "Start P/S Resolution" header being the beginning of the resolution section.

8.3.3 If there is more than one Data Collector on a Data Set, a separate header must be inserted for the tubes acquired by each operator in the resolution section.

8.3.4 Discrepancies which result in the Primary call being correct will be reflected by entering "OK" in the S/G ID Column in the main body of the resolution report, and no additional information will be required in the resolution section of the report. An "OK" shall also be replaced next to the call on the Compare Sheet.

8.3.5 Additions or changes to a Primary record will be done by placing all parts of the corrected call; i.e., VOLTS, DEG, IND CH#, LOC, and EXT in the resolution section, and then negating the original call be entering 'NO' in the S/G ID column of the original record in the main body of the resolution report.

8.3.6 Discrepancies may exist where the Primary call is incorrect. These calls will be negated by entering 'NO' in the S/G ID column in the body of the resolution report. If there are multiple calls for a particular tube, only the call(s) which are incorrect shall be negated, and no further action is required providing there remains at least one primary call for this tube. If all calls for a particular tube are incorrect, all of the records are to be negated in the main body of the resolution report, and an NDD record is to be added to the resolution section.

8.3.7 Discrepancies that involve incorrect single or multiple secondary calls, are to be addressed by placing a "NO" on the compare sheet only next to each incorrect call. Compare sheets are filed with the final report/resolution sheet in the corresponding graphic's folder.

8.3.8 Discrepancies that cannot be resolved during the initial resolution process and that require Overall Lead Analyst review are to be negated by entering 'NO' in the S/G ID column in the main body of the resolution report and identified in the resolution section. An 'LAR' record is identified by entering the original call into the resolution section with the characters 'LAR' in the % column. Upon subsequent resolution, the call identified in the resolution section as 'LAR' is to be negated by entering 'LR' in the S/G ID column, and placing the corrected call; i.e., VOLTS, DEG, IND, CH#, LOC, and EXT in the 'LAR' resolution section of the report. The original call in the main body of the final report will stay negated, and the call of record will then be the call made in the LAR resolution section of the report.

8.3.9 When utilizing Westinghouse ANSER™ software, the Resolution Analysts must make sure they are toggled to "RES" in final report window before storing to media of record. This includes LAR and 3rd party resolutions.

8.3.10 At the end of a resolution report, a single line stating "End P/S Resolutions" shall be entered. After QA of resolution report, store to a hard disk and to optical. Print a copy of resolution report and turnover the copy along with graphics and folder to Data Management. Use "END Lead Analyst Review" for completion of LAR section.

8.3.11 For examples of standard header formations, a typical compare sheet, and a typical final report, including the subsequent resolution process, reference Figures 1, 3 and 4.

9.0 BOBBIN PROBE SPECIFICS

The following are the basic guidelines for calibration, evaluation, and reporting criteria of data collected with bobbin coils. As all analysis systems have different features and ways of being manipulated, no technical operating instructions are included in this section. (Refer to operating manuals, as necessary, for this information.)

9.1 Setup

Refer to the applicable calibration standard drawings for as-built % thru-wall of defects on the standard. The same calibration standards must be used in the respective steam generators throughout the current outage and at all future steam generator inspections.

9.1.1 Establish Mixes

9.1.1.1 Mix 1 - Prime frequency/quarter frequency differential mix; set up by eliminating TSP; degree versus percent curve.

9.1.1.2 Mix 2 - AVB mix; set up by eliminating TSP; prime frequency/quarter frequency differential mix (as directed by the Analysis Technique Specification Sheet (ANTS)), volts versus percent curve.

9.1.1.3 Overall Lead Analyst may designate any additional mixes as needed for a particular evaluation.

9.1.2 Set Rotations

9.1.2.1 Set probe motion horizontal. Initial excursions from the 100% thru-wall hole shall be starting down on differential channels and up on absolute channels.

When probe motion is not evident, the dent signal can be adjusted to horizontal as an option.

9.1.2.2 If low frequency is used for structure identification (e.g. 10-30 kHz) then the differential channel shall be rotated such that the initial excursion of the support plate signal is to the left and then down with the transition line vertical. The low frequency absolute channel shall be rotated such that the initial excursion of the support plate signal is down and to the left, and the measurement points lie vertical (270°).

9.1.3 Set Volts

9.1.3.1 Set voltage on the four 20% flat bottom drill holes on standard to 4.0 volts peak-to-peak on prime frequency differential channel. Store to all other channels and mixes.

9.1.3.2 Set Mix 1 to 2.75 volts peak-to-peak on the four 20% flat bottom drills.

9.1.4 Set Curves

9.1.4.1 Calibration curves shall be established using either "as-built" dimensions from the standard.

9.1.4.2 All ASME standard tube wall degradation curves typically use:

Set Point 1 - 100%
Set Point 2 - 60%
Set Point 3 - 20%

9.1.4.3 All AVB wear scar mix curves (normally Mix 2) typically use:

Set Point 1 - 0% at 0.0 volts
Set Point 2 - 20% (or closest to)
Set Point 3 - 40% (or closest to)

9.1.4.4 Differential curves shall utilize max rate for phase angle measurements unless a straight transition cannot be located. Absolute curves shall utilize volts peak-to-peak only. AVB curves (differential or absolute) shall utilize vertical max for volts measurement.

9.1.4.5 Curves shall be set up on differential degradation channels, Mix 1, and AVB Mix. The analyst may set up any additional curves to aid in the analysis as needed.

9.1.5 Set Spans

9.1.5.1 Adjust span on prime frequency differential channel and on Mix 1 so that the signal from the four 20% flat bottom drill holes on the ASME standard is at least 1/2 screen height peak-to-peak.

9.1.5.2 For other frequencies and mixes, adjust spans such that ASME Standard flaw transition signals are clearly discernible for adequate placement of measurement points.

9.1.6 After the screen is set up with the proper viewing channels and strip chart channels (normally Mix 1 Vertical and Channel 6 Vertical), the analyst must store the set up to the media of record.

9.1.7 Refer to Table 5 for the Bobbin Coil Probe Setup.

9.1.8 The Overall Lead Analyst shall instruct the analysts if any additional setup parameters are required. These will be documented on the applicable ANTS.

9.2 Evaluation (Bobbin Coil)

9.2.1 When evaluating the bobbin data, the analyst should consider several points which can make the analysis more accurate and complete. Some of these considerations are:

A. Previous history of the steam generator.

B. Location of the signal in the tube in relation to the appropriate support structure.

C. Location of the tube in the bundle.

D. Presence of deposits, PVN, or denting at location of signal being evaluated.

E. Previous history of other sites with the steam generator type or chemistry.

F. Loose parts found in the steam generator.

G. Material type of other components affecting the steam generators such as condensers, feedwater heaters, etc; for example, the use of copper materials as opposed to titanium, stainless steel, etc.

H. Relevant tube pull data that may be relevant.

9.2.2 The analyst may make use of the previous available history Data Sets of both bobbin and other probe types along with any previous and present graphics books to aid in the evaluation of signals.

9.3 Reporting Criteria (Bobbin Coil)

9.3.1 Refer to general reporting criteria rules for all probe types contained in 7.0.

9.3.2 Dents (DNT) shall reported at intersections from the Mix 1 channel. The reporting threshold shall be defined in the ANTS.

Dings (DNG) shall be reported from channel 1 in the freespan. The reporting threshold shall be defined in the ANTS.

9.3.3 PVN shall be reported from Mix 1 at intersections and from prime frequency differential channel in free span. The reporting threshold shall be defined in the ANTS.

9.3.4 I-Code and % Calls

Where a qualified sizing technique exists, the analyst should assign percent values to indications of degradation, however, signals may be observed that act like flaws yet cannot be quantified due to signal distortion. This can be caused by any number of outside interferences affecting the signal, such as denting, deposits, geometry of the tube or the flaw, probe motion, expansions of the tube, etc. In such a case, one of the appropriate I-codes (DI, NQI, DRI, DSI, DTI) may be used to characterize the indication. Section 9.5 contains the definitions of each I-code.

9.3.4.1 An I-code call indicates that the analyst believes the indication represents degradation of the tube wall.

9.3.4.2 All I-code calls which stand after the resolution process are recommended to have RPC performed on them. See Figure 5 for a typical sequence of events involved for the resolution of I-code discrepancies.

Any I-code calls that stand after the resolution process which do not have RPC performed on them are recommended to have tube repair actions performed on them unless other test methods, alternative plugging criteria, tube pulls, and/or historical data review justify leaving the tube in service.

9.3.4.3 If RPC is performed on an I-code call and does not confirm, the original bobbin call shall be changed from an I-code call (NQI, DI, DRI, DSI, DTI) to a corresponding N-code call (NQN, DIN, DRN, DSN, DTN), via an LAR (Lead Analyst Resolution) and will be tracked on subsequent inspections.

9.3.5 MBM and MMB calls are normally limited to baseline inspections only. Any "new" signals which resemble MBM's or MMB's that did not appear on baseline data or any previous MBM or MMB calls which show a change in size or character should be examined carefully and evaluated conservatively (See Appendix A for Free Span Signal flow chart).

9.3.6 All degradation calls other than AVB wear and MBM's, shall be called from either the prime frequency differential channel or from the Mix. Mix 1 is used when the indication is at a support plate or at the inside of the tubesheet or if there are deposits present which are affecting the indication. The prime frequency differential channel is normally used when the indication is in "free span" tubing and appears to have negligible outside factors affecting it. The Overall Lead Analyst shall designate any additional channels to call degradation from and what area of the tube to use them in as needed.

9.4 Graphics Requirements (Bobbin Coil)

9.4.1 Graphics plots are required for all indications which are pluggable or repairable (i.e. 40% or greater), all "I" codes and all PID's.

9.4.2 Additional graphics requirements shall be defined by the Overall Lead Analyst.

9.4.3 Graphics plots shall display lissajous windows as defined by the Overall Lead Analyst.

A suggested graphics plot that could be used containing 4 lissajous windows is as follows:

Upper Left Window	--	Mix 1
Upper Right Window	--	Channel 1
Lower Left Window	--	Channel 3
Lower Right Window	--	Channel 6

In the case of AVB wear indications, the upper left window should display Mix 2 (AVB Mix) instead of Mix 1.

9.4.4 All graphics will be taken by the resolution analyst(s).

9.5 Bobbin Coil Codes

A. ADS - "Absolute Drift Signal" Used when the analyst detects a positive "Y" and negative "X" component on an absolute OD mix elimination signal. Considered an unquantifiable signal flagged for future monitoring. Has been determined under laboratory examination of S/G tube samples to signify a possible "IGA" condition; however, it is not confined to such a phenomenon. Requires location and range if applicable and channel.

B. ANF - "Anomaly Not Found" Used by an analyst when a previously reported anomaly cannot be located within 0.50" of the previously called anomaly.

C. ANR - "Anomaly Not Reportable" Used by an analyst when a previously reported anomaly does not meet the present reporting criteria.

D. BDA - "Bad Data" requires retest.

E. BLG - "Bulged" tube Requires location, volts, phase angle, and channel.

F. CUD - Indicates the presence of "Copper" deposits. Requires location and range if applicable, volts, phase angle and channel. The reporting threshold will be defined in the ANTS.

G. DNG - Localized tube deformation on the free span tubing.

H. DNT - Indicates "Dent" in the tubing. This is a service induced tube deformation coincident with support plate, tubesheet, AVB, etc.

I. DRI - Indicates a Distorted Roll Transition Indication". This is a special case "I-code" used to define suspect roll transitions occurring in partially expanded tubes near the tube end. This indication is too distorted to quantify but is reportable and requires additional testing techniques for clarification. This code is changed to DRN if subsequent RPC or Cecco testing does not confirm the indication. GRAPHICS PLOT REQUIRED.

J. DSI - Indicates "Distorted Support Indication" - An I-code used in lieu of a (%) through wall value on a signal located within or extending out from a support structure which is reportable but too distorted to quantity. This indication requires additional testing techniques for clarification. This code is changed to DSN if subsequent RPC or Cecco testing does not confirm the indication. GRAPHICS PLOT REQUIRED

K. DTI - Indicates "Distorted Tubesheet Indication" - I-code used in lieu of a (%) through wall value on a signal starting within 0.5" of the top of tubesheet and extending out from or down into the tubesheet which the analyst believes to be an indication but too distorted to quantify. This indication requires additional testing techniques for clarification. This code is changed to DTN if subsequent RPC or Cecco testing does not confirm the indication. GRAPHICS PLOT REQUIRED.

L. FSD - Free Span Differential Signal which behaves like a flaw. This signal should be addressed by review of previous history and/or sample RPC testing. GRAPHICS PLOT REQUIRED.

M. FSI - Free Span Indication indicates a signal with a meaningful change from history or which did not exist in history or historical data is considered to have poor signal-to-noise correlation. Requires RPC testing for further characterization. GRAPHICS PLOT REQUIRED.

N. INF - Indicates "Indication Not Found". Used by an analyst when a previously reported indication cannot be detected within 0.50" of the previously reported indication.

O. INR - Indicates "Indication Not Reportable". Similar to "INF" except signal is present; however, current analysis results do not meet pre-established guidelines on signal reporting.

P. MBM - Indicates "Manufacturing Buff Mark". Reference Appendix A for suggested disposition techniques.

Q. MMB - Indicates "Multiple Manufacturing Buff Marks", usually over a range. Reference Appendix A for suggested disposition techniques.

R. NDD - "No Detectable Degradation".

S. NQI - Indicates "Non Quantifiable Indication" - An I-code used in lieu of a (%) through wall value on a signal located in free span area of the tube which is reportable but too distorted to quantify. This indication is treated the same as all other I-codes in the database and requires RPC for further clarification. This code is changed to NQN if subsequent RPC does not confirm the indication. GRAPHICS PLOT REQUIRED.

T. NT - "NO TEST"

U. NTE - "No Tubesheet Expansion"

V. PID - "Positive ID". GRAPHICS PLOT REQUIRED

W. PLG - "Plugged Tube"

X. PLP - "Possible Loose Part"

Y. PVN - Indicates the presence of a "Permeability Variation". Requires location, and range if applicable, volts, phase angle and channel. The reporting threshold will be defined in the ANTS.

Z. RES - Signal remaining after elimination of tube support plate signal.

aa. RST - "Restricted Tube"

bb. SLG - Indicates "Sludge". Used in measuring or quantifying deposits which lie on the O.D. of the tubing.

cc. TIU - Indicates "Tube ID Uncertain". The tube will be retested for ID verification.

10.0 GENERAL ROTATING PROBE GUIDELINES

This section will address the basic setups, evaluation, and reporting criteria for rotating probes. More specific instructions for particular rotating probe types can be found in additional modules to these guidelines.

10.1 Types of Rotating Probes & Coils

The following coil types for rotating probes currently exist in the industry today and are commonly used in industry today:

A. .080" midrange pancake coil
B. .100" midrange pancake coil
C. .115" midrange pancake coil
D. .080" hi-frequency shielded pancake coil
E. Plus point coil
F. Axial wound coil (circumferentially sensitive)
G. Circumferentially wound coil (axially sensitive)

These coils can be contained on straight section, U-bend, or gimbaled probe heads.

10.2 General Setup Guidelines (RPC)

Table 6 describes the basic rotation, voltage, and span settings for rotating coils.

10.2.1 Mixing and filters are not required but are optional. All indications shall be reported from the applicable coil on the primary frequency channel.

10.2.2 Curve settings are not required but may be used if dictated by the Overall Lead Analyst in the ANTS.

10.2.3 The response of the trigger signal shall be set vertical with the span set below saturation.

10.2.4 Set scale based on the standard (refer to standard drawing).

10.2.5 Scale may also be set between two structures or on a support plate as needed.

10.2.6 Store setup to media of record.

10.2.7 Plot the standard on all degradation channels, making sure the 40% EDM notch (axial or circ depending on coil used) is clearly visible. If not, adjust spans accordingly. Reference Table 6 for specifics.

10.2.8 Verify proper probe rotation speed per Acquisition Technique Specification Sheet (ACTS).

10.3 Evaluation (RPC)

10.3.1 It is recommended that while the tube is loading, the prime frequency channel or the next highest frequency, if it is greater than one-half of the prime frequency, should be monitored. Verify that the complete extent to be tested has been recorded.

10.3.2 Scroll the entire test extent with all frequencies as necessary to confirm any possible indications and to locate the largest amplitude signal with respect to the applicable steam generator structure. C-Scan, Lissajous and strip chart displays shall all be monitored during this process.

10.3.3 Axial and circumferential length measurement features shall be used to further enhance the analysis.

10.3.4 Potential flaws detected by RPC may have to be identified in the presence of lift-off and conductive/magnetic discontinuities similar to interferences encountered by bobbin probes. Thus, the various data categories available with RPC testing should be examined in totality to obtain the best categorization of any signal or set of signals observed. These include the coil types, isometric displays, strip charts, or C-Scan and lissajous signatures obtained for each scan line.

10.3.5 Phase angle behavior, especially for cracks, is well known to provide inaccurate depth information, even for parts of relatively simple flaws. Thus for single or multiple cracks, multiple or plated pits and graded wastage, phase angles may vary broadly. Combination of small flaw signals with lift-off signals will produce combination phase angles which may rotate the flaw angle in either clockwise or counter clockwise direction. These factors may create contradictions between apparent flaws which are visually evident on C-Scan and the traditional phase angle analysis concept. The following flaw identification principles should be employed to assume conservative disposition of possible flaw indications:

10.3.5.1 Observation of vertical components in the C-Scan displays for individual scan lines are evidence of the possible existence of a flaw. Phase angle correlation with other frequency channels is not required, though it may be observed for many flaws.

10.3.5.2 Interferences from magnetic or conductive deposits may be reduced with RPC relative to bobbin, but the RPC is still subject to such interference. However, tube pull data has not been demonstrated from to be a significant factor. Therefore use of such an explanation to reject possible flaw indications should be minimized.

10.3.5.3 Lift-off signals which compromise bobbin detection of flaws in dents and expanded transitions are greatly reduced by the use of surface-riding RPC's but lift-off influence may still be evident. This may cause a visibly evident flaw to be rejected as lift-off. Particular care should be employed to verify that the interpretation as lift-off is reasonable considering the possibility that a flaw signal with lift-off is reasonable considering the possibility that a flaw signal with lift-off may exist; e.g. signals that have short axial or long circumferential lengths are not consistent with local diameter changes.

10.4 __**Reporting Criteria (RPC)**__

10.4.1 Refer to Letter Codes, Section 10.6, in these guidelines, and Appendix B for criteria for calling crack-like indications as well as other reportable types of degradation and non-degradation.

10.4.2 There will be no minimum voltage criteria for reporting degradation.

10.4.3 All calls shall be referenced from the center point of the intersection being tested. Report both the start (Inch 1) and end points (Inch 2) for each axial (SAI, MAI) indication.

10.4.4 Enter the intersection designator in the extent column of the final report for all tubes tested except NT and RST where no intersection is present. EXAMPLES: TSH TSH, 1H 1H, etc.

10.4.5 PVN may be called for a tube which displays permeability variations of sufficient signal amplitude which the analyst feels could mask possible degradation.

10.4.6 A UDS call may be used for cases where the analyst observes a signal which cannot be characterized as a crack-like indication but believes should be brought to the attention of the Resolutions and/or Lead Analyst.

10.4.7 A length versus width (arc length), DIM measurement shall be entered into the report along with the actual call for all crack-like indications (SAI, MAI, SCI, MCI).

10.4.8 All degradation calls should be made from the frequency specified in the ANTS.

10.4.9 The analyst should continually be aware that other forms of degradation may exist which may not be cracks. This is more likely to be true at locations "away" from the transition being inspected, and an appropriate letter code shall be used to characterize the indication.

10.5 Graphics (RPC)

10.5.1 Graphics plots are required for any tube degradation and will be made by the resolution analysts(s).

10.5.2 The graphics plots shall include one page containing an isometric plot of the most suitable channel (and coil) which shows the indication most clearly along with the corresponding lissajous window showing the largest or clearest representative lissajous signal with properly placed measurement dots.

10.5.3 The Overall Lead Analyst shall designate any additional graphics requirements in the ANTS as needed.

10.6 Letter Codes (RPC)

The following letter codes apply to crack-like indications only.

A. SCI - "Single Circumferentially Oriented Indication" This term is to be used when the isometric plot depicts a crack-like indication whose axial extent is usually less than its circumferential extent. This type of indication is normally located within transition areas or dented support plate edges.

B. MCI - "Multiple Circumferentially Oriented Indications" Same definition as SCI except more than one SCI is present. Requires LIG measurements.

C. SAI - "Single Axial Indication" When displayed in an isometric plot, this indication will usually have an axial extent which is greater than its circumferential extent. This indication may be found immediately adjacent to transitions (or dents) and may run into or through the transition (or dent), in free length tubing, e.g., in sludge pile areas, as well as in small radius u-bends.

D. MAI - "Multiple Axial Indications" Same definition as SAI except more than one SAI except more than one SAI is present. Requires LIG measurements.

E. LIG - "Ligament" Used as an additional measurement where multiple crack-like indications are present in the same axial location are called. "LIG" denotes the "clean" space between the indications. LIG is measured in circumferential degrees and extends from null return of one indication to null departure of the immediately adjacent indication. All ligaments must be measured and in combination with the indications, should total approximately 360 degrees when all circumferential degree measurements are added.

F. PIT - A localized corrosion attack on the tubing related to oxygen ingress through continuous condenser inleakage and the presence of copper on the secondary side.

G. VOL - Volumetric indication that can be associated with thinning, manufacturing or service induced phenomena. This signal will normally present a shallow % thru-wall and large amplitude response from the bobbin coil. Care must be taken in the reporting and disposition of VOL calls as intergranular attack (IGA) may exhibit volumetric signal characteristics.

Other letter codes which may be used with RPC are:

H. BDA - "Bad Data"

I. DEP - Deposit(s)

J. MBM - "Manufacturing Buff Mark"

K. NDD - "No Detectable Degradation"

L. NT - "No Test"

M. PID - "Positive I.D."

N. PLP - "Possible Loose Part"

O. PVN - "Permeability Variation"

P. RST - "Restricted"

Q. SCM - "See Comment"

R. TIU - "Tube I.D. Uncertain"

S. UDS - "Undefinable Signal" This indication is used to identify a signal which the analyst cannot characterize as a crack-like indication but believes should be brought to the attention of the shift lead analyst or the Overall Lead Analyst for further discussion and a potential decision to either continue calling and track on subsequent inspections, investigate further by other techniques (e.g., UT or tube pull), and/or repair actions on the basis of conservatism.

11.0 PLUS POINT PROBE GUIDELINES

The purpose of this section is to establish instructions pertaining to the analysis of steam generator eddy current inspection data using an RPC probe consisting of a standard pancake (115 mils diameter), a plus point (+Pt) wafer coil, and high frequency shielded pancake (80 mils diameter). This section provides instructions for the setup and calibration of the probe, the evaluation of the data, and the documentation of the results. While this section addresses a specific configuration of the probe, the principles contained herein are applicable to other similar probes (for example where the 80 mil high frequency coil is replaced with an 80 mil mid-range coil).

11.1 Description of the Probe (Typical)

11.1.1 115 mil Pancake Coil

This is a standard mid-range pancake coil. The purpose of this coil is to improve the ability to detect ODSCC. Reference the ACTS for the frequency configuration.

11.1.2 +Pt Wafer Coil

This coil has both axial and circumferential windings on a single coil. The output is the difference between the two windings. This results in a compensated output - i.e. if both windings are equally affected by the environment, the result is a null output. This means that the coil, by design, minimizes the effect of expansion transitions, support structures and deposits. The analyst must also be aware that slowly varying volumetric effects (e.g. wastage or volumetric IGA)may also be minimized by this coil design. This coil is typically operated at the same frequencies as the 115 mil pancake. The compensating nature of the probe allows for the differentiation of circumferential and axial indications. On a given channel, if an axial indication yields a positive response (goes up), a circumferential indication yields a negative response (goes down).

11.1.3 80 mil High Frequency Pancake Coil

This is a shielded pancake coil which is wound to achieve a higher optimum operating frequency. The purpose of this coil is to improve the ability to detect PWSCC. Reference the ACTS for the frequency configuration

11.2 Calibration Setup Information

Refer to Table 7 for the +Point Probe set-up.

In general, the information provided in this section is generic in its application. However, all examples and channel references herein will be made with respect to the tester configuration used with the ANSER software and the Tecrad TC6700 Eddy Current Acquisition Unit. The frequencies are applied to the coils as defined in the applicable ACTS

11.2.1 Calibration Standards

The calibration standard shall include axial and circumferentially oriented notches, both ID and OD oriented.

11.3 Process Channels

In order to achieve both a circumferential and an axial +Pt channel, set up a filter channel for each plus point channel and leave the settings at the default (2 coefficients, low cut = 0 Hz and high cut = 200 Hz) setting. The default setting has little or no effect on the data. These channels can be set up as circumferential channels.

11.3.1 Amplitude Scale

Set the amplitude for each coil type (BY COIL in the SETUP menu of the ANSER eddy current software) as per Table 7.

11.3.2 Rotational Setting

Set the phase for each individual coil type per Table 7. Where probe motion (lift-off) is evident, set it to be horizontal on the pancake coils. The rotation of all channels should be adjusted such that the ID EDM notches on the standard provide a positive vertical response. This may make the 100% EDM lie at an angle somewhat greater than 20°channels (e.g. the plus point channels will most likely rotate such that the 100 % defect is 30 - 35 degrees off of the horizontal). For the low frequency locator channel, set the support response to be vertical and down. Set the trigger channel such that the large pulse goes up and the small pulses are horizontal. Figures 6 through 13 show graphics of the EPRI recommended standard defects for all three coils.

11.3.3 Viewing Parameters

Set the minimum spans as per Table 7.

Alignment of the coils using the software is recommended to aid in the viewing of the data. This is most easily done on an axial notch in the standard.

11.3.4 Store the setup parameters to hard and optical disks.

11.4 <u>Data Evaluation</u>

The evaluation of the data requires an understanding of the applicability and operation of all three coils on the probe. The 115 mil pancake is a good general application coil, and is sensitive to both O.D. and I.D. indications of any orientation. The 80 mil HF pancake is designed to be operated at frequencies which enhance the detectability of I.D. indications. It also is sensitive to all orientations of indications. The +Pt coil compensates for signal sources that both windings detect in a like manner. This provides some degree of signal reduction to sources of lift-off. The lift-off signal from the +Pt coil is a significant improvement over that of the pancake, but there may still be a noticeable vertical component to the signal which tends to manifest itself largely on the channels which are set up for circumferential indications. Figures 14 through 16 show the effect of lift-off for all three coils on a localized dent.

The analyst must use some discretion in the presence of lift-off. Also, the analyst must be aware of what signal a volumetric indication may yield when using the +Pt coil. First, the compensating nature of the coil design may reduce or even eliminate signals from a slowly varying volumetric condition. Therefore, the pancake coils should also be reviewed. Secondly, the volumetric indication will cause the signal to vary on both sides of the base line. This means that there will be a positive vertical response on both the axially and circumferentially set-up channels. Depending on the nature of the indication, this response may or may not be symmetric (like a flat-bottom hole).

In general, the prime frequency channels for all three coils should be used for the screening of the data. Where geometry is not having a significant effect, some correlation should be able to be achieved between the +Pt and at least one of the pancake coils (115 mil for O.D. indications and the 80 mil for I.D. indications), however, any channel exhibiting flaw-like behavior should be reported.

In reviewing the data, the analyst shall review the C-Scan displays of all coils for discontinuities. It should be recognized that the +Pt data shall be reviewed on both axial and circumferentially setup channels. The analyst shall scroll through the region of interest while reviewing the Lissajous (X-Y) display for possible indications. If a possible indication is found, the analyst should review the data from the pancake coils for confirmation at that location. Figures 17 through 20 show the response of the +Pt coil and the pancake for typical defects in Inconel 600 mill annealed tubing.

The phase relationships and confirmation by other coils should be viewed in the light of other influences which the probe experiences. The analyst should feel free to use his/her discretion in reporting signals which are felt to be indicative of a degraded condition, but do not necessarily meet all of the criteria indicated above. The over-riding rule of analysis should be: "If you think there is an indication, report it."

11.5 Recording, Reporting and Resolving Of Results

As this probe is a type of rotating probe, reporting and resolution methodology shall be per Section 10.0 and Appendix C. The typical reporting codes should include, as a minimum:

A. NDD - No Detectable Degradation

B. SAI - Single Axial Indication

C. SCI - Single Circumferential Indication

D. MAI - Multiple Axial Indications

E. MBM - Manufacturing Burnish Mark

F. MCI - Multiple Circumferential Indications

G. MMI - Mixed Mode Indications

H. VOL - Volumetric Indication

I. PAI - Possible Axial Indication (+Pt signal with no confirmation from the pancake coil)

J. PCI - Possible Circumferential Indication (+Pt signal with no confirmation from the pancake coil)

K. WAR - Indication of Wear

Additional indication codes may be used as designated by the lead analyst or as directed by the ANTS.

The resolution analysts shall review all reported indications. The resolution analysts shall confirm all indications with respect to type/orientation and resolve discrepancies between primary and secondary analysts.

11.5.1 OD axial and circumferential indications shall be reported and measured from the applicable +Pt channel as defined in the ANTS.

11.5..2 All indications which are classified as ID in origin shall be reported and measured from the 80 mil high frequency coil.

11.5..3 All volumetric indications shall be reported and measured using the 115 mil mid-range coil.

11.5..4 Graphics shall include, as a minimum, a C-Scan and Lissajous figure of the reporting channel and will be taken by the resolution analyst(s).

12.0 CECCO-5 GUIDELINES

The purpose of this section is to establish instructions pertaining to the analysis of Indian Point Unit 2 steam generator eddy current data using Cecco-5 probe technology.

12.1 Cecco-5 Probe Technology

Cecco-5 (C5) probes are multiple element transmit-receive (T/R) probes. T/R probes are, by nature of their operational principles, less sensitive to liftoff than standard impedance probes. The probe also has a module with a conventional impedance bobbin coil. The C5 was designed to screen for cracking in the presence of a geometric variation. The C5 exhibits good sensitivity to both axial and circumferential indications. The probe consists of two bracelets, each having an array of up to six T/R pairs (Figure 21). The second bracelet is rotationally offset from the first in order to achieve 100% coverage.

The receive coils are wound in opposition to one another and connected in series. This configuration yields a consistent differential signal. Cecco probes are **not** compensating probes and, therefore, produce signals which are consistent information regardless of flaw position relative to the coil (i.e. all down first). There are some instances when an inverted signal can be observed in the presence of an indication. This signal yields an inverse response (i.e. up first instead of down) due to the direction of the eddy currents in this region. It is a small amplitude signal which can occur when one coil very strongly detects an indication which is not quite long enough to be picked up by the adjacent coil. A coil which is adjacent to that coil will show an indication which forms normally and is a large amplitude signal (typically about 10x or more).

The tester used for the Cecco probes is the Tecrad TC6700 Eddy Current Acquisition Unit (ECAU). The number of channels of raw data produced by a specific probe is somewhat dependent upon the probe size. For the C5/Bobbin, the ECAU produces 80 channels of raw data for a 0.680 inch to 0.720 inch diameter probe and 56 for a .640 inch diameter probe. The difference in the number of channels has to do with the smaller probe having fewer T/R pairs. Reference the applicable ACTS for specific configuration parameters such as sampling and probe speed. Boiler code pertaining to digital data acquisition along with current tester limitations would allow testing up to 16 inches per second, but a certain amount of "over-sampling" is desired as circumferential indications have very little axial extent and would produce fewer data points than an equivalent axial indication.

12.2 General Calibration Setup Information

Refer to Section 9.0 or the ANTS for the setup of the bobbin segment. The steps outlined herein are for the Cecco segments of the probe only. The software specific information provided in this procedure applies to Westinghouse ANSER Software Versions. Unless stated otherwise, it is assumed that the software is in the SETUP mode of operation for all steps.

12.2.1 Calibration Standards

For the setup of the T/R channels, the standard being used needs to have, as a minimum, two general features: a geometric variation and a groove. The geometric variation should be a 360° dent or expansion. The groove can be the typical 10% OD groove from the ASME, a 10% ID groove or good tube/bad sleeve standard, as applicable. Other discontinuities may be added as desired for probe setup or process verification as defined in the ANTS.

12.2.2 Establish Process Channels

There are two types of process channels available to the analyst. The first is the conventional two frequency mix. The second is a compensation "mix" (for lack of a better term). The compensation mix involves the simple subtraction of one channel from another, thus using the uncompensated raw data to produce a compensated output.

The analyst should understand the strengths and weaknesses of each type of data processing technique. In order to do this, some understanding of the processing techniques is required.

The conventional mix rotates and sizes a signal on one frequency in order to match (to the degree possible) the same signal on another. This is typically done using the signal from a support ring on the standard. The support ring exhibits a significant phase change from one frequency to the other, whereas the defects on the standard lie roughly in the same phase plane on both frequencies. The end result of the mix is the elimination of the support structure. There is some loss of defect signal, but the signal to interference (signal to noise) ratio of the defect to the tube support plate mix residual is much greater than that for the signal to the support signal for a raw channel. The advantages of the conventional mix are that it is not limited in its sensitivity with respect to axiosymmetric indications (for example, the 10% OD groove) and it reasonably eliminates the support structure in most instances. The disadvantages are that deposits which do not match the phase behavior of the object "mixed out" on the standard may result in a large mix residual and the effectiveness of the mix will be greatly reduced, and the resultant mix is still sensitive to lift-off (i.e. uncompensated).

A compensation mix involves the subtraction of the output of one channel from that of another at the same frequency. The result is that there is a null output if both channels sense exactly the same thing. For the Cecco probes, adjacent channels from the same bracelet are used in order to minimize any sensitivity to probe speed variations. The advantages to this technique are that any effect of deposit or geometry that both channels sense equally is eliminated and that the phase information is retained even though the geometric effect is greatly reduced. The disadvantages are that if both channels see a defect signal equally (for example, the 10% OD groove) the indication is eliminated, and that some signals may now form 180° out of phase making any residual a little more difficult to interpret. *The potential impact of this limitation must be understood if the analyst is to use this as a tool, and the analyst must review the raw **and** the process channels in order to determine the state of the tubing.* The disadvantages are somewhat reduced by the fact that the sensing regions are relatively small and the likelihood of an indication being completely axiosymmetric is fairly small.

In general, the use of the compensation mix is recommended over the conventional mix. This is especially true where regions of geometric variation are of great interest. The localizing of the compensation yields reasonable results even when the geometry change is somewhat irregular as in an explosive expansion or an ovalized tube.

12.2.2.1 Conventional Mixes

12.2.2.1.1 The channels used for the conventional mix will vary with the number of sensing points in the probe. If the probe has 24 sensing points, a typical mix for one sensing point might be 1:25, 1:49, or 25:49, depending on the frequencies used. In the MIX MENU, set up the appropriate number of mixes and select the channels appropriately per the ANTS (Example in Figure 22).

12.2.2.1.2 Locate the signal to be mixed out on channel 1.

12.2.2.1.3 Perform the mix using the left mouse button for only the odd numbered channels.

12.2.2.1.4 Locate the signal to be mixed out on channel 2.

12.2.2.1.5 Perform the mix using the left mouse button for only the even numbered channels.

12.2.2.2 Compensation Mixes

12.2.2.2.1 The channels used for a compensation mix will always be adjacent channels on the same bracelet at the same frequency. The channel selection for the mix might be 1:3, 2:4, etc. until a "wrap around point is hit. For a 24 sensing region probe, this would at channels 23 and 24. Their secondary mix components would be channels 1 and 2, respectively. Set up the mix channels per the ANTS. Very often, this will be done on a middle or low frequency, depending on the application (Example in Figure 23).

12.2.2.2.2 Perform the compensation mix on all channels using the right mouse button. Since this is a simple subtraction, it does not matter where the locator bar is in the data.

12.2.3 Rotate Raw Data Channels

12.2.3.1 Locate the dent (expansion) and center the signal in the window using Channel 1.

12.2.3.2 Get a Vpp measurement on the signal and rotate it until it lies at 180° (0°). This puts lift-off horizontal such that the groove on the standard should yield a signal which starts off going down as with a conventional bobbin setup.

12.2.3.3 Move the mouse cursor to the rotation number in the upper right corner of the Lissajous display and press the middle mouse button. This will set up the rotation for all channels from that bracelet.

12.2.3.4 Locate the dent (expansion) and center the signal in the window using Channel 2.

12.2.3.5 Get a Vpp measurement on the signal and rotate it until it lies at 180° (0°). This puts lift-off horizontal such that the groove on the standard should yield a signal which starts off going down as with a conventional bobbin setup.

12.2.3.6 Move the mouse cursor to the rotation number in the upper right corner of the Lissajous display and press the middle mouse button. This will set up the rotation for all channels and compensation mixes from that bracelet. The rotation number (upper right corner of Lissajous display) for each mix should be set to match the rotation of its parent channel. For example, if Channel 1's rotation is 246°, the rotation of Mix 1 (1:3 compensation mix) should also be 246°.

12.2.3.6.1 Channels which are 180° out of phase are that way because either a transmit coil or a receive coil set are wired backwards. These channel will occur in pairs separated by two channel numbers (for example channels 8 and 10). Using the example channels as the test case, the mix performed per 12.2.2.2.2 will actually be additive, rather than subtractive for mixes 6 and 10. The mix channels which are added will be readily noticed by the amplitude of the groove signal. Instead of being eliminated (or nearly so), it will be approximately doubled in amplitude as compared to the raw channel. Determine which channels exhibit this behavior.

12.2.3.6.2 Re-mix those channels (6 and 10 in the example) using the middle mouse button. This performs an addition of the two channels rather than a subtraction.

This is necessary because the channels used to make up the mix are "out of phase".

12.2.3.7 Conventional Mix Channels

Conventional mix channels should be rotated with probe motion horizontal.

12.2.4 Coil Offset

12.2.4.1 Enable the offset function by clicking on the "N" next to the Auto Locate button with the left mouse button. The button will turn to a green "O".

12.2.4.2 Put channel #1 in the left strip chart and channel #2 in the right strip chart. To offset the coil groups hold down the "Ctrl" key and the middle mouse button and drag the channel #2 strip chart until it is aligned with the channel #1 strip chart. A more exact offset can be done by holding down the "Ctrl" key and clicking the right and left mouse button in the expanded strip chart area.

12.2.4.3 Put a bobbin channel into the strip chart that had channel #2 in it and align it the same way as in 12.2.4.2.

12.2.5 Setting Amplitude Scale

12.2.5.1 Locate the signal which will be used for setting the amplitude scale on Channel 1 (typically the 10% OD groove). Set that signal to the voltage described in the approved analysis technique sheet (ANTS). Store that value to all odd numbered channels by holding down the Shift key and using the middle mouse button on the voltage display.

12.2.5.2 Locate the signal which will be used for setting the amplitude scale on Channel 2 (typically the 10% OD groove). Set that signal to the voltage described in the ANTS. Store that value to all even numbered channels by holding down the Shift key and using the middle mouse button on the voltage display.

12.2.5.3 This will put all channels at a single frequency at approximately the same level. There will be some small differences due to differences in cabling from coil to coil. These are not of great importance since the amplitude is not being used for any critical measurement (for example, alternate plugging criteria). This is just to put the display on a comfortable scale for the analyst.

12.2.5.4 Set voltage on the four 20% flat bottom holes and normalize to the bobbin coil group per the ANTS.

12.2.6 Setting Curves

12.2.6.1 No calibration curves are required for the Cecco channels. Set curves for the bobbin channels as per the ANTS.

12.2.7 Setting Display Spans

12.2.7.1 Terminate the SETUP mode by selecting DONE in the SETUP menu.

12.2.7.2 Go to a known signal (for example, 10% OD groove) on a channel and set the span per ANTS.

12.2.7.3 Press the middle mouse button on the span number (upper right corner of the Lissajous display) to set all channels of the same frequency to the same span number.

12.2.7.4 Repeat steps 12.2.7.2 and 12.2.7.3 for one channel of each frequency and a process channel.

12.2.8 Enhanced Data Display

12.2.8.1 Select LISS GROUP from the SETUP menu.

12.2.8.2 Setup the Lissajous group in accordance with the examples for type of probe being used (Figures 24 and 25).

12.2.8.3 The Lissajous Group permits the viewing of the strip chart displays (F6, F7, or F8) in layers by using <Shift> and the function key or <shift><Ctrl> and the function key. The setups given in this document place one frequency at a time on the strip display (Figure 26).

12.2.8.4 The Lissajous Group also permits toggling through the four or eight Lissajous displays (F2 and F4, respectively) in a manner similar to the strip charts as discussed in 12.2.8.3.

12.2.9 Cecco C-Scan

12.2.9.1 Manually set a scale using the ASME standard dimensions.

12.2.9.2 Enable "CECCO" or "CECCO 2 LISS" under the "RPC" pull down menu.

12.2.9.3 Each channel of a certain Liss. group is an axial slice of the C-Scan. Stepping through the C-Scan plot can be accomplished by doing the following.

12.2.9.3.1 Pick the Liss. group to be viewed by clicking the "Liss. group X" button.

12.2.9.3.2 Set the "CIR STEP=X" button to the correct increment. The setting should be 15 for a 24 channel probe and 23 for a 16 channel probe.

12.2.9.3.3 Step through the C-Scan by clicking the left or right mouse button on the "AD= X RD= X" button.

12.2.9.4 The 4-Lissajous screen (F2), 16 stripchart (F7), and 24 stripchart (F8) can be accessed from the C-Scan display via the function keys. Press the (F9) function key to get back to the C-Scan display.

12.3 APPLICATION OF THE C5 PROBE

12.3.1 Scope of Application

The C5 is designed for the detection of both axially and circumferentially oriented indications. It's general application to the inspection of steam generator tubing should be for screening for indications in specific regions of interest. The application of the probe to expansion transition regions and dented intersections yields detectability comparable to RPC. The scope of use should be limited to detection of indications. Since the coils cannot discriminate between axial and circumferential indications, characterization should be performed using another technique.

The .680 and .700 inch diameter probes for 7/8" tubing have 24 sensing regions. The probe for severe denting application (.640 inch diameter) tubing has 16 sensing regions.

12.3.3 Data Evaluation

Tubes shall be screened using the C-Scan displays which are best applicable to the probe and the region of the tube being examined. Review each of the four Lissajous groups on the C-Scan displays for vertical displacements and return to the four lissajous display for further evaluation.

It is permissible to make small adjustments in the rotation of the raw and multi-frequency mix (if used) channels during the course of the evaluation to bring the residual probe motion "back" to horizontal, thus increasing the detectability of the indications. The need to make a large adjustment (> 5 degrees) may indicate that a connection in the probe or extension has been stressed but has not broken. This will greatly affect mixes which use the affected raw data channels and should be used as an indicator for probe and/or cable change.

12.3.4 Reporting Criteria

The reporting criteria will normally be controlled by ANTS. If no specific direction is given, report all flaw-like indications as PI (Possible Indication) in the % column of the report. The attendant amplitude, phase angle, channel, location and completed extent must be reported.

12.3.5 Required Graphics

The graphic requirements will normally be controlled by ANTS. Typically, graphics are required for all reported flaw-like calls. The C-Scan display with the reporting channel and, if the two Lissajous C-Scan display is used, a supporting channel is recommended to be printed. Again, all graphics will be taken by the resolution analyst(s).

12.4 C5 Dented intersection and Sludge Pile Inspection

12.4.1 Scope of Application

The C5 coils shall be used for analysis of dented TSP's, dented TTS intersections and the hot or cold leg sludge pile region of the tubes.

12.4.2 Data Evaluation

12.4.2.1 View the Cecco C-Scan for possible indications for all Lissajous groups. Indications should typically have a downward and upward formation on the C-Scan plot. To best scan the data, set the "CIR STEP= X" button to be able to view each channel as you step through the data using the Absolute/Relative Degree (AD= X RD= X) button.

12.4.2.2 Center the support region in the C-Scan display and assure that the data offsets are correct. These may change slightly due to the resistance of the probe in passing through the dent. If the data cannot be aligned to facilitate analysis, the data shall be rejected for that intersection (RC5).

12.4.2.3 Step through the C-Scan display using the Absolute/Relative Degree (AD= X RD= X) button. This allows for the review of the individual data channels, Lissajous and expanded strip charts, which comprise the C-Scan display.

12.4.2.4 If a possible indication is found, further evaluation may be performed using the 4 lissajous display (F2 screen).

12.4.2.4.1 Perform a measurement of the signal on the process channel. If the measurement encompasses the entire dent signal on the raw channels, it may be a non-relevant signal. If the signal measured on the mix only represents a small portion of the dent signal, the signal may be due to a degraded condition. The dent signal on the raw data channels will typically appear deformed when a flaw is associated with the dent.

12.4.2.4.2 If a crack-like indication extends outside of the dent, there will typically be a signal ahead of or behind the dent. This signal may appear as half of a differential flaw-like signal, i.e. it may go down first and then go up as it comes into the dent, or it may go up as the probe exits the dent and then return to null. The signal may not be symmetric in its formation.

12.4.2.4.3 On the compensation mix, when an indication of limited circumferential extent is observed, there is typically a compensated response which is approximately equal in amplitude and forms opposite of the flaw response (up then down).

12.4.2.4.4 When an indication is detected on the compensation mix, there will typically be at least a distortion of one or more of the raw data channels associated with that process channel. *It must always be recognized that a nominally symmetrical 360 degree indication could be compensated out by this type of process channel. Therefore, the raw data channels should always be screened in addition to the mixes.*

12.4.2.4.5 Indications found at dented tube support plate intersections shall be reported as ***SPI*** (Support Plate Indication) , those at dented tube sheet intersections shall be reported as ***TSI*** (Tube Sheet Indication) and those within the sludge pile regions shall be reported as ***PI*** (Possible Indication)

12.5 <u>C5 Roll Transition Inspection</u>

12.5.1 Scope of Application

The C5 coils shall be used for analysis of the hard rolled transition regions within a partially expanded tubesheet.

12.5.2 Data Evaluation

12.5.2.1 View the Cecco C-Scan for possible indications for all Lissajous groups. Indications should typically have a downward and upward formation on the C-Scan plot. To best scan the data, set the "CIR STEP= X" button to be able to view each channel as you step through the data using the Absolute/Relative Degree (AD= X RD= X) button.

12.5.2.2 Center the roll region in the C-Scan display and assure that the data offsets are correct. If the data cannot be aligned to facilitate analysis, the data shall be rejected for that intersection (RC5).

12.5.2.3 Step through the C-Scan display using the Absolute/Relative Degree (AD= X RD= X) button. This allows for the review of the individual data channels, Lissajous and expanded strip charts, which comprise the C-Scan display.

12.5.2.4 The nature of crack-like indications in the roll transition may vary significantly. There may be relatively isolated single axial or circumferential indications, or there may be indications of mixed mode about the entire circumference of the tube. The C5 will react differently to these two situations.

12.5.2.4.1 If the indications are isolated, the probe's response will typically be a clear differential response on the vertical channel of the coil(s) sensing the indication.

12.5.2.4.2 If the indications are mixed mode or extend about the entire circumference, the response may look like an absolute coil response in either direction depending on how the indication passes through the sensing region.

13.0 RPC/BOBBIN ROLL ANALYSIS

The purpose of this guidelines is to establish instructions pertaining to Indian Point Unit 2 steam generator eddy current inspection data using the combination RPC/Bobbin Probe for the roll expansion. This guideline provides instructions for analysis set-up, evaluation, and documentation of the results for pre and post re-roll.

13.1 RPC/Bobbin Eddy Current Probe Technology

This probe was developed to evaluate DRI (Distorted Roll Transition Indication) eddy current responses that may be reported using Bobbin Coil or Cecco 5 inspection. The probe has both a rotating pancake coil (100 mil diameter), which is used for detection of cracks, and a bobbin coil, which is used for location measurement (Figure 27). This probe is used pre-reroll and post-reroll to ensure that the required F* distance is obtained during the repair activity. A probe Pneumatically Actuated Tensioner should also be used to minimize probe skip that can occur during acquisition.

13.2 Analysis Setup Information

13.2.1 Calibration Standard

The standard used shall be defined in the ACTS.

13.2.2 Setting Rotations

13.2.2.1 Pancake Coil

Set probe motion horizontal with flaws going up first.

13.2.2.2 Differential Bobbin Coil

Using the 100% axial notch rotate the response 40 to 45 degrees on all differential coils.

13.2.2.3 Absolute Bobbin Coil

This coil is being used to evaluate the new expansion diameter. Therefore, the set-up requirements for profile will be conducted as defined in the ANTS.

13.2.3 Setting Volts

Locate the 100% notch at 400 kHz on the pancake coil and set to 20 volts (or per ANTS).

13.2.4 Set Axial Dimension (Scale)

The axial scale should be set for each tube that is examined. Set STD on the center of the expansion transition using the pancake coil as shown in Figure 28. Using RPC 6 (1.0") center the expansion transition on the bobbin data as indicated in Figure 29.

13.3 <u>Data Evaluation</u>

13.3.1 Pre-Reroll

The data will be evaluated for flaw(s) at the expansion transitions and reported using standard codes as defined in Section 10.6.

If the expansion transitions are NDD no further evaluation is required. If the expansion transition(s) has a flaw, the following entries (referenced from the tube end) must be entered into the report:

BRT - Bottom Roll Transition (Figure 30)
CRT - Crack Tip (Figure 31)
HRM - Hard Roll Missing (if applicable)

An example report is included as Figure 32.

13.3.2 Post-Reroll and Verification of 1995 Rerolled Tubes.

The purpose for the post-reroll examination is to identify the crack tip location and the new bottom of roll locations. Listed below are the codes to be used:

NCT - New Crack Tip (Figure 33)
NRT - Bottom of New Roll Transition (Figure 34)

Using these measurements from the tube end, F* can be calculated by subtracting (NCT) from (NRT) to determine acceptance. An example report is included as Figure 35.

13.4 <u>Any additional requirements shall be documented in the ANTS</u>.

14.0 BOBBIN PROFILOMETRY

14.1 <u>Bobbin Profile for Roll Expansion Repair by Re-rolling</u>

14.1.1 On the largest dent on the standard, set Vpp for the prime frequency absolute channel to 200 volts. Store this scale to the other channels.

14.1.2 In the PROFILE menu, select SLEEVE PROFILE. In the PROFILE CONFIG turn on only MEASURE CURSOR and SAVE RESULTS TO REPORT 1(See Figure 36).

14.1.3 Adjust the NOM and CAL values to the as-built dimensions for the expansion standard and set the screening as shown in Figure 37.

14.1.4 Set the location indicators to TEH and TSH on the top and bottom, respectively.

14.1.5 Locate the bottom edge of the tubesheet expansion standard and set this to TEH using the indictor button.

14.1.6 Locate the top edge of the tubesheet expansion standard and set this to TSH using the indictor button. The profile of the expansion will now be displayed (Figure 38).

14.1.7 Move the MEAS cursor to the nominal portion of the standard, and set this point using the NOM button.

14.1.8 Move the MEAS cursor to the proper expansion set and set this point using the CAL ID button. The system should now be calibrated. Move the MEAS cursor around to verify that the nominal and expansion diameters are displayed correctly.

NOTE

The profile calibration is automatically stored to disk and restored upon booting the software

14.2 Upper (New Roll) and Lower (Old Roll) Expansion Measurements

14.2.1 Run in the tube to be profiled and set the locations for TEH and TSH. This will plot the profile between these two points.

14.2.2 Due to varying tube properties and inner diameters, it may be necessary to normalize the data the plot in a nominal area of the tube. To do this move the MEAS cursor to a nominal area and press the NOMINAL button shifted. This will cause the profile to be redrawn.

14.2.3 Center the MEAS cursor in the lower expansion (i.e. old roll; Figure 39) near TEH and press the LOWER EXP button to enter the diameter into the final report.

14.2.4 Center the MEAS cursor in the upper expansion (i.e. new roll; Figure 40) and press the UPPER EXP button to enter the diameter into the final report. Figure 41 shows a typical report entry.

INDUSTRY		INDIAN POINT 2
	1965	Contract- design code used
	1966	
	1967	
Conn Yankee critical	1968	
	1969	
	1970	
	1971	
Surry 1, TP 3 critical	1972	
Surry 2 critical	1973	May 22- critical; T_{hot} 593 F: Phosphate chemistry, J-nozzles installed
	1974	Aug. 1 - commercial operation
First tubes plugged for denting	1975	Apr - AVT Jun - Reduced T_{hot} 581 F
SG users group formed	1976	1R
EPRI SGOG formed	1977	Feb- Reduced T_{hot} 576 F
	1978	2R- TSP sample removed Sludge lancing started Boric acid addition started
	1979	3R - 1st tubes plugged; Profilometry started
Sep.- Surry 2 replaced; T_{hot} 605 F	1980	
	1981	
IP 3 girth weld leak	1982	5R - FWH, MSR tubing replaced
	1983	
	1984	6R - First sludge pile pitting detected
	1985	Replacement SGs contracted
	1986	Jan.-25% plugging limit approved
	1987	8R- Girth weld cracking
	1988	Jan.- Replacement SGs on site Jan-SG 23 dryout during heatup after RFO; first AVB wear recorded
	1989	9R - W mechanical plugs show SCC
	1990	10Mid Increased T_{hot} to 586 F

Table 1
Steam Generator Chronology Highlights

INDUSTRY		INDIAN POINT 2
	1965	Contract- design code used
	1966	
	1967	
Conn Yankee critical	1968	
	1969	
	1970	
	1971	
Surry 1, TP 3 critical	1972	
Surry 2 critical	1973	May 22- critical; T_{hot} 593 F: Phosphate chemistry, J-nozzles installed
	1974	Aug. 1 - commercial operation
First tubes plugged for denting	1975	Apr - AVT Jun - Reduced T_{hot} 581 F
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EPRI SGOG formed	1977	Feb- Reduced T_{hot} 576 F
	1978	2R- TSP sample removed Sludge lancing started Boric acid addition started
	1979	3R - 1st tubes plugged; Profilometry started
Sep.- Surry 2 replaced; T_{hot} 605 F	1980	
	1981	
IP 3 girth weld leak	1982	5R - FWH, MSR tubing replaced
	1983	
	1984	6R - First sludge pile pitting detected
	1985	Replacement SGs contracted
	1986	Jan.-25% plugging limit approved
	1987	8R- Girth weld cracking
	1988	Jan.- Replacement SGs on site Jan-SG 23 dryout during heatup after RFO; first AVB wear recorded
	1989	9R - W plugs show SCC
	1990	10Mid Increased T_{hot} to 586 F

Table 1
Steam Generator Chronology Highlights

Industry		Indian Point 2
	1991	10R- Full stretch T_{hot} 589 F; 3083 MWT Major girth weld repair 1/3 condenser replaced
	1992	
	1993	11R First roll transition PWSCC First plugging for AVB wear
	1994	
	1995	12R - Decon, Nozzle dams installed, Ti condenser replacement completed Dec- ETA started
Last domestic W mod 44(Pt. Beach 2) replaced	1996	
	1997	13R

Table 1 (Continued)
Steam Generator Chronology Highlights

	SG 21	SG 22	SG 23	SG 24	TOTAL
Total, as designed	3,260	3,260	3,260	3,260	13,040
Plugged Pre-service	93	95	94	102	384
In service	186	249	162	171	768
Total	279	344	256	273	1,152
In service, %	5.7	7.6	5.0	5.3	5.9
Total, %	8.6	10.6	7.9	8.4	8.8
Remaining in service	2,981	2,916	3,004	2,987	11,888

Table 2
Status of Steam Generator Tubes

40% and Greater Wall Loss Indications (pitted in sludge pile region)

	1984	1986	1987	1989	1991	1993	1995
Steam Generator 21	38	18	17	37	9	13	8
Steam Generator 22	29	38	16	24	10	12	2
Steam Generator 23	2	3	28	15	4	16	0
Steam Generator 24	15	17	29	0	4	15	2
Total	84	76	90	76	27	56	12

Restricted Tubes (dented)

	1984	1986	1987	1989	1991	1993	1995
Steam Generator 21	10	10	3	10	0	0	0
Steam Generator 22	38	8	0	13	1	0	0
Steam Generator 23	9	10	11	30	0	0	0
Steam Generator 24	27	5	5	2	0	0	1
Total	84	33	19	55	1	0	1

Other Reasons

	1984	1986	1987	1989	1991	1993	1995
Steam Generator 21	0	0	2	1	1	0	1
Steam Generator 22	0	3	0	0	10	2	4
Steam Generator 23	0	0	0	1	1	0	1
Steam Generator 24	0	0	0	11	0	1	2
Total	0	3	2	13	12	3	8

Cumulative Plugging Totals

	1984	1986	1987	1989	1991	1993	1995
Steam Generator 21	149	177	199	247	257	270	279
Steam Generator 22	200	249	265	303	324	338	344
Steam Generator 23	136	149	188	234	239	255	256
Steam Generator 24	179	201	235	248	252	268	273
Total	666	778	889	1032	1072	1131	1152

TABLE 3
Steam Generator Tubes Plugged since 1984

NO.	DATE	SG	Row -Col	LOC	CAUSE OF FAILURE	REPAIR
1	3/75 (cy. 1)	22	45- 54	TSH	@AVT changeover circ. crack?	Expl. plug
2 F	11/76 (cy. 2)	24	44- 55,56	6C	unknown	Expl. plugs
3	8/79 (3 RFO)	22	2- 17,19,20, 31,32,33 28- 82 33- 18 34- 6,17 44- 40	???	Leak in group of 11 tubes Not inspected	Expl. plugs
4	4/81 (4 RFO)	23	2- 46,47	2C	Not inspected	W Mech. plugs
5 F	8/81 (cy. 5)	23	2- 62	3C	After startup hydro	W Mech. plug
6 F	2/11/84 (cy. 6)	22	32- 15	TTSH	Pinhole-after trip	W Mech. plug
7	2/86 (7 RFO)	23	20- 37	4H	On hydro-?	W Mech. plug
8 F	7/7/88 (cy. 9) (17 days o/s) 7/17/88	22	45- 52,53, 54 44- 54 19- 54	H plug H plug H plug TTSH?	3/75 exp. plug leak same- TTS fisheye hole same- repaired 3x EC-No Defect	Welded thimble plugs Welded thimble plug Welded thimble plug W Mech. plug
9	3/22/94	24	44- 36	H plug	1/76 exp. plug; operated @ 90% power; located leak during 1995 RFO	W A690 Mech plug
10	3/95 (12 RFO)	22	4-92	3H-.46	On Hydro- OD single axial @lower edge@ severe dent	W A690 mech. plug

NOTE: F- forced outage

Table 4
Steam Generator Tube leaks

DIFFERENTIAL CHANNELS

	Channel 1	Channel 3	Channel 5	Channel 7	Mix 1
Span	100% TWH @ 1/2 Screen height.	Same as Channel 1	Same as Channel 1	TSP at Approx. 1/2 Screen height	Same as Channel 1
Phase		Same as Channel 1	Same as Channel 1	TSP signal vertical w/initial excursion down & left	Probe mot. horiz. flaws down first
Curve	Phase - depth 100, 60, 20% use actual std. %	Same as Channel 1	Same as Channel 1	None Required	Same as Channel 1
Volts	Set Channel 1 20% FBH to 4.0 volts, normalize to all channels.	Same as Channel 1	Same as Channel 1	Same as Channel 1	Set (4) 20% FBH's to 2.75 volts

ABSOLUTE CHANNELS

	Channel 2	Channel 4	Channel 6	Channel 8	Mix 2
Span	60% TWH @ 1/2 Screen height	Same as Channel 2	Same as Channel 2	TSP at approx. 1/2 Screen height	60% TWH @ 1/2 screen height
Phase	Probe mot. horiz. flaws going up	Same as Channel 2	Same as Channel 2	TSP signal initial excursion down & left	Probe mot. horiz. flaws going up
Curve	None required	None required	Phase - depth 100, 60, 20% use actual std.%	None required	Volts - depth 40%, 20%, 0% AVB actuals, use vert. max
Volts	Normalize from Channel 1	Same as Channel 2	Same as Channel 2	Same as Channel 2	Set 40% AVB wear to 5 volts

TABLE 5
SET-UP FOR BOBBIN PROBE COILS

Coil Type	Operating Frequency Range	Prime(Reporting) Frequency	Volts Setting	Phase Setting	Minimum Span
115 Mil Pancake	100-400 kHz	300 kHz	20 volts - 100% Axial	Probe Motion Horiz.	40% Full Screen on the OD Axial
Axial Sensitive	100-400 kHz	300 kHz	20 volts - 100% Axial	Probe Motion Horiz.	40% Full Screen on the OD Axial
Circ. Sensitive	100-400 kHz	300 kHz	20 volts - 100% Circ.	Probe Motion Horiz.	40% Full Screen on the OD Circ.

TABLE 6
SET-UP FOR ROTATING PROBE COILS

Coil Type	Operating Frequency Range	Prime (Reporting) Frequency	Volts Setting	Phase Setting	Minimum Span Setting
.080" midrange	100-400 kHz	300 kHz	20 volts - 100% axial notch @ 300 kHz*	Probe motion horizontal 100% axial notch 18-22°	40% OD axial notch 50% screen ht.
.100" midrange	100-400 kHz	300 kHz	20 volts - 100% axial notch @ 300 kHz*	Probe motion horizontal 100% axial notch 18-22°	40% OD axial notch 50% screen ht.
.115" midrange	100-300 kHz	300 kHz	20 volts - 100% axial notch @ 300 kHz*	Probe motion horizontal 100% axial notch 18-22°	40% OD axial notch 50% screen ht.
.080" hi-frequency shielded	300-600 kHz	600 kHz	20 volts - 100% axial notch @ 600 kHz*	Probe motion horizontal**	20% ID axial notch 50% screen ht.
Plus-Point Axial flaws vertical	100-300 kHz	300 kHz	20 volts - 100% axial notch @ 300 kHz*	Probe motion horizonta 100% axial notch 30-35°	40% OD axial notch 50% screen ht.
Plus-Point Circ flaws vertical	100-300 kHz	300 kHz	20 volts - 100% circ notch @ 300 kHz*	Probe motion horizontal 100% circ notch 30-35°	40% OD circ notch 50% screen ht.
Axial Wound	100-400 kHz	300 kHz	20 volts - 100% circ notch @ 300 kHz*	Probe motion horizontal 100% circ notch 18-22°	40% OD circ notch 50% screen ht.
Circumferentially Wound**	100-400 kHz	300 kHz	20 volts - 100% axial notch @ 300 kHz*	Probe motion horizontal 100% axial notch 18-22°	40% OD axial notch 50% screen ht.

*Store this voltage setting to all other frequencies for this coil
**Rotate the 20% ID axial/circumferential notch (if available) to 4-5°. If the 20% ID notch is not available, set the probe wobble horizontal

Table 7
Set-Up For +Point

Line	SG Row Col Volts Deg	% Ch	Location		Beg End
1	*Start Data Set Report Header*				
2	ANSER Rev. 8.1		Start REEL 2	ABC 2A	PRI
3		Probe	EB560LLMC		
4		REEL	2		
5			Spence WJ III		01/31/9
6			Torrence JN II		6
7		STD	Z1565		Operato
8		CAL	0030		r
9					
10	*Operator or Analyst Change Header*				04/11/9
11		Probe	Header		5
12		REEL	EB56OLLMC		
13			2		
14			Bowser GC III		
15			Daniels JN II		
16	*End Data Set Header*				
17		Cal	0323		01/31/9
18			End REEL 2		6
19					
20	*Start P/S Resolutions Header*				
21			Header		04/11/9
22		Probe	EB56OLLMC		5
23		REEL	2		
24			Turley GM III		
25			Lemieux MA II		
26			Start P/S		
27			Resolutions		
28	*End P/S Resolutions Header*				
29					01/31/9
30					6
31	*Note Separate Header Needed for the		End P/S		Operato
32	Tubes		Resolutions		r
33	Acquired for Each Operator on Data				
34	Set*				

Figure 1
Standard Westinghouse Report Headers

Row	Column	Location		PRI	SEC	Final	Res.	Res.	Date
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

Resolution

Justification
1 ______
2 ______
3 ______
4 ______
5 ______
6 ______
7 ______
8 ______
9 ______

Lead Analyst

Figure 2
Resolution Disposition Sheet

```
***************** PRIMARY VS. SECONDARY   Discrepancies, ABC - IA, Tape  38    *********

..................................................................................
 Row Col            Ind   Loc     Inch1     Inch2  Volt Bgn End |           Remark
..................................................................................
            OK NO                                               |
P  13  38 |__|__| <NDD>            .00                  TEH TEC | Tube not in Secondary rept.
..................................................................................
            OK NO                                               |
S  21  38 |__|__|  NDD                                  TEH TEC | NDD discrepancy.
P  21  38 |__|__| <UDA>   6H      -.06             .46  TEH TEC | NDD discrepancy.
..................................................................................
            OK NO                                               |
S  22  38  __ __  <NDD>                                 TEH TEC | NDD discrepancy.
P  22  38 |__|__|   PI    1H       .00             .42  TEH TEC | NDD discrepancy.
..................................................................................
            OK NO                                               |
P  40  38 |__|__|   PI    5H       .00             .58  TEH TEC | Unmatched Primary call.
S  40  38 |__|__|   PI    7H       .00            1.15  TEH TEC | Unmatched Secondary call.
..................................................................................
            OK NO                                               |
S  41  38 |__|__|  NDD                                  TEH TEC | NDD discrepancy.
P  41  38 |__|__| < PI>   7H      -.03             .70  TEH TEC | NDD discrepancy.
..................................................................................
            OK NO                                               |
P  21  39  __'__| <NDD>                                 TEH TEC | NDD discrepancy.
S  21  39  __ __    PI    6H       .00             .38  TEH TEC | NDD discrepancy.
..................................................................................
            OK NO                                               |
P  32  39 |__|__  <NDD>                                 TEH TEC | End-test discrepancy.
S  32  39 |__|__|  NDD                                  TEH TSC | End-test discrepancy.
..................................................................................
 Row Col            Ind   Loc     Inch1     Inch2  Volt Bgn End |           Remark
..................................................................................
                              Page  1 of  1

Calibration standard serial number.
    Pri:                          STD     ASV00192
    Sec:                          STD     ASV00192

Unmatched Primary header record(s):
    Pri:                          PROBE   EL720LLMC
    Pri:                                  PARRIS TB       II      OPERATOR
    Pri:                          CAL     2151                    03/30/95
    Sec:                          PROBE   EL720LLMC
    Sec:                                  PARRIS TB       II      OPERATOR

    .................... End of Compare Printout ...........................
```

Figure 3
Sample Discrepancy/Compare Sheet

REPORT 1 FOR FILE SCP_1_C_1_015_PRI_ANSER_ec073_3A

STORE RESTORE HEADERS RESO PRINT UTIL

PRI RELOAD QA REPORT

10 1	SG	ROW	COL	VOLTS	DEG	%	CH	LOCATION	BEG	END
1	ANSER 8.1 Rev 64				11/04/96 14			START REEL 125 ABC 15A	RES	
2						PROBE		B720MPRC3C52PH		
3						REEL		125		
4								SPENCE WJ III	04/04/95	
5								PARRIS JR II	OPERATOR	
6						STD		MGT04894		
7						CAL		0425	04/04/95	
8	11	37	28			NDD			6H	6H
9	NO	39	36	0.86	91	COI	4	1H +0.26	1H	1H
10	NO	39	36	100	115	DIM	OD	1H +311.0	1H	1H
11	NO	40	38	1.31	26	MAI	4	4H +0.07	4H	4H
12	NO	40	38	100	42	DIM	OD	4H +563.0	4H	4H
13	OK	14	92	1.16	76	MAI	4	1H +0.00	1H	1H
14	OK	14	92	100	42	DIM	OD	1H +568.0	1H	1H
15						CAL		0451	????	
16								END REEL 125		
17								HEADER		
18						PROBE		B720MPRC3C52PH		
19						REEL		125		
20								OBAZENU DJ III	03/21/97	
21								PARRIS JR II	OPERATOR	
22								START P/S RESOLUTIONS		
23	11	39	36	0.57	122	MAI	4	1H -0.10	1H	1H
24	11	39	36	100	88	DIM	OD	1H +123.0	1H	1H
25	3D	40	38	1.31	255	SAI	5	4H +0.00	4H	4H
26	3D	40	38	100	35	DIM	OD	4H +120.0	4H	4H
27								HEADER		
28						PROBE		B720MPRC3C52PH		
29						REEL		125		
30								STOCK WF III	03/21/97	
31								PARRIS JR II	OPERATOR	
32								3'D PARTY RESOLUTIONS		
33	11	40	38	1.31	255	MAI	5	4H +0.00	4H	4H
34	11	40	38	100	136	DIM	OD	4H +120.0	4H	4H
35								END 3'DPARTY RESOLUTIONS		

Figure 4
Sample Final Report

Discrepancy Resolution Logic

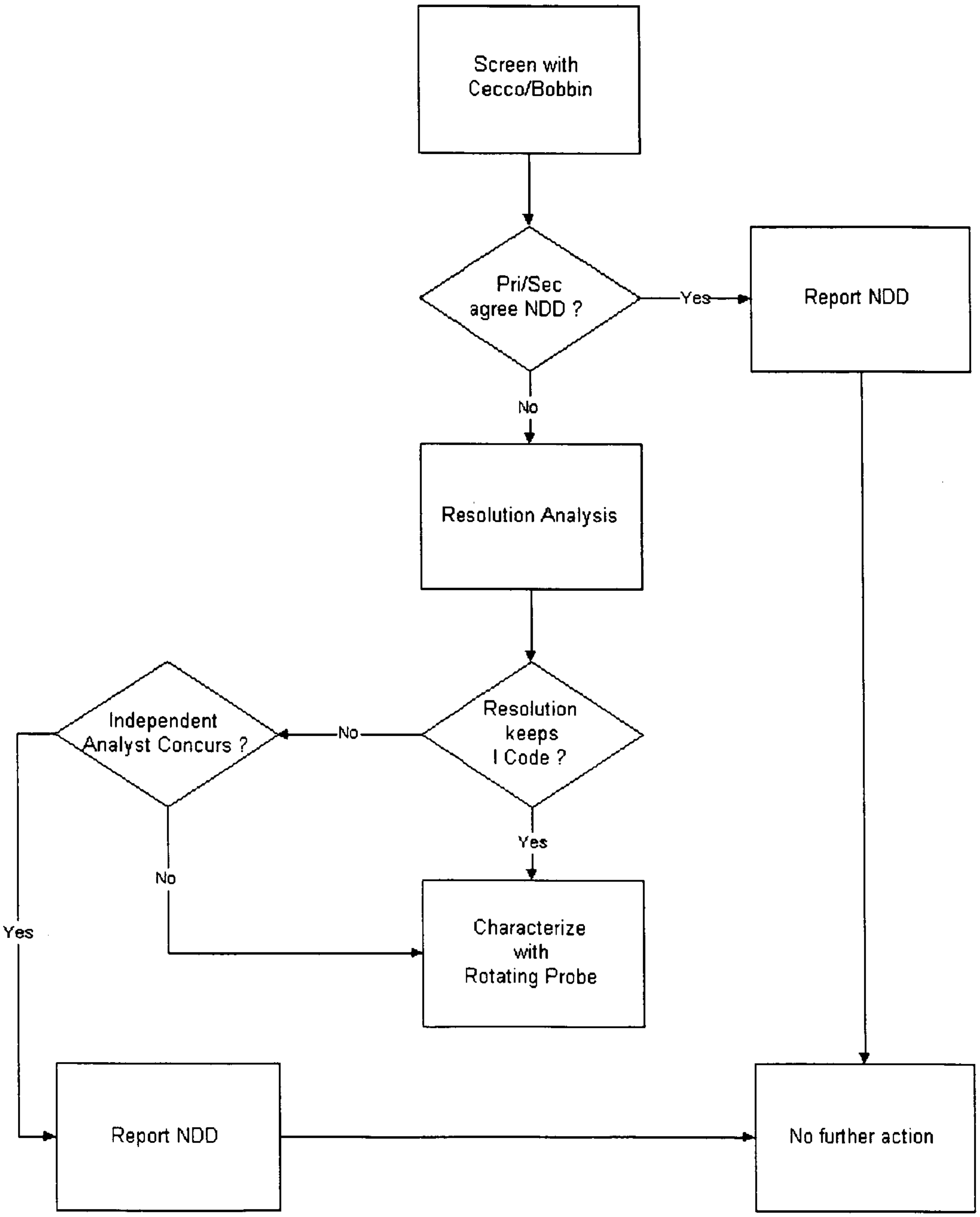


Figure 5

Typical I-Code Disposition Flowchart

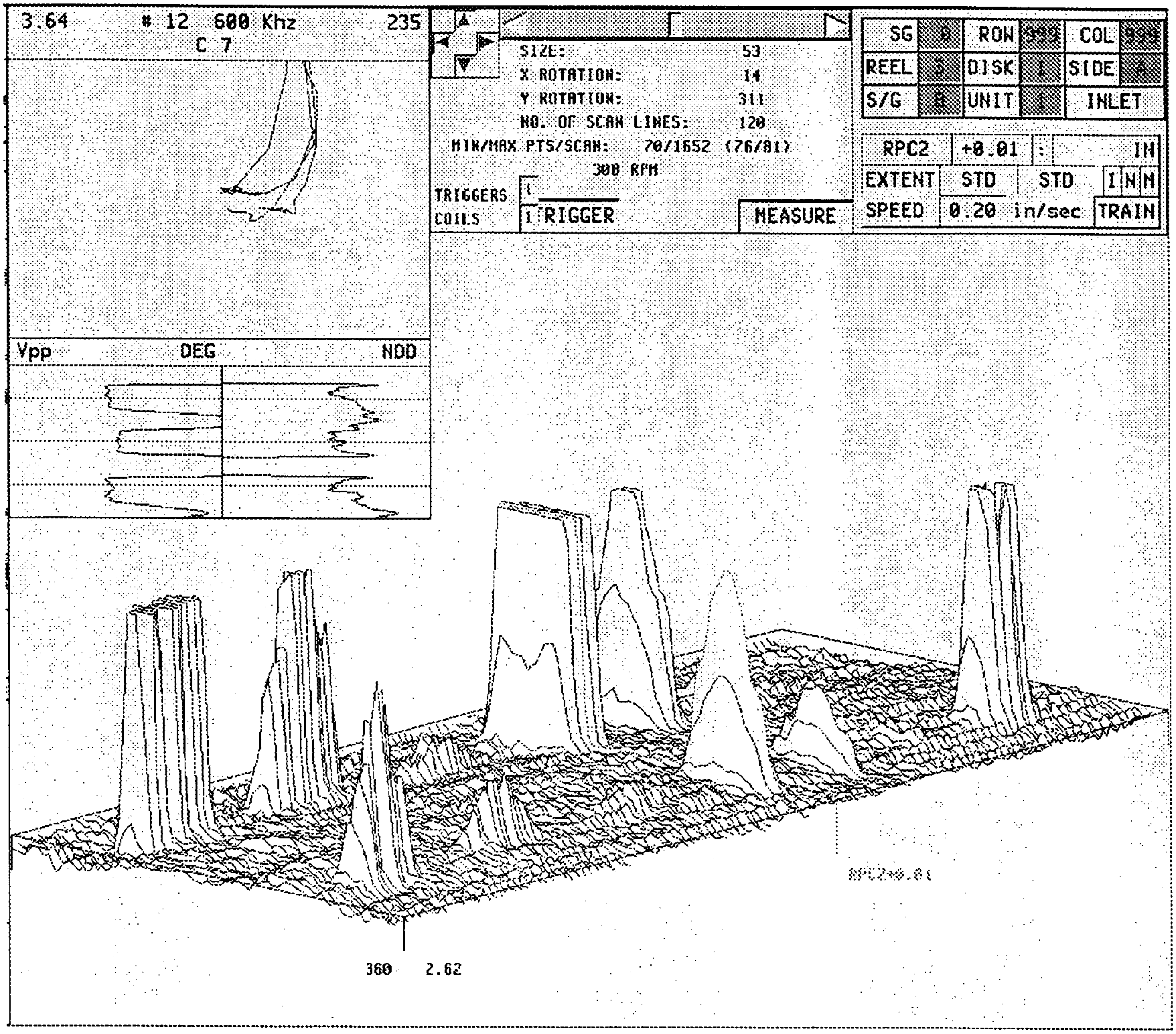


Figure 6

EPRI Recommended Standard Defects for +-Point Coils

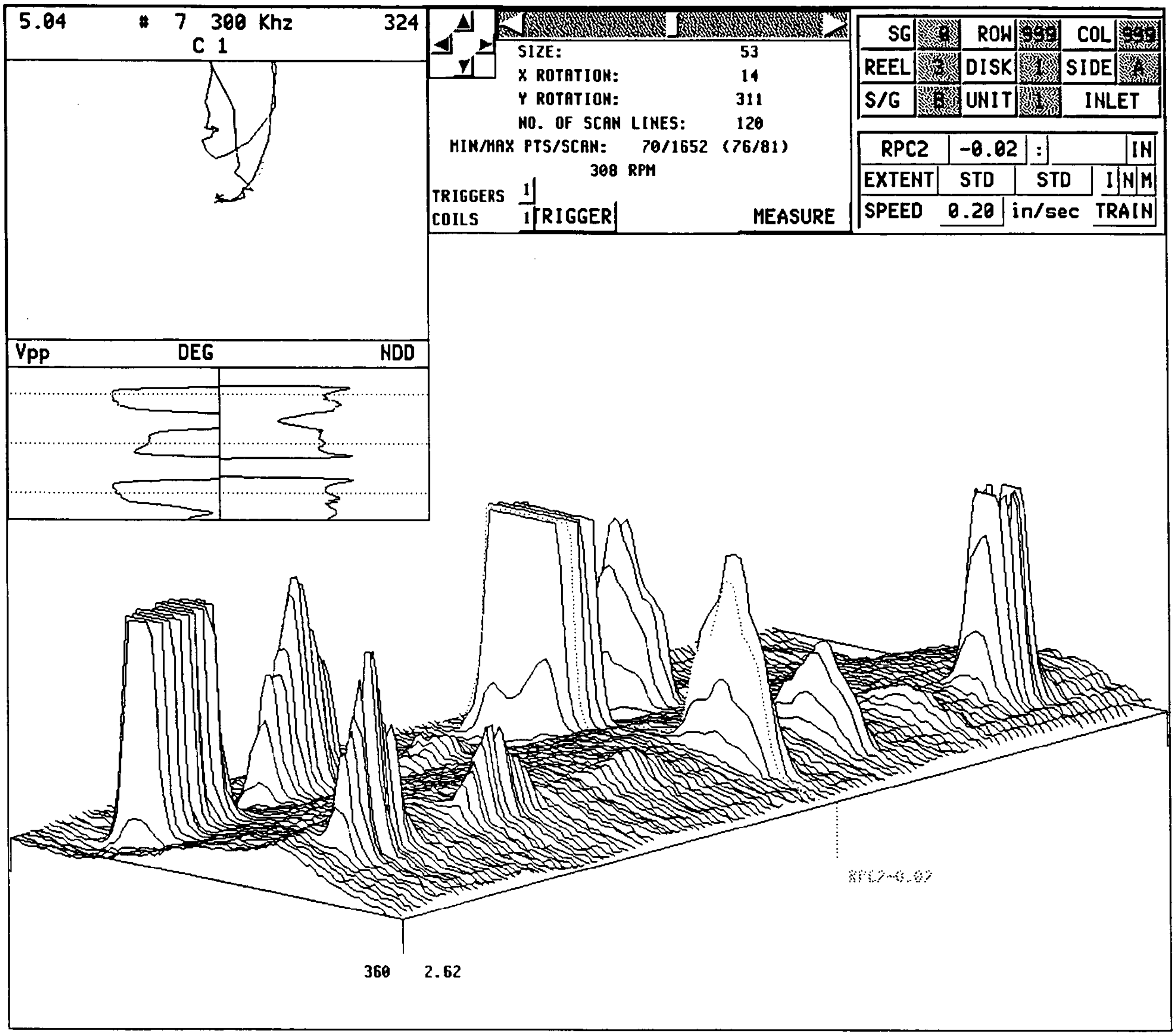


Figure 7
EPRI Recommended Standard Defects for +-Point Coils

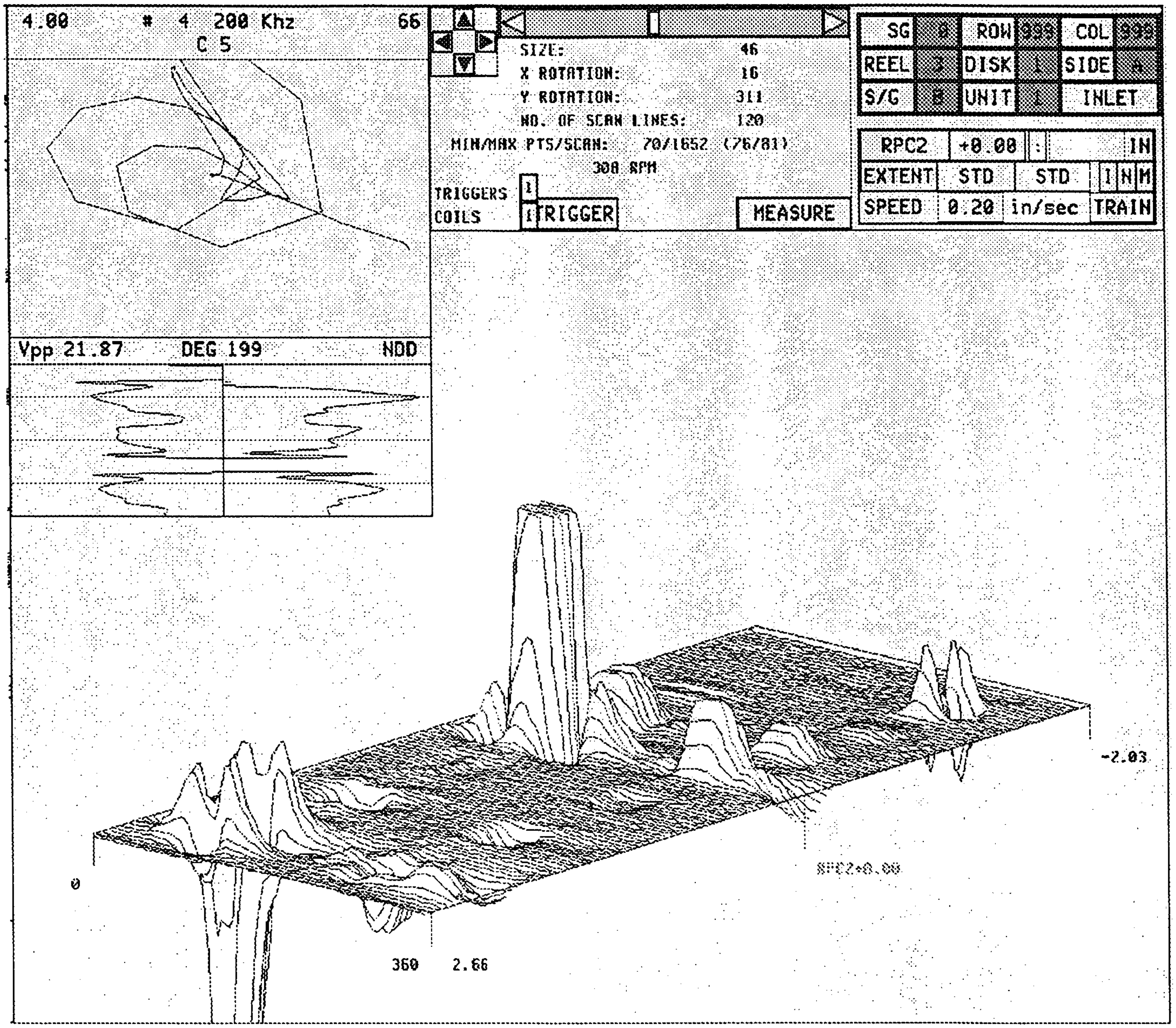


Figure 8

EPRI Recommended Standard Defects for +-Point Coils

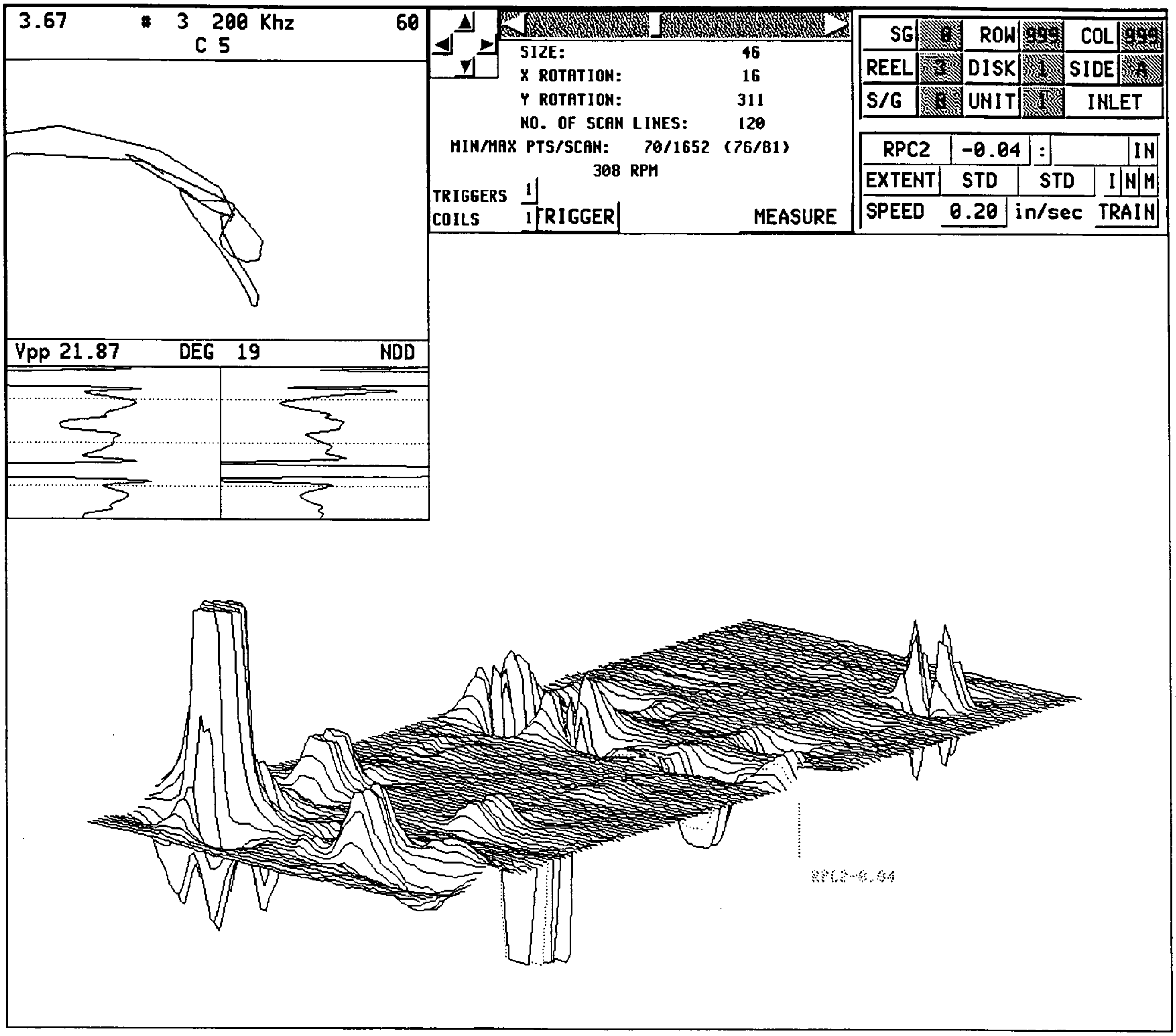


Figure 9

EPRI Recommended Standard Defects for +-Point Coils

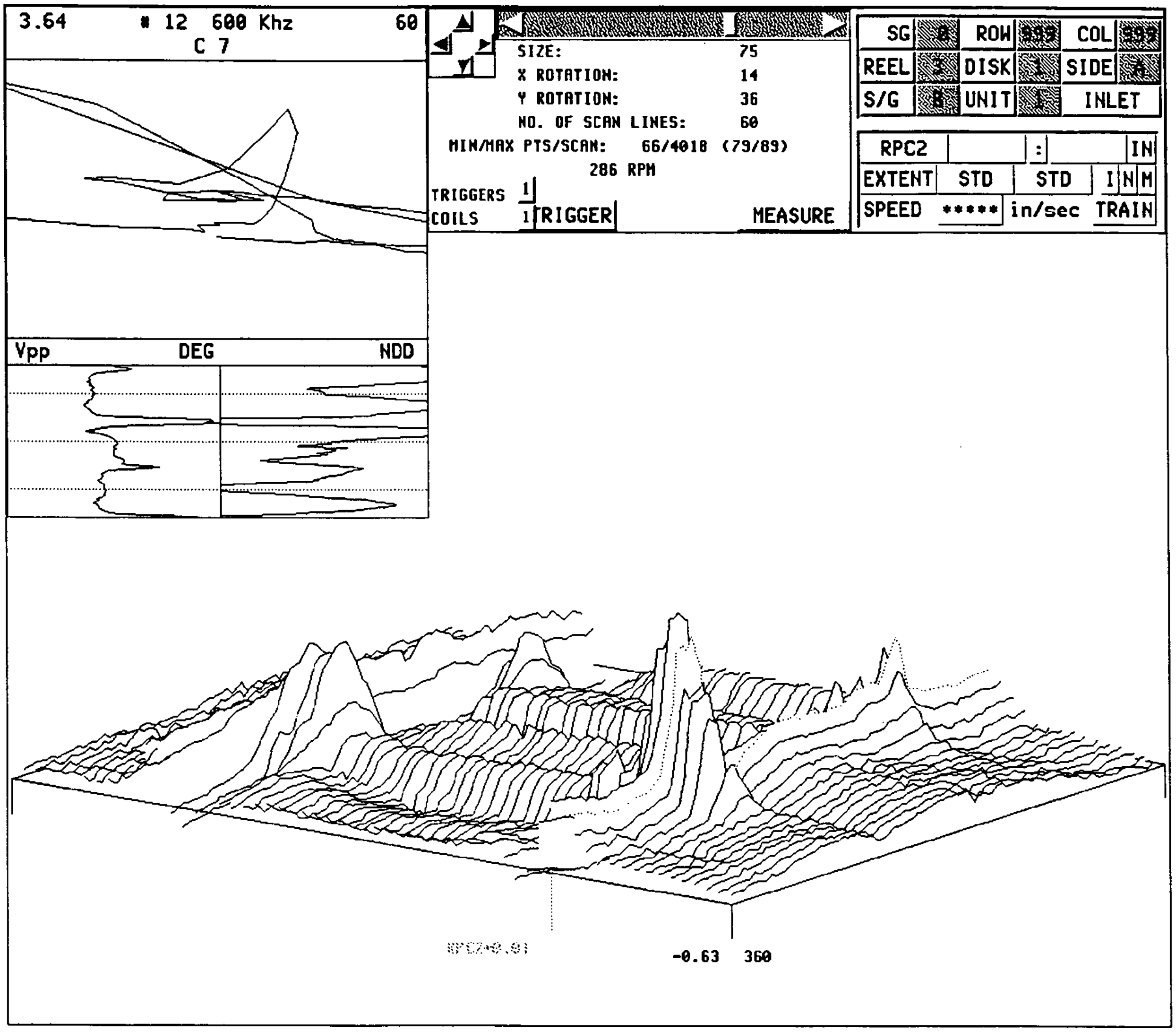


Figure 10
EPRI Recommended Standard Defects for +-Point Coils

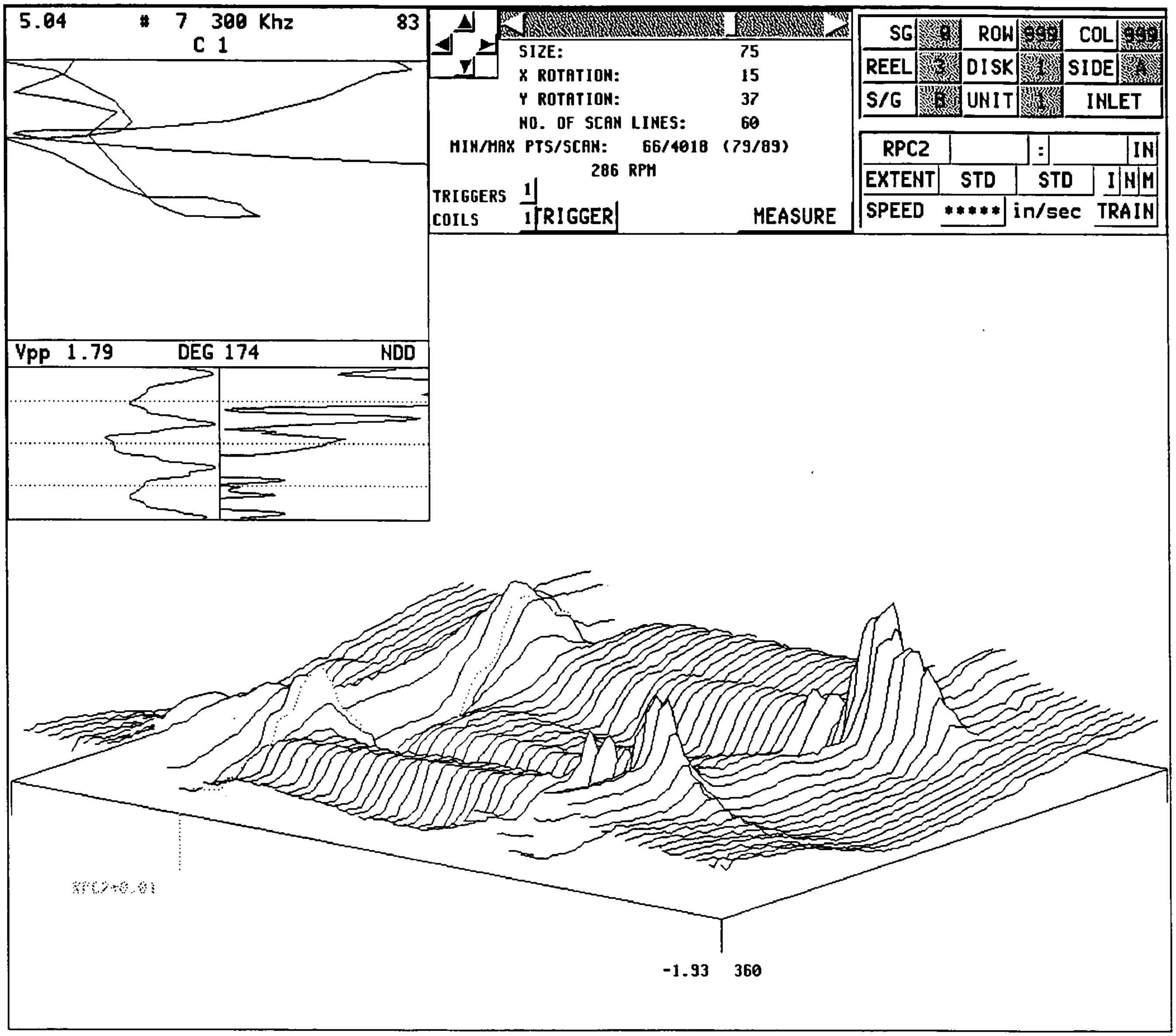


Figure 11
EPRI Recommended Standard Defects for +-Point Coils

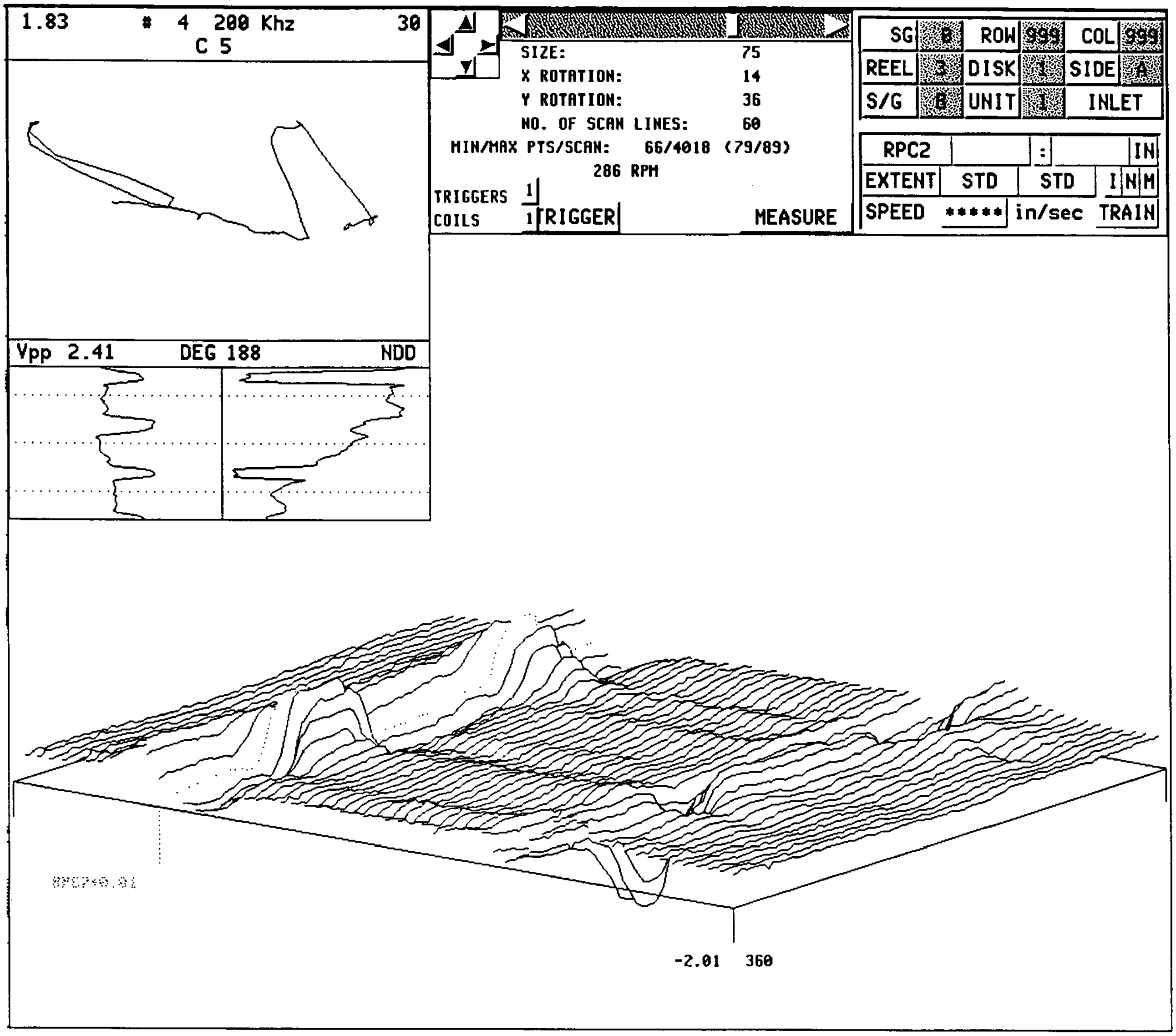


Figure 12
EPRI Recommended Standard Defects for +-Point Coils

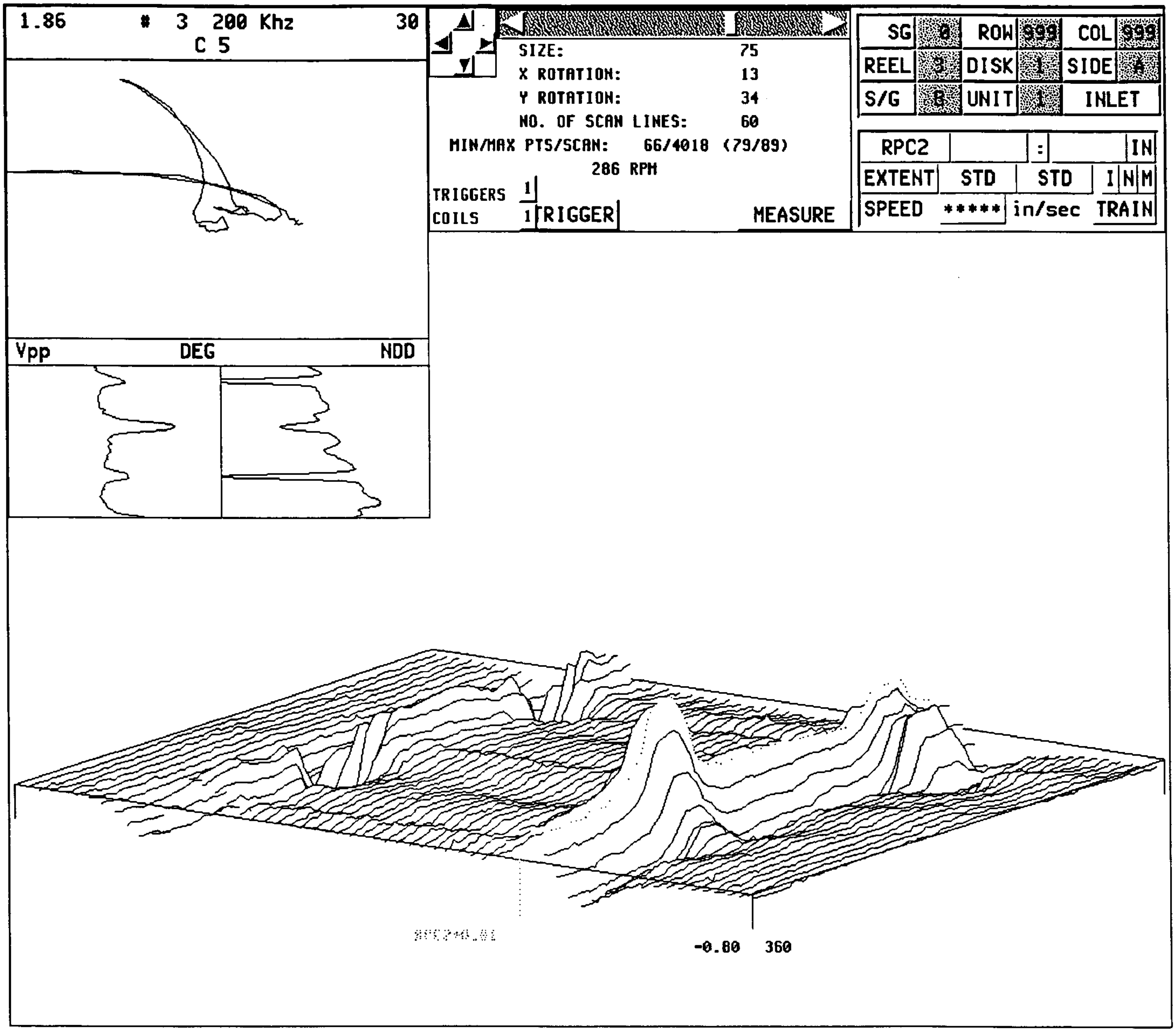


Figure 13
EPRI Recommended Standard Defects for +-Point Coils

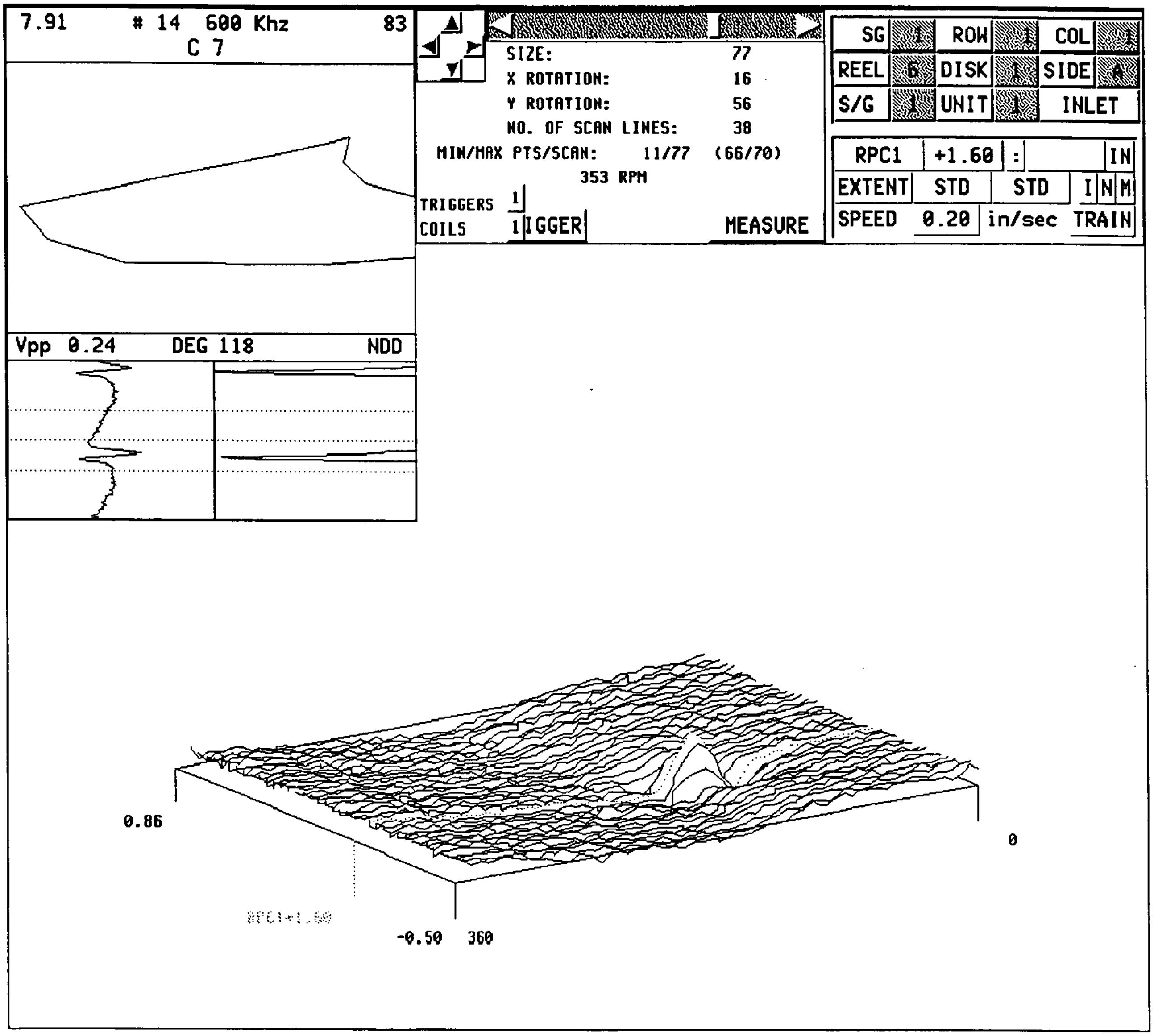


Figure 14
Effects Of Lift-Off on +-Point Coils

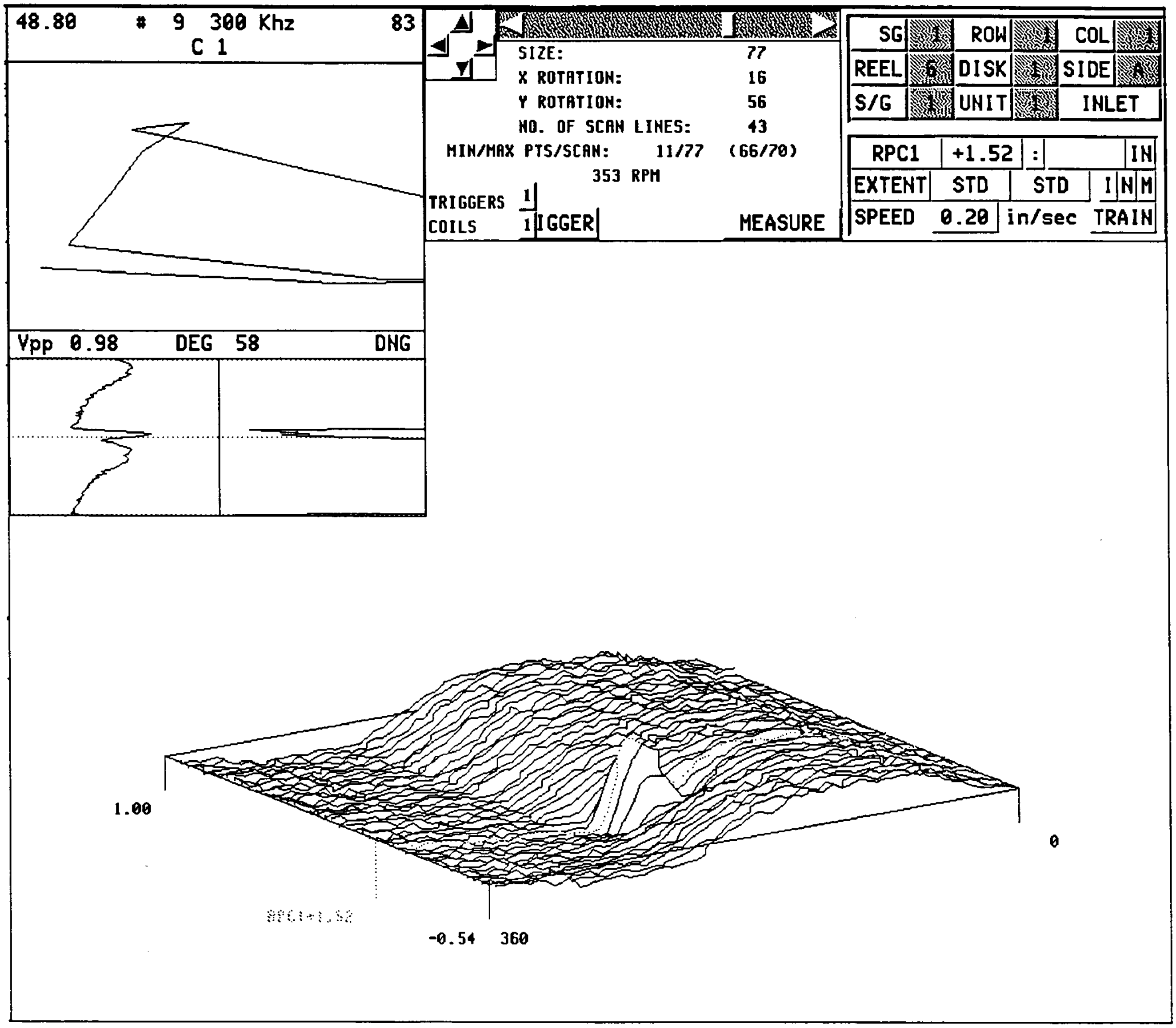


Figure 15
Effects Of Lift-Off on +-Point Coils

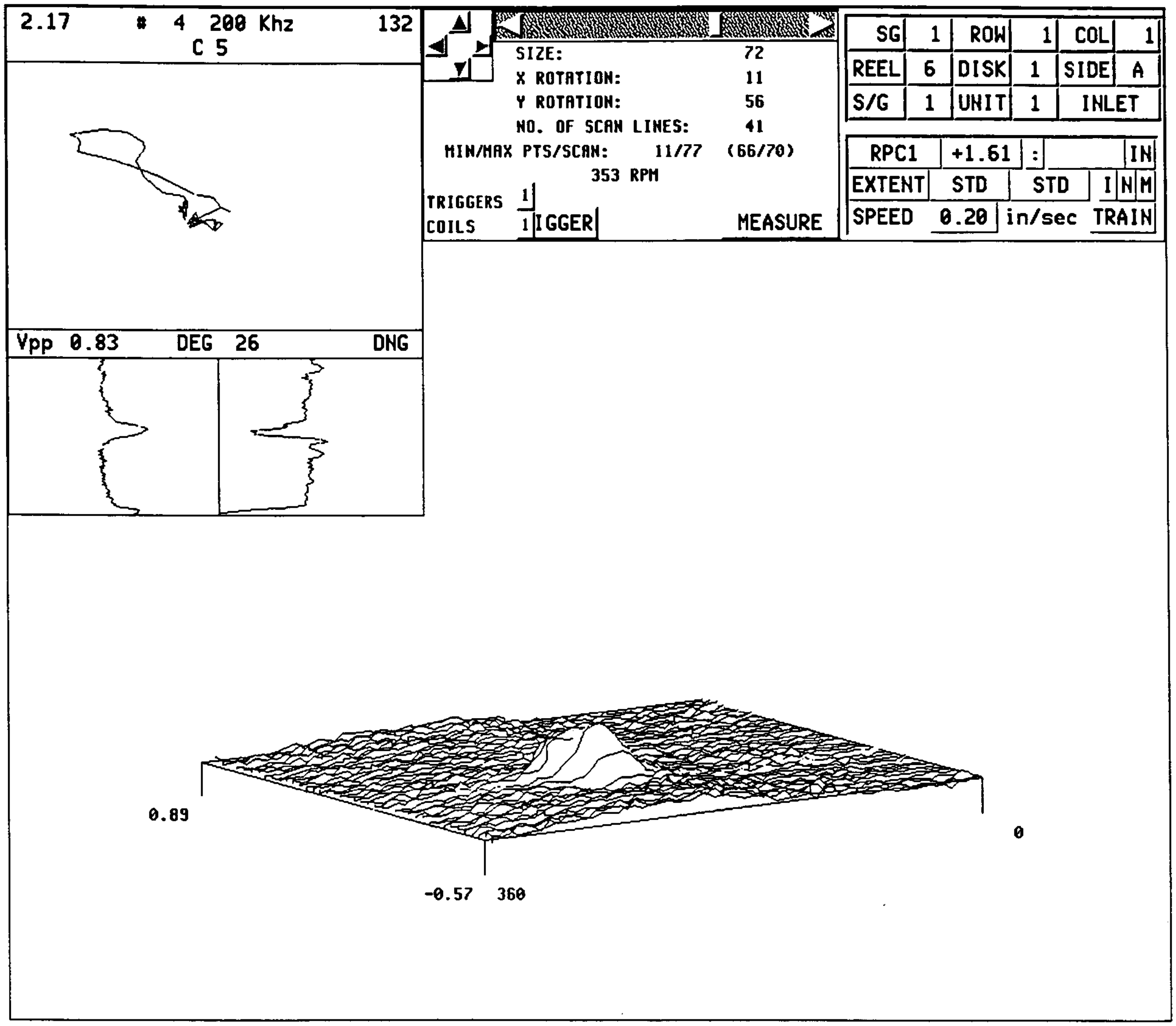


Figure 16
Effects Of Lift-Off on +-Point Coils

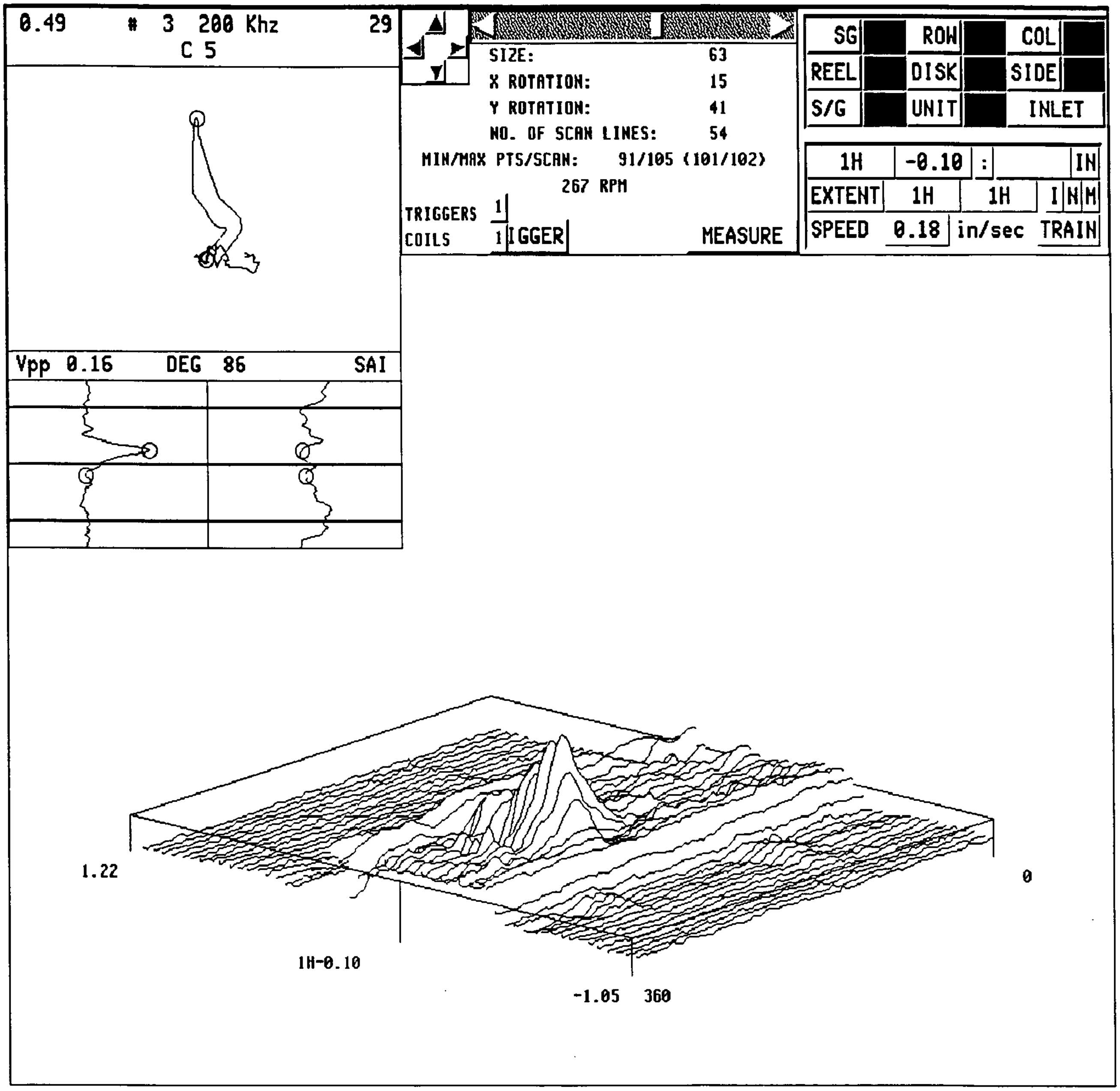


Figure 17A
Response of Pancake Coils for Typical Defect

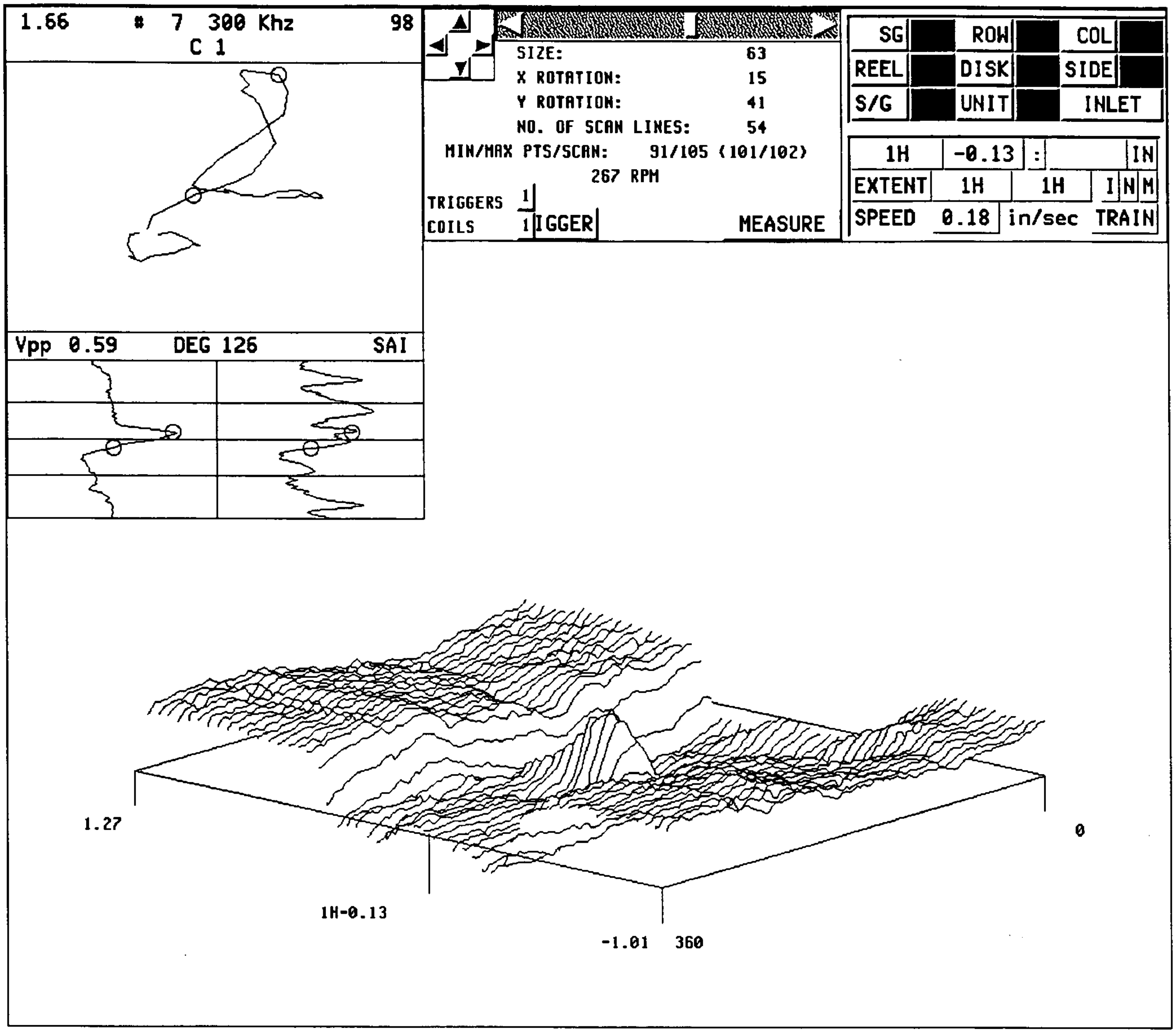


Figure 17B
Response of +-Point Coils for Typical Defect

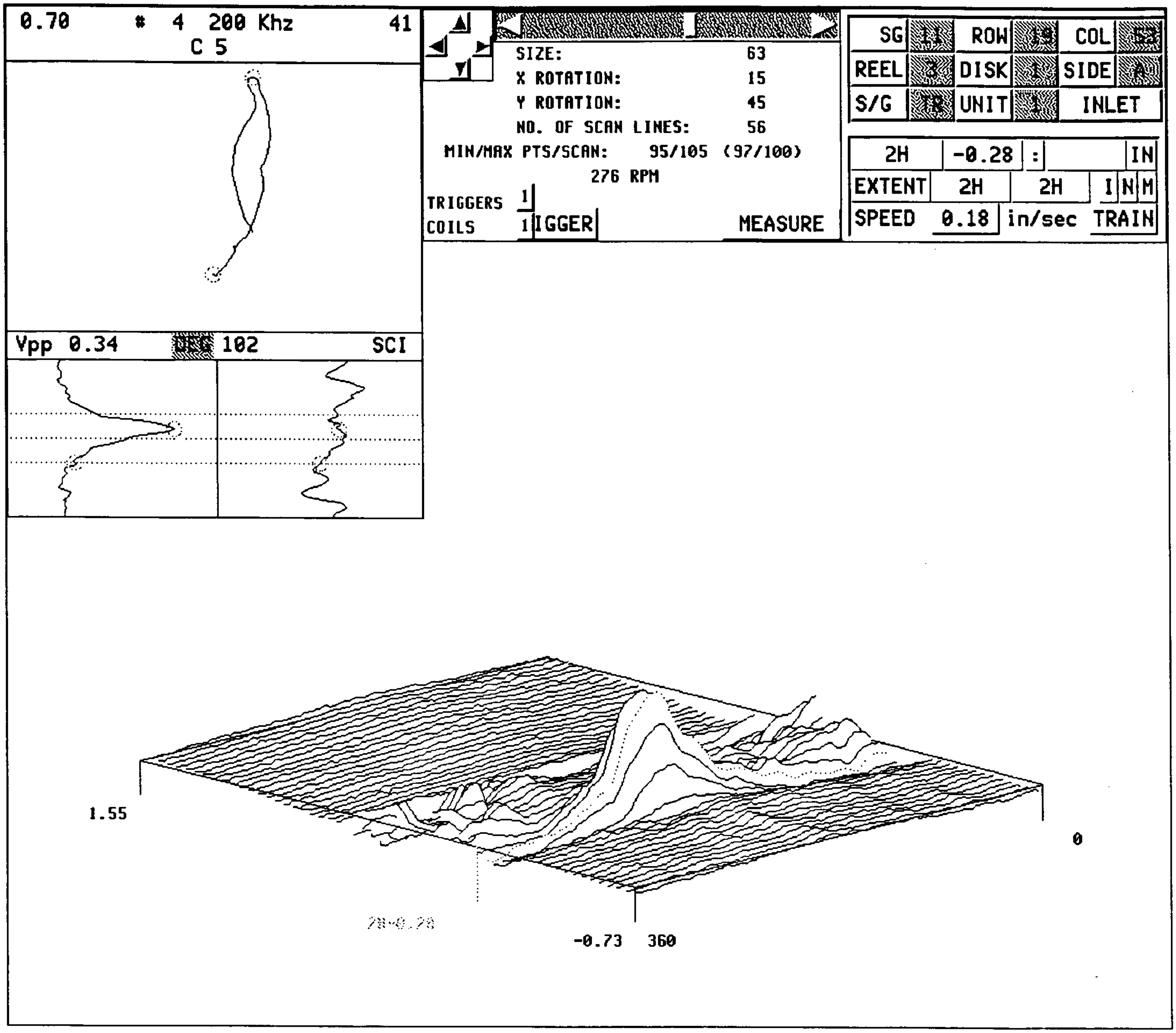


Figure 18A
Response of Pancake Coils for Typical Defect

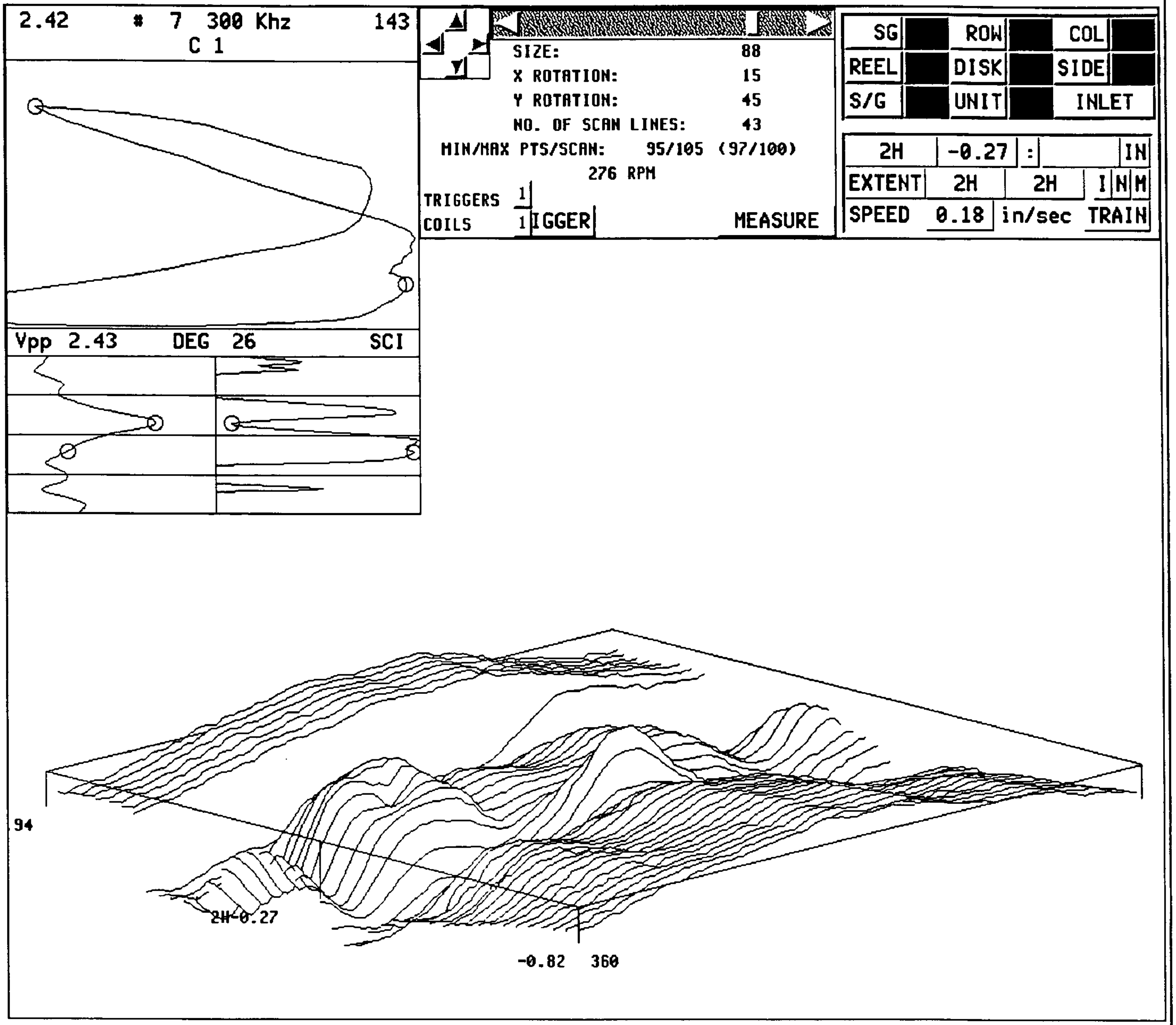


Figure 18B
Response of +-Point Coils for Typical Defects

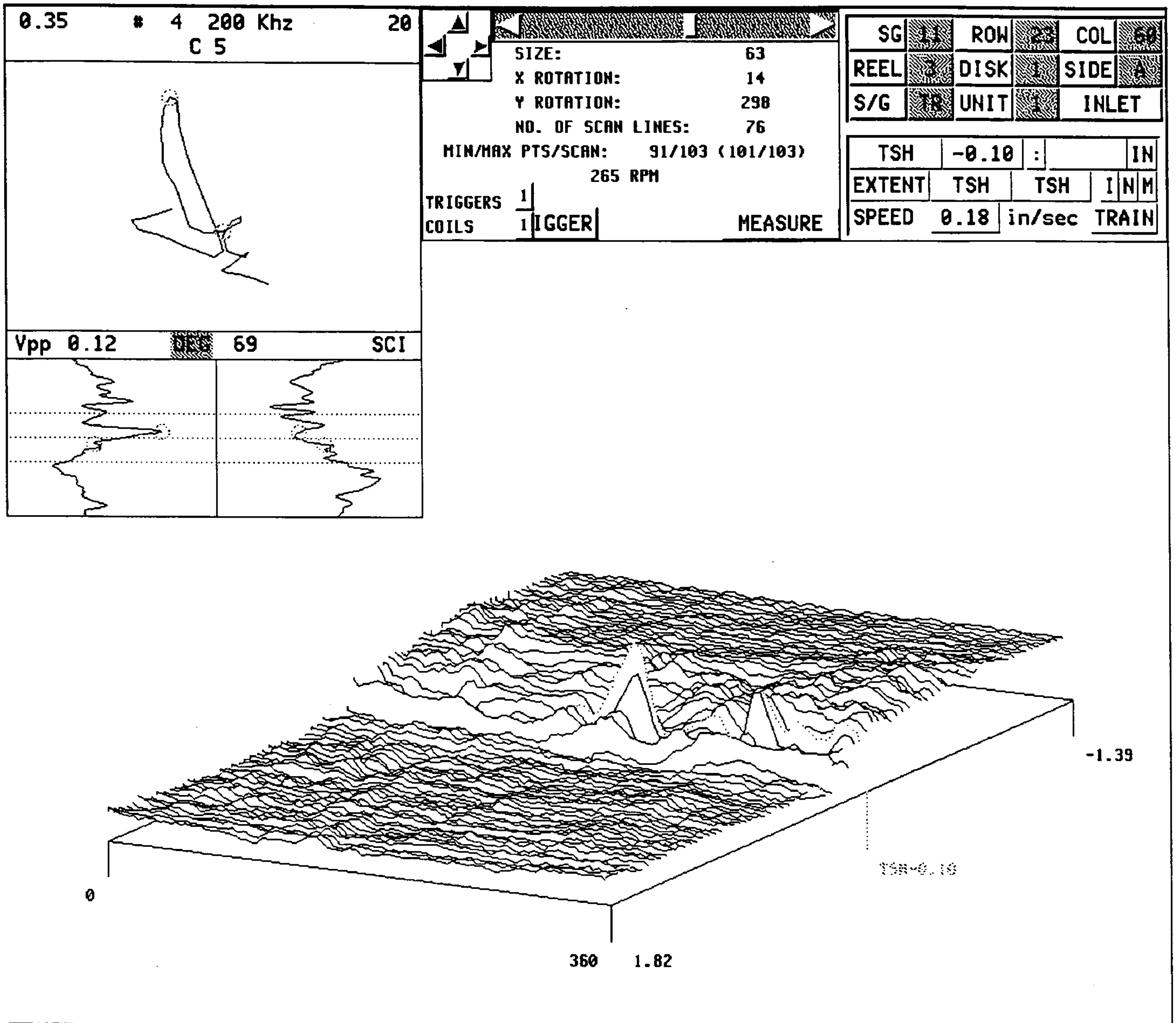


Figure 19A
Response of Pancake Coils for Typical Defect

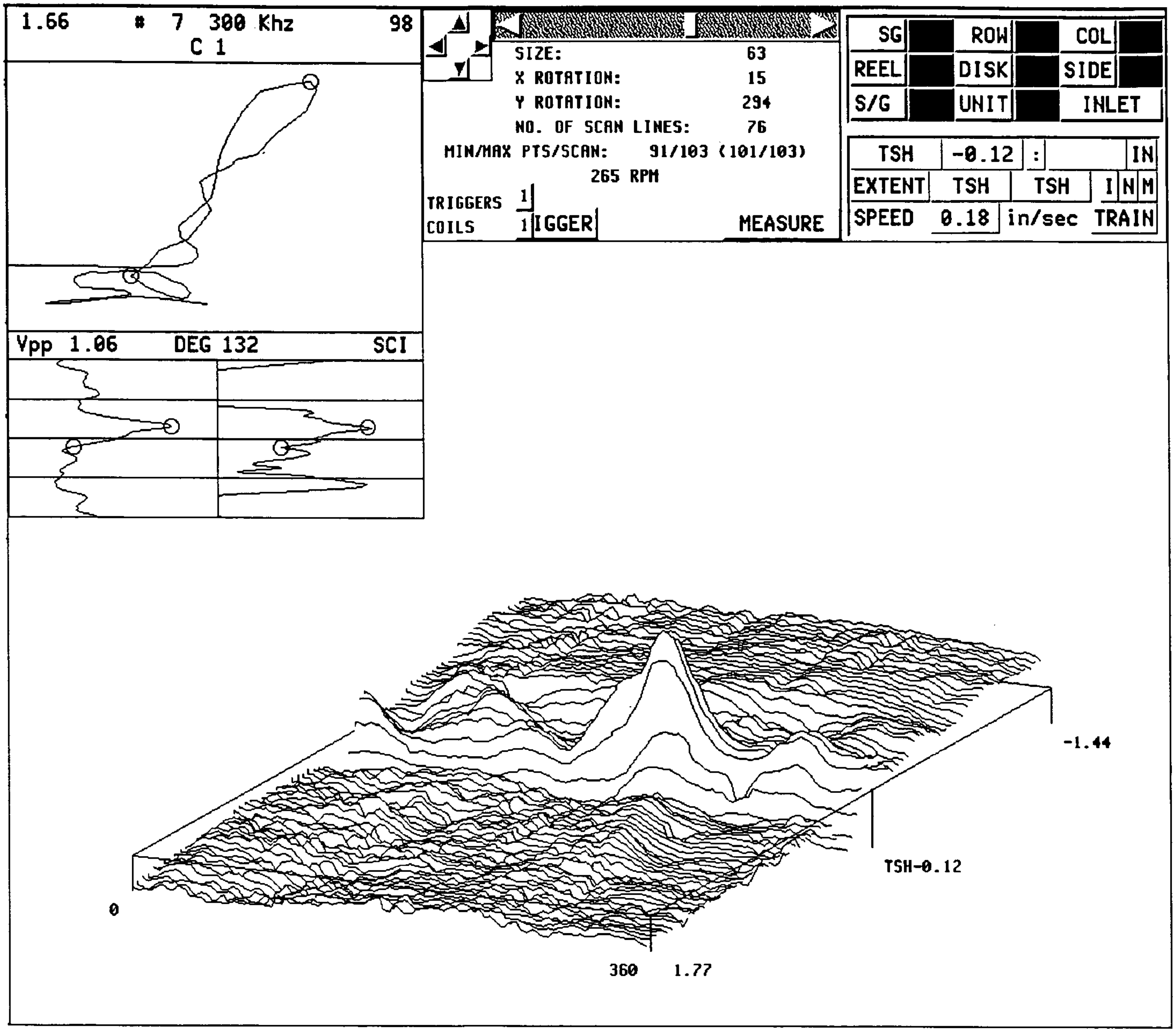


Figure 19B
Response of +-Point Coils for Typical Defect

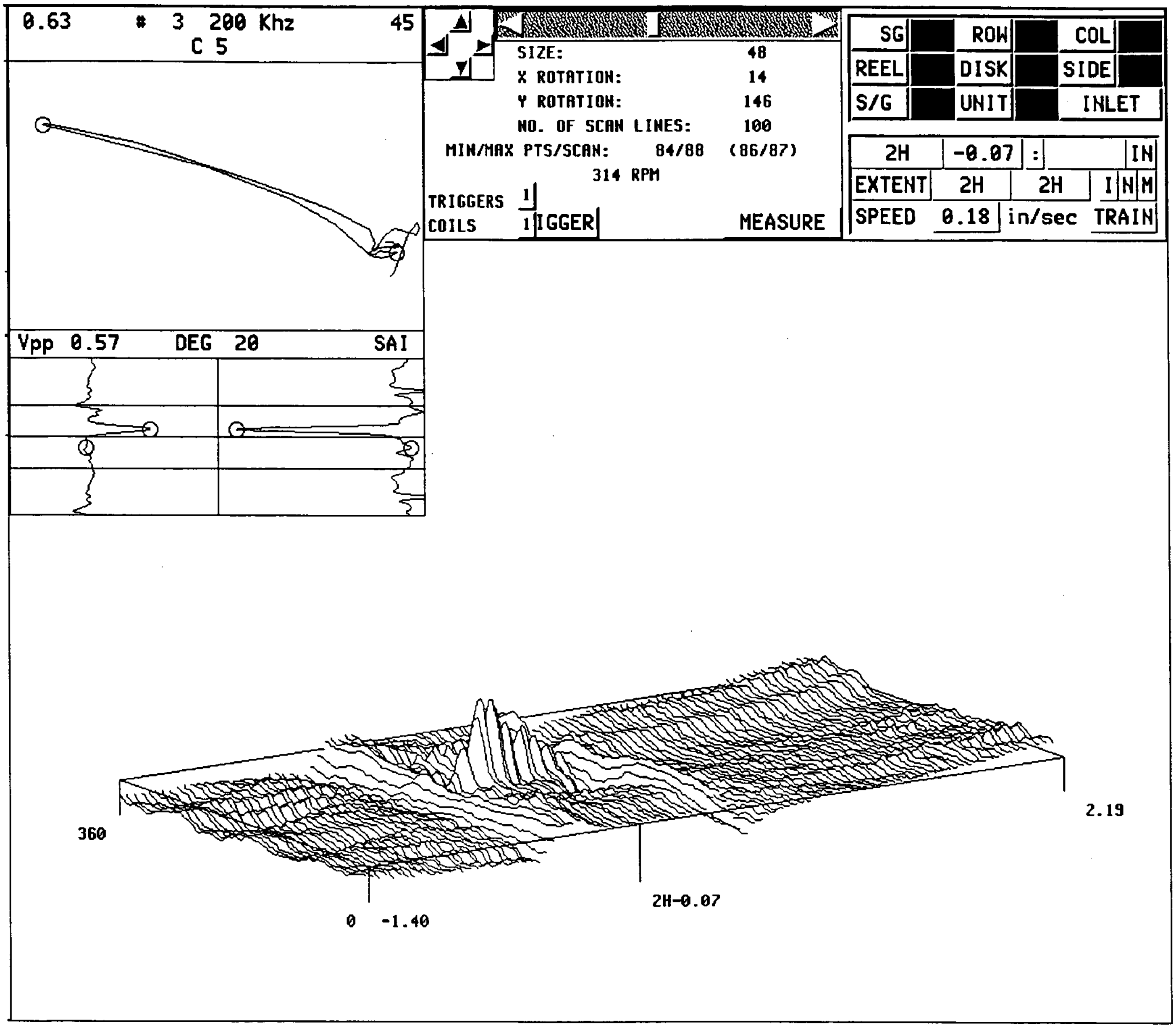


Figure 20A
Response of Pancake Coils for Typical Defect

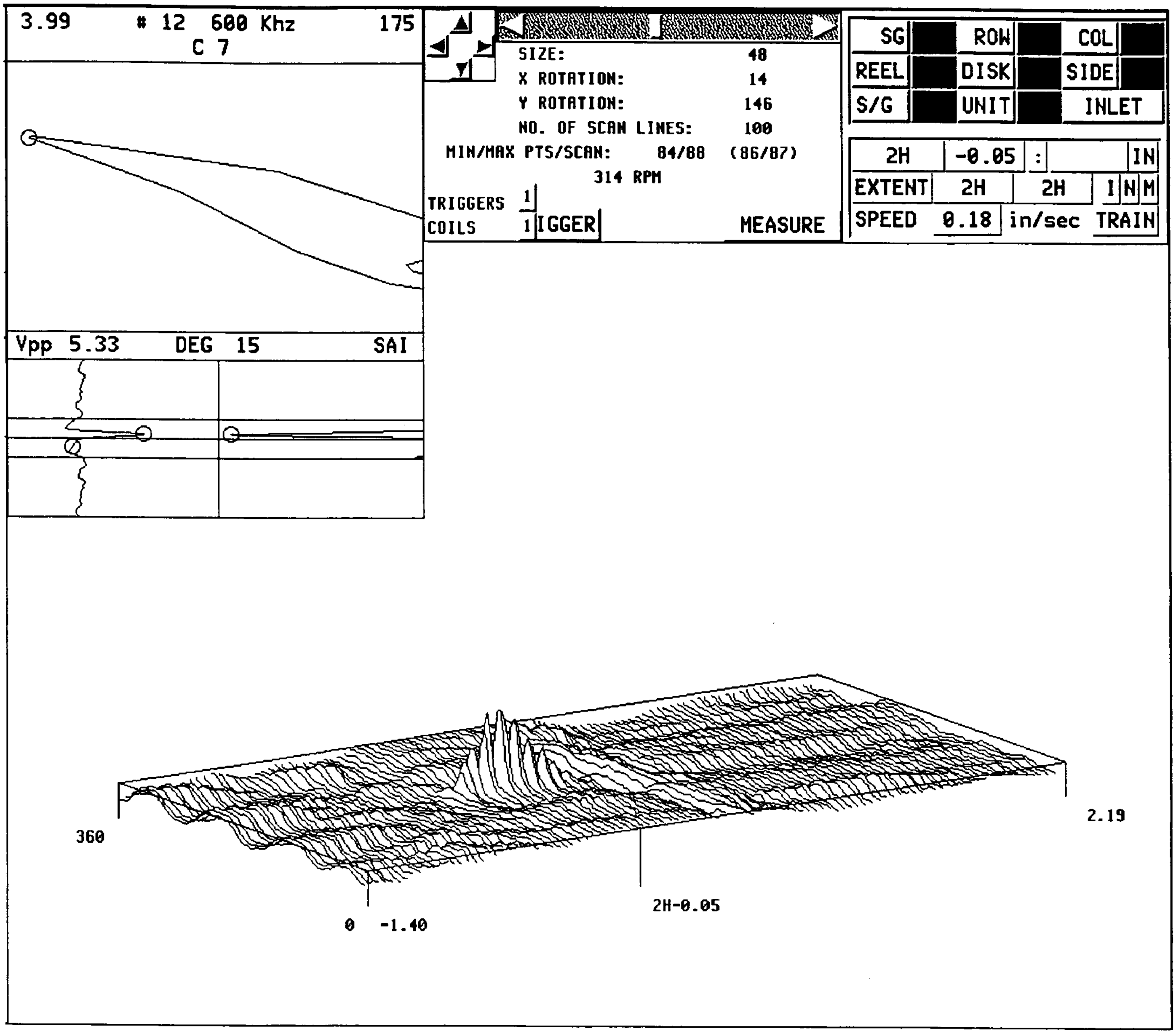


Figure 20B
Response of +-Point for Typical Defect

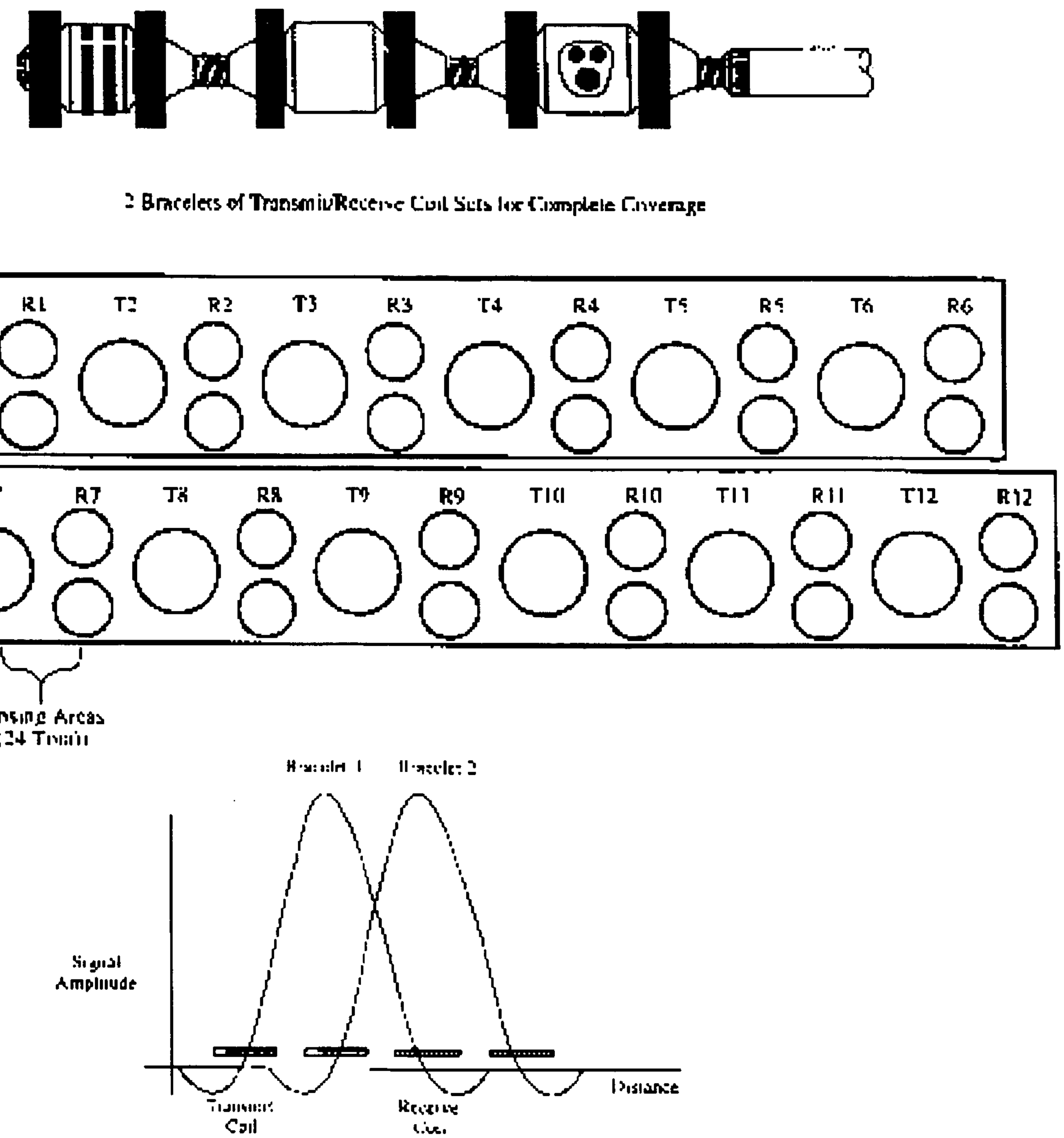


Figure 21
C5-Cecco Probe Configuration

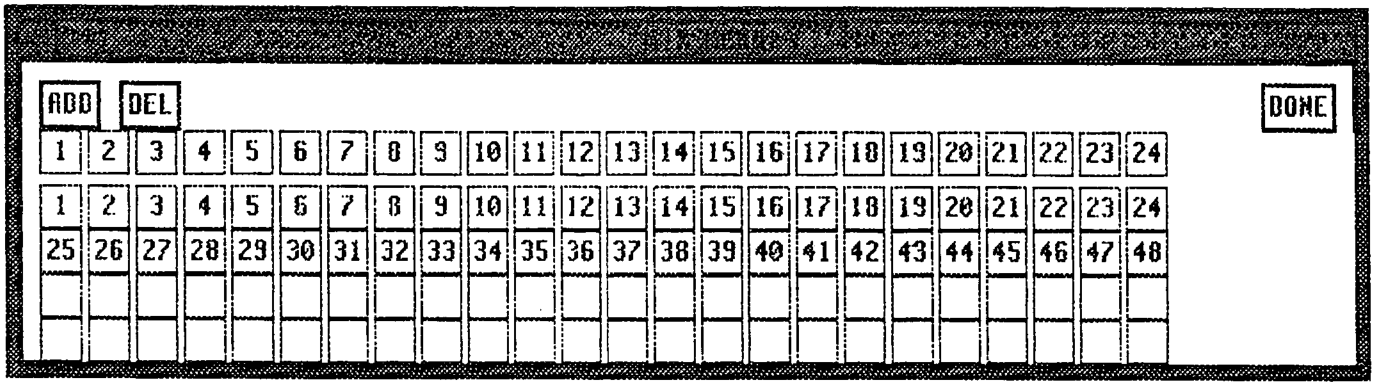


Figure 22
C5-Cecco Conventional Mixes

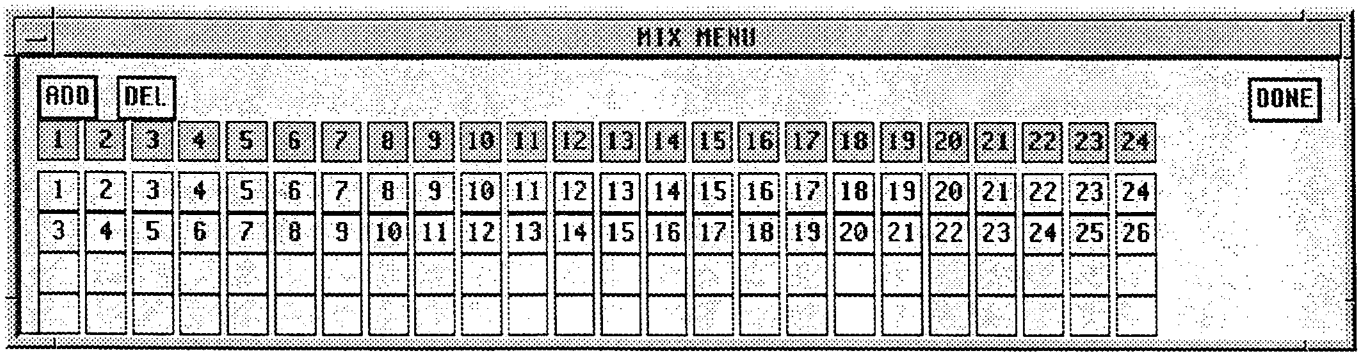


Figure 23
C5-Cecco Compensation Mixes

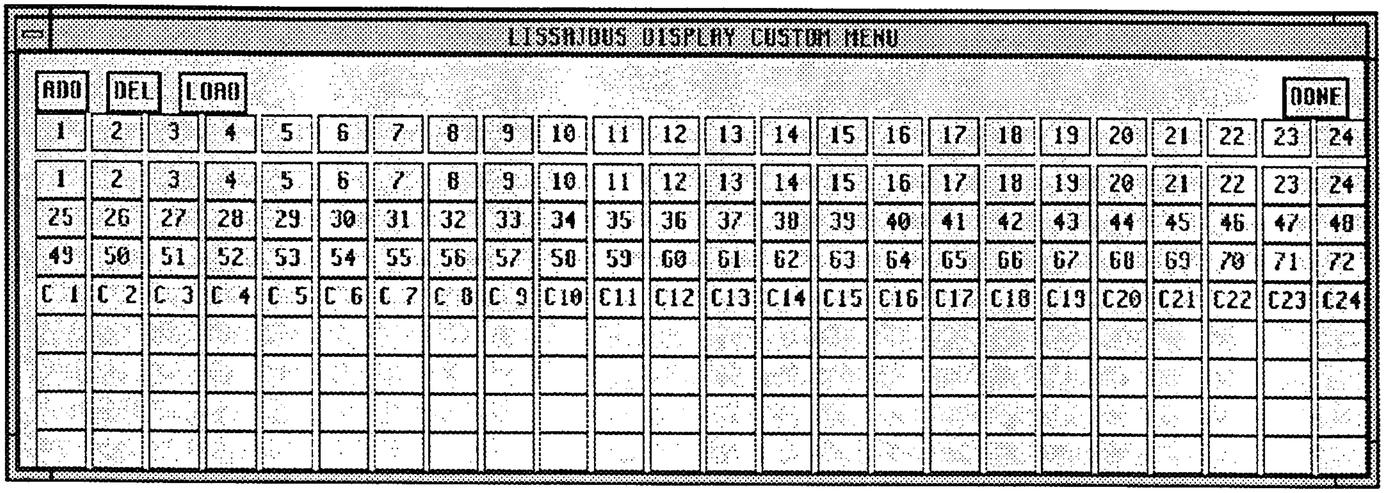


Figure 24
C5-Cecco Lissajous Group Set-Up

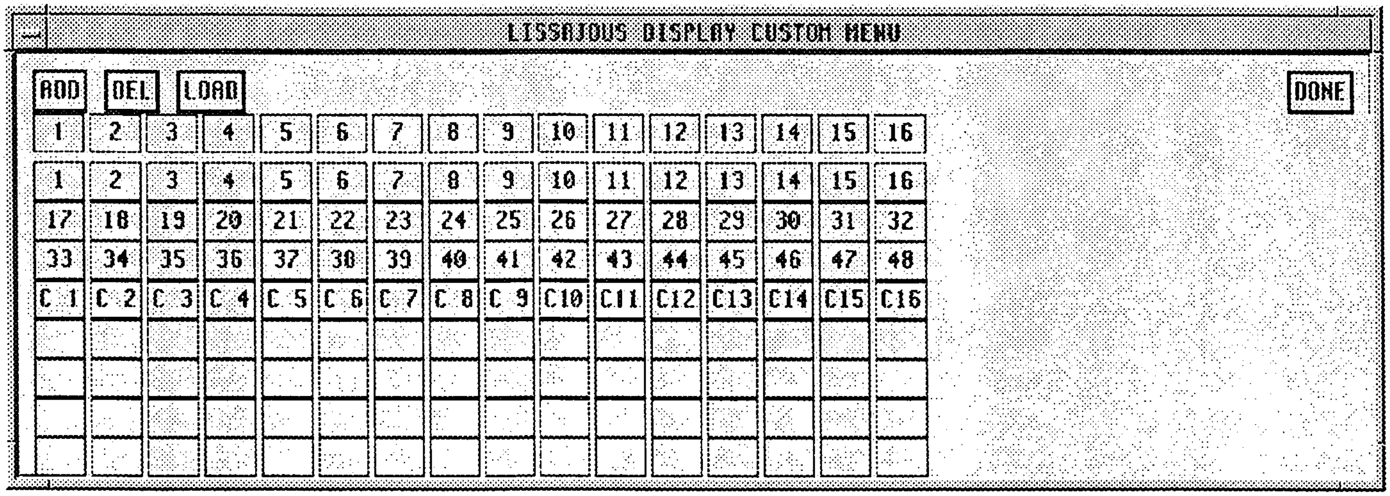


Figure 25
C5-Cecco Lissajous Group Set-Up

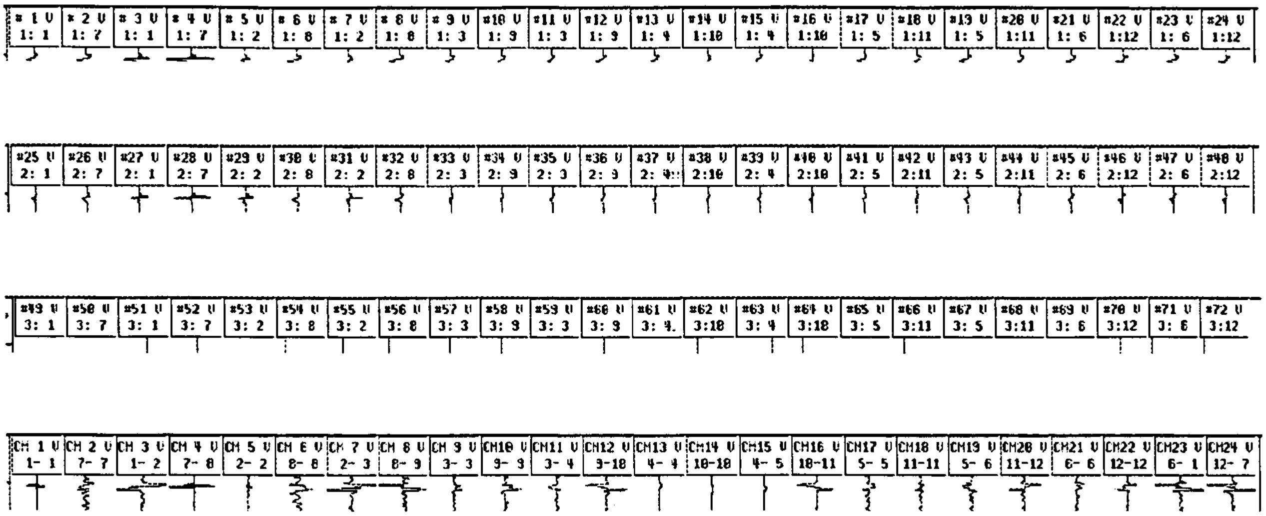


Figure 26
C5-Cecco Lissajous Group Set-Up

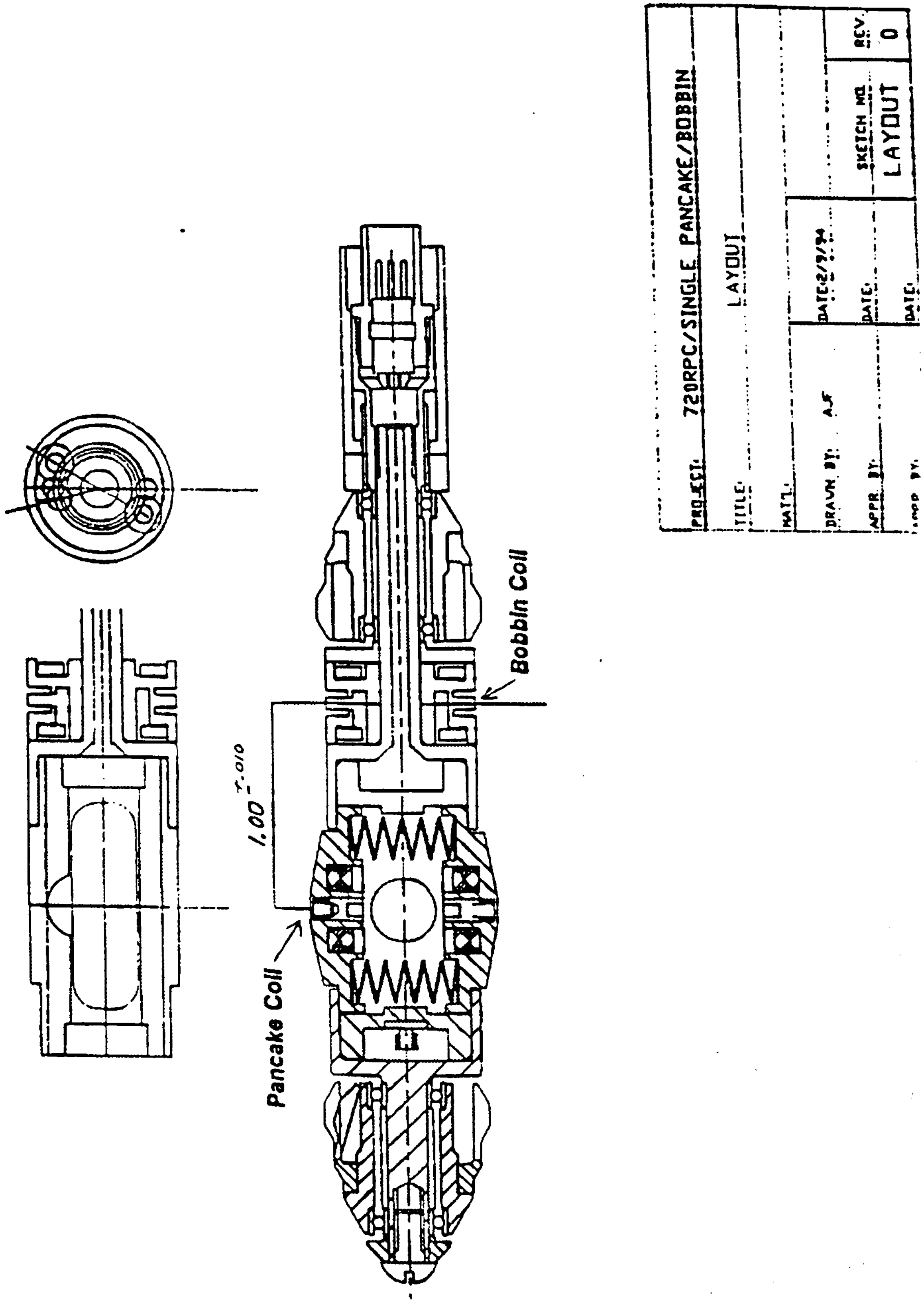


Figure 27
RPC/Bobbin Probe Layout

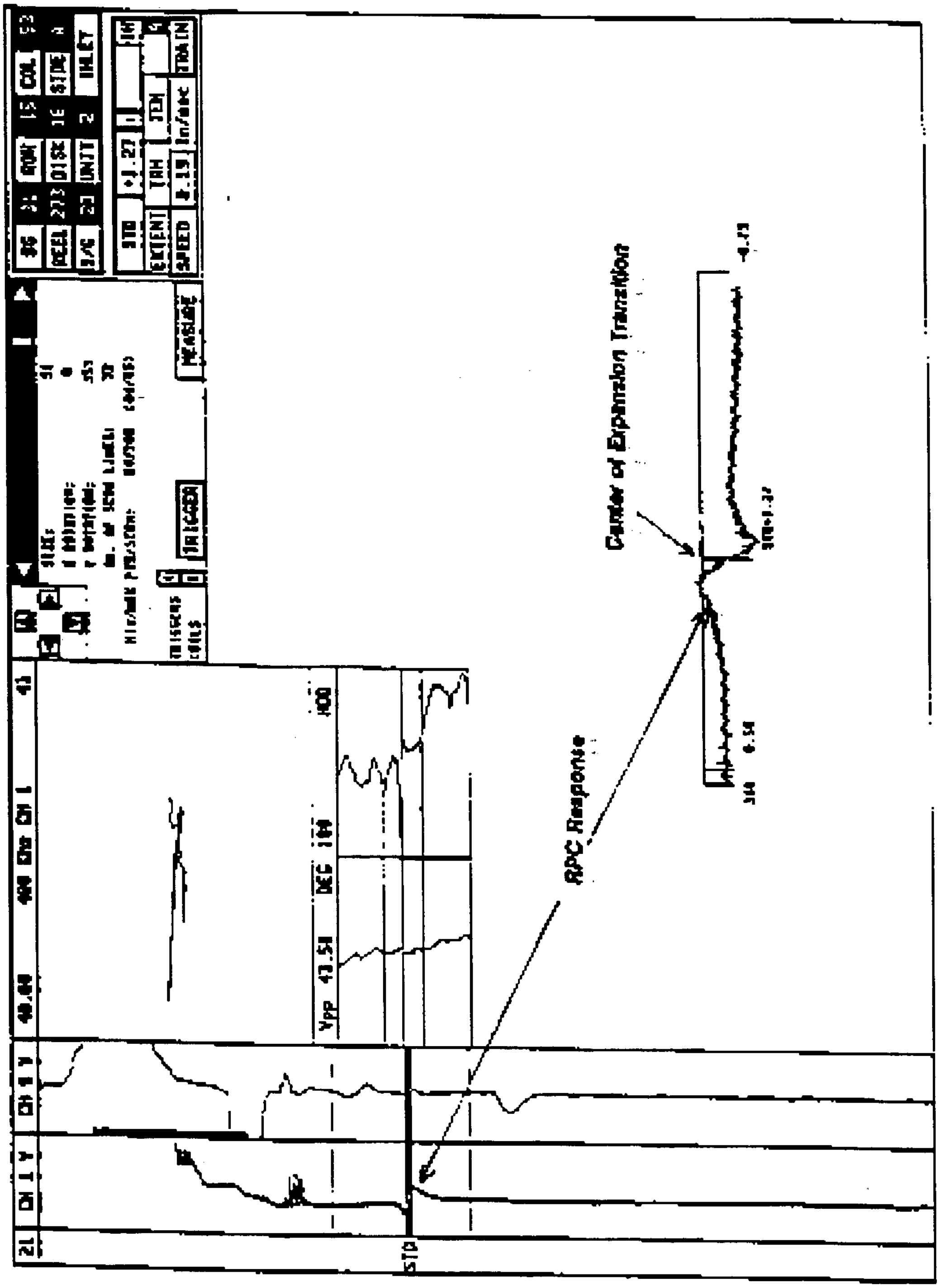


Figure 28
Pancake Coil In Center of Transition

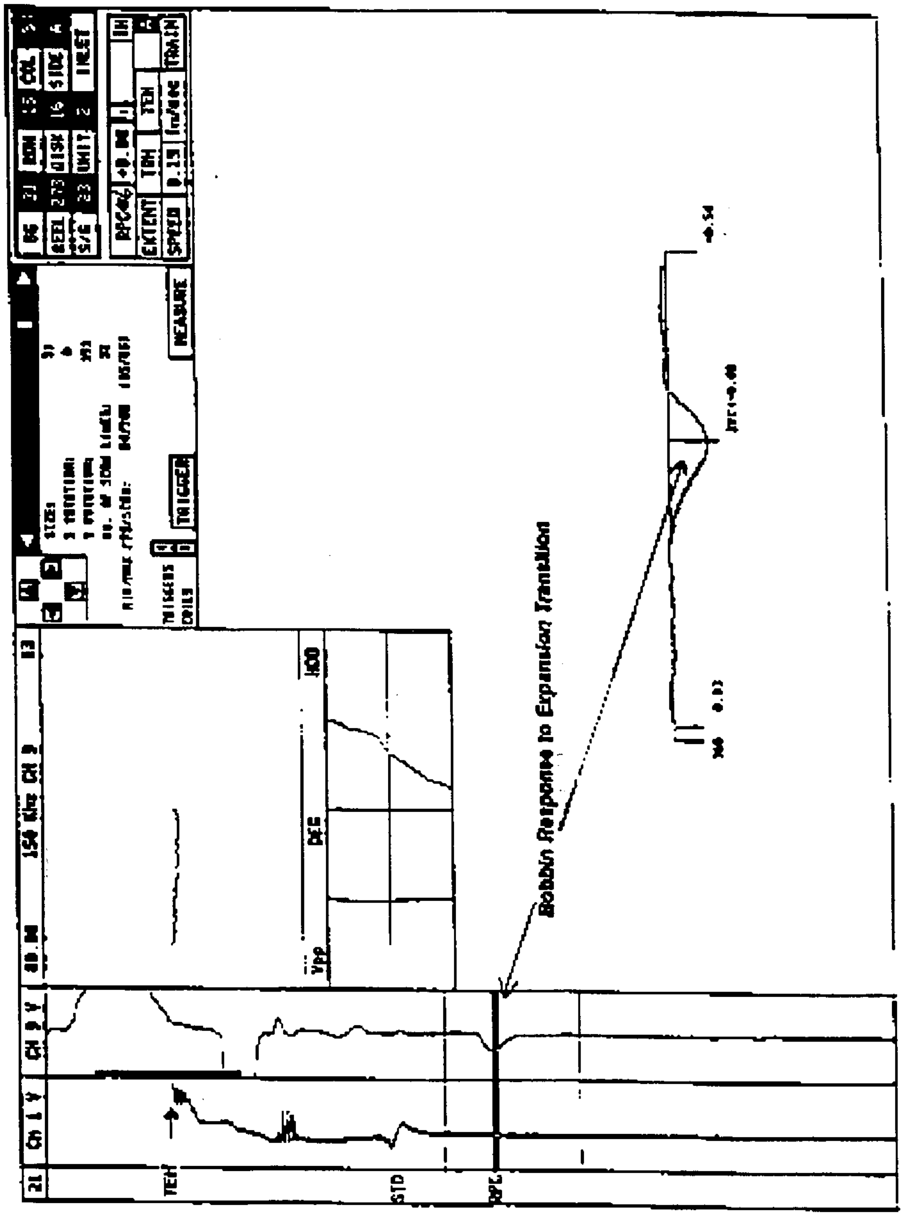


Figure 29
Bobbin Coil In Center of Transition

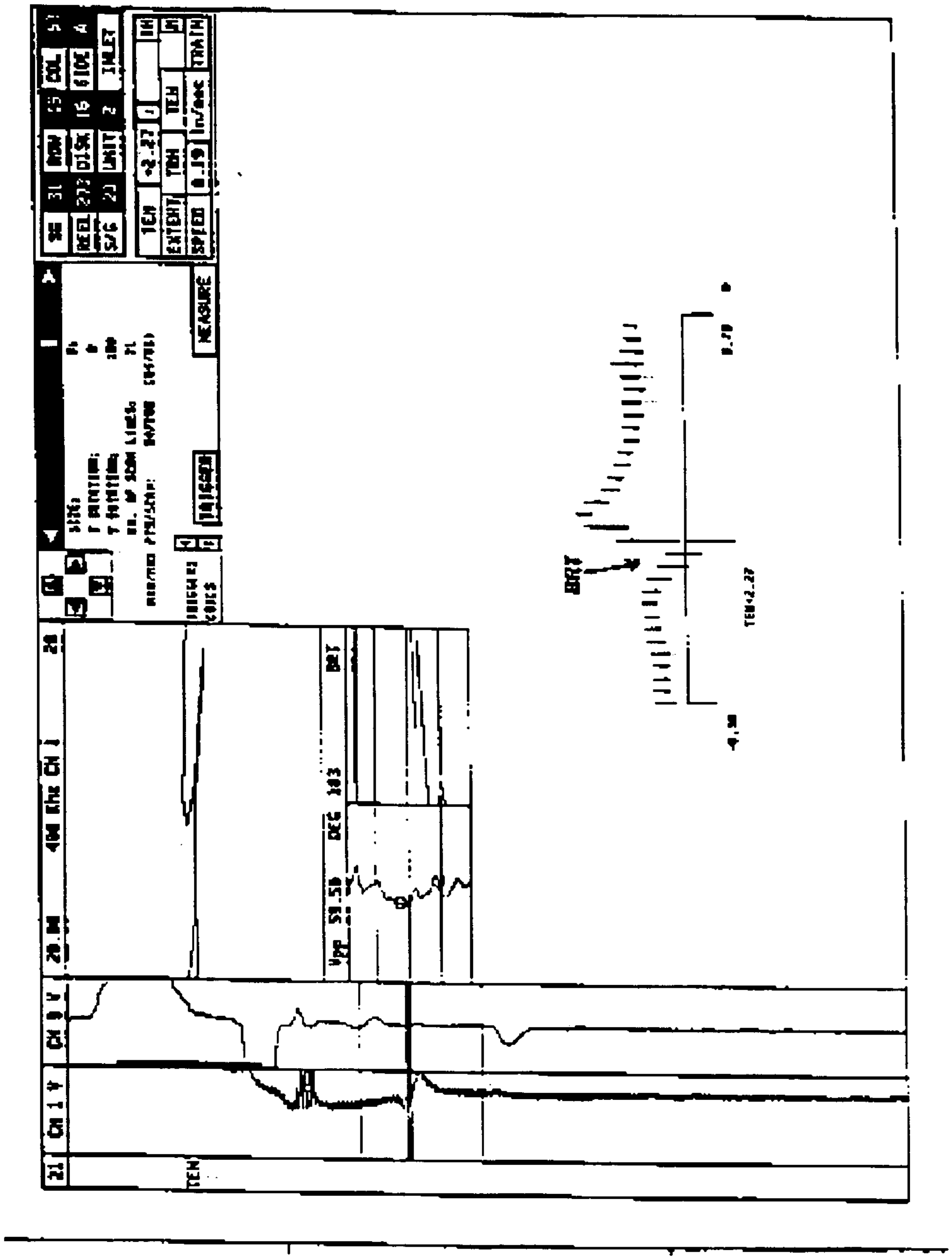


Figure 30
Bottom of Roll Transition

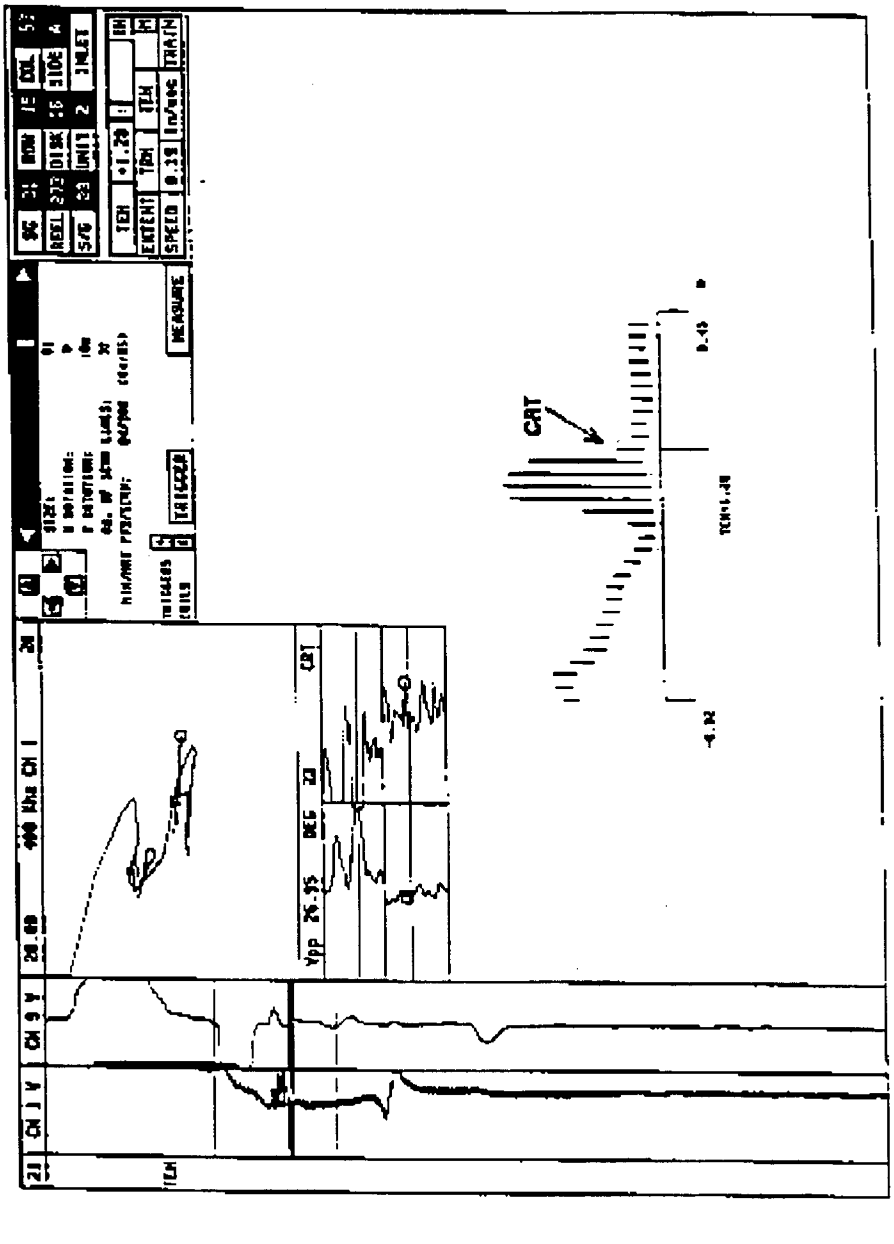


Figure 31
Crack Tip

LINE	SG	ROW	COL	VOLTS	DEG	%	CH	LOCATION			BEG	END
1	ANSER REV 6.2.9 6/6/94							START REEL 249		15B	PRI	
2						PROBE		RB720RPCBOBBH				
3						REEL		249				
4								LOOPER VR III			08/18/95	
5								GRUBISA MJ		II	OPERATOR	
6						STD		MQT01292				
7						CAL		2102			04/01/95	
8	31	15	53	46.40	12	COI	1	TEH	+1.23		TRH	TEH
9	31	15	53			BRT	1	TEH	+2.27		TRH	TEH
10	31	15	53			CRT	1	TEH	+1.28		TRH	TEH

Figure 32
Typical RPC/Bobbin Pre-Reroll Final Report

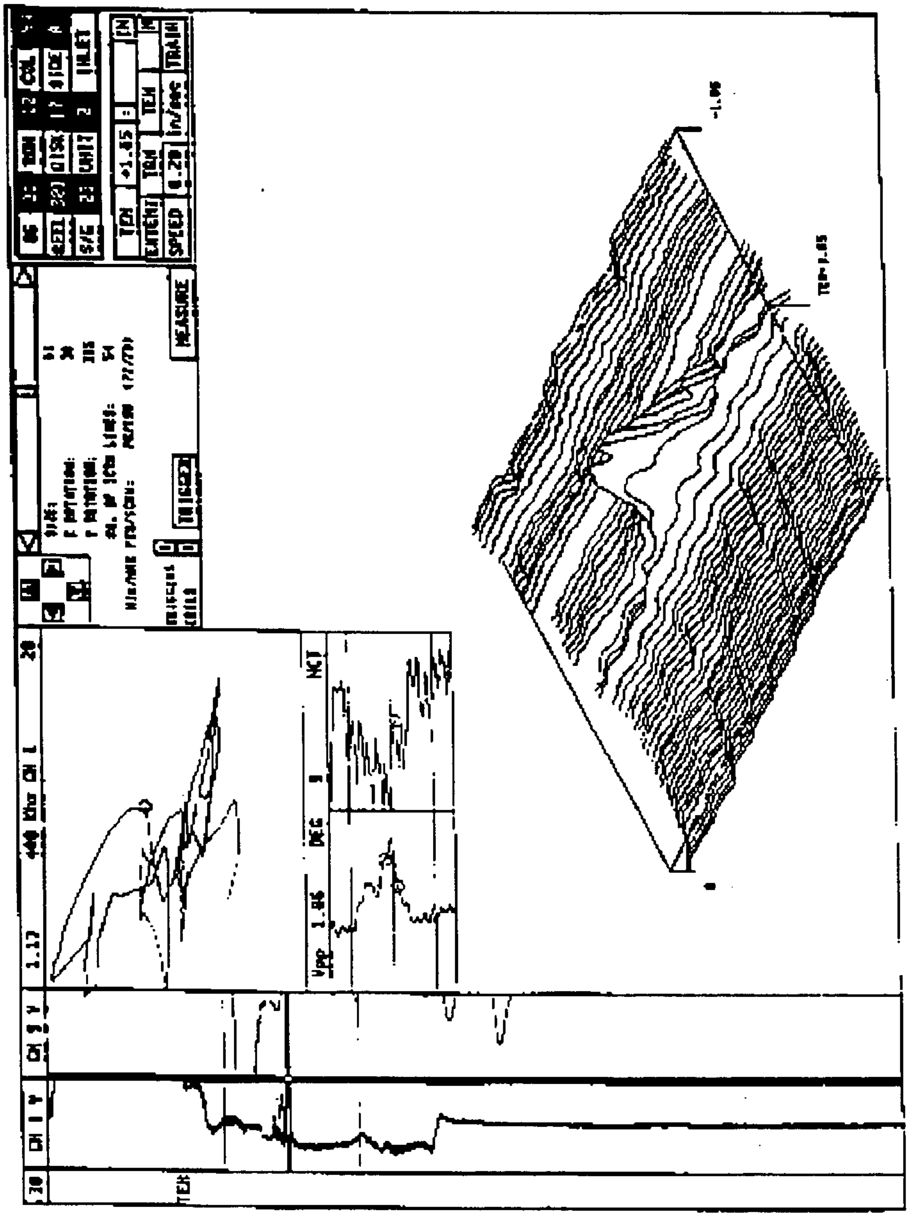


Figure 33
New Crack Tip

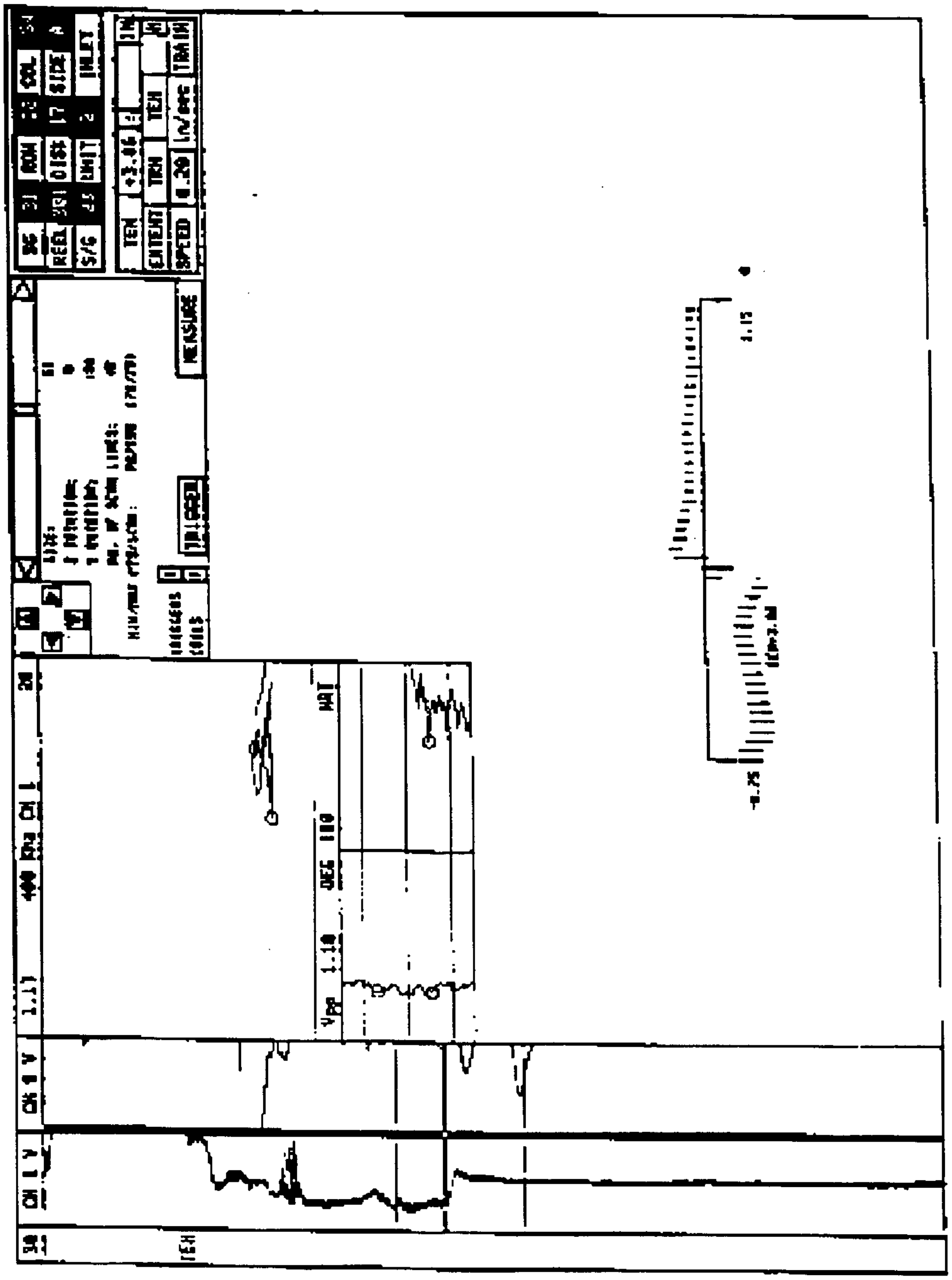


Figure 34
Bottom of New Roll Transition

```
LINE  SG ROW COL VOLTS DEG  %  CH  LOCATION                        BEG END

  1   ANSER REV 6.2.9.saqar 2/17/95START REEL 301          17A PRI
  2                                PROBE  RB720RFCBOBPH
  3                                REEL   301
  4                                       LOOPER VR III
  5                                       PERSHING AP              08/18/95
  6                                STD    MGT01692           I     OPERATOR
  7                                CAL    0549                     04/08/95
  8   31   12  54   1.06     9 NCT    1 TEH       +1.65            TEH TEH
  9   31   12  54   1.18   180 NRT    1 TEH       +3.86            TEH TEH
```

SIGNATURE ______________________________ DATE 08/18/95 PAGE 1/1

Figure 35
Typical RPC/Bobbin Post-Reroll Final Report

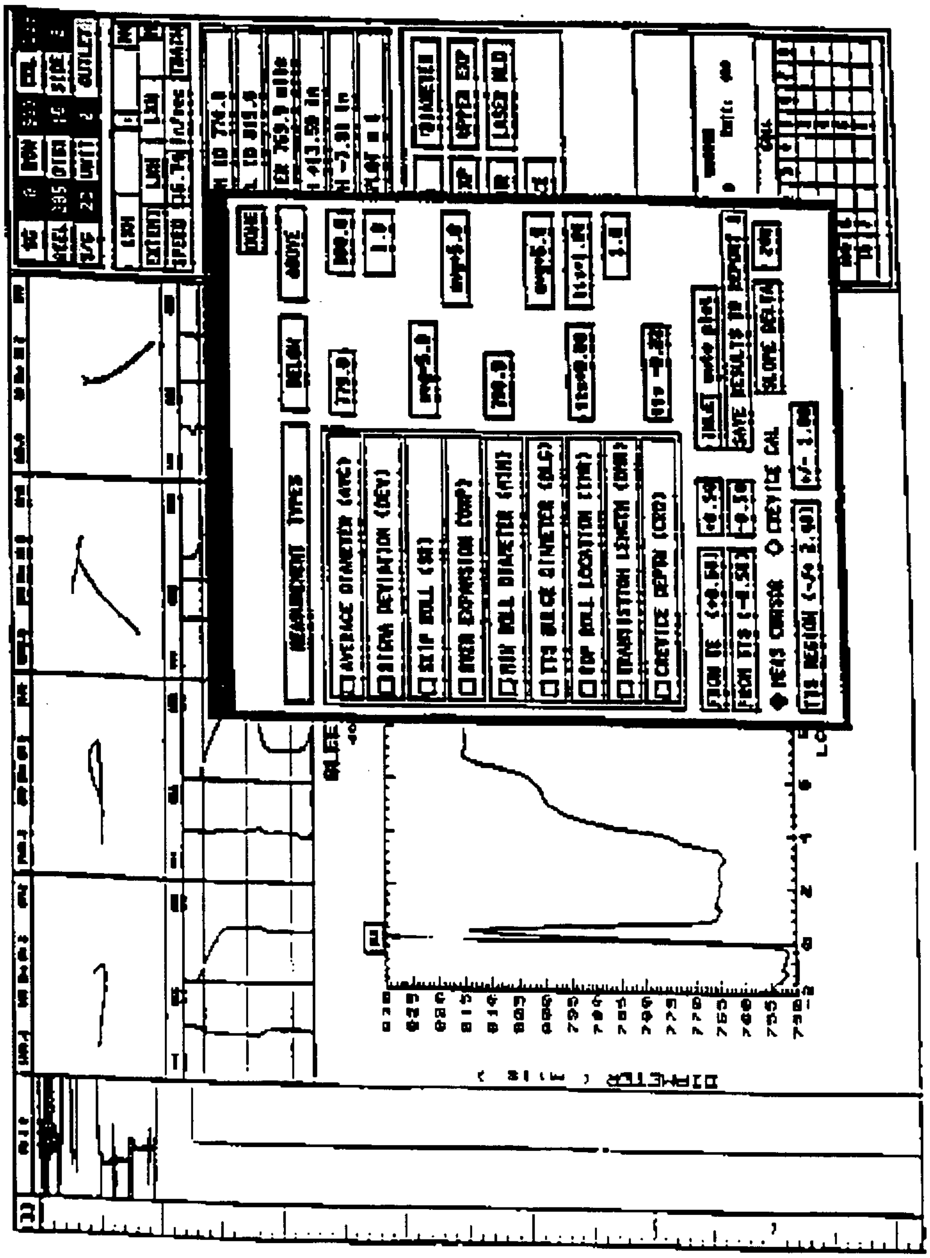


Figure 2

Figure 36
Bobbin Profilometry "Profile Config"

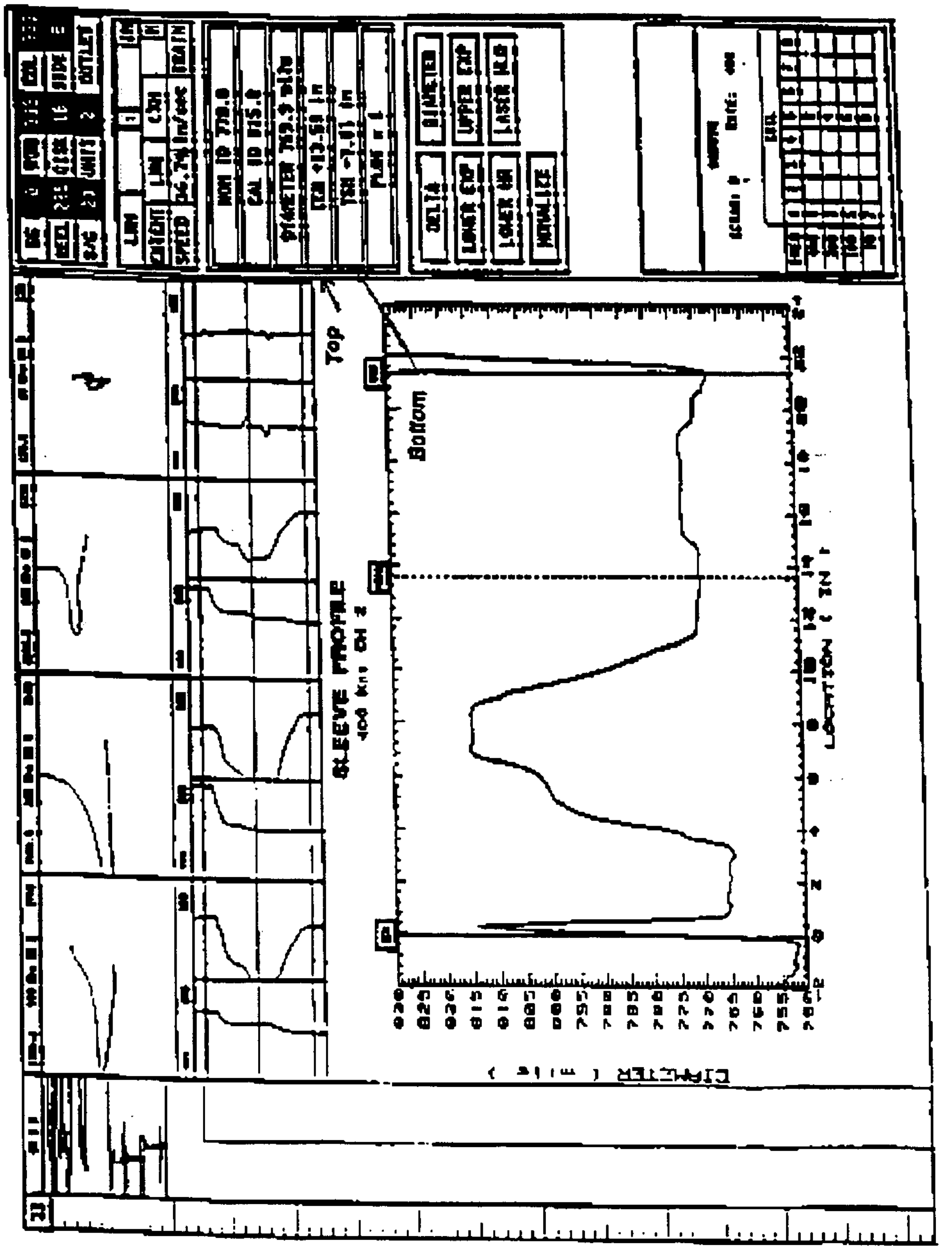


Figure 3

Figure 37
Bobbin Profilometry "Screening" Config

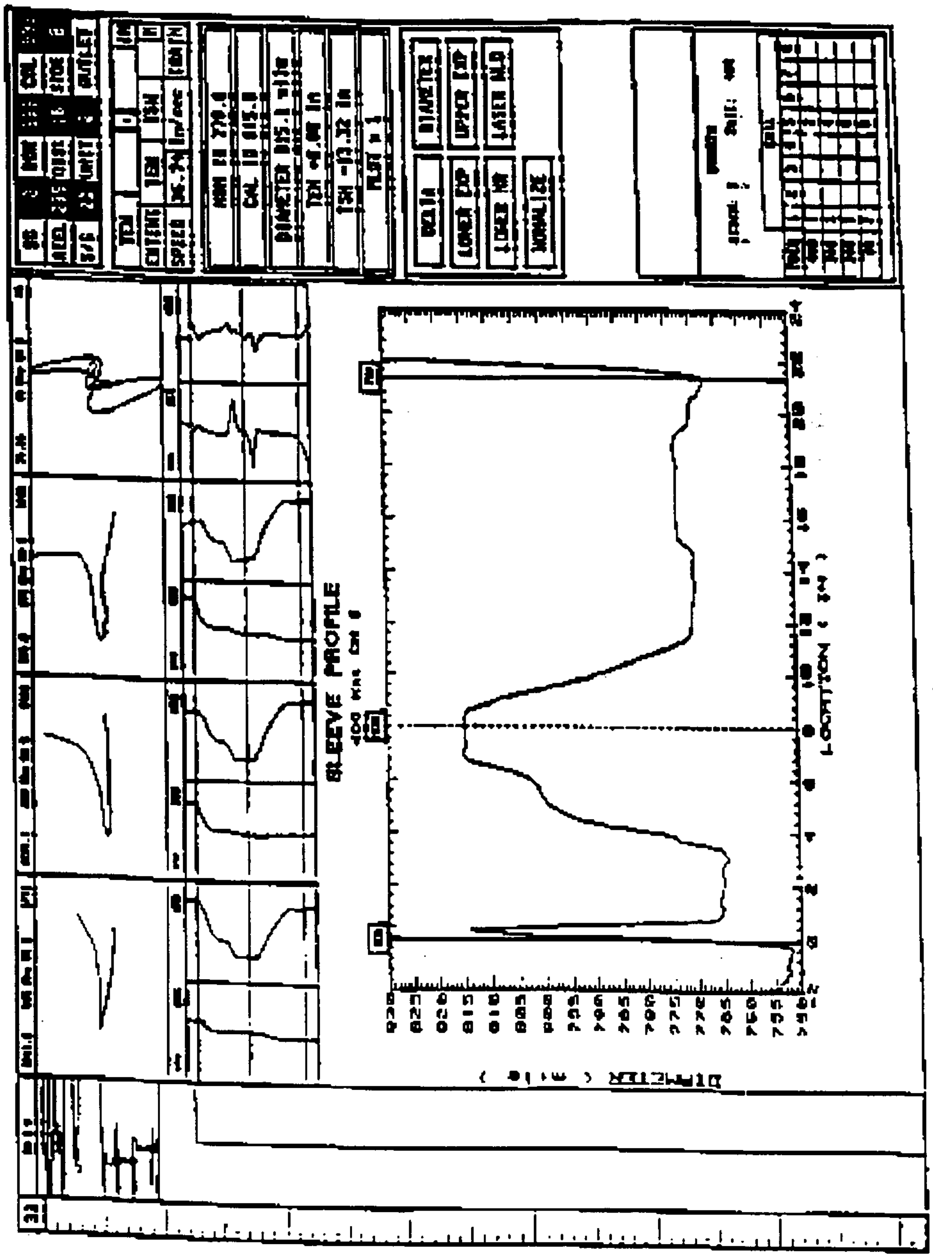


Figure 4

Figure 38
Typical Profile Expansion

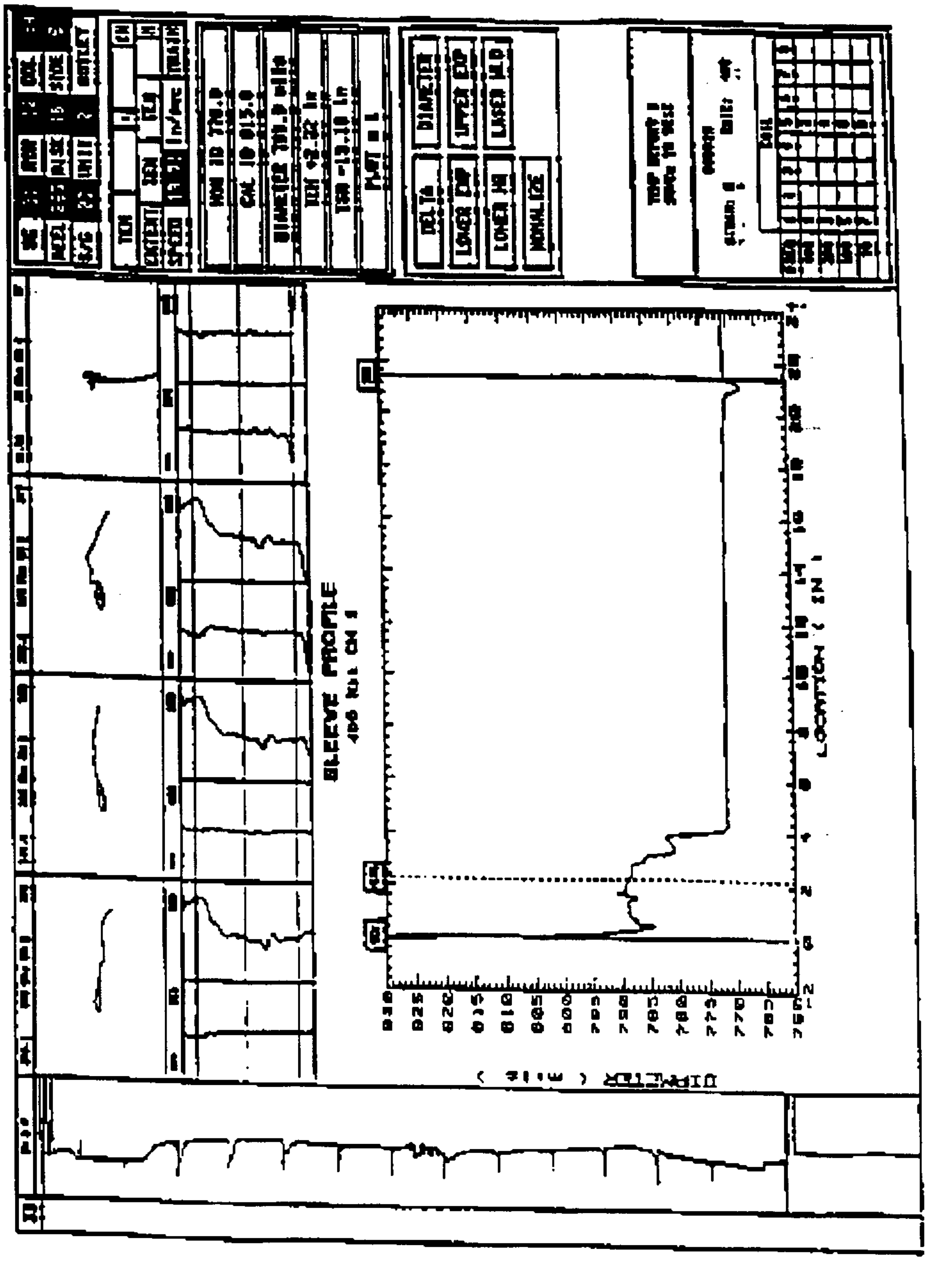


Figure 5

Figure 39
Cursor Centered In Old Roll Expansion

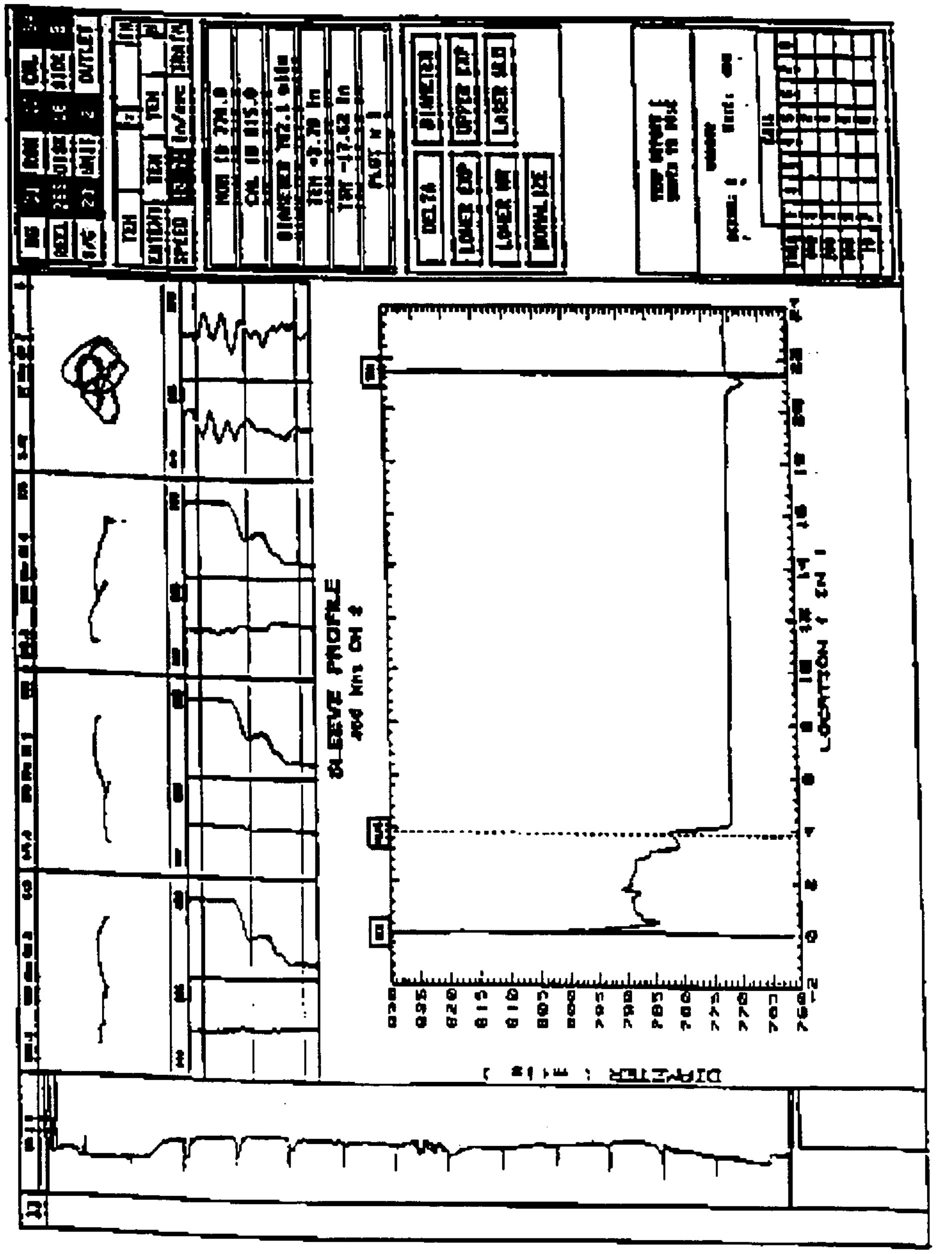


Figure 6

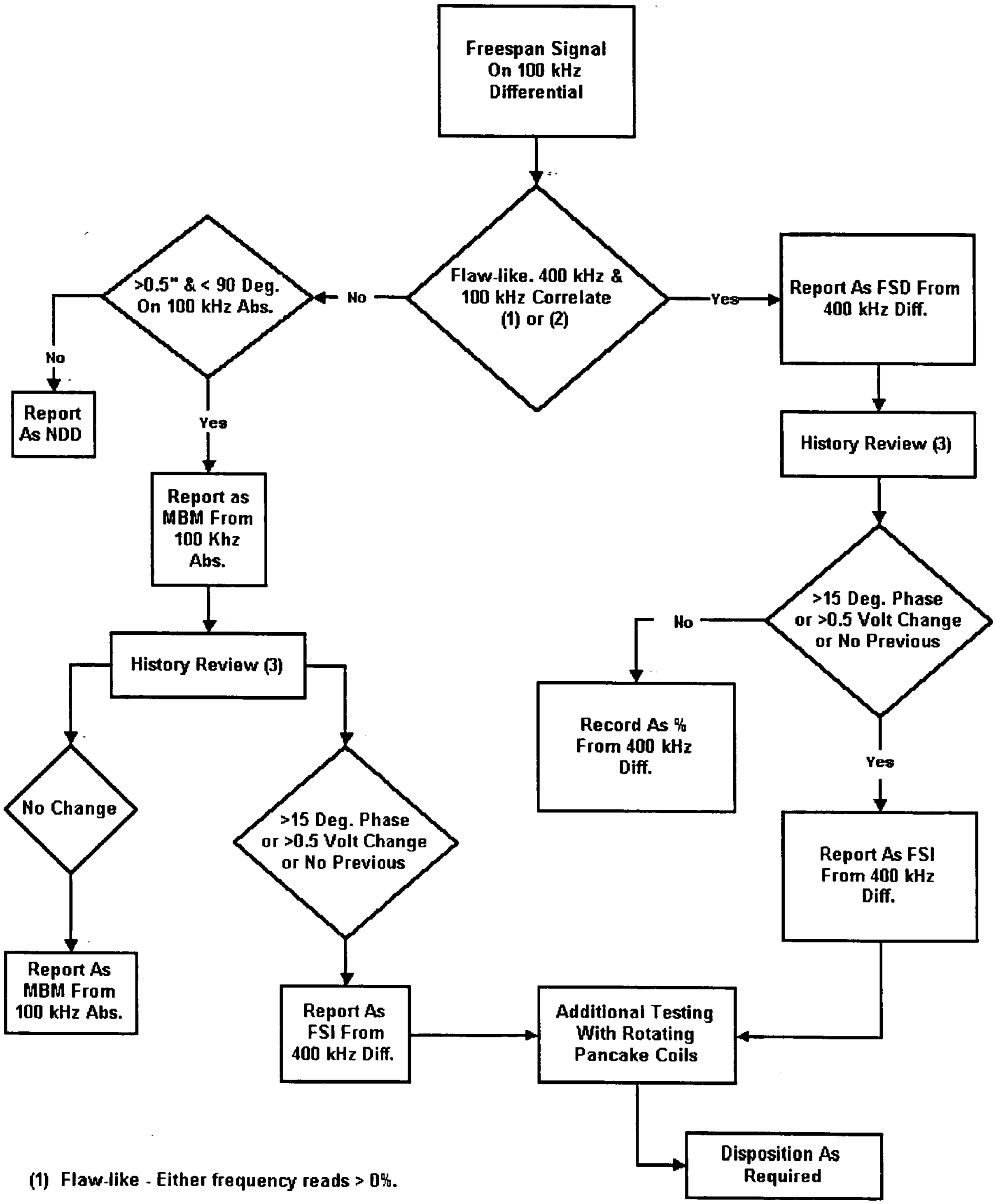
Figure 40
Cursor Centered In New Roll Expansion

```
LINE  SG ROW COL VOLTS DEG  %  CH  LOCATION                        BEG END
  1   ANSER REV 6.2.10 6/18/95     START REEL 285            6B PRI
  2                          PROBE  EB700LLMC
  3                          REEL   285
  4                                 LOOPER VR III                  08/24/95
  5                                 VERNON DP            L         OPERATOR
  6                          STD    ADD492
  7                          CAL    2143                           04/06/95
  8   31   12   54 798.8     LXH  2 LXH       +0.00                TEH TEH
  9   31   12   56 782.1     UXH  2 UXH       +0.00                TEH TEH

SIGNATURE ________________________  DATE 08/24/95         PAGE 1/1
```

Figure 7

Figure 41
Typical Post-Expansion Profile Final Report

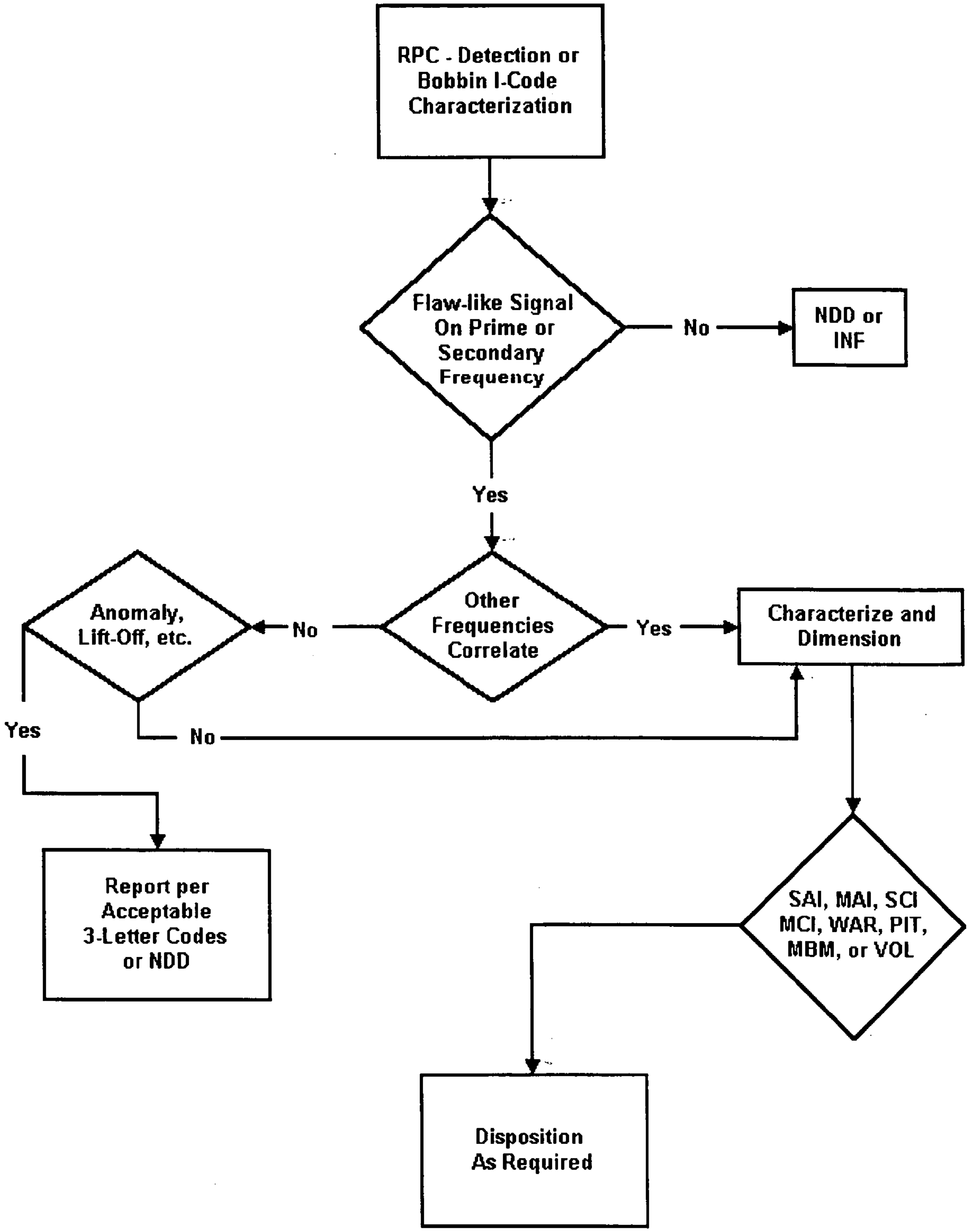


(1) Flaw-like - Either frequency reads > 0%.

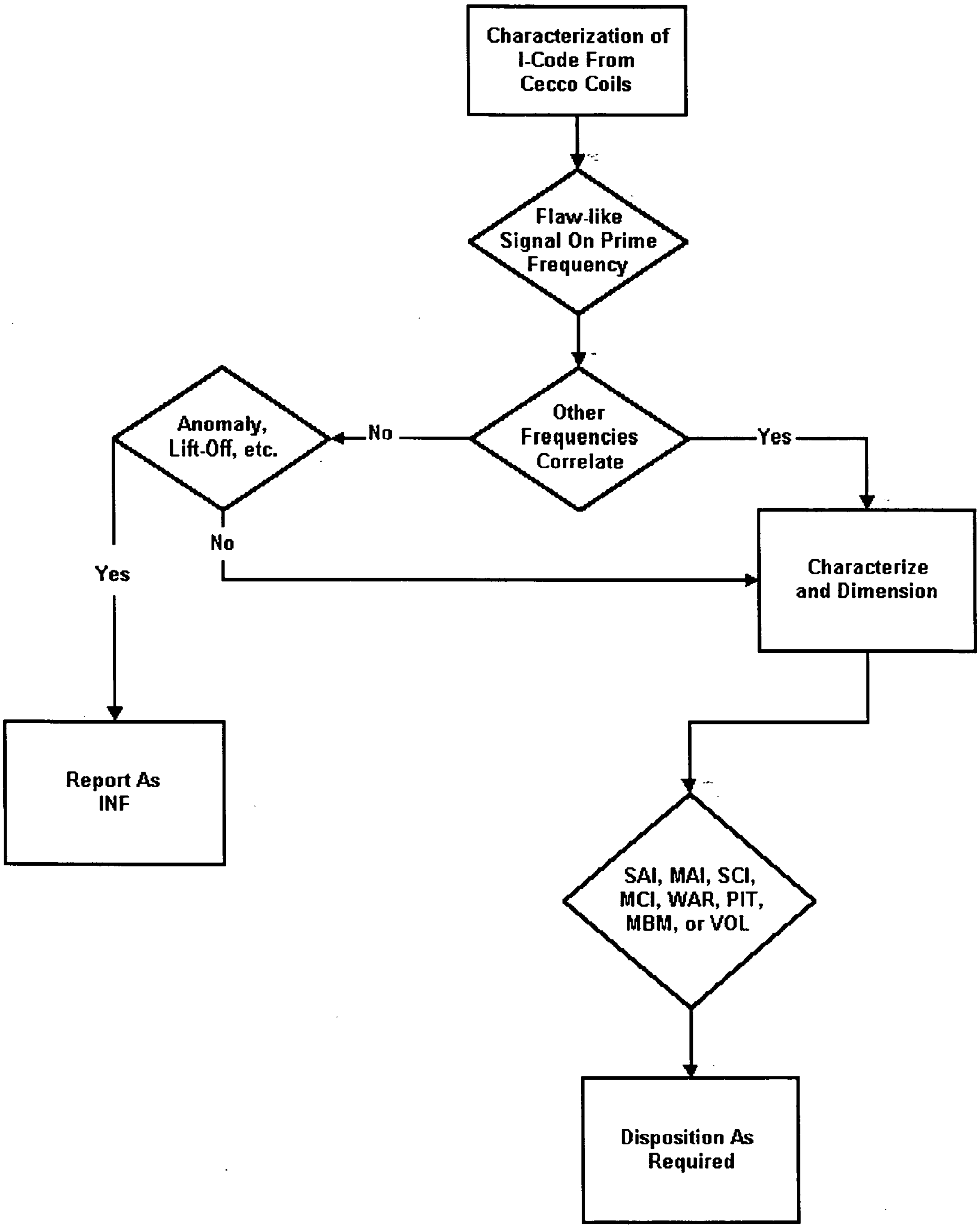
(2) Correlate - Both frequencies read > 0%.

(3) Compare against most recent historical examination.

Appendix A
Freespan Bobbin Evaluation Chart



Appendix B
RPC Evaluation Chart



Appendix C
RPC Characterization of Cecco I-Codes

APPENDIX D

S/G EDDY CURRENT DATA ANALYSIS

SITE ______________________ UNIT ______________________
DATE_____

AREA OR TOPIC OF CONCERN: ____

____

____

____

IF SPECIFIC TUBES OF CONCERN:

SG	ROW	COL	LOCATION		SG	ROW	COL	LOCATION

TEST TYPE ALREADY PERFORMED ON AREA OF CONCERN: ______________________

WESTINGHOUSE RECOMMENDATION AND REASON ______________________

____

____

____

ADDITIONAL COMMENTS: ____

____

Westinghouse Lead Analyst ______________________ Date ____________

Westinghouse Coordinator ______________________ Date ____________

Utility concurs with the Westinghouse recommendation(s) and will implement them as described above.

Utility Signature ______________________ Date ____________

Utility does not concur with the above indicated Westinghouse recommendation(s).

Reason: ____

____

Utility Signature ______________________ Date ____________