# CAROLINA POWER & LIGHT COMPANY

# SHEARON HARRIS NUCLEAR POWER PLANT

# UNIT 1

## EDDY CURRENT EXAMINATION REPORT

## SEPTEMBER 1995

## DOCUMENT NO. IR-ISI-152

**ASEA BROWN BOVERI**
**COMBUSTION ENGINEERING, INC.**
**NUCLEAR POWER BUSINESSES**
**OUTAGE SERVICES**

| | | |
|---|---|---|
| PREPARED BY: | T Thomas W Brian<br>LEVEL III | 10-26-95<br>DATE |
| APPROVED BY: | James D. Ford<br>Q.A. ENGINEER | 10/26/95<br>DATE |
| APPROVED BY: | Roger Brown<br>OUTAGE PROJECT MANAGER | 10/26/95<br>DATE |

9609300109 960919
PDR ADOCK 05000400
Q PDR

Document No: IR-ISI-152

TO: Carolina Power & Light Co.

## CERTIFICATE OF PERFORMANCE

Carolina Power & Light Co.
Shearon Harris Plant
Steam Generator Eddy Current Examination

Combustion Engineering, Inc., hereby certifies that the Harris steam generator eddy current examinations performed during September 1995 were in compliance with CP&L Purchase Order XM 10370000 / WA# XS 10370016. Documentation attesting to this conformance is contained within the data of this QC Records Package.

James D. Ford
Q. A. Engineer

## ABSTRACT

This document summarizes the examination program, results, and presents information concerning examination procedures, personnel and equipment used for inspection at the Shearon Harris RFO-6 1995 outage.

The examination outage included eddy current inspections of approximately 29% of the tubes in each steam genrator utilizing bobbin probes for defect examination. The bobbin probe inspection included all of the outlet (cold leg) pre-heater roll expanded tubes and all of the periphery tubes. All previous indications of tube degredation were also examined. Rotating coil (MRPC) examinations were performed on 100% of the inlet (hot) side top-of-tube-sheet expansion transitions, and a sample of dented intersection greater than 5 volts, favoring the hot leg side. MRPC inspections were also performed on a 20% sample of the pre-heater expansions in steam generator "C", and on suspect bobbin coil indications (diagnostics). There were several repairable indications with detail contained in the text of this document.

# TABLE OF CONTENTS

TITLE PAGE

CERTIFICATE OF PERFORMANCE

ABSTRACT

TABLE OF CONTENTS

VOLUME I

SECTION I

GENERAL INFORMATION

Tab

1.1 Introduction

1.2 Examination Summary and Results

Work Scope Summary
Inspection Summary
Steam Generator Graphic Displays

1.3 Acquisition Test Parameters

SECTION II

PROCEDURES

Tab

2.1 Engineering Periodic Test EPT-232T Cover sheet & List of Effective pages

| | | |
|---|---|---|
| | HNP-100-001 Rev. 0 | Tool and Equipment Accountability for Carolina Power & Light - Shearon Harris |
| 2.2 | STD-NSS-072 Rev. 5 | Manual Installation and Removal of ABB/Combustion Engineering GENESIS Manipulators |
| 2.3 | STD-NSS-078 Rev. 7 | Setup, Checkout and Operation of ABB/Combustion Engineering GENESIS Manipulators |
| 2.4 | HNP-007 Rev. 0 | Remote Installation, Calibration and Removal of SM-10/20 Manipulator |

| | | |
|---|---|---|
| 2.5 | HNP-004 Rev. 0 | Procedure for Multifrequency Eddy Current Examination of Nonferromagnetic Steam Generator Tubing Using MIZ-18A/MIZ-30 Equipment.<br>HNP-004 procedure sign-off sheets |
| 2.6 | HNP-005 Rev. 0 | Eddy Current Data Analysis Procedure - Evaluation of Westinghouse Steam Generator Tubing<br><br>Steam Generator Eddy Current Interpretation Guidelines Revision 1 |
| 2.7 | HNP-006 Rev. 0 | Procedure for Control of Eddy Current Data for Use with Multiforth or Eddynet Acquisition Systems. |

## SECTION III

## PERSONNEL and EQUIPMENT

| Tab | | |
|---|---|---|
| 3.1 | QAP-2.4 | Combustion Engineering Certification Program for Nondestructive Examination Personnel. |
| 3.2 | | Certified Personnel List |
| 3.3 | | Equipment (RDAU) Certification Records<br>Calibration Standard Certification Records |
| 3.4 | | Preliminary report transmittal and CP&L receipt acknowledgement. |

# VOLUME II

## STEAM GENERATOR #A EXAMINATION DATA

Tab

A-1 All Data on all Tubes sorted in Row - Column order.

A-2 Eddy Current Calibration Sheets.

## STEAM GENERATOR #B EXAMINATION DATA

Tab

B-1 All Data on all Tubes sorted in Row - Column order.

B-2 Eddy Current Calibration Sheets.

## STEAM GENERATOR #C EXAMINATION DATA

Tab

C-1 All Data on all Tubes sorted in Row - Column order.

C-2 Eddy Current Calibration Sheets.

# INTRODUCTION

Combustion Engineering, Inc. conducted an in-service eddy current examination of the steam generator (S/G) tubing at Carolina Power & Light (CP&L) Shearon Harris Nuclear Power Plant in September 1995. The purpose of the examination was to assess the condition of the S/G's, identify tubes requiring repair and to provide the necessary information needed to fulfill Technical Specification requirements.

The examination program included multi-frequency bobbin coil and motorized rotating pancake coil (MRPC) testing for indications of degradation, manufacturing buff marks, dents, and deposits.

The examinations were conducted in accordance with Combustion Engineering Procedure No. HNP-004 Rev. 0 in compliance with the USNRC Regulatory Guide 1.83 "Inservice Inspection of PWR Steam Generator Tubes", Revision 1, dated July, 1975 and the ASME Boiler and Pressure Vessel Code, Section XI "Rules for Inservice Inspection of Nuclear Power Plant Components", 1983 Edition, with Summer 1983 Addenda, and the Shearon Harris Technical Specifications.

The eddy current data analysis variables were established in accordance with the Procedure No. HNP-005 Rev. 0 "Eddy Current Data Analysis Procedure, Evaluation of Westinghouse Steam Generator Tubing", and the attached Guideline, "Steam Generator Eddy Current Interpretation Guidelines, Rev. 1". The data was independently analyzed by two groups of certified Level IIA (minimum) data analysts. Discrepancies between the two sets of evaluation results were reviewed by Lead Level III eddy current examiners representing both Primary and Secondary analysis groups. Data Acquisistion and Primary data analysis was performed by ABB/Combustion Engineering while Secondary data analysis was performed by Rockridge. Both Primary and Secondary data analysis was performed remotely via LAN/WAN at the ABB/Combustion Engineering Chattanooga Data Center, and Rockridge offices.

## WORK SCOPE

The examination program was conducted to meet all the necessary requirements of the Plant Technical Specifications. A examination was performed utilizing bobbin probe testing examining approximately 29% of the open tubes in each of the three steam generators. Examinations included peripheral tubes, and included 100% of the open pre-heater tubes which have a roll expansion at the second and third baffle support structure. Testing was performed from the outlet and inlet side of the steam generator.

Motorized Rotating Coil (MRPC) examinations were performed on the inlet side of all three steam generators at the top-of-tubesheet roll transitions of all open tubes[1]. MRPC inspections were also performed on a sample of pre-heater roll transitions (25 tubes) in steam generator "C", and dented intersections and row one and two u-bends in all three steam generators. MRPC inspections were used to diagnose bobbin coil indications (special interest).

### Component: SG #A

**Steam Generator Inspection Summary**

| Inspection type | No. of Tubes |
|---|---|
| Bobbin probe | 1317 |
| MRPC Top-of-Tubesheet | 4563 |
| MRPC U-Bend | 46 |
| MRPC Dented Int. | 5 |

### Component: SG #B

**Steam Generator Inspection Summary**

| Inspection type | No. of Tubes |
|---|---|
| Bobbin probe | 1334 |
| MRPC Top-of-Tubesheet | 4571 |
| MRPC U-Bend | 46 |
| MRPC Dented Int. | 7 |

[1]There are 4578 tubes in each of the three D4 series steam generators.

Component: SG #C

## Steam Generator Inspection Summary

| Inspection type | No. of Tubes |
|---|---|
| Bobbin probe | 1341 |
| MRPC Top-of-Tubesheet | 4565 |
| MRPC U-Bend | 49 |
| MRPC Dented Int. | 20 |
| MRPC Pre-Heater Int. | 25 |

## Probes Utilized

| | | |
|---|---|---|
| Bobbin Probe | A610MULC | .610" diameter magnetic bias |
| | A580SFRM | .580" diameter spring flex magnetic bias |
| | A560SFRM | .560" diameter spring flex magnetic bias |
| MRPC Probe | B620MRPC3C | .620" diameter three coil (0.115" pancake; axial, circ.) |
| | B580MRPCPH | .580" diameter single pancake coil (u-bend) |

## Summary

Full length bobbin coil eddy current examinations were conducted as summarized in the previous section of this report. The scan plan was provided by ABB/CE and approved by CP&L, and depicted a ~29% sample of tubes throughout all three steam generators. Tube indications reported were compared to previous data from past inspections to investigate any possible flaw growth.

Indications were reported in the <20% range, ≥20 to 39% range and ≥40% range. A summary of the 1995 outage % Through-wall indications sorted by RFO-6 indication size follows this section.

MRPC three-coil examinations of the hot leg top-of-tube-sheet transitions were performed on all open tubes in all three steam generators. Inspections in this area reported Axial and Circumferential indications which were subsequently repaired.

## Shearon Harris Repair History

The following tables list the repair history for the Shearon Harris steam generators. Included are the repairs made during RFO-6 by ABB/Combustion Engineering.

### Steam Generator "A" Repairs

| RFO | Date | Row | Col | Type of Plug | | Reason Plugged |
|---|---|---|---|---|---|---|
| | | | | HL | CL | |
| Shop | 3/83 | 12<br>19<br>38 | 2<br>12<br>16 | Welded<br>Welded<br>Welded | Welded<br>Welded<br>Welded | MFG Defect<br>MFG Defect<br>MFG Defect |
| RFO-1 | 9/88 | 15<br>2<br>41<br>44<br>47<br>6 | 3<br>59<br>59<br>59<br>59<br>113 | ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690 | ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690 | Three tubes plugged for AVB wear, three for other reasons |
| RFO-2 | 11/89 | 45 | 59 | ABB Rolled I690 | ABB Rolled I690 | AVB Wear |
| FO | 11/90 | 9<br>10 | 112<br>113 | B&W Rolled I690<br>B&W Rolled I690 | B&W Rolled I690<br>B&W Rolled I690 | AVB Wear<br>AVB Wear |
| RFO-3 | 4/91 | 20<br>23<br>6 | 99<br>99<br>94 | B&W Rolled I690<br>B&W Rolled I690<br>B&W Rolled I690 | B&W Rolled I690<br>B&W Rolled I690<br>B&W Rolled I690 | PWSCC<br>PWSCC<br>PWSCC |
| RFO-6 | 9/95 | 34<br>36<br>25 | 32<br>32<br>71 | ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690*<br>*Stake Installed | ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690 | SAI at the TTS & TS<br>SAI at the TTS<br>SCI at the TTS |

**Steam Generator "B" Repairs**

| RFO | Date | Row | Col | Type of Plug HL | CL | Reason Plugged |
|---|---|---|---|---|---|---|
| Shop | 3/83 | 49<br>49 | 81<br>82 | Welded<br>Welded | Welded<br>Welded | MFG Defect<br>MFG Defect |
| RFO-1 | 9/88 | 43<br>44 | 59<br>59 | ABB Rolled I690<br>ABB Rolled I690 | ABB Rolled I690<br>ABB Rolled I690 | AVB Wear<br>AVB Wear |
| RFO-5 | 4/94 | 49<br>47<br>12 | 34<br>51<br>85 | W Rolled I690<br>W Rolled I690<br>W Rolled I690 | W Rolled I690<br>W Rolled I690<br>W Rolled I690 | 50% Free Span CL<br>49% Free Span CL<br>Axial Indication in TS |
| RFO-6 | 9/95 | 39<br>43 | 81<br>46 | ABB Rolled I690<br>ABB Rolled I690 | ABB Rolled I690<br>ABB Rolled I690 | SAI at the TTS<br>MAI in the TS |

## Steam Generator "C" Repairs

| RFO | Date | Row | Col | Type of Plug HL | Type of Plug CL | Reason Plugged |
|---|---|---|---|---|---|---|
| Shop | 3/83 | 27<br>27 | 21<br>22 | Welded<br>Welded | Welded<br>Welded | MFG Defect<br>MFG Defect |
| Base Line | 1/85 | 23<br>23<br>24<br>24 | 30<br>31<br>30<br>31 | W Rolled I600<br>W Rolled I600<br>W Rolled I600<br>W Rolled I600 | W Rolled I600<br>W Rolled I600<br>W Rolled I600<br>W Rolled I600 | Tube Guides left during fabrication |
| RFO-1 | 9/88 | 42<br>45 | 56<br>59 | ABB Rolled I690<br>ABB Rolled I690 | ABB Rolled I690<br>ABB Rolled I690 | AVB Wear<br>AVB Wear |
| RFO-2 | 11/89 | 47<br>33 | 66<br>100 | ABB Rolled I690<br>ABB Rolled I690 | ABB Rolled I690<br>ABB Rolled I690 | Other<br>Other |
| RFO-3 | 4/91 | 29 | 45 | B&W Rolled I690 | B&W Rolled I690 | AVB Wear |
| RFO-4 | 10/92 | 22<br>27 | 73<br>62 | Welded I690<br>Welded I690 | B&W Rolled I690<br>B&W Rolled I690 | Tube Pull-Stabilizer<br>Tube Pull |
| RFO-5 | 4/94 | 23<br>23<br>24<br>24 | 30<br>31<br>30<br>31 | W Rolled I690<br>W Rolled I690<br>W Rolled I690<br>W Rolled I690 | W Rolled I690<br>W Rolled I690<br>W Rolled I690<br>W Rolled I690 | Removal of I600 plug<br>Removal of I600 plug<br>Removal of I600 plug<br>Removal of I600 plug |
| RFO-6 | 9/95 | 23<br>23<br>24<br>24 | 30<br>31<br>30<br>31 | Welded I690<br>Welded I690<br>Welded I690<br>Welded I690 | | Removal of Leaking W I690 plugs |
| | | 15<br>22<br>23<br>32<br>46<br>47 | 48<br>71<br>71<br>84<br>59<br>59 | ABB Rolled I690*<br>ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690 | ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690<br>ABB Rolled I690 | SCI at the TTS<br>SAI at the TTS<br>SAI at the TTS<br>SAI at the TTS<br>47% AV2, 42% AV3**<br>41% AV1** |
| | | | | * Stake Installed | | ** Wear |

ALL %TWD INDICATIONS

## Steam Generator "A"

| Row | Col | Volts | Deg | % | 94 | DIF | CH | LOC | ELEV | EXT | Probe |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 88 | 15.72 | 157 | 9 | 9 | 0 | 1 | 01C | 3.14 | TEHTEC | A610MULC |
| 47 | 56 | 0.20 | | 9 | nr | 9 | P2 | AV1 | 0.00 | TEHTEC | A610MULC |
| 22 | 105 | 0.94 | 129 | 13 | 17 | -4 | 1 | 01H | 1.01 | TEHTEC | A610MULC |
| 47 | 63 | 0.55 | | 15 | 11 | 4 | P2 | AV2 | 0.00 | TEHTEC | A610MULC |
| 46 | 59 | 0.63 | | 17 | 17 | 0 | P2 | AV3 | 0.06 | TEHTEC | A610MULC |
| 42 | 59 | 0.73 | | 19 | 14 | 5 | P2 | AV1 | -0.03 | TEHTEC | A610MULC |
| 49 | 46 | 0.40 | | 19 | 14 | 5 | P2 | 07C | 0.42 | TEHTEC | A610MULC |
| 39 | 64 | 0.75 | | 20 | 19 | 1 | P2 | AV3 | 0.03 | TEHTEC | A610MULC |
| 40 | 59 | 0.83 | | 21 | 20 | 1 | P2 | AV4 | -0.03 | TEHTEC | A610MULC |
| 47 | 56 | 0.52 | | 21 | 16 | 5 | P2 | AV3 | 0.00 | TEHTEC | A610MULC |
| *1 | 114 | 1.07 | 92 | 23 | nr | 23 | P1 | TSH | 0.15 | TSHTSH | B620MRPC3C |
| 42 | 59 | 0.90 | | 23 | 24 | -1 | P2 | AV3 | 0.02 | TEHTEC | A610MULC |
| 46 | 59 | 0.93 | | 23 | 26 | -3 | P2 | AV4 | 0.09 | TEHTEC | A610MULC |
| 37 | 16 | 1.20 | 147 | 25 | nr | 25 | 1 | 01H | 0.99 | TEHTEC | A610MULC |
| 47 | 56 | 0.71 | | 26 | 21 | 5 | P2 | AV2 | 0.00 | TEHTEC | A610MULC |
| 47 | 56 | 0.69 | | 26 | 21 | 5 | P2 | AV4 | 0.00 | TEHTEC | A610MULC |
| 49 | 43 | 0.60 | | 26 | 22 | 4 | P2 | 07C | 0.39 | TEHTEC | A610MULC |
| 31 | 64 | 1.43 | | 30 | 29 | 1 | P2 | AV2 | 0.51 | TEHTEC | A610MULC |
| 49 | 61 | 1.83 | 109 | 30 | 31 | -1 | P1 | 09C | 0.09 | TEHTEC | A610MULC |
| 49 | 84 | 0.20 | 143 | 34 | 37 | -3 | 1 | 03C | 25.79 | TEHTEC | 1610MULC |

*Loose part indication measured with MRPC pancake coil.

*None of the defective (≥40%) flaw signals reported during this inspection indicated any growth of previous indications greater than 10%*[2]. Other indications which did change more than 10%, and were not reported during RFO-5 were reviewed during the RFO-6 inspection and showed no significant change.

[2]Indications from RFO-6 which were not reported during RFO-5 are shown as "nr" (not reported). These indications have been reviewed and indicate no apparent change.

## Steam Generator "B"

| Row | Col | Volts | Deg | % | 94 | DIF | CH | LOC | ELEV | EXT | Probe |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 41 | 34 | 0.18 | | 7 | 15 | -8 | P2 | AV2 | 0.00 | TEHTEC | A610MULC |
| 48 | 72 | 0.30 | | 12 | 19 | -7 | P2 | 05C | 0.47 | TEHTEC | A610MULC |
| 45 | 63 | 0.43 | | 13 | 15 | -2 | P2 | AV2 | -0.06 | TEHTEC | A610MULC |
| 39 | 18 | 0.30 | | 15 | nr | 15 | P2 | 11H | 0.38 | TEHTEC | A610MULC |
| 47 | 72 | 0.42 | | 16 | 15 | 1 | P2 | 05C | 0.65 | TEHTEC | A610MULC |
| 41 | 38 | 0.44 | | 17 | 18 | -1 | P2 | AV3 | -0.12 | TEHTEC | A610MULC |
| 46 | 59 | 0.50 | | 18 | nr | 18 | P2 | AV4 | 0.00 | TEHTEC | A610MULC |
| 29 | 67 | 0.72 | 155 | 19 | 14 | 5 | 1 | 10C | -0.83 | TEHTEC | A610MULC |
| 28 | 97 | 0.46 | | 22 | 20 | 2 | P2 | AV4 | 0.17 | TEHTEC | A610MULC |
| 40 | 96 | 0.82 | | 25 | nr | 25 | P2 | 02C | 0.52 | TEHTEC | A610MULC |
| 42 | 56 | 0.74 | | 25 | 23 | 2 | P2 | AV2 | -0.03 | TEHTEC | A610MULC |
| 45 | 59 | 0.77 | | 25 | 24 | 1 | P2 | AV4 | 0.00 | TEHTEC | A610MULC |
| 45 | 59 | 0.86 | | 27 | 27 | 0 | P2 | AV1 | 0.00 | TEHTEC | A610MULC |
| 46 | 59 | 0.88 | | 27 | 25 | 2 | P2 | AV2 | 0.00 | TEHTEC | A610MULC |

## Steam Generator "C"

| Row | Col | Volts | Deg | % | 94 | DIF | CH | LOC | ELEV | EXT | Probe |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 34 | 59 | 1.17 | 120 | 5 | nr | 5 | P1 | 03C | 0.00 | TEHTEC | A610MULC |
| 6 | 74 | 1.21 | 159 | 6 | nr | 6 | 1 | 04C | 6.80 | TEHTEC | A610MULC |
| 32 | 77 | 0.31 | | 8 | 11 | -3 | P2 | AV3 | -0.03 | TEHTEC | A610MULC |
| 48 | 59 | 0.31 | | 8 | nr | 8 | P2 | AV2 | 0.00 | TEHTEC | A610MULC |
| 37 | 86 | 0.33 | | 10 | 9 | 1 | P2 | AV3 | -0.05 | TEHTEC | A610MULC |
| 40 | 60 | 0.35 | | 10 | 13 | -3 | P2 | AV2 | 0.00 | TEHTEC | A610MULC |
| 39 | 74 | 0.39 | | 11 | nr | 11 | P2 | AV3 | 0.00 | TEHTEC | A610MULC |
| 30 | 46 | 0.33 | | 12 | 25 | -13 | P2 | AV3 | -0.08 | TEHTEC | A610MULC |
| 49 | 34 | 0.43 | | 12 | 13 | -1 | P2 | AV2 | 0.24 | TEHTEC | A610MULC |
| 48 | 59 | 0.53 | | 14 | 13 | 1 | P2 | AV1 | -0.03 | TEHTEC | A610MULC |
| 49 | 67 | 0.40 | | 14 | nr | 14 | P2 | 07C | -0.32 | TEHTEC | A610MULC |
| 14 | 78 | 42.16 | 154 | 15 | 7 | 8 | 1 | 02C | -0.03 | TEHTEC | A610MULC |
| 28 | 45 | 0.49 | | 15 | 15 | 0 | P2 | AV1 | 0.00 | TEHTEC | A610MULC |
| 33 | 43 | 0.53 | | 15 | 17 | -2 | P2 | AV3 | 0.05 | TEHTEC | A610MULC |
| 33 | 45 | 0.51 | | 15 | 13 | 2 | P2 | AV3 | -0.09 | TEHTEC | A610MULC |
| 34 | 45 | 0.51 | | 15 | 15 | 0 | P2 | AV3 | -0.19 | TEHTEC | A610MULC |
| 40 | 56 | 0.50 | | 15 | 13 | 2 | P2 | AV1 | -0.11 | TEHTEC | A610MULC |
| 43 | 59 | 0.55 | | 15 | 12 | 3 | P2 | AV2 | -0.05 | TEHTEC | A610MULC |
| 40 | 56 | 0.57 | | 16 | 18 | -2 | P2 | AV3 | -0.08 | TEHTEC | A610MULC |
| 34 | 46 | 1.69 | | 17 | nr | 17 | P2 | AV3 | -0.32 | TEHTEC | A610MULC |
| 27 | 46 | 0.49 | | 18 | 12 | 6 | P2 | AV1 | 0.00 | TEHTEC | A610MULC |
| 43 | 56 | 0.55 | | 18 | 17 | 1 | P2 | 09C | -0.38 | TEHTEC | A610MULC |
| 25 | 45 | 0.53 | | 19 | 22 | -3 | P2 | AV2 | -0.35 | TEHTEC | A610MULC |
| 41 | 56 | 0.59 | | 19 | 23 | -4 | P2 | AV2 | 0.00 | TEHTEC | A610MULC |
| 33 | 45 | 0.80 | | 21 | 13 | 8 | P2 | AV1 | -0.02 | TEHTEC | A610MULC |
| 28 | 46 | 0.79 | | 22 | 16 | 6 | P2 | AV2 | 0.00 | TEHTEC | A610MULC |
| 30 | 46 | 0.67 | | 22 | 12 | 10 | P2 | AV1 | -0.44 | TEHTEC | A610MULC |
| 44 | 59 | 0.96 | | 23 | 23 | 0 | P2 | AV2 | 0.00 | TEHTEC | A610MULC |
| 23 | 45 | 0.90 | | 24 | 22 | 2 | P2 | AV2 | 0.00 | TEHTEC | A610MULC |

## Steam Generator "C"

| Row | Col | Volts | Deg | % | 94 | DIF | CH | LOC | ELEV | EXT | Probe |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45 | 56 | 0.82 | | 24 | 14 | 10 | P2 | AV4 | 0.00 | TEHTEC | A610MULC |
| 40 | 19 | 0.91 | | 25 | 20 | 5 | P2 | AV4 | -0.22 | TEHTEC | A610MULC |
| 36 | 59 | 0.62 | 142 | 26 | nr | 26 | 1 | TSH | 1.23 | TEHTEC | A610MULC |
| 46 | 59 | 1.12 | | 26 | 14 | 12 | P2 | AV4 | 0.00 | TEHTEC | A610MULC |
| 39 | 86 | 1.08 | | 27 | 25 | 2 | P2 | AV3 | 0.00 | TEHTEC | A610MULC |
| 14 | 77 | 2.29 | 139 | 29 | 32 | -3 | 1 | 02C | 1.90 | TEHTEC | A610MULC |
| 34 | 44 | 1.81 | | 31 | 24 | 7 | P2 | AV2 | 1.13 | TEHTEC | A610MULC |
| 31 | 45 | 1.51 | | 32 | 30 | 2 | P2 | AV1 | 0.00 | TEHTEC | A610MULC |
| 41 | 20 | 1.76 | | 33 | 31 | 2 | P2 | AV4 | 0.00 | TEHTEC | A610MULC |
| 45 | 56 | 1.59 | | 35 | 31 | 4 | P2 | AV1 | 0.00 | TEHTEC | A610MULC |
| 4 | 105 | 0.35 | 138 | 36 | 39 | -3 | 1 | 01C | 1.58 | TEHTEC | A610MULC |
| 22 | 99 | 2.27 | 110 | 37 | 37 | 0 | P1 | 01H | 0.67 | TEHTEC | A610MULC |
| 30 | 44 | 1.67 | | 37 | 29 | 8 | P2 | AV2 | -0.03 | TEHTEC | A610MULC |
| 30 | 45 | 2.26 | | 39 | 33 | 6 | P2 | AV1 | 0.00 | TEHTEC | A610MULC |
| 47 | 59 | 2.28 | | 41 | 36 | 5 | P2 | AV1 | 0.00 | TEHTEC | A610MULC |
| 46 | 59 | 2.67 | | 42 | 32 | 10 | P2 | AV3 | 0.00 | TEHTEC | A610MULC |
| 46 | 59 | 3.48 | | 47 | 39 | 8 | P2 | AV2 | 0.00 | TEHTEC | A610MULC |

Another aspect of this outage, was the inspection of dented intersections with three-coil MRPC technique. A selection of 20% of the dented intersections greater than five volts as reported during RFO-5 were examined. The selection included all of the straight section hot leg tubes in steam generators "A" and "B", and the majority of the straight section hot leg tubes in steam genertor "C", as well as a selection of straight section cold leg tubes in all three steam generators. *None of the dented intersections reported any indications indicative of degradation.*

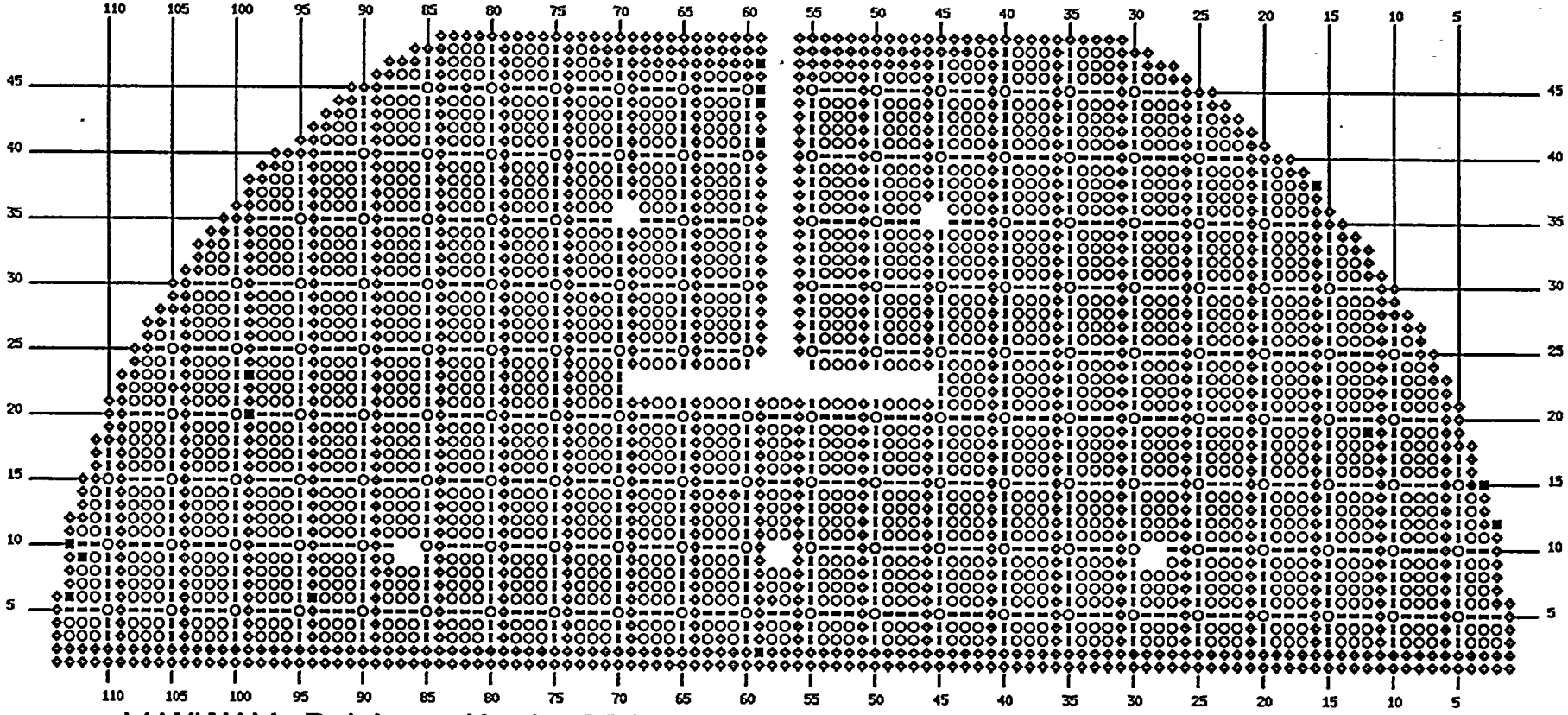
A sample of 20% (twenty five) tubes were inspected in steam generator "C" at the cold leg pre-heater expansions. The three-coil MRPC coil was utilized and included both expansion transitions at 02C and 03C. *None of the expanded intersections reported any indications indicative of degradation.*

A sample of 20% of the row one and two U-bend locations were examined utilizing a single coil (pancake) MRPC probe. The area examined ranged from 07H-07C. *None of the U-bends reported any indications indicative of degradation.*

Additional information may be found by reviewing the graphic tube-sheet maps found in the following sections. These include:

Tubes Examined with Bobbin Probe
Tubes Examined with Bobbin Probe which exhibit % Through wall Indications
Tubes Examined with MRPC Probe for Top-of-Tube-sheet area
Tubes Examined with MRPC Probe for Dented Locations
Tubes Examined with MRPC Probe for U-bend Locations
Tubes Examined with MRPC Probe for Pre-Heater transitions (SG "C" only)
Tubes Examined with MRPC PRobe exhibiting MCI, SCI, MAI or SAI indications (TTS)

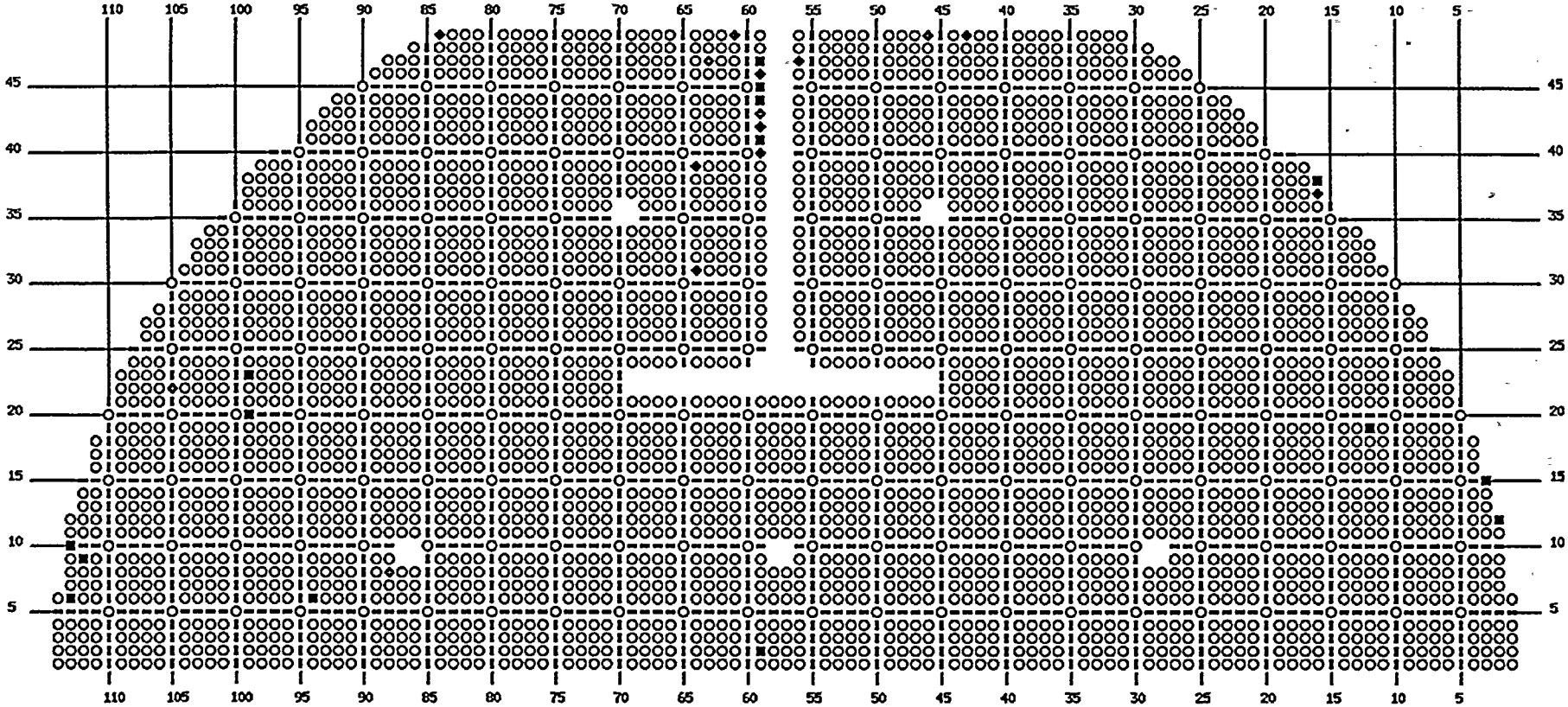
# Carolina Power & Light Shearon Harris UNIT: 1 SG: A All Tubes Tested with Bobbin Probe




## MANWAY Database: Harris_SGA_1995 Model: W_Series_D4 OUTLET NOZZLE

| Character | Total |
|---|---|
| ○ Default Tube | 3246 |
| ■ Default Plug | 15 |
| Default Stay | 122 |
| ◇ Non-Stat Query Result: | 1317 |

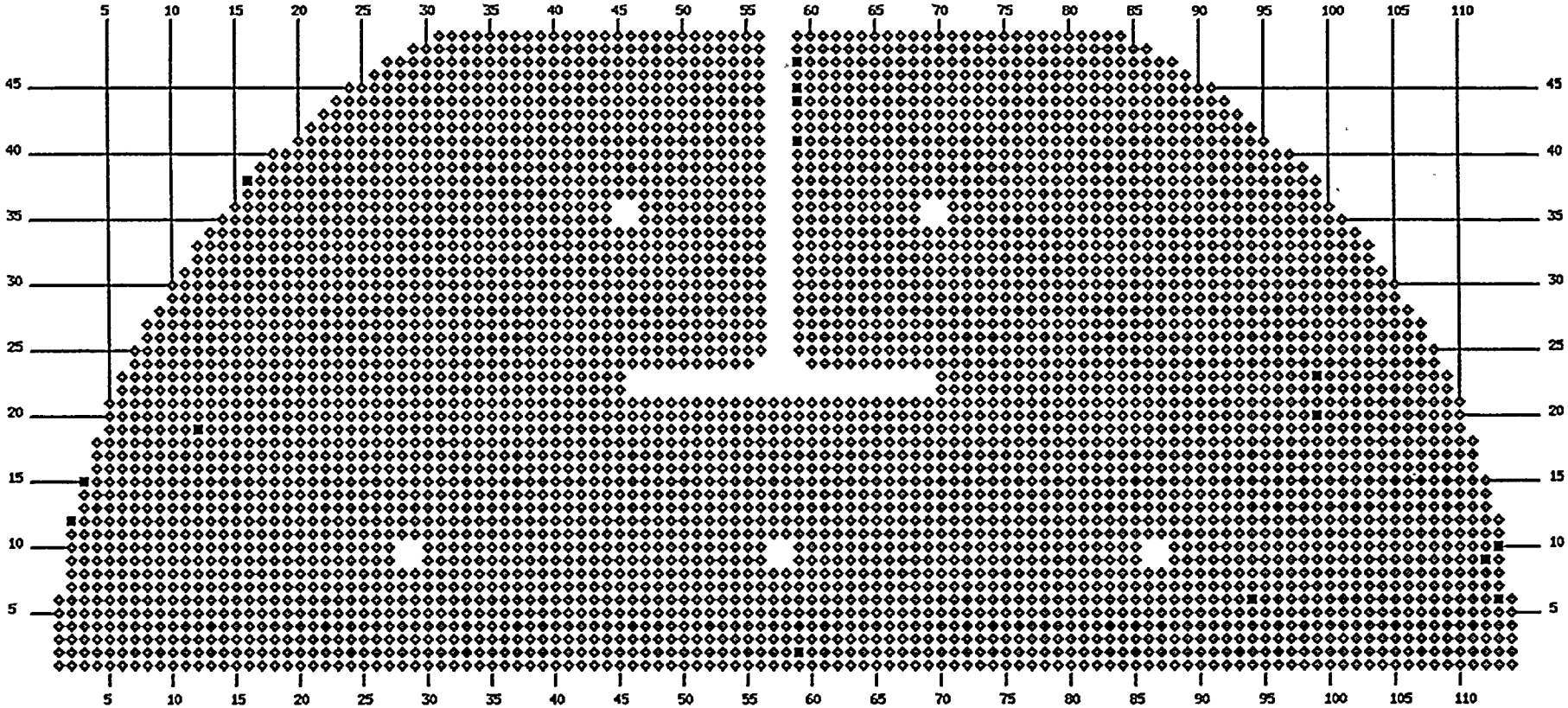
# Carolina Power & Light Shearon Harris UNIT: 1 SG: A % TWH Indications




## MANWAY Database: Harris_SGA_1995 Model: W_Series_D4 OUTLET NOZZLE

| Character | Total |
|---|---|
| ○ Default Tube | 4543 |
| ■ Default Plug | 15 |
| Default Stay | 122 |
| ◆ 1 —> 19 Percent | 5 |
| ◆ 20 —> 39 Percent | 10 |
| ◇ 40 —> 99 Percent | 0 |

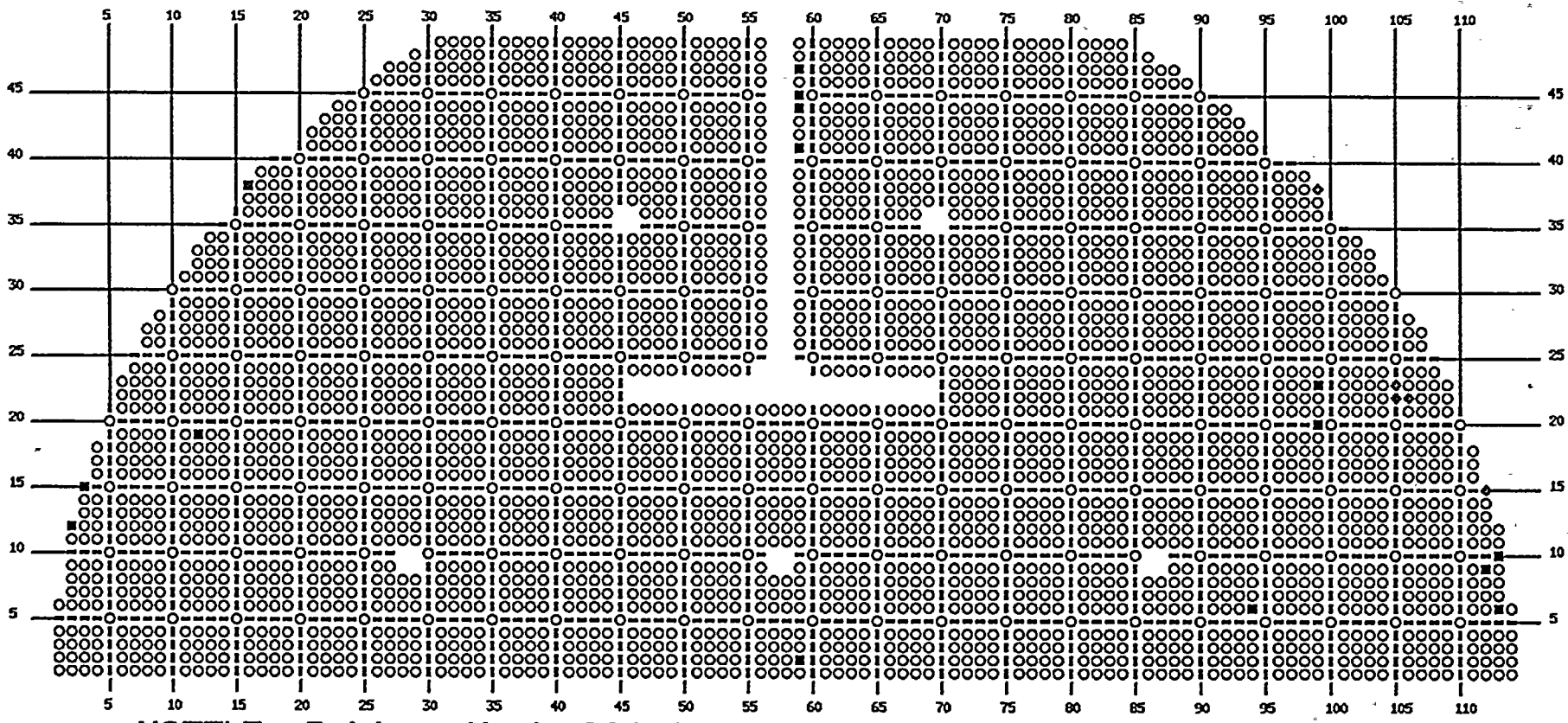
# Carolina Power & Light Shearon Harris UNIT: 1 SG: A TSH MRPC Exams




NOZZLE Database: Harris_SGA_1995 Model: W_Series_D4 INLET MANWAY

| Character | Total |
|---|---|
| ■ Default Plug | 15 |
| Default Stay | 122 |
| ◇ Non-Stat Query Result: | 4563 |

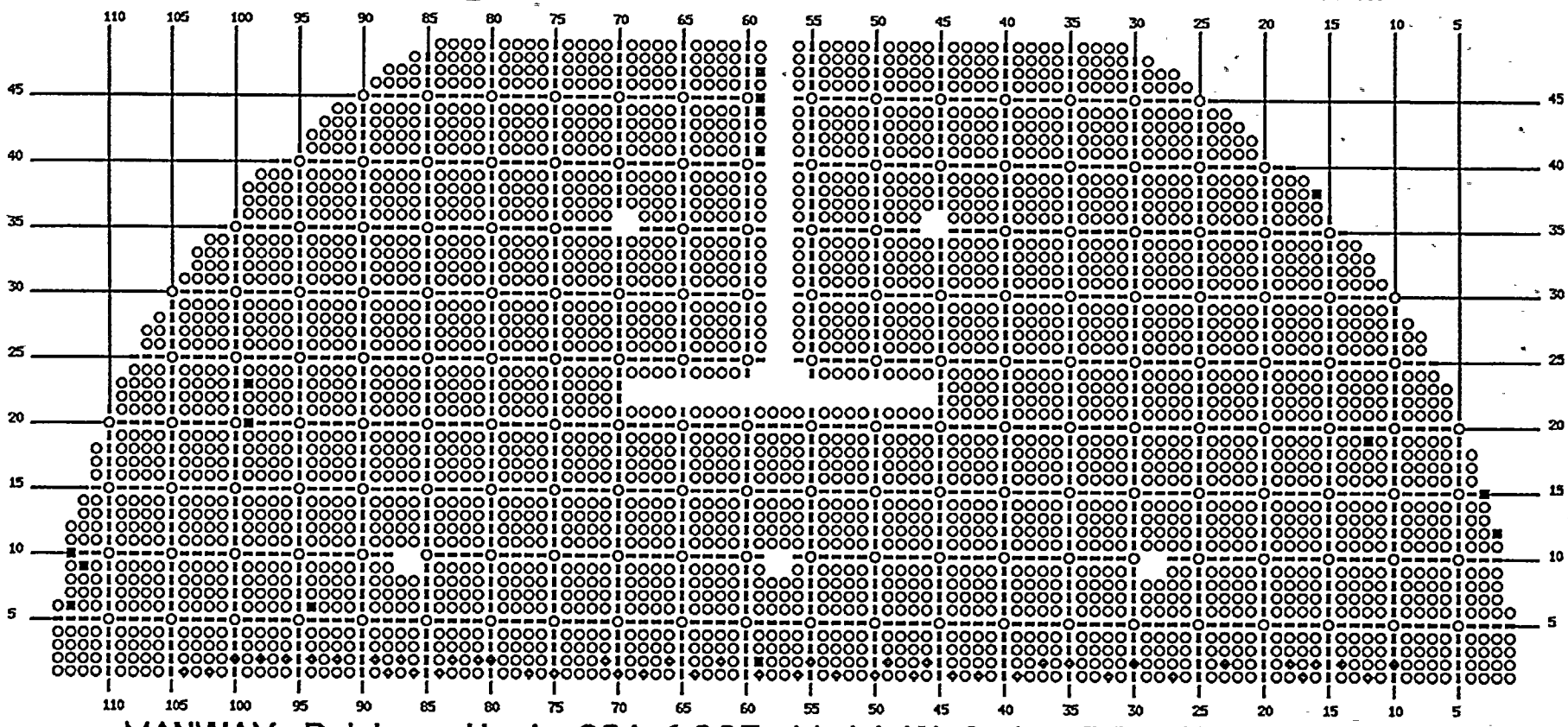
Carolina Power & Light Shearon Harris UNIT: 1 SG: A All Tubes Tested at Dented Locations (MRPC)




NOZZLE Database: Harris_SGA_1995 Model: W_Series_D4 INLET MANWAY

| Character | Total |
|---|---|
| ○ Default Tube | 4550 |
| ■ Default Plug | 15 |
| Default Stay | 122 |
| ◆ Non-Stat Query Result: | 5 |

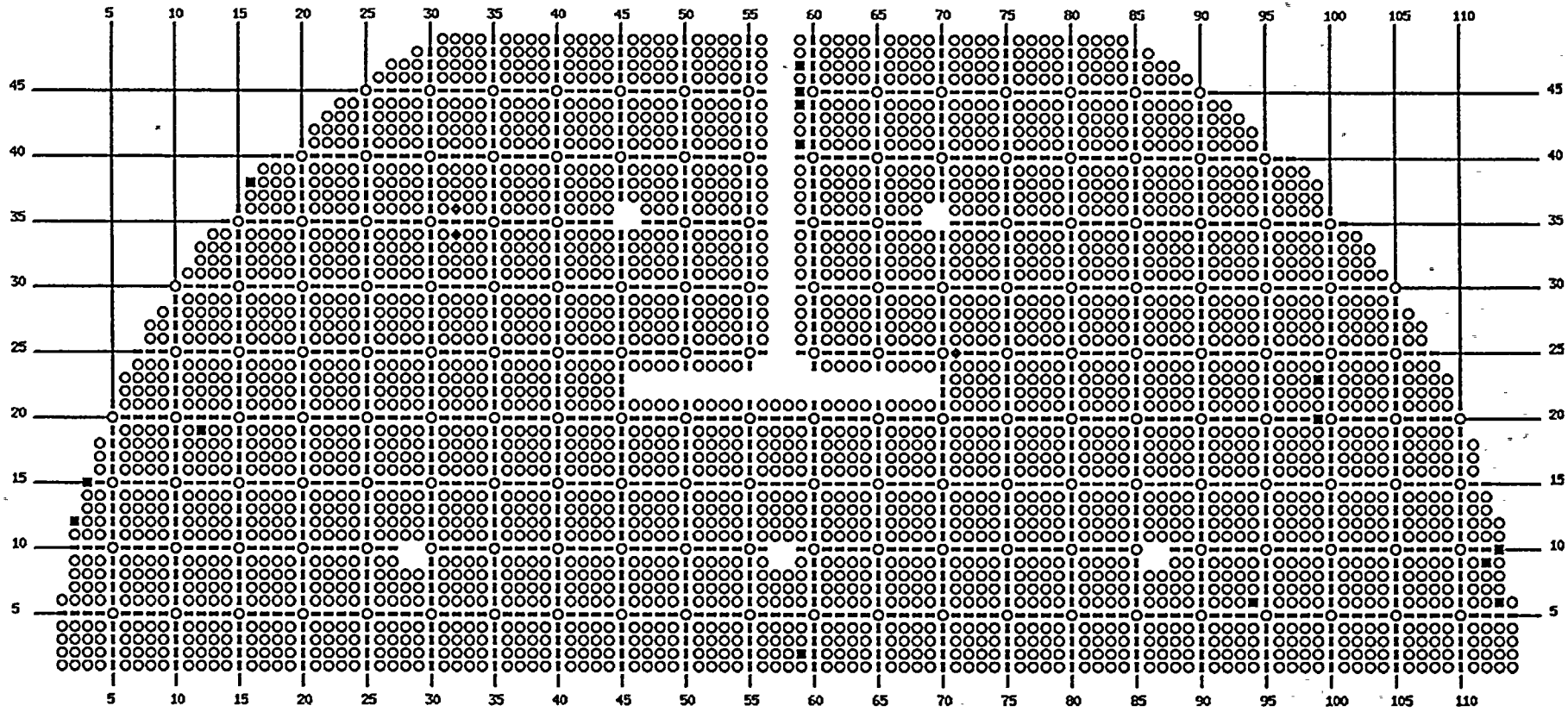
# Carolina Power & Light Shearon Harris UNIT: 1 SG: A U-Bend MRPC Exams




## MANWAY Database: Harris_SGA_1995 Model: W_Series_D4 OUTLET NOZZLE

| Character | Total |
|---|---|
| ○ Default Tube | 4517 |
| ■ Default Plug | 15 |
| Default Stay | 122 |
| ◇ Non-Stat Query Result: | 46 |

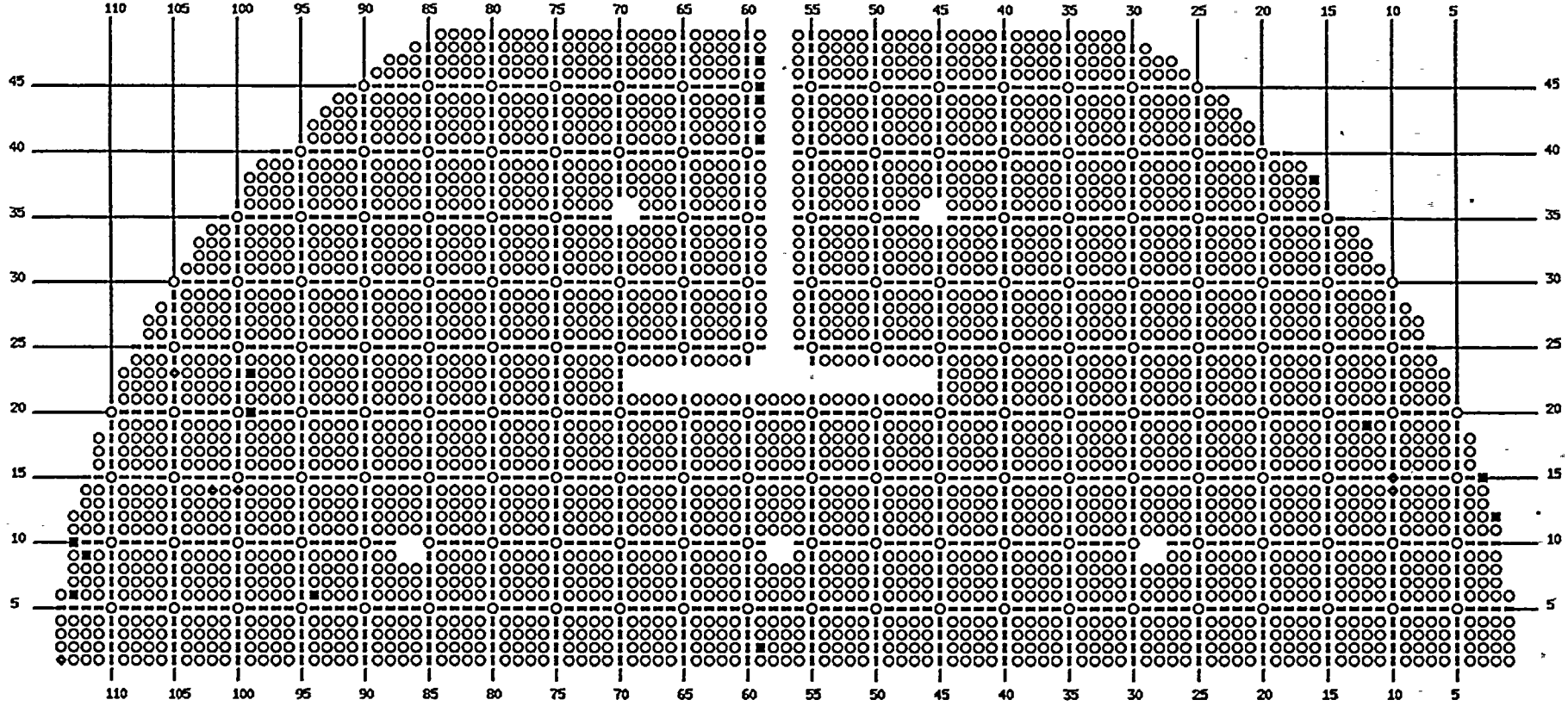
Carolina Power & Light Shearon Harris UNIT: 1 SG: A Tubes with MCI, SCI, MAI, SAI Report Entries




NOZZLE Database: Harris_SGA_1995 Model: W_Series_D4 INLET MANWAY

| Character | | Total |
|---|---|---|
| ○ | Default Tube | 4560 |
| ■ | Default Plug | 15 |
| | Default Stay | 122 |
| ◇ | MAI Indications | 1 |
| ◆ | MCI Indications | 0 |
| ◆ | SAI Indications | 1 |
| ◇ | SCI Indications | 1 |

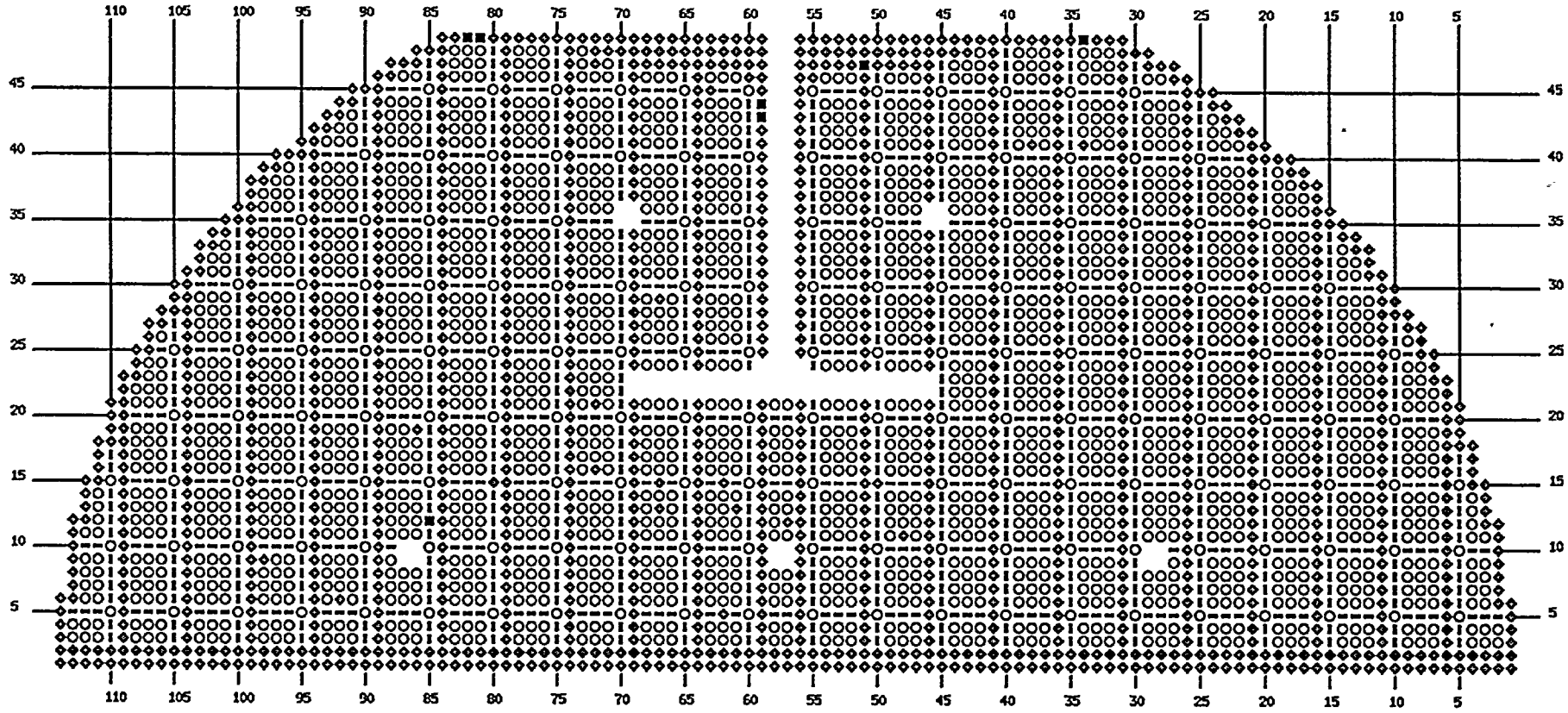
# Carolina Power & Light Shearon Harris UNIT: 1 SG: A Tubes with PLP Report Entries




## MANWAY Database: Harris_SGA_1995 Model: W_Series_D4 OUTLET NOZZLE

| Character | | Total |
|---|---|---|
| ○ | Default Tube | 4537 |
| ■ | Default Plug | 15 |
| | Default Stay | 122 |
| ◇ | PLP Indications | 6 |

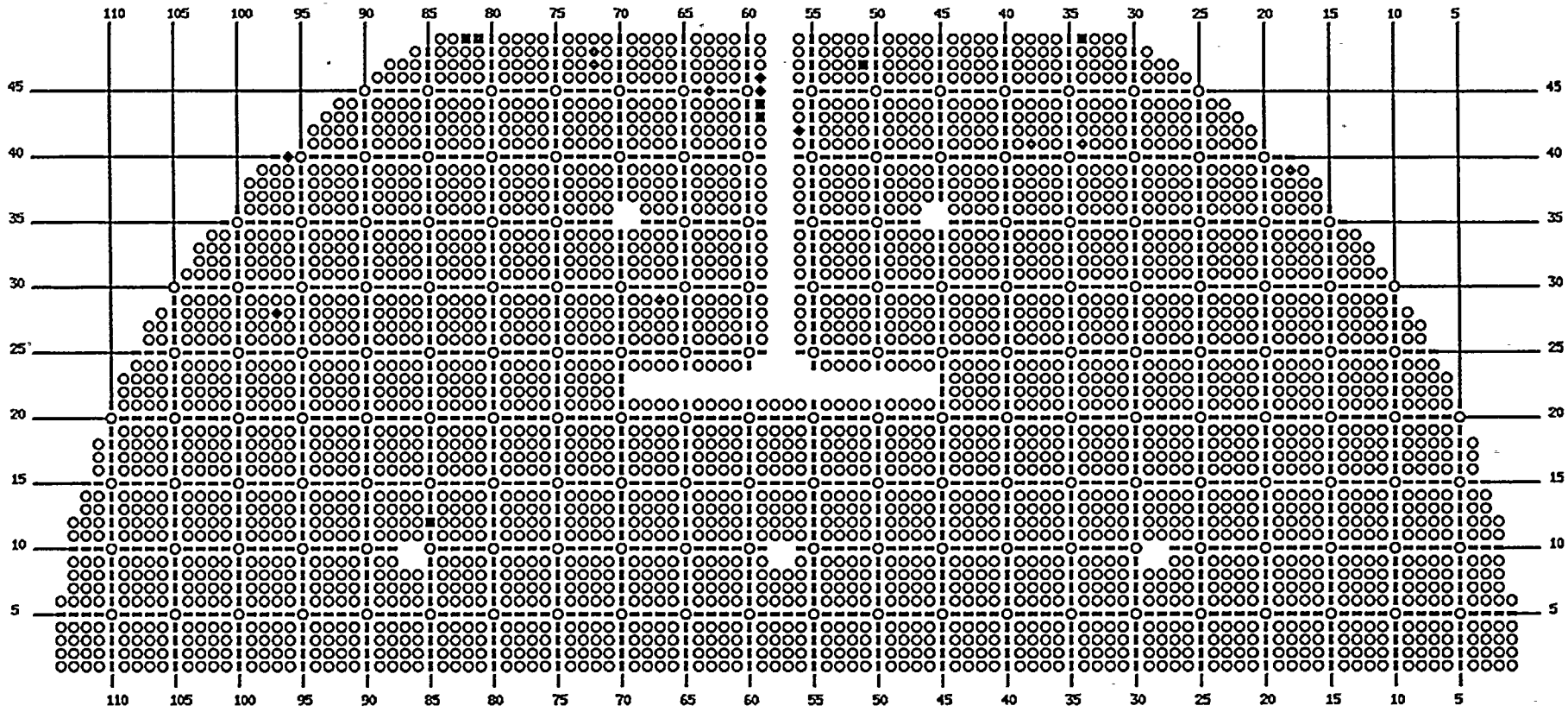
# Carolina Power & Light Shearon Harris UNIT: 1 SG: B All Tubes Tested with Bobbin Probe




## MANWAY Database: Harris_SGB_1995 Model: W_Series_D4 OUTLET NOZZLE

| Character | Total |
|---|---|
| ○ Default Tube | 3237 |
| ■ Default Plug | 7 |
| Default Stay | 122 |
| ◇ Non-Stat Query Result: | 1334 |

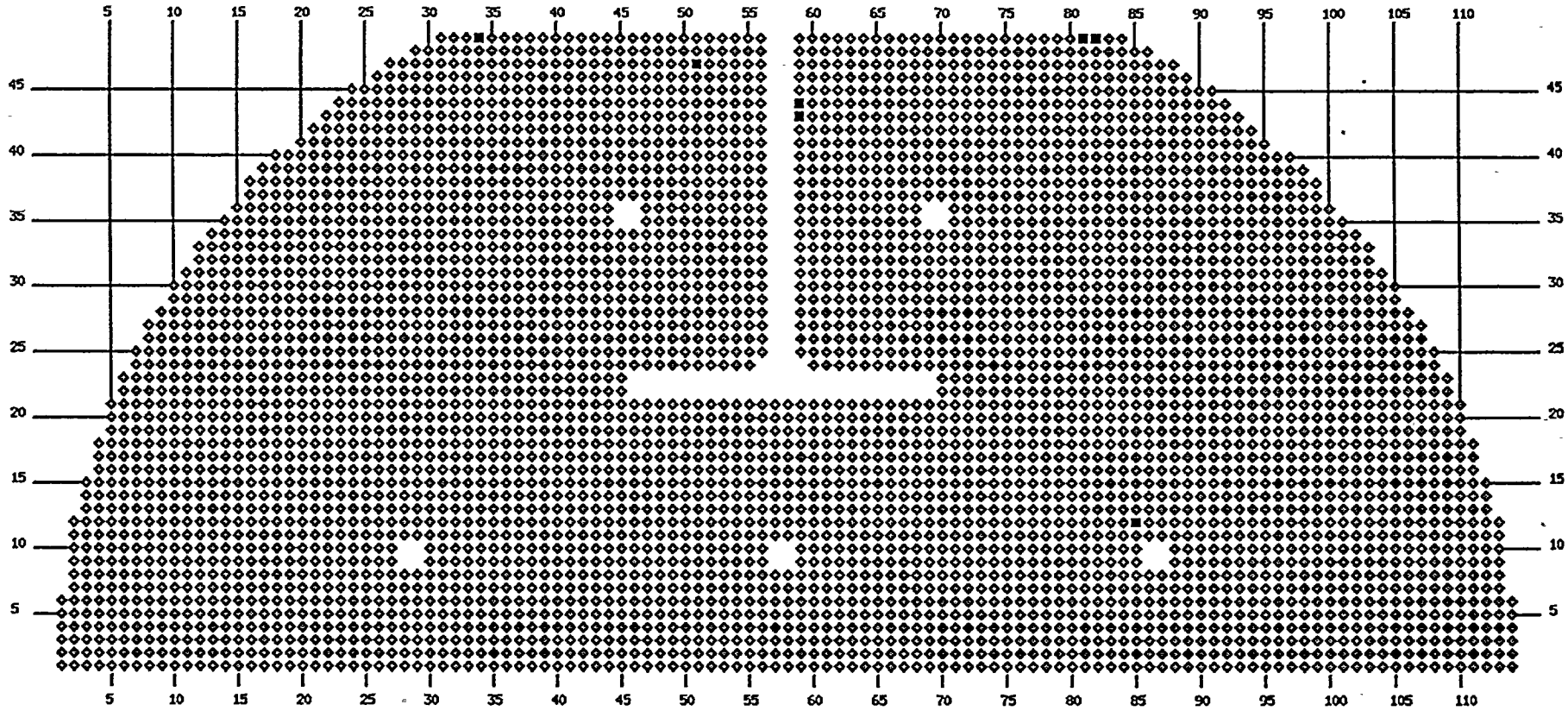
# Carolina Power & Light Shearon Harris UNIT: 1 SG: B % TWH Indications




## MANWAY Database: Harris_SGB_1995 Model: W_Series_D4 OUTLET NOZZLE

| Character | Total |
|---|---|
| ○ Default Tube | 4559 |
| ■ Default Plug | 7 |
| Default Stay | 122 |
| ◆ 1 —> 19 Percent | 7 |
| ◆ 20 —> 39 Percent | 5 |
| ◆ 40 —> 99 Percent | 0 |

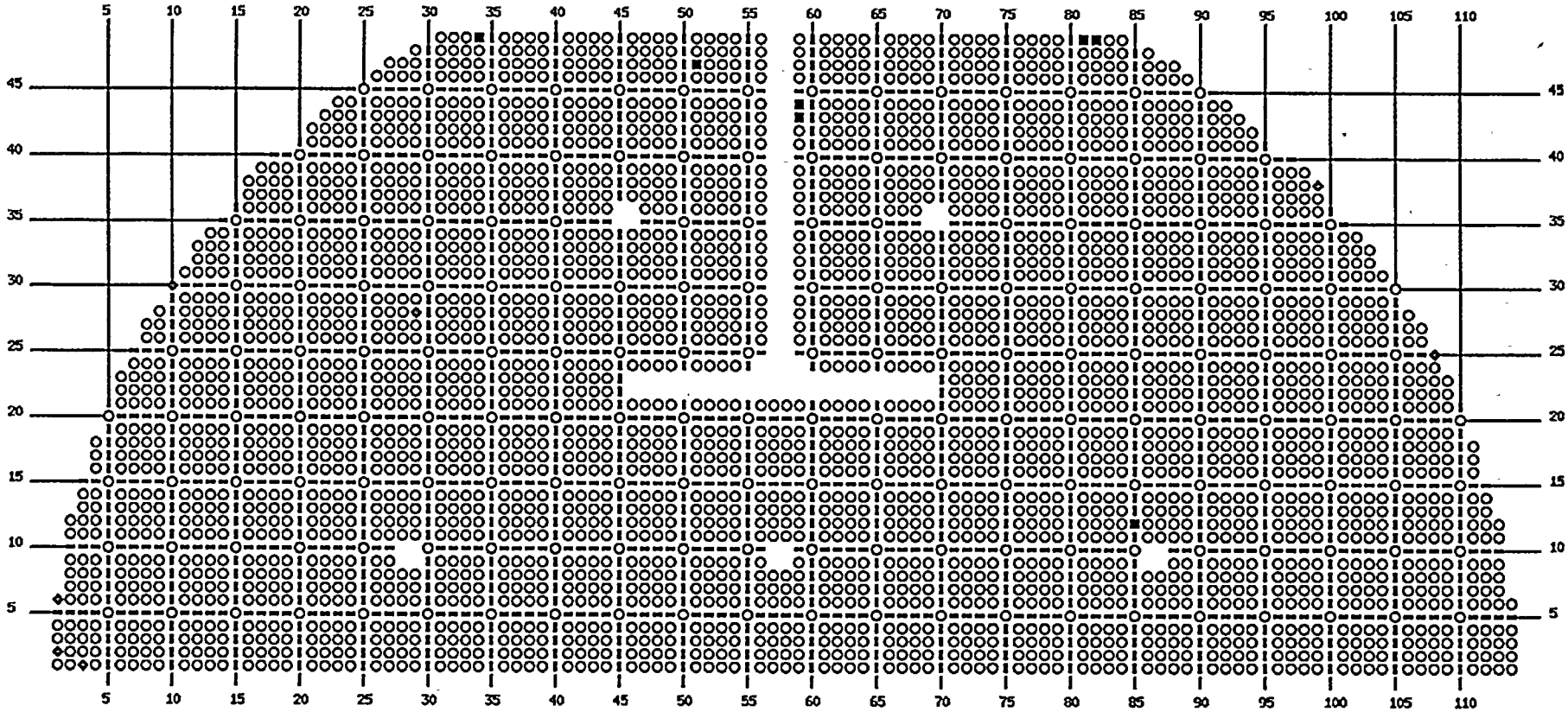
# Carolina Power & Light Shearon Harris UNIT: 1 SG: B TSH MRPC Exams




NOZZLE Database: Harris_SGB_1995 Model: W_Series_D4 INLET MANWAY

| Character | Total |
|---|---|
| ■ Default Plug | 7 |
| Default Stay | 122 |
| ◇ Non-Stat Query Result: | 4571 |

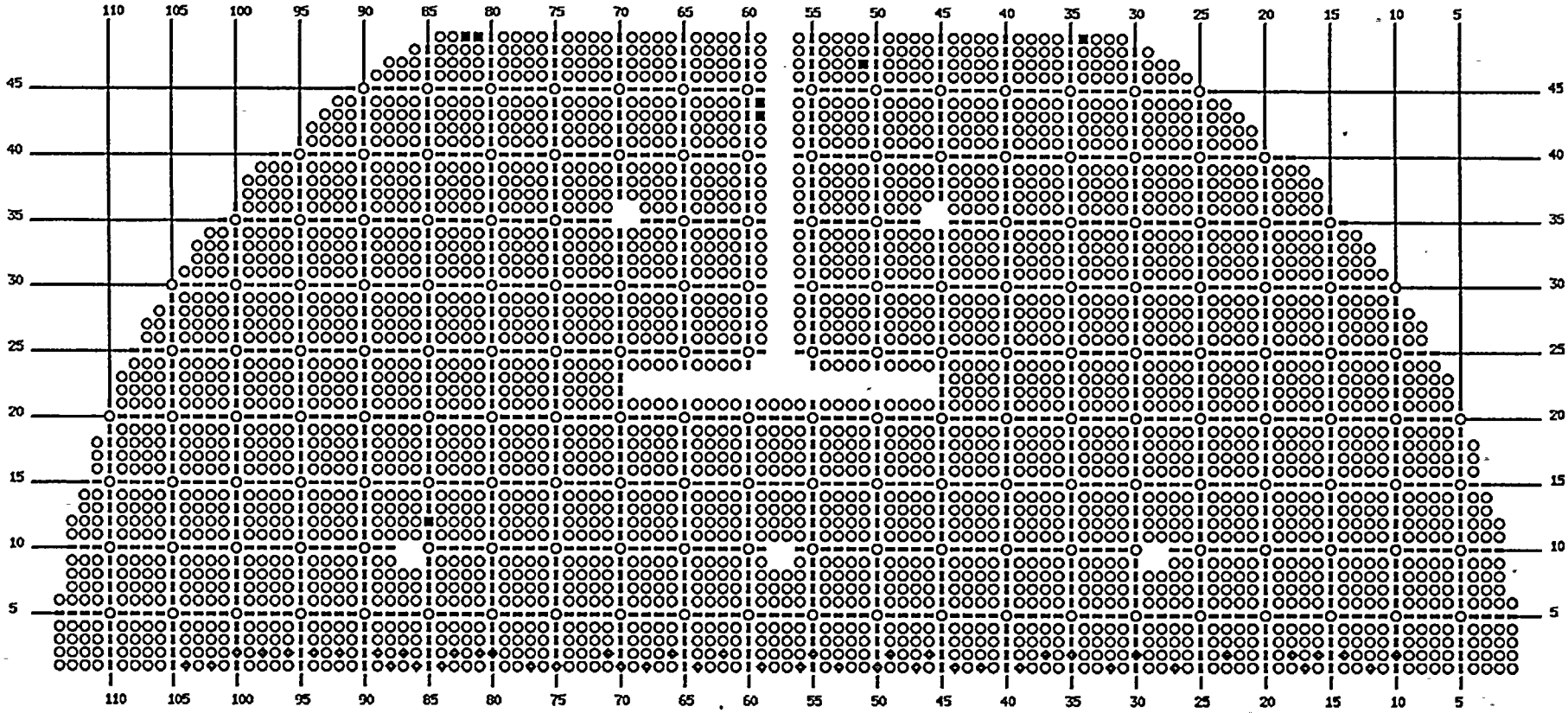
Carolina Power & Light Shearon Harris UNIT: 1 SG: B All Tubes Tested at Dented Locations (MRPC)




NOZZLE Database: Harris_SGB_1995 Model: W_Series_D4 INLET MANWAY

| Character | Total |
|---|---|
| ○ Default Tube | 4564 |
| ■ Default Plug | 7 |
| Default Stay | 122 |
| ◇ Non-Stat Query Result: | 7 |

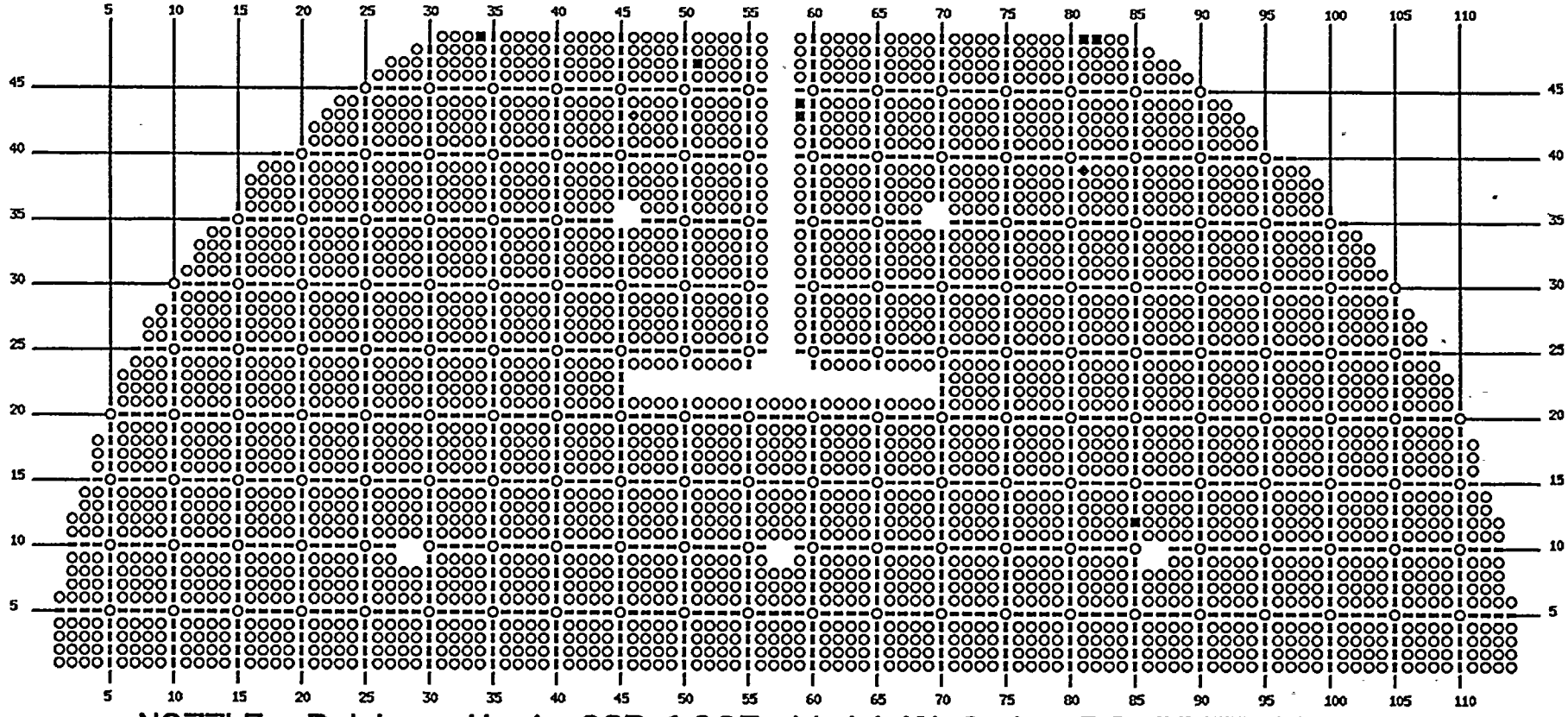
# Carolina Power & Light Shearon Harris UNIT: 1 SG: B U-Bend MRPC Exams




## MANWAY Database: Harris_SGB_1995 Model: W_Series_D4 OUTLET NOZZLE

| Character | Total |
|---|---|
| ○ Default Tube | 4525 |
| ■ Default Plug | 7 |
| Default Stay | 122 |
| ◇ Non-Stat Query Result: | 46 |

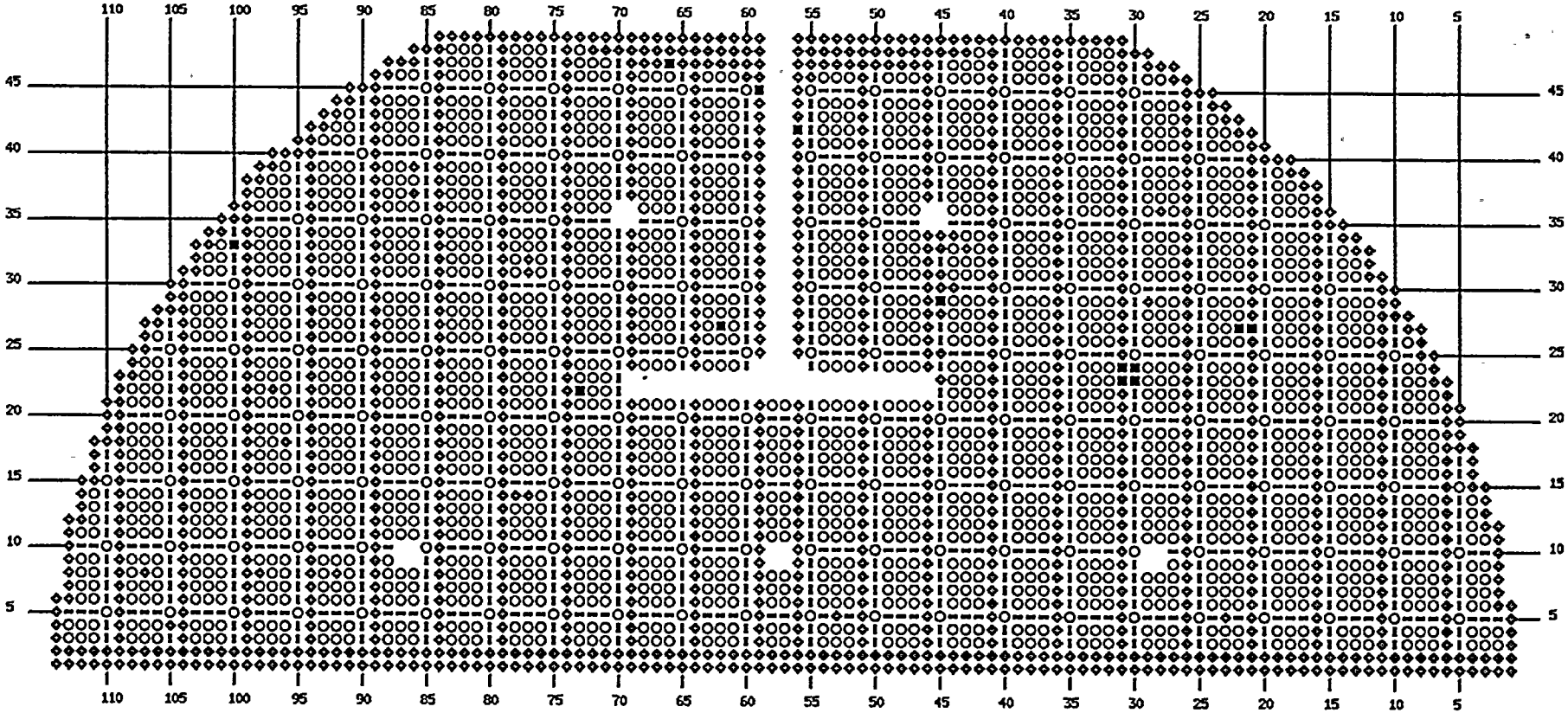
Carolina Power & Light Shearon Harris UNIT: 1 SG:/B Tubes with MCI, SCI, MAI, SAI Report Entries



NOZZLE Database: Harris_SGB_1995 Model: W_Series_D4 INLET MANWAY

| Character | | Total |
|---|---|---|
| ○ Default Tube | | 4569 |
| ■ Default Plug | | 7 |
| Default Stay | | 122 |
| ◆ MAI | Indications | 1 |
| ◆ MCI | Indications | 0 |
| ◆ SAI | Indications | 1 |
| ◆ SCI | Indications | 0 |

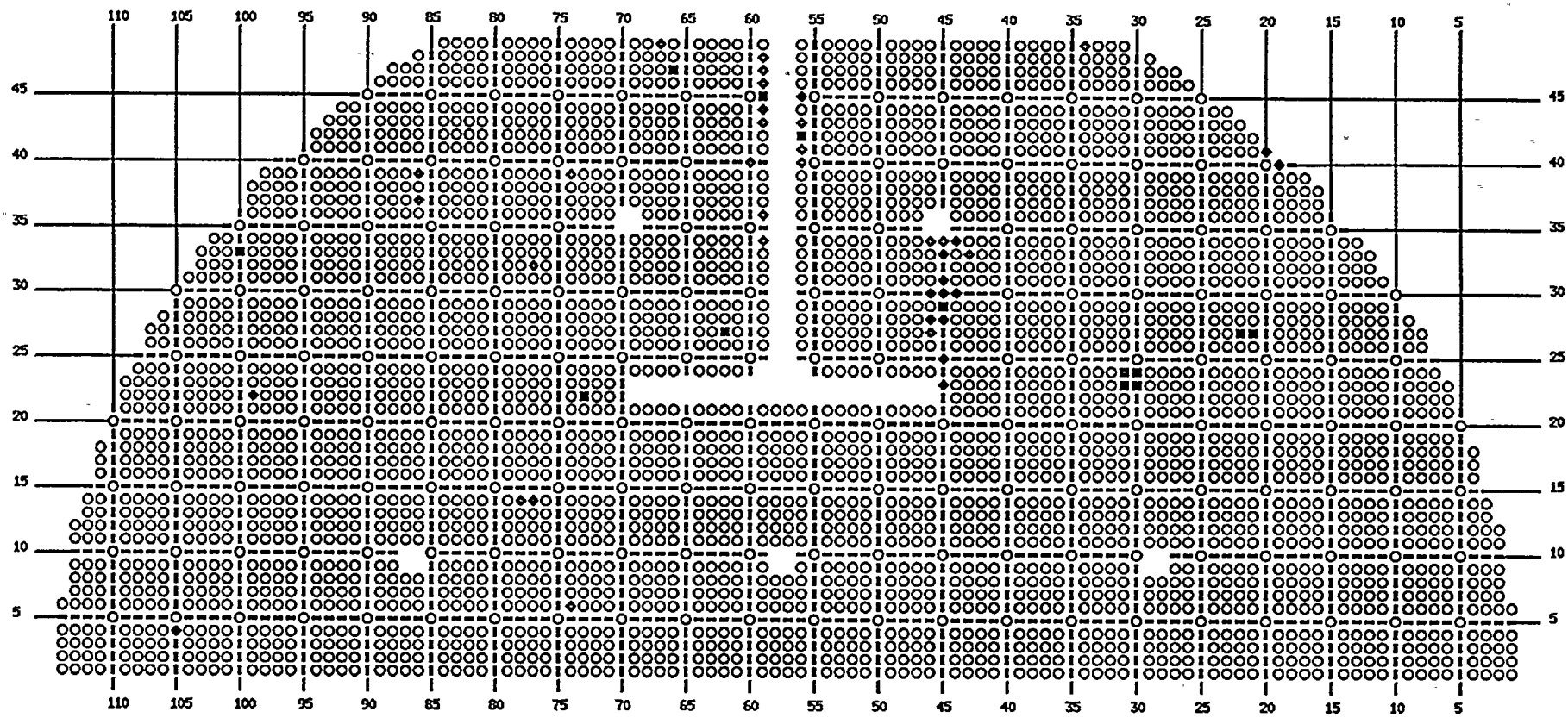
# Carolina Power & Light Shearon Harris UNIT: 1 SG: C All Tubes Tested with Bobbin Probe




## MANWAY Database: Harris_SGC_1995 Model: W_Series_D4 OUTLET NOZZLE

| Character | Total |
|---|---|
| ○ Default Tube | 3224 |
| ■ Default Plug | 13 |
| Default Stay | 122 |
| ◆ Non-Stat Query Result: | 1341 |

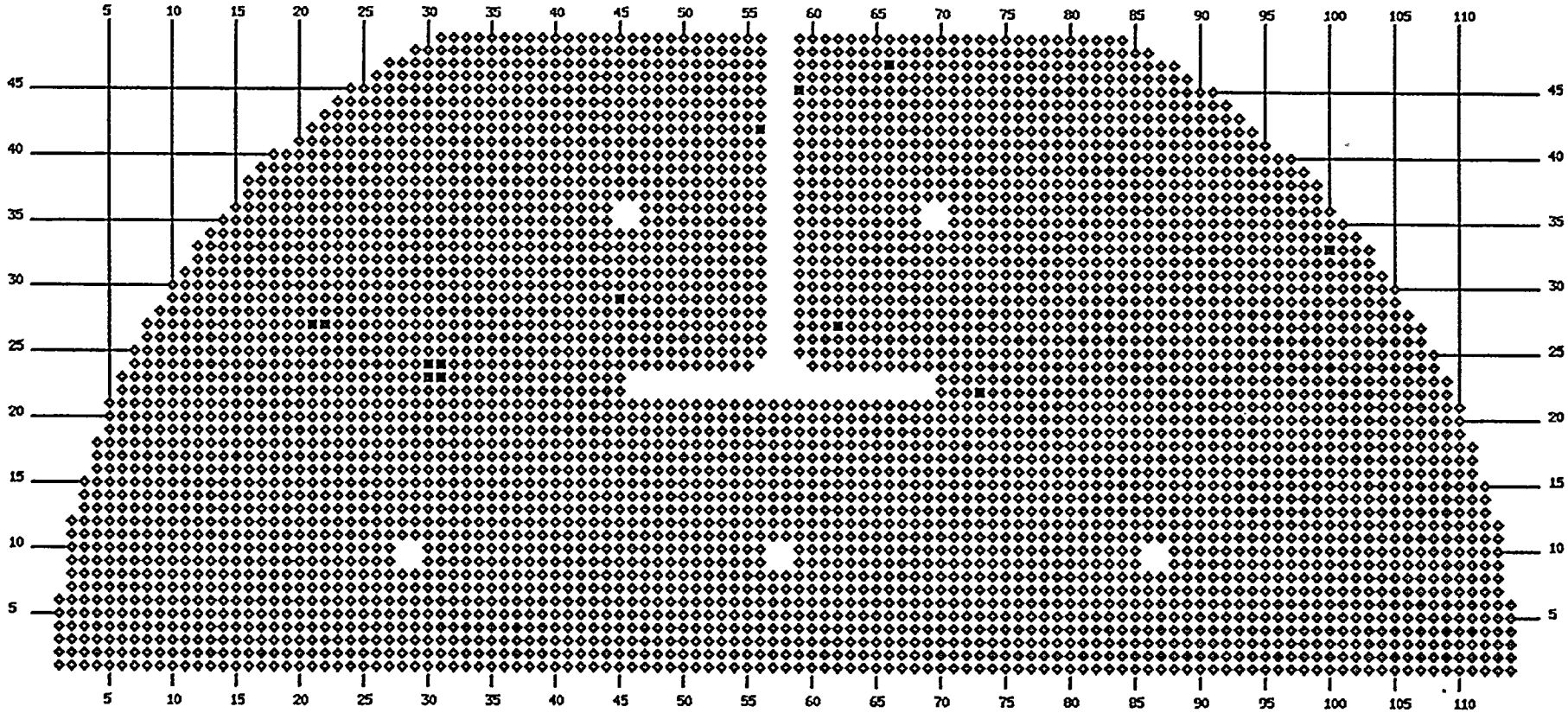
# Carolina Power & Light Shearon Harris UNIT: 1 SG: C % TWH Indications




## MANWAY Database: Harris_SGC_1995 Model: W_Series_D4 OUTLET NOZZLE

| Character | | Total |
|---|---|---|
| ○ | Default Tube | 4526 |
| ■ | Default Plug | 13 |
| | Default Stay | 122 |
| ◆ | 1 —> 19 Percent | 20 |
| ◆ | 20 —> 39 Percent | 17 |
| ◆ | 40 —> 99 Percent | 2 |

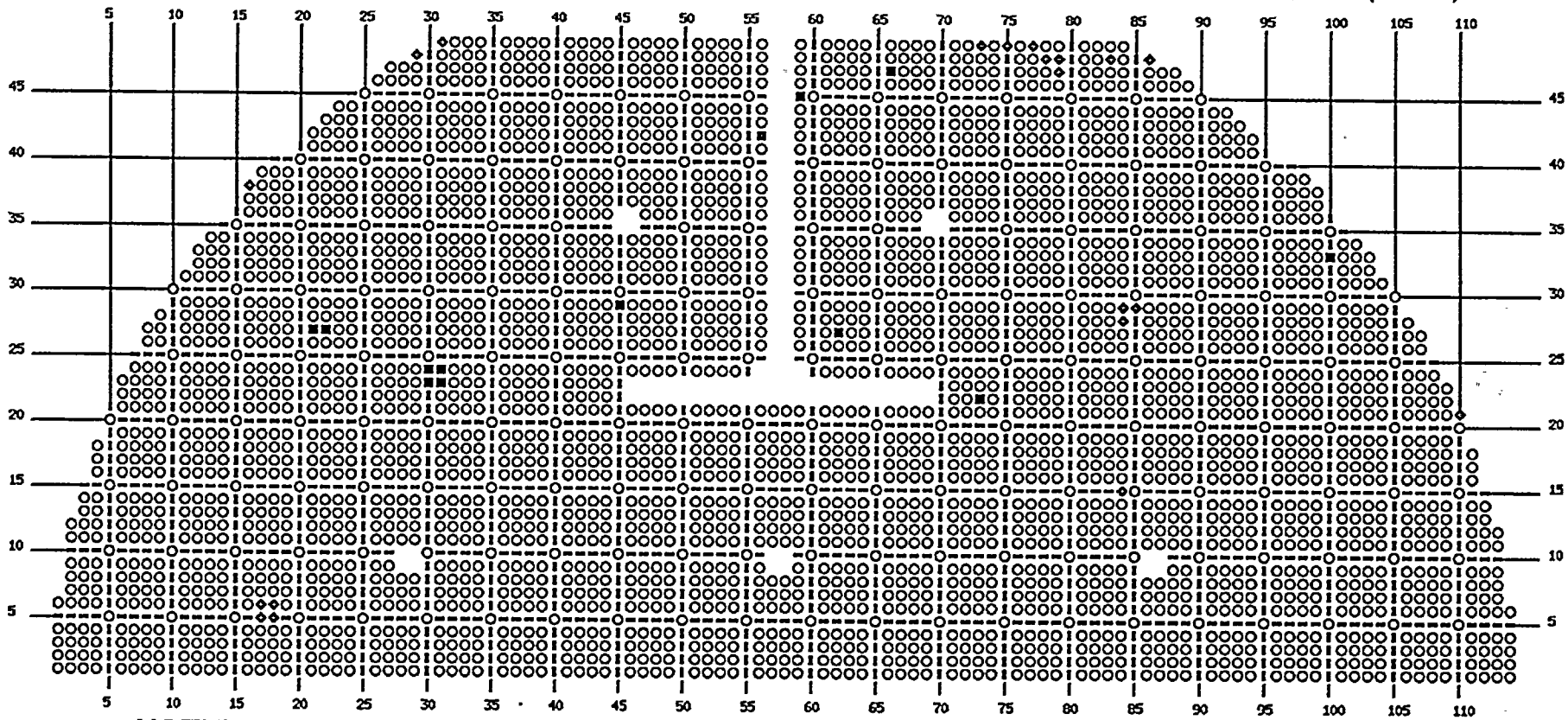
# Carolina Power & Light Shearon Harris UNIT: 1 SG: C TSH MRPC Exams




NOZZLE Database: Harris_SGC_1995 Model: W_Series_D4 INLET MANWAY

| Character | Total |
|---|---|
| ■ Default Plug | 13 |
| Default Stay | 122 |
| ◇ Non-Stat Query Result: | 4565 |

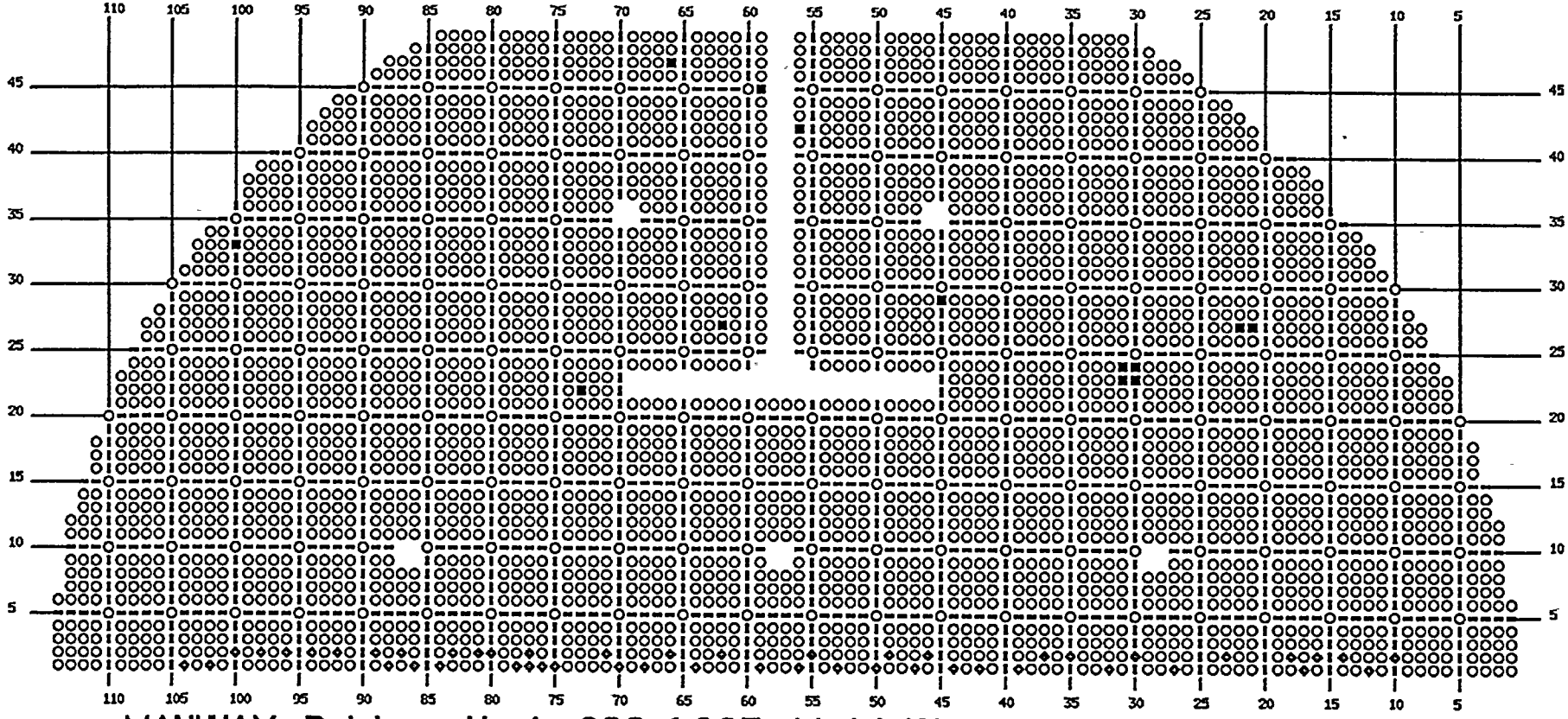
Carolina Power & Light Shearon Harris UNIT: 1 SG: C All Tubes Tested at Dented Locations (MRPC)



NOZZLE Database: Harris_SGC_1995 Model: W_Series_D4 INLET MANWAY

| Character | Total |
|---|---|
| ○ Default Tube | 4545 |
| ■ Default Plug | 13 |
| Default Sleg | 122 |
| ◇ Non-Stat Query Result: | 20 |

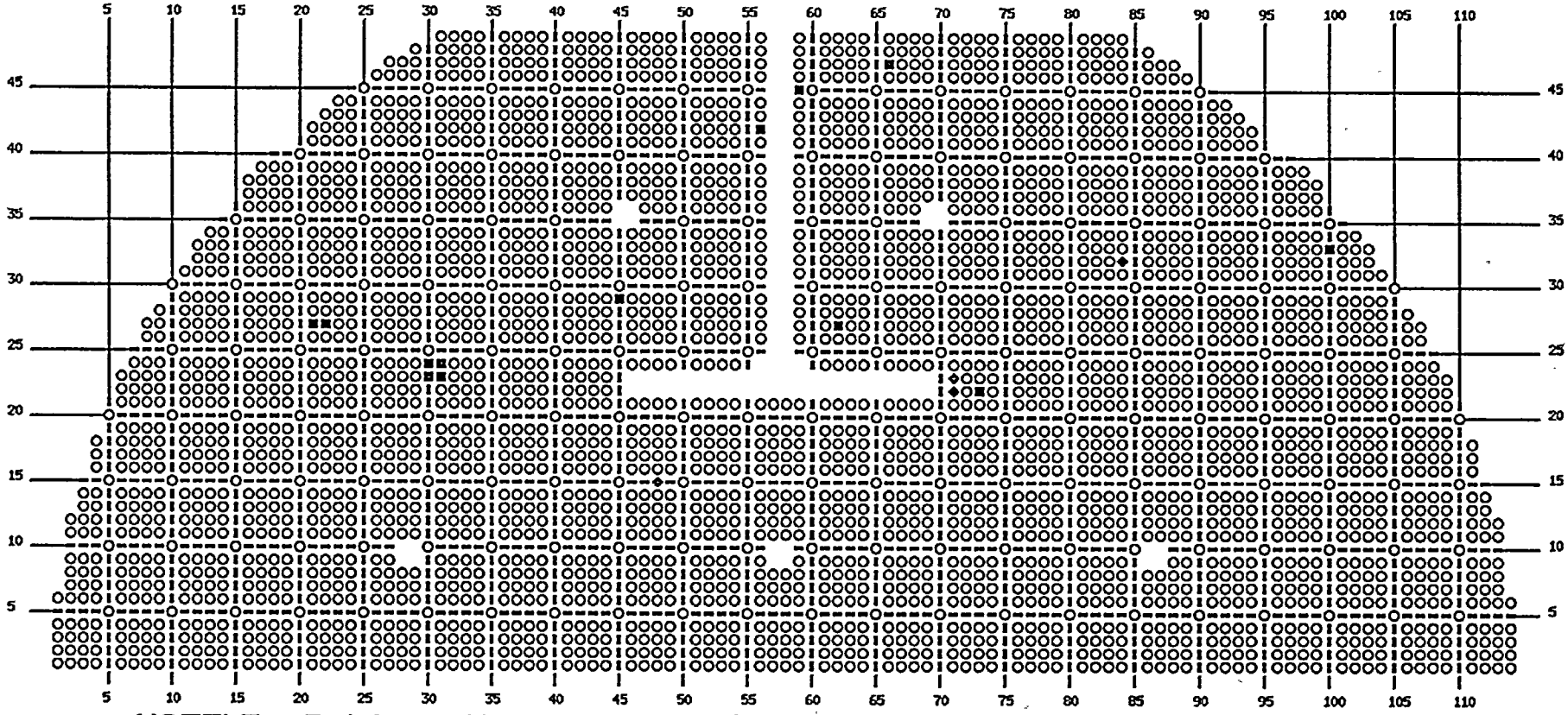
# Carolina Power & Light Shearon Harris UNIT: 1 SG: C U-Bend MRPC Exams




## MANWAY Database: Harris_SGC_1995 Model: W_Series_D4 OUTLET NOZZLE

| Character | Total |
|---|---|
| ○ Default Tube | 4516 |
| ■ Default Plug | 13 |
| Default Stay | 122 |
| ◇ Non-Stat Query Result: | 49 |

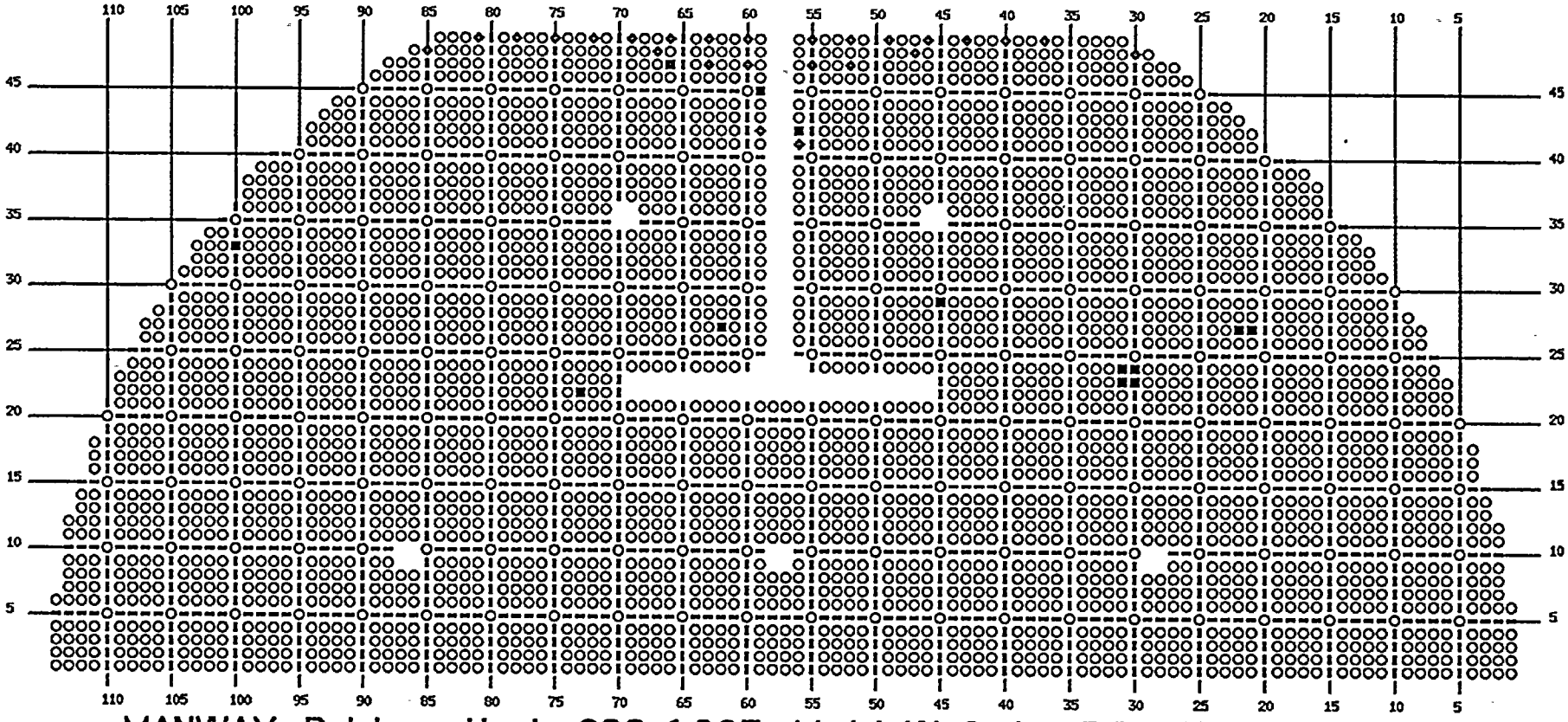
Carolina Power & Light Shearon Harris UNIT: 1 SG: C Tubes with MCI, SCI, MAI, SAI Report Entries




NOZZLE Database: Harris_SGC_1995 Model: W_Series_D4 INLET MANWAY

| Character | | Total |
|---|---|---|
| ○ | Default Tube | 4561 |
| ■ | Default Plug | 13 |
| | Default Stay | 122 |
| ◆ | MAI Indications | 0 |
| ◆ | MCI Indications | 0 |
| ◆ | SAI Indications | 3 |
| ◆ | SCI Indications | 1 |

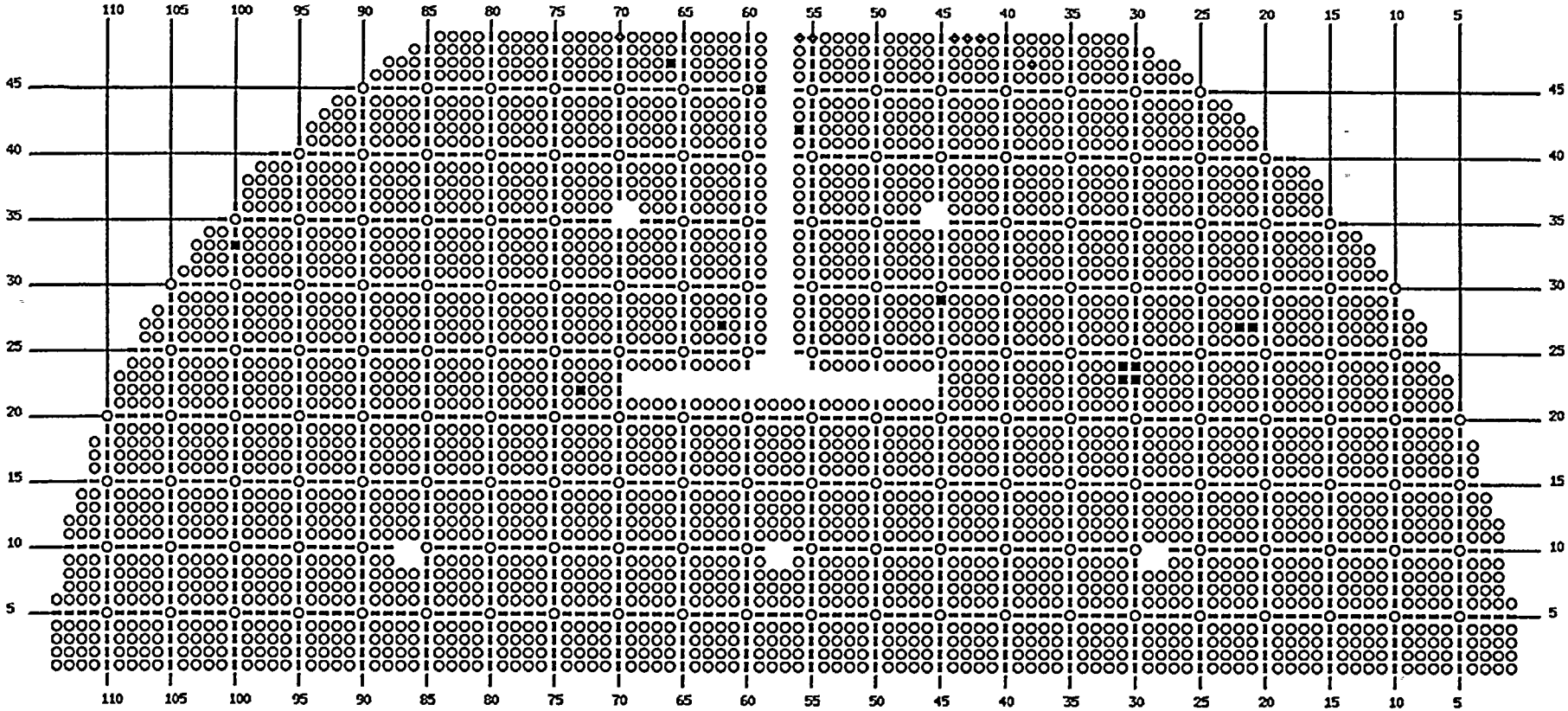
# Carolina Power & Light Shearon Harris UNIT: 1 SG: C Pre-Heater MRPC Exams




MANWAY Database: Harris_SGC_1995 Model: W_Series_D4 OUTLET NOZZLE

| Character | Total |
|---|---|
| ○ Default Tube | 4540 |
| ■ Default Plug | 13 |
| Default Stay | 122 |
| ◇ Non-Stat Query Result: | 25 |

# Carolina Power & Light Shearon Harris UNIT: 1 SG: C Tubes with PLP Report Entries




## MANWAY Database: Harris_SGC_1995 Model: W_Series_D4 OUTLET NOZZLE

| Character | Total |
|---|---|
| ○ Default Tube | 4558 |
| ■ Default Plug | 13 |
| Default Stay | 122 |
| ◆ PLP Indications | 7 |

# MULTI-FREQUENCY EDDY CURRENT INSPECTION
# SET UP INSTRUCTION
# MIZ-30

| SITE: | UNIT: | COMPONENT: | SIDE: | DATE: |
|---|---|---|---|---|
| HNP | 1 | S/G A, B, C | (HOT) COLD | 9/16/95 |

| PROBE: | CALIBRATION STANDARD (describe other) |
|---|---|
| B 620 MRPC3C* | ~~ASME~~ NB 9-16-95 G/T EDM/FBH OTHER: AS REQ'D |

| PROCEDURE | TEST PURPOSE: |
|---|---|
| HNP-004 REV-Ø | ROTATING COIL EXAM OF TTS • DUAL G/T |

## MIZ-30 CONFIGURATION

NUMBER: 1
NAME: MRPC TTS

SAMPLES PER SECOND: 1230

| | Board #1 | | Board #2 | | Board #3 | | Board #4 | | Board#5 | | Board #6 | | Board #7 | | Board #8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Probe # 1 | | Probe # 1 | | Probe # 2 | | Probe # 2 | | Probe # | | Probe # | | Probe # | | Probe# | |
| | DRIVE A D | DRIVE B C | DRIVE A D | DRIVE B C | DRIVE A D | DRIVE B C | DRIVE A D | DRIVE B C | DRIVE A D | DRIVE B C | DRIVE A D | DRIVE B C | DRIVE A D | DRIVE B C | DRIVE A D | DRIVE B C |
| Drive Polarity | N | N | N | N | N | N | N | N | | | | | | | | |
| Group number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| Coil number | 1 | 3 | 5 | 7 | 1 | 3 | 5 | 7 | | | | | | | | |
| FRQ1 TS #1 400 G1 12V | D | | D | D | D | | D | D | | | | | | | | |
| FRQ2 TS #2 600 G1 12V | D | | D | D | D | | D | D | | | | | | | | |
| FRQ3 TS #3 100 G1 12V | D | D | D | D | D | D | D | D | | | | | | | | |
| FRQ4 TS #4 10 G1 12V | D | | | | D | | | | | | | | | | | |
| FRQ5 TS #5 G V | | | | | | | | | | | | | | | | |
| FRQ6 TS #6 G V | | | | | | | | | | | | | | | | |
| FRQ7 TS #7 G V | | | | | | | | | | | | | | | | |
| FRQ8 TS #8 G V | | | | | | | | | | | | | | | | |

Special notes to Operator/Analyst: * OTHER SIZES MAY ALSO BE REQ'D

900** RPM @ 1230 SAMPLES/SEC. @ 0.5" AXIAL TRANSLATION PER SEC.
DATA TAKEN ON PUSH – CAL. STD ON PUSH – PULL AS REQ'D

** WITHIN ACCEPTABLE TOLERANCE

See Appendix F for Setup Instruction detail

Prepared by: _____ Level III Date 9-16-95

# MULTI-FREQUENCY EDDY CURRENT INSPECTION
# SET UP INSTRUCTION
# MIZ-30

| SITE: | UNIT: | COMPONENT: | SIDE: | DATE: |
|---|---|---|---|---|
| HNP | 1 | S/G A, B, C | (HOT) COLD | 9 / 16 / 95 |

| PROBE: | CALIBRATION STANDARD (describe other) |
|---|---|
| B620 MRPC 3C * | ~~ASME~~ G.T EDM/FBH OTHER: AS REQ'D |

| PROCEDURE | TEST PURPOSE: |
|---|---|
| HNP-004 REV. Ø | ROTATING COIL EXAM OF DENT/EXP/SPEC. INT. |

## MIZ-30 CONFIGURATION

NUMBER: 2
NAME: MRPC SI 1

SAMPLES PER SECOND: 400

| | Board #1 | | Board #2 | | Board #3 | | Board #4 | | Board #5 | | Board #6 | | Board #7 | | Board #8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Probe # 1 | | Probe # 1 | | Probe # | | Probe # | | Probe # | | Probe # | | Probe # | | Probe # | |
| | DRIVE A D | B C | DRIVE A D | B C | DRIVE A D | B C | DRIVE A D | B C | DRIVE A D | B C | DRIVE A D | B C | DRIVE A D | B C | DRIVE A D | B C |
| Drive Polarity | N | N | N | N | | | | | | | | | | | | |
| Group number | 1 | 1 | 1 | 1 | | | | | | | | | | | | |
| Coil number | 1 | 3 | 5 | 7 | | | | | | | | | | | | |
| FRQ1 480 TS #1 G I 12V | D | | D | D | | | | | | | | | | | | |
| FRQ2 600 TS #2 G I 12V | D | | D | D | | | | | | | | | | | | |
| FRQ3 100 TS #3 G I 12V | D | D | D | D | | | | | | | | | | | | |
| FRQ4 10 TS #4 G I 12V | D | | | | | | | | | | | | | | | |
| FRQ5 TS #5 G V | | | | | | | | | | | | | | | | |
| FRQ6 TS #6 G V | | | | | | | | | | | | | | | | |
| FRQ7 TS #7 G V | | | | | | | | | | | | | | | | |
| FRQ8 TS #8 G V | | | | | | | | | | | | | | | | |

Special notes to Operator/Analyst: * OTHER SIZES MAY BE USED

300 RPM @ 400 SAMPLES @ .2" AXIAL TRANSLATION/SEC.
DATA ON PUSH - IF PULL REQ'D, CAL. STD ON PULL ALSO

See Appendix F for Setup Instruction detail

Prepared by: T. Romm W. Bini Level III Date 9-16-95

# MULTI-FREQUENCY EDDY CURRENT INSPECTION
# SET UP INSTRUCTION
# MIZ-18A

| SITE: | UNIT: | COMPONENT: | SIDE: | DATE: |
|---|---|---|---|---|
| HNP | 1 | S/G A,B,C | (HOT) (COLD) | 9/16/95 |

| PROBE: * | CALIBRATION STANDARD (describe other) |
|---|---|
| A610 MULC OR SFRM | ASME: SEE AS-BUILT DWG. OTHER: AVB |
| PROCEDURE HNP-004 REV. Ø | TEST PURPOSE: BOBBIN COIL FULL LENGTH |

## *MIZ-18A CONFIGURATION*

NUMBER: (3)
NAME: BOBBIN

SAMPLES PER SECOND: 400 @ 12" – 800 @ 22"

| FREQ. SEQUENCE | | PROBE CHANNEL SELECT | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | COIL 1 | COIL 2 | COIL 3 | COIL 4 | COIL 5 | COIL 6 | COIL 7 | COIL 8 |
| 1 | 550 KHz | X | | | | X | | | |
| 2 | 100 KHz | X | | | | X | | | |
| 3 | 800 KHz | X | | | | X | | | |
| 4 | 35 KHz | X | | | | X | | | |

Special Notes to Operator/Analyst * OTHER SIZES MAY BE USED AS REQ'D

800 SAMPLES/SEC @ 22"/SEC PULL SPEED

400 SAMPLES/SEC @ 12"/SEC PULL SPEED

See Appendix A for Setup Instruction Details

Prepared by: [signature] Level III Date 9-16-95

# MULTI-FREQUENCY EDDY CURRENT INSPECTION
# SET UP INSTRUCTION
# MIZ-18A

| SITE: | UNIT: | COMPONENT: | SIDE: | DATE: |
|---|---|---|---|---|
| HNP | 1 | S/G A, B, C | HOT (COLD) | 9/16/95 |

| PROBE: | CALIBRATION STANDARD (describe other) |
|---|---|
| B 580 MRPC UB | ASME: GT STD (ASME) OTHER: AS REQ'D |
| PROCEDURE HNP-004 | TEST PURPOSE: U-BEND MRPC INSPECTION |

## *MIZ-18A CONFIGURATION*

NUMBER: 4
NAME: MRPC UB

SAMPLES PER SECOND: 400

| FREQ. SEQUENCE | | PROBE CHANNEL SELECT | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | COIL 1 | COIL 2 | COIL 3 | COIL 4 | COIL 5 | COIL 6 | COIL 7 | COIL 8 |
| 1 | 400 KHz | X | | | | | | | |
| 2 | 600 KHz | X | | | | | | | |
| 3 | 100 KHz | X | | | X | | | | |
| 4 | 10 KHz | X | | | | | | | |

Special Notes to Operator/Analyst DATA ON PULL

300 RPM @ .2"/SEC 11H - 11C

See Appendix F for Setup Instruction Details

Prepared by: [signature] Level III Date 9-16-95

# MULTI-FREQUENCY EDDY CURRENT INSPECTION
# SET UP INSTRUCTION
# MIZ-18A

| SITE: | UNIT: | COMPONENT: | SIDE: | DATE: |
|---|---|---|---|---|
| HNP | 1 | S/G A, B, C | HOT (COLD) | 9/16/95 |

| PROBE: | CALIBRATION STANDARD (describe other) |
|---|---|
| B 610 MRPC 3C * | ASME: GT STD OTHER: B3 REQ'D |
| PROCEDURE HNP-004 | TEST PURPOSE: TTS / DENT / EXP / SI |

## MIZ-18A CONFIGURATION

NUMBER: 5
NAME: MRPC SI2

SAMPLES PER SECOND: 400

| FREQ. SEQUENCE | | PROBE CHANNEL SELECT | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | COIL 1 | COIL 2 | COIL 3 | COIL 4 | COIL 5 | COIL 6 | COIL 7 | COIL 8 |
| 1 | 400 KHz | X | | | | X | | X | |
| 2 | 600 KHz | X | | | | X | | X | |
| 3 | 100 KHz | X | | | X | X | | X | |
| 4 | 10 KHz | X | | | | | | | |

Special Notes to Operator/Analyst * OTHER SIZES AS REQUIRED

400 SAMPLES/SEC @ 0.2" PULL SPEED - DATA ON PUSH
300 RPM
IF DATA IS REQ'D ON PULL, CAL. STD. ON PULL ALSO

See Appendix F for Setup Instruction Details

Prepared by: T Thomas C Bryan Level III Date 9-16-95

CAROLINA POWER & LIGHT COMPANY

SHEARON HARRIS NUCLEAR POWER PLANT

PLANT OPERATING MANUAL

VOLUME 6

PART 9

| | |
|---|---|
| PROCEDURE TYPE: | Engineering Periodic Test |
| NUMBER: | EPT-232T |
| TITLE: | ABB/Combustion Engineering, XS10370016, Temporary Procedure for Steam Generator Outage Related Activities (Expires: 12/31/98) |

REVISION 0

NOTE: This procedure has been screened in accordance with PLP-100 criteria and determined to be a Case III procedure. No additional management involvement is required.

WORKING DOCUMENT - VERIFIED CORRECT
SIGNATURE 9/12/95 DATE 9/18/95 REVERIFY BY (DATE)

Roy n Brown Re Verified 9-17-95 Reverify By 9-22-95
P.K. Levy Reverified 9-22-95 Reverify By 9-26-95

INF CONTROLLED COPY #378

EFFECTIVE AUG 2 2 1995

RECEIVED
AUG 1 5 1995
HNP
DOCUMENT CONTROL

# TOOL AND EQUIPMENT ACCOUNTABILITY

# FOR

# CAROLINA POWER & LIGHT - SHEARON HARRIS

HNP-100-001, REV. 0

CHATTANOOGA FIELD SERVICES
COMBUSTION ENGINEERING, INC.
1201 RIVERFRONT PARKWAY
CHATTANOOGA, TN 37402

CONTRACT NO. XM10370016

PREPARED BY: _____ DATE: 8-7-95

COGNIZANT SUPERVISOR APPROVAL: _____ DATE: 8/7/95

FIELD OPERATIONS APPROVAL: _____ DATE: 8/7/95

Q.A. APPROVAL: _____ DATE: 8/7/95

## 1.0 PURPOSE

To describe the provisions for control of all items which are used inside a steam generator, reactor vessel or other components where ABB-Combustion Engineering is responsible for accountability of tools and equipment in a controlled area.

## 2.0 REFERENCES/ADDENDUM

2.1 Material Log

2.2 Discrepancy Notice

2.3 MMM - 011 : Cleanliness, housekeeping, foreign material exclusion, (FME), classification and work practices. (HNP- procedure)

2.4 AP-619 : Foreign material exclusion (FME). (HNP- procedure)

## 3.0 DEFINITIONS

3.1 Controlled Area - A controlled area is any area defined by the utility to require material accountability.

## 4.0 PROCEDURE

### 4.1 GENERAL

4.1.1 This procedure shall be in effect as noted in Paragraph 1.0 above.

4.1.2 The Task Manager will ensure that a log keeper is assigned for each shift. The log keeper may be changed during the shift, depending on specific requirements of the particular task. The log keeper will be familiar with the requirements of this procedure.

4.1.3 The Task Manager shall assure that shift change over includes assignment of a log keeper and that status of equipment inside the controlled area is clearly understood. Equipment may remain inside as long as the log reflects this status.

4.1.4 The accountability log may be kept in the controlled area, or may be kept in a remote area if voice and/or communication is maintained continuously when tools or equipment are being moved into a controlled area.

4.1.5 The log keeper will be responsible for ensuring that the log is properly kept, that all personnel moving tools and equipment into or out of the controlled area are familiar with the requirements of this procedure, and that the log reflects all items entering or leaving the controlled area.

4.1.6 If foreign objects are found inside the controlled area and are removed, they shall be noted in the "out" section of the log with an explanatory note including location.

4.2 DETAILED PROCEDURE

4.2.1 The log keeper will fill in all information required at the top of the log sheet.

4.2.2 As material is moved into the controlled area, the log keeper will identify each item and the initials of the person moving it into the controlled area. This information together with quantity, date and time will be entered in the log.

4.2.3 As material is removed from the controlled area and upon completion of examination of the item by the person(s) who removed it, the information shall be recorded on the log.

4.2.4 Items which are not in some way securely attached to each other shall be considered separate items and shall be individually identified in the log.

4.2.5 Upon completion of work and prior to closing controlled area, the ABB-CE Task Manager shall review the log sheets and ensure that all items logged in were also logged out or otherwise accounted for. If discrepancies are noted, the Task Manager will notify the CP&L representative in writing on Addendum 1 and initiate an investigation to resolve the discrepancies.

4.2.6 The Task Manager shall collect all log sheets once the area has been closed. This information shall be retained in the site office until completion of the task, with copies provided to CP&L upon request.

**ADDENDUM 1** S/G A _____

## MATERIAL ACCOUNTABILITY DISCREPANCY NOTICE

ADDENDUM 1 S/G B _____

## MATERIAL ACCOUNTABILITY DISCREPANCY NOTICE

ADDENDUM 1 S/G C _____.

## MATERIAL ACCOUNTABILITY DISCREPANCY NOTICE

ADDENDUM 2
S/G A _____ TOOL AND MATERIAL ACCOUNTABILITY LOG

UTILITY _____ PROCESS _____
COMPONENT _____ UNIT _____ PAGE _____

| ITEM | IN | | | | OUT | | | |
|---|---|---|---|---|---|---|---|---|
| | QUAN. | DATE/ TIME | CKD.BY | LOG BY | QUAN. | DATE/ TIME | CKD.BY | OG BY |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

**ADDENDUM 2**

**S/G A __________ TOOL AND MATERIAL ACCOUNTABILITY LOG**

UTILITY ____________________ PROCESS ____________________
COMPONENT ____________________ UNIT ____________________ PAGE __________

| ITEM | IN | | | | OUT | | | |
|---|---|---|---|---|---|---|---|---|
| | QUAN. | DATE/ TIME | CKD.BY | LOG BY | QUAN. | DATE/ TIME | CKD.BY | OG BY |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

ADDENDUM 2
S/G B _____ TOOL AND MATERIAL ACCOUNTABILITY LOG

UTILITY _____ PROCESS _____
COMPONENT _____ UNIT _____ PAGE _____

| ITEM | IN | | | | OUT | | | |
|---|---|---|---|---|---|---|---|---|
| | QUAN. | DATE/ TIME | CKD.BY | LOG BY | QUAN. | DATE/ TIME | CKD.BY | OG BY |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

**ADDENDUM 2**
**S/G B _____ TOOL AND MATERIAL ACCOUNTABILITY LOG**

UTILITY _____ PROCESS _____
COMPONENT _____ UNIT _____ PAGE _____

| ITEM | IN | | | | OUT | | | |
|---|---|---|---|---|---|---|---|---|
| | QUAN. | DATE/ TIME | CKD.BY | LOG BY | QUAN. | DATE/ TIME | CKD.BY | OG BY |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

ADDENDUM 2

S/G C __________ TOOL AND MATERIAL ACCOUNTABILITY LOG

UTILITY ______________________ PROCESS ______________________

COMPONENT ______________________ UNIT ______________________ PAGE __________

| ITEM | IN | | | | OUT | | | |
|---|---|---|---|---|---|---|---|---|
| | QUAN. | DATE/ TIME | CKD.BY | LOG BY | QUAN. | DATE/ TIME | CKD.BY | OG BY |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

ADDENDUM 2

S/G C ________ TOOL AND MATERIAL ACCOUNTABILITY LOG

UTILITY ______________________ PROCESS ______________________

COMPONENT ______________________ UNIT ______________________ PAGE ________

| ITEM | IN | | | | OUT | | | |
|---|---|---|---|---|---|---|---|---|
| | QUAN. | DATE/ TIME | CKD.BY | LOG BY | QUAN. | DATE/ TIME | CKD.BY | OG BY |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

# MANUAL INSTALLATION AND REMOVAL

# OF

# ABB/COMBUSTION ENGINEERING

# GENESIS MANIPULATORS

PROCEDURE NO.: STD-NSS-072

PRIMARY SUPPORT TECHNOLOGIES

NUCLEAR OPERATIONS

ABB COMBUSTION ENGINEERING, INC.

WINDSOR, CONNECTICUT

PREPARED BY: R J Tobin Jr. DATE: 6-28-95
R. J. Tobin,
Field Service Engineer

APPROVED BY: [signature] DATE: 6/30/95
H. Labieniec, Manager
Primary Support Technologies

APPROVED BY: [signature] DATE: 7/5/95
B. H. Nelson,
Quality Assurance Engineer

REV. NO.: 05

DATE: 7-5-95

5

## Table of Contents


| Section | Description | Page |
|---|---|---|
| 1.0 | Purpose Statement | 3 |
| 2.0 | References | 3 |
| 3.0 | Definition | 3 |
| 4.0 | Prerequisites | 3 |
| 5.0 | Procedure: Installation | 5 |
| 6.0 | Procedure: Removal | 7 |

## 1.0 PURPOSE STATEMENT

1.1 To provide direction for manual installation and removal of Combustion Engineering, Inc. GENESIS Manipulators.

## 2.0 REFERENCES

2.1 ABB/Combustion Engineering Nuclear Services QA Manual (if applicable)

2.2 Contract Operating Procedures Manual (if applicable)

2.3 GENESIS Manipulator Operational Procedure, STD-NSS-078

## 3.0 DEFINITION

3.1 GENESIS: The C-E Steam Generator Manipulator System. There are two types of GENESIS systems employed to perform steam generator services: GENESIS 2000 and FLEXIVERA. The main differences between the two systems are that GENESIS 2000 has a UNIX based control system; whereas FLEXIVERA has an IBM type PC based control system.

## 4.0 PREREQUISITES

4.1 Initial Conditions

4.1.1 A radiation work permit has been issued to cover this work.

4.1.2 Steam generator primary manway covers and stud bolts have been removed.

4.1.3 Nozzle dams or covers are installed in the primary piping nozzle openings.

4.1.4 The steam generator has been ventilated to an acceptable level of dryness (i.e. no water dripping from the tube sheet), and excess standing water in the primary channel heads has been removed.

4.1.5 A ventilation system is attached to the opposite leg of the steam generator. Ventilation should be adequate to maintain temperature inside the steam generator primary head less than 120°F (49°C).

4.1.6 The tubesheet or tubesheet templates have been marked for the locations of the manipulator.

4.1.7 A communications system from the steam generator platform workers to the computer work station is setup and operational.

4.1.8 A pan and tilt camera has been installed inside the steam generator plenum and is functional. Sufficient lighting is a requirement for manipulator installation and removal.

4.1.9 Work step 6.0 (pre-operational check out) of Reference 2.3 has been completed.

4.1.10 Gripper alignment plates have been installed on the manipulator leg relative to the type steam generator being repaired/tested.

4.1.11 All manipulator Remote Control valves have been put into the released position.

**NOTE:** On **GENESIS 2000** the Control Station Operator (CSO) will remotely toggle the switches to "RELEASE". For **FLEXIVERA** this is accomplished by toggling the Pendant switches to "RELEASE". Ensure that the feet bypass valve has been closed.

4.1.12 To enable efficient installation and removal operation, two platform workers and one control station operator are required.

4.1.13 Elastomers on the manipulator leg have been visually examined for wear and bulges, and replaced if necessary.

4.1.14 All cables and hoses for the Genesis manipulator are properly connected.

4.2 Services Required

4.2.1 Computer console: 110V/15 amps/60 Hz

4.2.2 T.V. Monitor Cabinet: 110V/15 amps/60 Hz

4.2.3 Manway Manipulator Junction Box: Continuous air supply - dry, oil free, 90 psig, 50 SCFM

4.2.4 Remote Audio/Video Box: Continuous air supply - dry, oil free, 90 psig, 50 SCFM; 100V/15 amps/60 Hz

4.2.5 Remote Genesis Control Cabinet: Continuous air supply - Dry, oil free, 90 psig, 50 SCFM; 110V/15 amps/60 Hz (if required).

4.3 Special Equipment

4.3.1 Combustion Engineering GENESIS Manipulator

4.3.2 Closed Circuit Video and Lighting Equipment

4.3.3 Audio Equipment

## 5.0 PROCEDURE: INSTALLATION

5.1 Verify satisfactory completion of all prerequisites in Section 4.0.

5.2 Verify that all cables and air hoses for the GENESIS manipulator are properly connected.

5.3 Using the manual mode, check that the servo-motors controlling the leg, shoulder, and elbow function properly.

a. Ensure that all cables and pneumatic lines are untangled and can be moved freely.

b. Check the position of the feet. Feet should be in the retracted position. If not, have the CSO (Genesis 2000) or the platform worker (Flexivera) retract them.

**CAUTION:** A Pendant air valve switch can be repositioned accidently. Care should be taken when pulling hoses near the pendant so that a

valve is not inadvertently actuated.

c. Elastomers on the manipulator and tackle gripper fingers should be in the relaxed position (gripper center shaft extended with no pump pressure exerted on the gripper device).

d. The movable leg carriage shall be near the midpoint of the leg.

5.4 Following completion of the above functional checks, a jumper can enter the primary channel head. The platform worker will then hand him in the manipulator footpad (if required). The footpad shall be positioned in the bottom of the plenum under the marked position for the manipulator should it be required. Ensure a rope lanyard exists off the footpad; lanyard can be tied outside the manway to supplement potential remote operations at a later time.

5.4.1 The platform worker will quickly pass in the manipulator leg thru the manway, fingers first, and continue to feed the umbilical cable into the plenum. The jumper must insert the gripper fingers into the marked tubes and push the manipulator up against the tubesheet. Once the top of the leg is flush with the tubesheet, the platform worker or the CSO must pressurize the leg grippers to approximately 100 bar (1500 psi). A check must be made to ensure that the grippers have straightened the leg. If leg is not quite flush with the tubesheet surface at this point, depressurize the leg grippers, and as soon as the pressure from the feet have pushed the leg up flush, energize the grippers once again at the hydro-pump. When it is determined that the leg is plumb with the tubesheet, extend the feet. Open the leg air bypass valve and close the leg locking hydraulic check valve (if so equipped).

**NOTE:** For Footpad Use Only — The footpad shall be manually positioned underneath the leg such that the feet make as much surface contact as possible. It may be necessary to retract the feet to reposition the footpad to an optimum location.

**NOTE:** In some instances a different form of leg stabilizer may be used, commonly referred to as a backpad, in lieu of a footpad. The backpad will have a lanyard attached to it and can be installed from the manway once the manipulator leg installation has been completed.

5.5 The platform worker will next pass the arm assembly in thru the manway again feeding the umbilical cable and the jumper will fully seat the shoulder dovetail plate of the arm into the dovetail fitting of the leg carriage. Ensure that the dovetail fitting is properly seated, and rotate the dovetail lock to secure the dovetail to the leg carriage.

5.6 Conduct GENESIS manipulator initialization and location procedures per work step 7.0 of Reference 2.3.

## 6.0 PROCEDURE: REMOVAL

**NOTE:** Manipulator arm must be driven to manway to remove any tools that may be connected to it's end fitting prior to manipulator removal.

6.1 Arm should be folded tightly or straight out if possible and the leg lowered to approximately its midpoint position.

6.2 Close the feet bypass line and open the leg locking hydraulic check valve (if so equipped).

6.3 At this point, the jumper can enter the channel head. He will remove the arm from its dovetail fitting and quickly pass it out thru the manway to the platform work who will be pulling out the arms umbilical simultaneously.

6.4 Release the feet. Then release the finger grippers. (Failure to do this in this order may result in the grippers hanging up in the tubes.) The jumper must pass the leg out of the manway feet first to avoid getting tangled in the umbilical. The platform worker will be pulling out the excess cable at this time. The jumper can now exit the steam generator channel head.

6.5 The footpad can be removed by the platform worker by manually pulling on the rope lanyard affixed to the footpad until it is out of the primary head, if a footpad has been used.

# SETUP, CHECKOUT, AND OPERATION

# OF

# ABB/COMBUSTION ENGINEERING

# GENESIS MANIPULATORS

PROCEDURE NO. STD-NSS-078

PRIMARY SUPPORT TECHNOLOGIES

ABB COMBUSTION ENGINEERING

NUCLEAR OPERATIONS

WINDSOR, CONNECTICUT

PREPARED BY: Robert H. Tolin Jr. DATE: 6-28-95
Field Service Engineer

APPROVED BY: _____ DATE: 6/30/95
Supervisor, Primary Support Technologies

APPROVED BY: _____ DATE: 7/5/95
Field Quality Operations

REVISION NO. 07

DATE: 7-5-95

7 Major Revision

Table of Contents


| Section | Description | Page |
|---|---|---|
| 1.0 | Purpose | 3 |
| 2.0 | References | 3 |
| 3.0 | Definitions | 3 |
| 4.0 | Prerequisites | 3 |
| 5.0 | Precautions | 4 |
| 6.0 | Equipment Setup and Checkout | 4 |
| 7.0 | Genesis In-Generator Checkout | 7 |
| 8.0 | Manipulator Repairs | 9 |
| 9.0 | Genesis Camera Installation/Removal/Movement | 10 |
| 10.0 | Genesis End Effector Installation/Delivery | 11 |
| Appendix A | Checkout Guideline | 13 |

## 1.0 PURPOSE:

1.1 Provide general instructions to setup, checkout, and to operate the GENESIS Manipulator.

## 2.0 REFERENCES:

2.1 Vermaat Technics Manipulator User's Manual.

2.2 Remote Installation and Removal of ABB/Combustion Engineering GENESIS Manipulators, STD-NSS-074.

2.3 Manual Installation and Removal of ABB/Combustion Engineering GENESIS Manipulators, STD-NSS-072.

2.4 ABB/Combustion Engineering Nuclear Operations Quality Assurance Manual (if applicable)

## 3.0 DEFINITIONS:

3.1 **GENESIS:** The C-E Steam Generator Manipulator System. It is also referred to as **FLEXIVERA** or **GENESIS 2000.** The **GENESIS** system is comprised of a control station, which is located in a non-contaminated area (ie: control trailer or other designated area), and the manipulator, which is located in the primary S/G channel head with its associated components located on or near the S/G platform.

3.2 **End Effector:** Tools, such as those employed for plugging, sleeving, or eddy current testing which are placed on the GENESIS arm for delivery to a particular tube location.

## 4.0 PREREQUISITES:

4.1 A radiation work permit has been issued to cover this work.

4.2 A pre-staging area has been made available near the steam generator which is suitable for equipment set-up and checkout.

4.3 A radiologically clean area has been made available in which to setup the GENESIS control station.

4.4 A communications system has been installed linking the in-containment work area(s) to the GENESIS control station.

4.5 All cables and pneumatic lines for the GENESIS manipulator, and for the tube sheet camera, are strung from the in-containment work area(s) to the GENESIS control station.

## 5.0 PRECAUTIONS:

5.1 Where possible, cables shall be routed where they are least likely to be damaged.

5.2 The GENESIS manipulator computer is EMI (electro-magnetic interference) sensitive. Care should be taken in setting up the control station so that power transformers, welding equipment, etc., are located as far from the computer and controller as possible. Where possible operate the GENESIS manipulator on a power source separate from that used by welding equipment.

5.3 When the **GENESIS** arm is not being used, place the main motor control switch in **INHIBIT/Standby mode.**

**NOTE:** Sections 6.0 through 10.0 are stand-alone processes which may be completed in sequence or independently, as dictated by job circumstances.

## 6.0 EQUIPMENT SETUP AND CHECKOUT:

**NOTE:** As appropriate, protect cable electrical connectors from contamination by bagging and/or tapping.

### 6.1 Control Station:

6.1.1 Set up the amplifying unit, computer, computer monitor, keyboard, and video monitor control console.

6.1.2 Make all necessary cable connections between the equipment pieces set up per Step 6.1.1, and also with the cables strung from containment.

### 6.2 Pre-Staging Area:

6.2.1 Lay out the leg and arm of the GENESIS manipulator.

6.2.2 Connect all cables and pneumatic lines.

6.2.3 Ensure that the gripper plates and gripper size that are on the leg are correct for the type of steam generator where it is to be in stalled.

6.2.4 Perform pre-installation checkout of GENESIS equipment using **Appendix A** as a guide.

6.2.5 Repair or replace any GENESIS equipment that may be malfunctioning.

6.2.6 Connect cables and pneumatic lines to the tube sheet camera (if used).

6.2.6.1 Check each camera's functions (i.e. zoom, pan, tilt, focus, lights, iris, gripper). Repair or replace as becomes necessary.

6.2.7 After completing checks on manipulator equipment and tube sheet cameras, disconnect cables and pneumatic lines so that equipment may be removed to the work platform.

6.2.8 Transport GENESIS equipment to the work platform.

6.3 **Work Platform Setup/Checkout:**

**NOTE:** During setup/checkout repair/replace malfunctioning equipment.

6.3.1 Arrange equipment in an orderly fashion at the work platform to facilitate equipment's installation in the generator.

6.3.2 As necessary, re-route cables and pneumatic lines for the GENESIS manipulator and tube sheet cameras to the work platform.

6.3.3 Make tackle hydraulic connections, and check gripper for expand/retract.

6.3.4 Re-connect cables and pneumatic lines to the tube sheet cameras.

6.3.4.1 Re-check each camera's functions (i.e. zoom,

pan, tilt, focus, lights, iris, gripper). Repair or replace if necessary.

6.3.5 Connect cables, pneumatic lines, and manipulator arm and leg to GENESIS Platform Junction Box, and hydraulic line to hydraulic pump, or to the extension cables from those items.

6.3.6 With the robot in manual control mode, test leg upward/downward travel, and shoulder, elbow and wrist movement (movement should be smooth and steady). Also, check leg feet extend/retract, leg gripper expand/retract, and level lights function. Also check snorkel camera for picture and lights.

6.3.7 **GENESIS Platform Initialization** (As Required):

6.3.7.1 With the system in manual control, orient arm for initialization.

6.3.7.2 Initialize computer (switch in Position "2" for **Flexivera**, establish contact with the controller box for **GENESIS 2000.**

6.3.7.3 Input into memory the type of steam generator (and plenum - hotside vs coldside) in which GENESIS is to be installed.

6.3.7.4 Affect computer initialization (usually hardstop program). Ensure that it is performed successfully. Repeat as required.

6.3.7.5 Input locations in which leg finger grippers will be installed.

6.3.7.6 Input end effector tool to be used upon installation.

**NOTE 1:** A tubesheet camera is to be manually installed in the generator to aid in the installation of the GENESIS equipment, if possible.

**NOTE 2:** GENESIS is installed in the steam generator using Procedure STD-NSS-074, Remote Installation and Removal of

ABB/Combustion Engineering, GENESIS Manipulators, or STD-NSS-072, Manual Installation and Removal of ABB/Combustion Engineering GENESIS Manipulators.

## 7.0 GENESIS IN-GENERATOR CHECKOUT:

### 7.1 Pre-Initialization Actions:

**NOTE:** Section 7.1 is only applicable if the arm has not been initialized outside the S/G channel head (Sec. 6.3.7).

7.1.1 Camera Checkouts:

7.1.1.1 If snorkel is to be used, attach snorkel to the wrist. This makes all connections. Check the picture.

**NOTE:** If the snorkel camera (or light) is malfunctioning, remedy before installing on GENESIS.

7.1.2 Install snorkel on the GENESIS arm (to include mating of electrical connections).

7.1.3 Place GENESIS in manual control mode, while leaving the four "operate switches" in **"STANDBY"**.

7.1.4 Turn the "MOVE/INHIBIT" switch on the GENESIS control console to **"MOVE"**.

7.1.5 Turn **ON** the computer's **Power** switch.

7.1.6 Turn **ON** the video monitor control console **Power** switch.

7.1.7 Using Manual Mode position arm in a clear area in steam generator bowl.

7.1.8 Turn **ON** the leg "Operate" switch, and raise the carriage assembly so that the top of the snorkel alignment pin is approximately 4" away from the tube sheet. (As necessary adjust trim tab to prevent creep).

7.1.9 Turn the leg "Operate" switch to **"STANDBY"**. Then turn **ON** the shoulder, elbow and wrist "Operate" switches, and adjust trimmers until arm remains completely steady.

**CAUTION:** Leg trim should also be adjusted, but keep leg switch on **STANDBY** at all times when leg is not actually in use to prevent damage to the arm should it begin to creep.

7.1.10 (As required): With the GENESIS manipulator in manual control, use the shoulder, elbow and/or wrist "joy stick" controls to orient the arm for initialization.

7.1.11 Switch the GENESIS manipulator to computer control.

7.2 **Arm Initialization:**

7.2.1 Using the instructions which appear on the computer display screen, initialize the arm, usually by the "hardstop" method.

7.2.1.1 Check, and as required, correct, computer memory so that it reflects the steam generator series in which GENESIS is installed.

7.2.2 Check the **Leg Finger** locations in the computer. Change if necessary.

7.2.3 Enter the **tool** into the computer.

7.2.4 Check the tool parameters to ensure proper tool dimensions. Change if necessary, but only after consulting with the shift supervisor.

7.3 **In-Generator Accuracy Check:**

7.3.1 Command the tool to a known tube location.

7.3.2 (As required) use **minimal move** or **manual mode** to achieve proper centering.

**NOTE 1:** The known point may be corner location, or a point determined by tube sheet maps, ie a plug, tie rod, sleeve, etc.

**NOTE 2:** If initial inaccuracy is large, the cognizant C-E engineer will determine if the machine is operating properly, and if corrective measures are to be taken.

7.3.3 Turn the leg "Operate" switch **ON** and slowly raise until alignment pin enters the tube. Again, it may be necessary to use **Manual**

Mode.

7.3.4 Move manipulator to approximately five (5) known locations in various locations of the steam generator.

7.3.5 Calibrate the system as necessary for system accuracy.

7.3.6 Lower tool and have platform personnel remove snorkel alignment pin from the generator.

**NOTE:** A calibration check should be performed after a leg move.

7.4 **GENESIS Re-initialization:**

**NOTE:** GENESIS may require re-initialization at other times due to power loss, or due to Electro-Magnetic Interference (EMI) (as demonstrated by extraneous characters appearing on the display screen, if GENESIS flips into simulation mode and cannot be returned to normal operating mode, or if GENESIS fails to operate properly). If this occurs, then complete the following steps:

7.4.1 Remove any tool and/or end effector installed on the wrist which would interfere with arm initialization (if necessary).

7.4.2 Perform steps in Section 7.1 (Pre-Initialization Actions) as may be required to ready GENESIS for initialization.

7.4.3 Complete Section 7.2 to initialize the arm.

7.4.4 Complete Steps 7.3.1 and 7.3.2.

7.4.5 Turn the leg "Operate" switch ON and slowly raise until alignment pin/grippers/tool head enters the tube (again, it may be necessary to use Manual Mode or incremental move.

7.4.6 (As required): Position arm at manway and have platform personnel remove snorkel alignment pin from the generator.

## 8.0 MANIPULATOR REPAIRS:

8.1 In the event GENESIS requires repairs, perform only those steps in Sections 6.0 and 7.0 which are necessary to restore the manipulator to its operationally ready state.

**NOTE:** The GENESIS operator will consult with the Shift Supervisor if the problem appears to be of a magnitude which requires the manipulator (arm or leg) be removed from the steam generator.

## 9.0 (As Required): GENESIS CAMERA INSTALLATION/REMOVAL/MOVEMENT:

### 9.1 Remote Camera Installation:

**CAUTION:** When the camera is inserted in the tubesheet and is not being moved, its airline **Must** be disconnected at the quick-connect located on the platform. This will prevent inadvertent release of the camera from the tubesheet.

9.1.1 Attach tube sheet camera to end of snorkel.

9.1.2 Raise leg so that camera's gripper is approximately 4" from the tube sheet.

9.1.3 Deliver camera to the location where it is to be installed.

**NOTE:** Platform personnel should feed camera cables, and GENESIS umbilical into the generator as the arm is moving away from the manway.

9.1.4 Raise leg until the tip of the camera gripper is in the desired tube location.

9.1.5 Then, slowly insert gripper into the tube sheet.

9.1.6 Once it is approximately flush to the tubesheet, energize the camera gripper.

9.1.7 Note this position for future reference.

9.1.8 Lower leg until snorkel is free of camera retaining ring.

9.1.9 Turn the leg "Operate" switch to **STANDBY** and slowly back away from camera arm until free and clear (approximately 3 rows or lines/columns should be sufficient).

9.1.10 Check camera's functions (i.e. zoom, pan, tilt, focus, lights, iris, gripper).

9.2 **Camera Removal/Movement:**

9.2.1 Using GENESIS, deliver snorkel to the location where the camera is installed.

9.2.2 Using the snorkel camera drive the snorkel around the camera stem so that it is in a position to support the camera.

9.2.3 Release the camera gripper. Then lower the leg until the camera gripper is approximately 4" from the tube sheet.

9.2.4 Deliver the camera to the desired location.

**NOTE:** The GENESIS operator and platform personnel should work in concert to insure the camera cables do not become tangled, and sufficient cable/umbilical is fed into the generator as becomes required.

10.0 **GENESIS END EFFECTOR INSTALLATION/DELIVERY:**

10.1 **End Effector Installation:**

10.1.1 Position the arm as near the manway as possible.

**NOTE:** Use tube sheet camera(s) to enhance positioning.

10.1.2 **(As required):** Remove the snorkel. Or remove from GENESIS any other tools which are un-needed.

10.1.3 Enter into the GENESIS computer the tool to be used.

10.1.4 Check the tool parameters to ensure proper dimensions. Change if necessary.

10.1.5 Install the end effector on the dovetail fitting at the end of the GENESIS wrist.

10.2 **End Effector Delivery:**

10.2.1 Raise leg until the grippers of the end effector, or the top of the tool is approximately 4" from the tube sheet.

10.2.2 Platform personnel will feed sufficient end effector cables/lines and GENESIS umbilical to enable delivery to the

desired location.

10.2.3 Using GENESIS control, deliver end effector to the desired tube sheet location.

10.2.4 Slowly raise the leg until the (as appropriate) end effector grippers, alignment pin, or tool head are just below the tube(s) in which they will be inserted.

**NOTE 1:** Use the tube sheet camera (or tool camera) to insure that the grippers/pin/tool head are below the correct tube(s).

**NOTE 2:** As necessary, calibrate the system to improve alignment.

10.2.5 Slowly raise the leg and insert the end effector into the tube sheet, or until it is at the desired elevation below the tube.

**NOTE:** If arm is going to be at a particular location for an extended period, turn leg switch to **STANDBY**.

10.3 **Removing End Effector from Tube Sheet:**

10.3.1 Slowly lower leg until the end effector gripper/pin/tool head are approximately 4" below the tube sheet.

10.3.2 Move the manipulator to the next location, as required.

Appendix A

GUIDELINE
for
the
PRE-STAGING AREA CHECKOUT OF GENESIS

I. Manual Control Checkout:

1. Manual Leg Positioning.
2. Manual Shoulder Positioning.
3. Manual Elbow Positioning.
4. Manual Wrist (if used) Positioning.
5. Manual Flexirover (if used) Positioning.

II. Computer Control Checkout:

1. Configuration {S/G, plenum, tools, etc.}.
2. Initialization.
3. Run Program.
4. Tool File Check.
5. Commands.
6. Flexirover (if used) Position readout check.
7. Delta Plate Accuracy Check.

III. Checkout of Other GENESIS Equipment:

1. Platform Tool Box.
2. Snorkel Camera and Lights.
3. GENESIS Leg Level Lights.
4. Flexi-Rover Grippers and Level Lights.
5. Hydropumps.
6. Junction Box.
7. Leg-Arm-Tackle Installation Tools.
8. Tackle Function Test.
9. Back-up Air Compressor.

Project # _____

# REMOTE INSTALLATION, CALIBRATION AND REMOVAL OF SM-10/20 MANIPULATOR

Carolina Power & Light Co.

Shearon Harris

ABB COMBUSTION ENGINEERING NUCLEAR OPERATIONS

1201 Riverfront Parkway
Chattanooga, TN 37402

APPROVED BY: _____ DATE: 8-1-95
Quality Operations

APPROVED BY: _____ DATE: 8-1-95
Cognizant Supervisor

TABLE OF CONTENTS


| SECTION | TITLE |
|---|---|
| 1.0 | OBJECTIVE |
| 2.0 | REFERENCE |
| 3.0 | PREREQUISITE AND PRECAUTIONS |
| 4.0 | PROCEDURE: INSTALLATION AND SET-UP |
| 5.0 | CALIBRATION OF FIXTURE |
| 6.0 | OPERATION OF FIXTURE |
| 7.0 | REMOVAL OF FIXTURE |
| 8.0 | EMERGENCY REMOVAL OF FIXTURE |
| ATTACHMENT 1 | PROCEDURE SIGN OFF |

## 1.0 OBJECTIVE

1.1 This procedure provides the general instruction for Installation, Calibration and Removal of the SM-10/20 Manipulator. Actions are the same for the SM-10 and the SM-20 except where noted.

## 2.0 REFERENCE

2.1 ZETEC SM-10/20 Installation and Operating Guide

2.2 ZETEC SM-10/20 Inspection Planning System

2.3 ABB CENO Quality Assurance Manual, QAM-100, latest revision

## 3.0 PREREQUISITE

3.1 Steam generator primary manway cover(s) and stud bolts have been removed (as required). (Attachment 1 sign-off)

3.2 The steam generator shall be at an acceptable level of dryness. A HEPA system shall be installed and operating on one leg of the generator at all times. (Attachment 1 sign-off)

3.3 Prior to installation, the steam generator channel heads, should be cooled down to a proper temperature to prevent heat damage to equipment (approximately 90° F). (Attachment 1 sign-off)

3.4 Provisions must be made for personnel and equipment entry into and exit from the steam generator (i.e., ladders, scaffolds, or staging platform, lighting inside and outside the steam generator, breathing air supply, 120 VAC electricity, etc.). (Attachment 1 sign-off)

3.5 An area near the S/G suitable for the setup and installation of the equipment will be made available and cleared. (Attachment 1 sign-off)

3.6 Nozzle covers have been installed over the hot and cold leg nozzles of opened channel heads (as required). (Attachment 1 sign-off)

3.7 It is expected that very high levels of radiation will be encountered inside and adjacent to the primary head of the steam generators. Utmost care shall be taken in the set-up and performance of the examination to minimize personnel exposure to ionizing radiation and radioactive contamination.

Personnel engaged in the eddy current examination program shall be indoctrinated in the radiation protection rules, guidelines, protective clothing and equipment requirements in effect at the plant site.

## 4.0 PROCEDURE: Installation and Set-Up

### 4.1 General Outline

4.1.1 The installation and set-up for the SM-10/20 will involve hooking up fixture cables to the appropriate locations on the SM-10/20 control box; booting the ACQUISITION and FIXTURE CONTROL software, mounting the trunk assembly to the manway, setting an encoder offset; installing the arm assembly, installing the guide tube with conduit attached, leveling the arm assembly inside the steam generator and calibrating the fixture.

### 4.2 Computer Interface

4.2.1 **Remove** power from all instruments, with the exception of the controlling computer, **before** connecting or disconnecting cables.

4.2.2 The SM-10/20 can operate with or without the Remote Data Acquision Unit (RDAU) eddy current instrument. When operating alone, connect the interface cable, P/N 5-8103, directly to the SM-10/20 "computer" connector. Connect another interface cable to the LAN Box. The LAN Box then uses one cable for the ethernet LAN, and one to connect to the KILL switch.

4.2.3 When operating in conjunction with the RDAU, the SM-10/20 controller and RDAU are "daisy-chained" in series with the interface cable. The cable will attach to the "computer" connector of either instrument and a second cable will attach from the "auxiliary" connector of the first instrument to the "computer" connector of the second instrument.

4.3 Fixture Interface

4.3.1 The SM-10/20 Controller can be located up to 100 feet from the fixture. It is connected with extension cables, which can be "daisy-chained" as required.

4.3.2 Connect the three connectors of the extension cable assembly, P/N 4-008005, to the encoder, motor, and trunk connectors on the SM-10/20. Connect the opposite end of the cable to the encoder and motor connectors on the fixture harness, and to the trunk connector, located on the manway mount.

4.4 Video

4.4.1 Connect the video monitor with coaxial cable to the "monitor" connector on the controller. The fixture camera is connected via the motor connector. Verify the video is operational. (Attachment 1 sign-off)

4.4.2 Should it be required to use a camera separate from the one located on the fixture, an auxiliary camera input is available on the controller. When using this input, the fixture camera will need to be disconnected.

4.5 Powering Up

4.5.1 Assure that the 115/230 V selector plug is in the proper orientation. (Attachment 1 sign-off)

4.5.2 Plug unit in. There is no power switch.

4.5.3 Plug in the LAN Interface Box. SM-10/20 is now ready for computer control.

4.6 Initial Check-Out

4.6.1 Apply power to all components of the system.

4.6.2 The system will boot to X-Windows with the Eddynet Global Menu at the top.

4.6.3 Select Acquisition, Setup Acquisition, and type in the LAN interface number (LAN Box serial number). Select *Use* to enter the information and exit the window.

4.6.4 Select Acquisition, Fixture Control. This will initialize control of the fixture.

4.6.5 Select Tools, Enable Control from the Fixture Control window. This will establish control of the fixture. Press the LAN RESET button.

NOTE: Enable Control must be accomplished prior to any other control function.

4.6.6 Select File, Modify Setup and enter values required. The Modify Setup window contains information on generator type/leg, fixture type/layout, manway location, graphic window layout, specifics on tube number and pitch distances and fixture lengths. Select *Use* to enter the information.

4.6.7 Select Utilities, Graphics to display the Generator-Fixture Layout window.

4.6.8 From the Fixture Control window, click the *Lift*, *Arm* and *Pole* arrow keys with the mouse to verify all the motors operate correctly.

NOTE: Normally this "check-out" sequence is done in an area away from the steam generators, and afterward the fixture is carried up to the platform for installation.

4.6.9 Fold the camera arm up over the pole, until it reaches its mechanical limit. To facilitate guide tube pick-up at a later time, it is critical to ensure that the arm is folded in such a way that it will be able

to rotate towards the divider plate after installation (e.g., if the divider plate is to the left of the manway, the arm should be able to rotate clockwise from the mechanical stop; if the divider plate is to the right of the manway, the arm should be able to rotate counter-clockwise from the mechanical stop).

4.6.10 Operating the LAN Box KILL switch will do the following to the SM-10/20:

A. All motor power supplies will turn off.
B. All internal registers within the Controller will be reset to the motor off condition.

4.6.11 Remove AC power from the SM-10/20 controller before disconnecting cables. The fixture cables can be disconnected at this point and the fixture can be transported to the steam generator platform for installation.

4.6.12 Upon successful completion of the check-out initial Attachment 1, Section 3.3.

4.7 Installation Sequence

4.7.1 The sequence of installation steps is shown in Figure 1a through 7a for the SM-10 and Figures 1b through 6b for the SM-20.

4.7.2 SM-20: Loosen the two socket bolts. Determine which side of the trunk the divider plate is located on and swing the trunk until it touches the stop pin on the divider plate side. Re-tighten the two socket bolts.

4.7.3 Sm-10: Slide the trunk assembly through the manway, flat side down, until the manway mount reaches the manway (see Figure 1a).

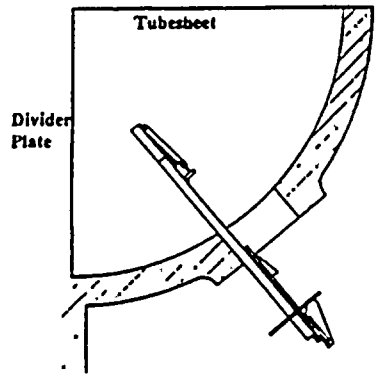



Figure 1a SM-10

SM-20: Slide the trunk assembly through the manway on its side using the stainless steel rail until the manway mount is flush with the manway flange (see Figure 1b).

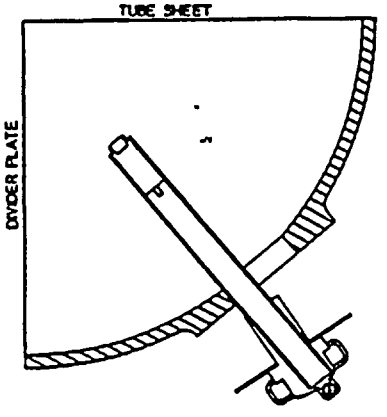



Figure 1b SM-20

4.7.4 SM-10: Rotate the trunk 180° (flat side up). See Figure 2a.

SM-20: Rotate the trunk 90°. See Figure 2b.

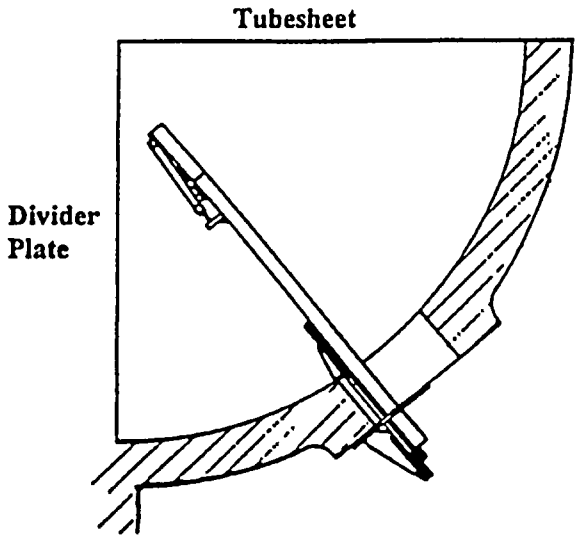



Figure 2a SM-10

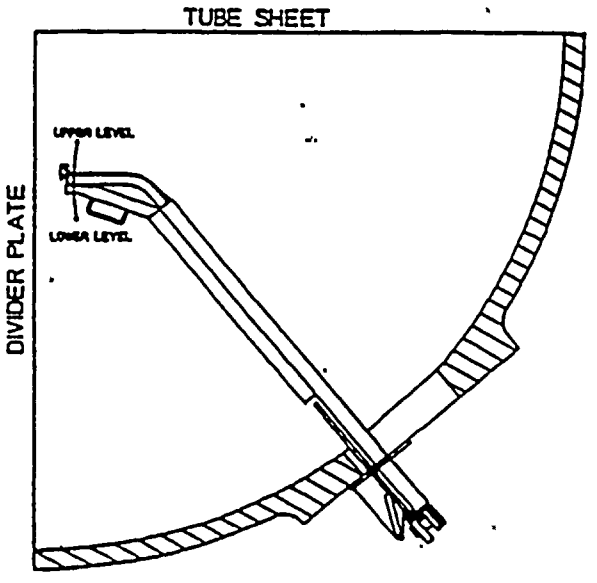



Figure 2b SM-20

4.7.5 Install the four manway bolts and washers, and hand-tighten them so that the manway mount remains flush with the manway flange. See Figures 3 and 4.

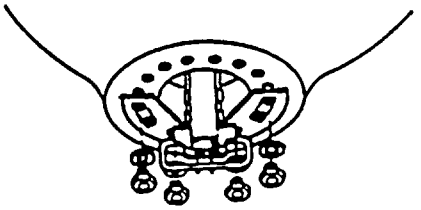


Figure 3a, SM-10

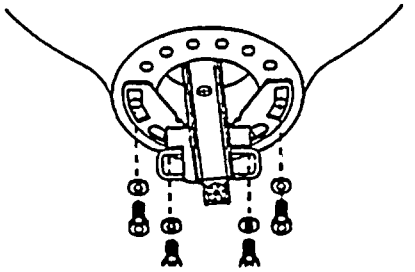


Figure 3b, SM-20

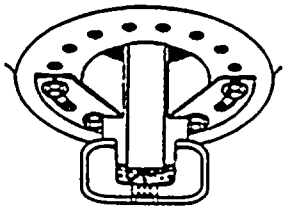


Figure 4a, SM-10

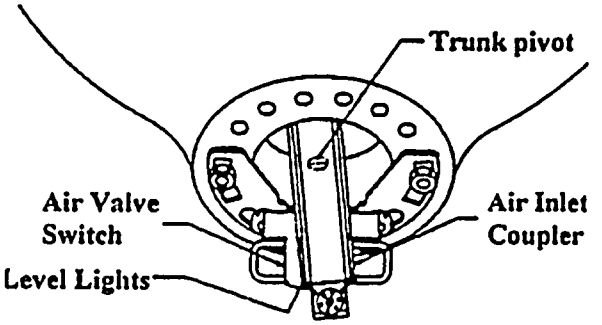



Figure 4b, SM-20

4.7.6 Re-connect the trunk extension cable. Apply AC power to the SM-10/20 controller.

4.7.7 SM-10: Rotate the manway mount until the green light on the lower set of three indication lights comes on.

SM-20: Rotate the trunk a few degrees either way until the LOWER green light comes on.

4.7.8 Install the manway clamp approximately over the pivot point (see Figure 4), ensuring that the top of the clamp assembly securely contacts the curved surface of the manway. Adjust the clamp as necessary so that it fits quite firmly when the lever is pushed all the way up. Verify the green light is on and the trunk wheels are tight against the bottom of the manway.

4.7.9 Tighten the four manway bolts evenly, starting with the two bottom bolts, using a spanner or large screwdriver. The LOWER green light may flash on and off during this tightening process.

4.7.10 When the tightening is complete, the LOWER green light should be steady. If it is not, loosen the bolts, remove the clamp, and repeat steps 4.7.7, 4.7.8 and 4.7.9. The trunk is not correctly installed until the clamp is in, the bolts are tightened, the LOWER green light is lit, and the trunk wheels are tight.

**NOTE:** NEVER fully tighten the manway bolts unless the manway clamp is securely installed. The clamp simulates stress, and provides support for the entire trunk.

4.7.11 SM-10: Remove the manway clamp. The track assembly must now be moved far enough from the divider plate to allow the upper track to tilt to its level position. The track position is adjusted after loosening the three set screws located on the track increment scale above the lights. The track should be placed so that it rests against the divider plate, and then backed off enough distance so the upper track can reach a level state. This distance is about six (6) increments. Tighten the three set screws after track position is established. Make sure the green indicator light is still on. If not, rotate the manway mount until the light comes on. The track position increment reading should be documented for future use.

SM-20: A level adjustment knob is provided at the manway end of the trunk for use in adjusting the level state of the upper platform on the trunk. Turn the knob to its maximum clockwise position. This puts the trunk in its uppermost position, and provides a red-light condition. The trunk is brought down to a level mode after installing the arm assembly - step 4.7.25.

4.7.12 SM-20: Attach air line, 80 to 100 psi, to right side of trunk. **Verify that the solenoid switch is in the unlocked position (down).**

4.7.13 Select File, Archive, Remove Offset & Points.

4.7.14 SM-10: Fold the arm up over the top of the pole and against the mechanical stop. The arm assembly should be folded such that when the arm is reopened from the pole, the arm moves towards the divider plate. Select Tools, Set Offset. This will set an offset for the arm encoder. Estimate an offset for the pole encoder so that the picture on the display closely approximates the respective positions of the arm and pole inside the bowl. The offset for the pole encoder will be recalculated at the end of the calibration.

SM-20: Verify that the arm is still rotated against its mechanical stop (see step 4.6.7), and that the wheels are parallel to the pole. Select Tools, Set Offset. New variables will be stored to the Inspection Plan Map disc.

**NOTE:** If the arm is not against its mechanical stop, repeat the procedure(s) in Initial Check-Out until it is. An accurate calibration CANNOT be achieved unless the Set Offset is selected while the arm is against its stop.

4.7.15 SM-10: Install the arm assembly on the track rails and insert it through the manway. Slide the arm assembly until it locks into place. See Figure 5a.

SM-20: Remove the manway clamp.

4.7.16 SM-10: Install the manway clamp and go to 4.7.18.

SM-20: Check to see that carriage assembly is rotated so that the lock pin will engage at the top of the trunk (see Figure 5b). Then engage the camera arm wheels in the track and carefully slide the arm up the track. Ensure that the cables feed smoothly into the manway.

4.7.17 SM-20: When the camera arm reaches the lower latch, push the camera arm up just until the lower latch takes hold. Re-position yourself and push and lift the arm until the carriage is past the first latch. Let the arm slide back against the latch, coming to rest on the lower latch and raised 3 to 4 inches on the end closest to manway. This will allow the arm to clear the bowl. Tug on the arm to ensure that the lower latch is supporting the camera arm (see Figure 5b). Push the ball in on the end of the arm using the utility stick.

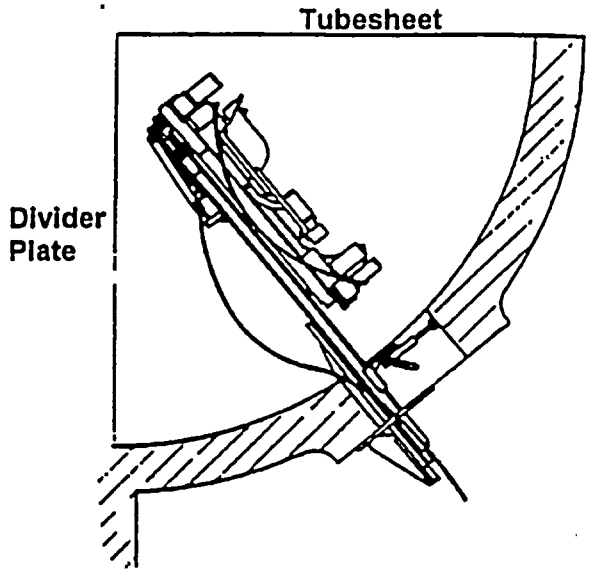



Figure 5a SM-10

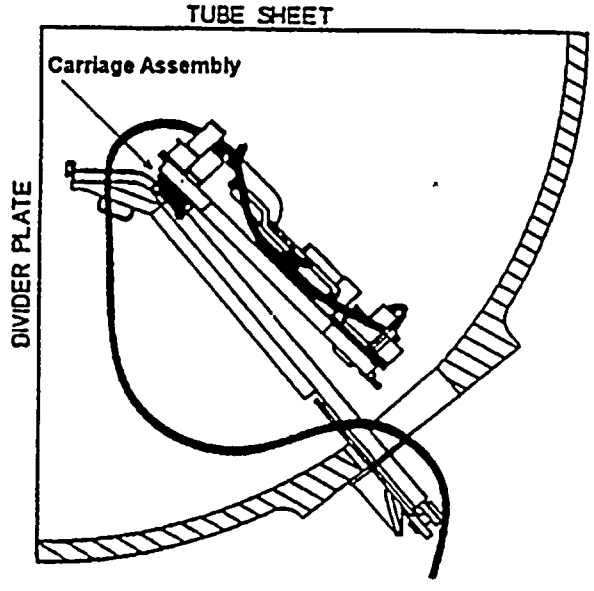



Figure 5b SM-20

4.7.18 For safety reasons, reinstall the manway clamp. To position the pole and arm for attaching the guide tube and conduit, select Tools, Guide Tube Pickup.

4.7.19 When the fixture is in position, reach just inside the manway and attach the guide tube and conduit assembly. Insert enough cable and conduit into the manway to allow full movement of the fixture. The cable and conduit should run along the side of the clamp opposite the divider plate.

4.7.20 SM-10: Reposition the fixture to its level position by selecting Tools, Level Tilt and clicking on *Auto Tilt* in the Fixture Leveling window. The green light on the upper track has reached a level state. The lights may flicker between red and green when it hits a level state. See Figure 6a.

**CAUTION:** If the upper track has been raised manually above the level position, the upper track will raise until the guide tube makes contact with the tube sheet. The track must then be lowered below the level position before leveling may begin.

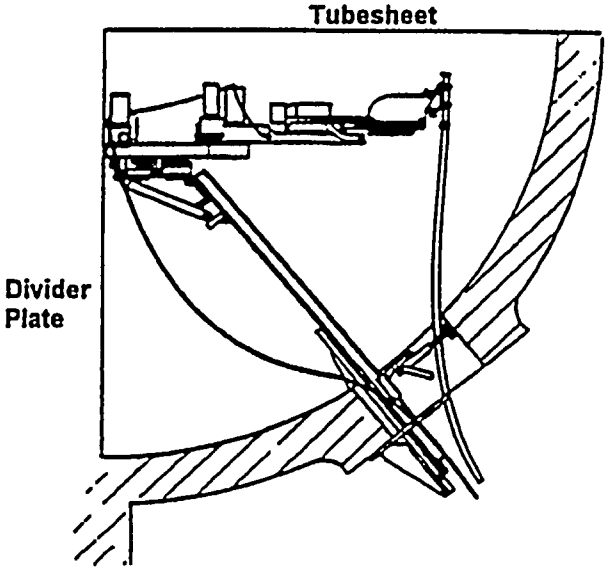



Figure 6a SM-10

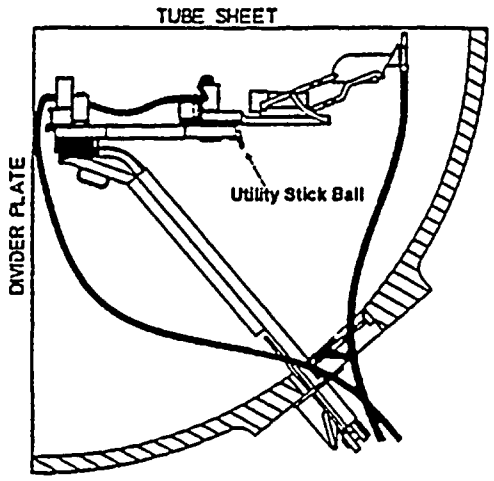



Figure 6b SM-20

4.7.21 SM-20: Attach the utility stick to the ball stud located on the end of the camera arm. Be sure that the utility stick is securely attached.

4.7.22 SM-20: Push the arm up and over the curved ramp until it latches securely in the top latch. The camera arm should be parallel to the tubesheet. See Figure 6b.

4.7.23 SM-20: Activate the air solenoid to lock the camera arm in position. The switch should be toggled to the "LOCK" position. Carefully pull the pole and camera arms back toward you, being prepared if the lock did not engage. Repeat steps 4.7.22 and 4.7.23 if the lock did not hold.

**CAUTION:** If the lock does not hold, the weight of the arms coming back down rapidly can be surprising.

4.7.24 SM-20: Remove the utility stick from the camera arm.

4.7.25 SM-10: Using the spanner, rotate the UP/DOWN trunk level adjustment screw CCW to lower the

trunk until the upper green light is lit. It is suggested to make this adjustment with the trunk being lowered into the leveled zone and stop on the high side of this adjustment. If the trunk is initially on the low side, rotate the adjustment screw CW up through the acceptance window, then lower it back down just until the upper green light comes on. This is necessary because when the pole and camera arms are fully extended to the far side of the generator, the excess weight adds to the fixture sag. Keeping the UP/DOWN level on the high side of the adjustment helps to compensate for this sag.

SM-20: Install the manway clamp. Insert enough cable and conduit into the manway to allow full movement of the fixture. The cables and conduit should run on the side of the manway clamp which is opposite the divider plate. Rotate the leveling knob counter-clockwise until the upper red light goes out and the upper green light comes on.

4.7.26 Initial Attachment 1 Section 3.4. Proceed with the calibration process.

## 5.0 CALIBRATION

5.1 Select the Lift up arrow to bring the guide tube closer to the tubesheet.

5.2 In the Free Run mode,use the ARM and POLE control arrows, position the guide tube under the first calibration point. Select Tools, Add Cal. Point to view the *Add Cal. Point* dialog box. When the guide tube is directly under the tube, insert the cursor into the text fields and input the correct tube encode for the first calibration point. Click *Use*.

5.3 Position the guide tube under the second calibration point as directed on the screen. Open the *Add Cal. Point* dialog box and input the encode of the second calibration tube. Click *Use*.

5.4 "Break" the arm by bringing the camera end out of the corner first.

5.5 Continue to the other side of the generator and

position the guide tube under the third calibration point. Repeat the *Add Cal. Point* steps.

5.6 Continue *Add Cal. Point* steps until all the required calibration points are saved in the setup file.

5.7 Check the setup file to verify that the calibration points are correct. To view the *Fixture Control Calibration Setup* dialog box, select Utilities, Setup. Scroll through the file with the scroll bar on the right-hand side of the dialog box checking the following lines:

5.7.1 NUM_CAL_POINTS="x" (where "x" equals the number of calibration points added)

5.7.2 ENCODER_ZERO="X" (where "X" equals arm and pole encoder values for the *set offset* position)

5.7.3 CALIBRATION_POINT="y","Y" (where "y" and "Y" equals one CALIBRATION_POINT entry for each added calibration point for the arm/pole encoder values and counts for each location)

5.8 If the setup file is correct, archive the calibration to the setup file by selecting File, Archive, Archive Calibration. Initial Attachment 1, Section 3.5.

## 6.0 OPERATION

6.1 To operate the fixture in the free run mode, from the Fixture Control window, select Mode, Free Run. This mode is useful for moving the fixture to a general area such as the manway or for breaking the arm to the opposite side of the tubesheet.

6.2 To move the fixture in free run mode, with the mouse, click the large rotational control buttons for continuous movement. Click and hold the small buttons for jog movement. The small buttons will only move the fixture when pressed and held. The location of the guide tube will be displayed under *Actual*.

6.3 To stop movement of the fixture click the *STOP* button in the lower left of the Fixture Control button.

6.4 To raise and lower the fixture, click the Lift arrow buttons.

6.5 To operate the fixture in the manual mode, from the Fixture Control window, select Mode, Manual. This mode allows inputting of "Desired" locations.

6.6 To move the fixture to a specific location, click the cursor to the "Desired" row or column box. Type the location and click *Move Fixture*.

6.7 The arrow buttons can also be used to input the desired location. Each click of an arrow button increments the desired location by one (up or down). Click *Move Fixture* to send the fixture to the next location.

6.8 The Lift arrow and the *STOP* buttons are in the same location in the manual mode as the free run mode and perform the same task.

6.9 If the guide tube needs to be centered or moved less than a tube pitch the *Jog* arrow buttons can be used. Clicking these arrows will add or subtract a distance to offset the *Actual* location. This is displayed under *Error*. Each time an arrow is pressed the adjustment is made by the amount of the jog increment (*Jog Inc.*). If the amount of *Error* is changed after the fixture is on condition, *Move Fixture* must be pressed to move the fixture the amount of the error induced. Care must be taken not to adjust the error too much so as to move the guide to an entire pitch and thus inspect the wrong tube.

6.10 To operate the fixture in the inspection mode, a preprogrammed inspection plan or data base must have been inputed prior to using the mode. To retrieve the inspection plan or data base, select File, Database, then either Select Test Plan or Select Database bringing up the respective selection window. Choose the appropriate file by clicking and clicking *Use*.

6.11 If Test Plan is chosen, the sort method must also be chosen. Click on *Select Sort Method*. Select the test pattern (test along rows or columns) and the starting point (low number to high number or high number to low number). Click on *Use*.

6.12 Select Mode, Inspection. The test plan will be displayed with a highlight bar across the *Selected Test*. Click on *Selected Test* to move the fixture. Click on *Next Test* to move fixture to the next entry. The highlight bar will move to the next entry as well as the fixture. The actual location will be displayed

under *Actual*.

6.13 The *Jog*, *Lift* arrow, and *STOP* buttons operate as in the manual mode. Adjustments to the jog increment are performed in the manual mode.

## 7.0 REMOVAL OF FIXTURE

7.1 Position the fixture for guide tube removal by selecting Tools, Guide Tube Pickup from the Fixture Control window.

NOTE: If the arm is not on the correct side of the generator (toward divider plate), break the arm to the correct side.

7.2 Remove the manway clamp.

SM-10: Remove the guide tube. Go to step 7.7.

SM-20: Attach the utility stick to the ball stud on the end of the camera arm. Turn air solenoid switch to the "UNLOCK" position.

7.3 SM-20: Release the upper latch by pulling the release trigger on the left side of the trunk. Lift the release trigger up so that it is locked in the release mode.

7.4 SM-20: Position yourself in such a way that you can use both hands on the utility stick to carefully roll the camera arm down to the lower latch.

7.5 SM-20: Remove the utility stick from the camera arm. Position the guide tube in front of the manway using the free run mode in necessary.

7.6 SM-20: Remove the guide tube.

7.7 Position the fixture for removal.

7.8 Reach inside the manway and grasp the end of the pole. With the other hand, pull the lock release ring located on the right side of the trunk. Hold the release until the carriage is past the latch.

**CAUTION: DO NOT HOLD IT ON TOP OF THE MOTOR OR YOU WILL PINCH YOUR HAND WHEN IT COMES DOWN THE TRUNK.**

7.9 Slowly lower the camera arm down the trunk, making sure the cable does not hang up on the end of the trunk.

7.10 SM-10: Disconnect the fixture cables.

SM-20: Disengage the wheels from the track and set the camera arm aside. Remove trunk extension cable and air line.

7.11 Remove the manway bolts.

7.12 Rotate the trunk 90° (on edge), and slide it out of the generator.

## 8.0 EMERGENCY REMOVAL

The SM-10/20 fixture has been designed for removal in the event that a motor or gearbox should fail with the fixture installed.

8.1 Remove the manway clamp.

8.2 Align the camera arm assembly over the trunk.

SM-20: attach the utility stick to the camera arm and release the upper latch (on the left side of the trunk). Turn the solenoid switch to the "UNLOCKED" position. It may be necessary to swing the arm from side to side to relax the air pistons.

8.3 Roll the camera arm down to the lower latch.

SM-20: Disconnect the utility stick from the camera arm.

8.4 If the lift assembly is up, it will be necessary to place the fixture into the approximate guide tube position. To remove the lift, loosen the draw bolt using a 1/4" nut driver. You may now slide the lift assembly away from the secondary pivot and remove it through the manway. Once the lift assembly has been removed, fold the fixture back up over the trunk.

8.5 Release the lower latch (on the right side of the trunk) and remove the camera arm from the steam generator.

NOTE: The primary and secondary rotation assemblies may be rotated manually in the event of a failure. If sufficient physical pressure is applied to either the primary pivot (which rotates the pole) or secondary pivot (which rotates the arm), the clutches will slip and allow free rotation of the pivot receiving the force.

Project No.: _____

# PROCEDURE FOR MULTIFREQUENCY EDDY CURRENT EXAMINATION OF NONFERROMAGNETIC STEAM GENERATOR TUBING USING MIZ-18/MIZ-30 EQUIPMENT

CAROLINA POWER & LIGHT CO.

SHEARON HARRIS

ABB COMBUSTION ENGINEERING NUCLEAR OPERATIONS

1201 Riverfront Parkway
Chattanooga, TN 37402

APPROVED BY: Robert A. Mikalobis DATE: 8-2-95
Cognizant Supervisor

APPROVED BY: Thomas W. Bipes DATE: 8-1-95
T. U. Bipes
Level III

APPROVED BY: James D. Ford DATE: 8/2/95
J. D. Ford
Quality Assurance

## TABLE OF CONTENTS


| SECTION | TITLE | PAGE |
|---|---|---|
| 1.0 | OBJECTIVE | 4 |
| 2.0 | SCOPE | 4 |
| 3.0 | REFERENCES | 4 |
| 4.0 | PERSONNEL REQUIREMENTS | 5 |
| 5.0 | PRECAUTIONS AND PREREQUISITES | 5 |
| 6.0 | CALIBRATION STANDARDS | 7 |
| 7.0 | EQUIPMENT | 8 |
| 8.0 | EQUIPMENT SETUP | 9 |
| 9.0 | EQUIPMENT OPERATION AND CALIBRATION | 11 |
| 10.0 | PROBE SPEED ADJUSTMENT | 13 |
| 11.0 | CALIBRATION VERIFICATIONS | 14 |
| 12.0 | EXAMINATION | 15 |
| 13.0 | OPERATING PRACTICES | 16 |
| 14.0 | MANIPULATOR POSITION VERIFICATION | 16 |
| 15.0 | RECORDING CRITERIA | 17 |
| 16.0 | EVALUATION | 17 |
| 17.0 | REPORTING CRITERIA | 17 |

TABLE OF CONTENTS (Cont'd)


| SECTION | TITLE | PAGE |
|---|---|---|
| FIGURE 1 | TYPICAL EDDY CURRENT TEST EQUIPMENT SET-UP DIAGRAM | 19 |
| FIGURE 2 | TYPICAL ASME CALIBRATION STANDARD | 20 |
| FIGURE 3 | TYPICAL MIZ-18 INTERCONNECTION SCHEMATIC | 21 |
| FIGURE 4 | TYPICAL MIZ-30 INTERCONNECTION SCHEMATIC | 22 |
| EXHIBIT A | TYPICAL EDDY CURRENT EXAMINATION SHEET | 23 |
| EXHIBIT B | TYPICAL SET UP INSTRUCTION FORM (MIZ-18) | 24 |
| EXHIBIT B-1 | TYPICAL SET UP INSTRUCTION FORM (MIZ-30) | 25 |
| EXHIBIT C | TYPICAL EDDY CURRENT CALIBRATION SHEET | 26 |
| EXHIBIT D | TYPICAL OPTICAL DISK LABEL | 27 |
| EXHIBIT E | CONFIGURATION FOR BOBBIN PROBE MIZ-18/30 | 28 |
| EXHIBIT F | CONFIGURATION FOR ROTATING PROBE MIZ-18/30 | 29 |
| EXHIBIT G | ROTATING PROBE CALIBRATION INFORMATION | 30 |
| EXHIBIT H | ROTATING PROBE SLIP-RING INFORMATION | 31 |
| EXHIBIT I | ROTATING PROBE PULSE INFORMATION | 32 |
| EXHIBIT J | CONFIGURATION FOR HIGH RESOLUTION BOBBIN PROBE MIZ-18 | 33 |
| APPENDIX A | BOBBIN COIL TEST PARAMETERS | 34 |
| APPENDIX B | ROTATING PROBE COIL TEST | 35 |
| APPENDIX C | HIGH RESOLUTION BOBBIN SET-UP AND CALIBRATION | 37 |
| ATTACHMENT 1 | PROCEDURE SIGN-OFF SHEETS | |

1.0 OBJECTIVE:

Eddy current examination of steam generator tubing is performed to assess the reactor coolant pressure boundary integrity. The results of this examination are permanently recorded and used for comparison with the results of past and/or subsequent steam generator tubing inspections. The eddy current equipment operator is responsible for proper equipment interconnection, equipment setup and collection of eddy current data. The shift supervisor will provide additional technical support during all these activities. The evaluation of the results will be performed in accordance with the procedure and guideline referenced in reference 3.6 and 3.7.

2.0 SCOPE:

This procedure, when used in accordance with the eddy current system setup and calibration parameters established in the specific appendices, meets the intent of the requirements of the USNRC Regulatory Guide 1.83 "Inservice Inspection of PWR Steam Generator Tubes", Revision 1, dated July, 1975 and the ASME Boiler and Pressure Vessel Code, Section XI "Rules for Inservice Inspection of Nuclear Power Plant Components", 1983 Edition, summer 1983 addenda.

3.0 REFERENCES:

3.1 ABB Combustion Engineering Nuclear Operations, Quality Assurance Manual, QAM-100, latest revision.

3.2 ABB Combustion Engineering Nuclear Operations, Quality Assurance Procedure Manual, QAM-101, latest revision.

3.3 Zetec Eddynet MIZ-18 Acquire Program User Guide.

3.4 Zetec Eddynet MIZ-30 Acquire 30D Program User Guide.

3.5 ASME Code Case N-401-1; Use of Digital Equipment.

3.6 Eddy Current Data Analysis Procedure Evaluation of Westinghouse Steam Generator Tubing., HNP-005, latest revision.

3.7 Shearon Harris/H. B. Robinson Steam Generator Eddy Current Data Analysis Guidelines.

3.8 Procedure for control of Eddy Current Data for use with Multiforth or Eddynet Acquisition Systems, HNP-006, latest revision.

## 4.0 PERSONNEL REQUIREMENTS:

ABB Combustion Engineering (ABB-CE) personnel shall be certified in accordance with ABB Combustion Engineering Procedure QAP 2.4 contained in Reference 3.2. If examiners are supplied by the purchaser, the purchaser will be responsible for their certification. In the event ABB-CE utilizes a subcontractor, ABB-CE will be responsible for certification either by examination to the requirements of QAP 2.4 or by auditing and accepting the subcontractor(s) written practice.

4.1 A Level I may perform specific calibrations and specific tests according to written instructions (procedure), and record the results. He shall receive the necessary guidance or supervision from a certified ET Level II or III.

4.2 A Level I trainee shall work with a certified individual (minimum Level I) while operating the eddy current test equipment (i.e. MIZ-18/MIZ-30).

4.3 The initial equipment set-up at the start of the test program shall be verified by a certified ET Level II or III.

4.4 The evaluation of the results of the eddy current examination must be conducted by a Data Analyst qualified to at least ET Level II with specific training for the evaluation of data from nonferromagnetic steam generator tubing.

4.5 Certification, including eye certification shall be verified for testing personnel and an entry made in Attachment 1 Procedure Sign-off, Section 1.

## 5.0 PRECAUTIONS AND PREREQUISITES:

5.1 It is expected that very high levels of radiation may be encountered inside and adjacent to the primary head of the steam generators. Utmost care shall be taken in the setup and performance of the examination to minimize personnel exposure to ionizing radiation and radioactive contamination.

5.2 Personnel engaged in the eddy current examination program shall be indoctrinated in the radiation protection rules, guidelines, protective clothing and equipment requirements in effect at the plant site as required.

5.3 The eddy current test equipment shall be set up in an area designated by the ABB-CE Shift Supervisor and approved by site personnel. All equipment set-ups will be at the direction of the ABB-CE Shift Supervisor or his designee. Figure 1 is an example of a typical ECT equipment set-up. (Attachment 1 sign-off)

5.3.1 If a Remote Data Acquisition and Analysis Trailer (RDAAT) is utilized, all data acquisition equipment, video equipment and communication equipment may be located in this trailer.

5.4 The steam generator shall be open on the primary side, dried and ventilated in such a manner as to provide proper temperature and humidity for personnel safety and comfort, and to prevent heat and moisture damage to equipment (approximately 90° F or less). (Attachment 1 sign-off)

5.5 The secondary side of the steam generator shall be cooled down to the extent that the temperature of the tubes and tubesheet are 120° F or less. (Attachment 1 sign-off)

5.6 Provisions must be made for personnel and equipment entry into and exit from the steam generator (i.e., ladders, scaffolds or staging, platforms, lighting inside and outside the steam generator, breathing air supply, 120 VAC electricity, etc.). (Attachment 1 sign-off)

5.7 Health Physics coverage shall be maintained at the steam generator during any personnel entry into the steam generator as required.

5.8 The Eddy Current Examination Sheets (Exhibit A) shall list all the tubes that are to be inspected. The Eddy Current Test Operator shall initial or check (✓) the sheet after each tube inspection. If multiple tubes are listed on one line, such as for dual guide tubes, one check will suffice for both tubes, if tested simultaneously. If tested individually, a check should be performed for each tube, using the appropriate column. If a tube cannot be inspected (or only partially tested), the disposition shall be noted in the comment section of the examination sheet, and in a message on the recording media. Data control is maintained in accordance with Reference 3.8 or as applicable. (Attachment 1 sign-off)

5.9 All examination/inspection forms, records, and examination sheets shall be dated and signed where required. 'NA' shall be written or typed in all blanks that are not applicable to the document. Black ink is required and the use of 'white out' or correction fluid is forbidden. Changes will be single lined through, initialed and dated indicating no further action was taken.

5.10 A communication system shall be set up between the Eddy Current Instrument Operator, the steam generator platform, and health physics personnel (containment). (Attachment 1 sign-off)

5.11 The primary piping nozzle openings shall have been sealed prior to installing ECT equipment in the steam generator. This is accomplished with nozzle dams or nozzle covers establishing a foreign material exclusion boundary to the primary system. (Attachment 1 sign-off)

6.0 CALIBRATION STANDARDS:

6.1 The calibration standard shall be fabricated from a length of tubing of the same alloy, nominal outside diameter, and nominal wall thickness as that in the steam generator. It may also contain secondary side features such as carbon steel support rings, copper rings, and other features as needed to provide signals for subsequent multi-parameter frequency mixing by the data analyst. Fabrication of the calibration standards shall meet the requirements of the ASME Code.

6.2 Documentation shall include an as-built drawing of the calibration standard, a mill test report, serial number and manufacturer's heat treat number for tube material used in the calibration standard.

6.3 The ASME calibration standard shall typically contain the following artificial discontinuities as a minimum, but other designs may be used as required for specific applications. See Figure 2 for a typical standard. Use as-built drawing of actual standard for specific details.

6.3.1 Single hole drilled 100% through wall 0.052 in. diameter.

6.3.2 Flat-bottomed drill hole 5/64 in. diameter x 80% through from the outer tube wall surface.

6.3.3 Flat-bottomed drill hole 7/64 in. diameter x 60% through from the outer tube wall surface.

6.3.4 Flat-bottomed drill hole 3/16 in. diameter x 40% through from the outer tube wall surface.

6.3.5 Four flat-bottomed drill hole 3/16 in. diameter, spaced 90 deg. apart around the tube circumference, 20% through from the outer tube wall surface.

6.3.6 1/16 in. wide 360 deg. circumferential groove. 20% through from the inner tube wall surface.

6.3.7 1/8 in. wide 360 degrees circumferential groove. 10% through from the outer tube wall surface.

6.3.8 Carbon steel ring, simulated support plate.

6.4 Other special calibration standards (when used) shall contain a variety of notches, holes and grooves for calibration of special setups such as high resolution bobbin and rotating probes.

6.5 Calibration standards used shall be logged in section 4.0 of Attachment 1 Procedure Sign-off.

7.0 EQUIPMENT:

All eddy current test equipment provided by ABB Combustion Engineering shall be certified to be equivalent or exceed the applicable requirements of the ASME Code, Section XI, Appendix IV, paragraph IV-3000, with Code Case N-401-1 addressing the use of digital examination equipment. ABB Combustion Engineering may utilize equipment provided by subcontractors that is certified to the above requirements. Documentation of calibration will be provided prior to the start of the inspection and be logged on Attachment 1 Procedure Sign-off. A typical equipment list is provided below.

7.1 HP Server Work Station 400 or 700 series computer or equivalent with hard disc drive, Eddynet Acquisition Software Installation Disc and Eddynet Acquisition Module.

7.2 Optical Disc Drive HP model 650/A or equivalent and a supply of properly formatted optical disks.

7.3 MIZ-18/MIZ-30° Remote Data Acquisition Unit (RDAU). Certificate of Calibration required.

7.4 LAN Interface Box° (not required when using MIZ-30.

7.5 LAN Reset Box.

7.6 Eddy Current test/reference probes. See appropriate appendix for probe size and type.

7.7 Remote controlled manipulator* (optional), eg. SM-10, SM-20, SM-22, Genesis.

7.8 Mechanical probe pusher and flexible probe guide material.

7.9 A calibration and reference standard* (hand held or in-line).

7.10 Eddy Current Examination Sheets.

7.11 Video Monitoring Equipment.

7.12 Communication System.

*NOTE: Equipment noted with an asterisk shall be logged on Attachment 1. In the event that equipment is replaced, replacement equipment shall be logged also.

8.0 EQUIPMENT SETUP:

8.1 Satisfy applicable requirements specified in Section 5.0 (Precautions and Prerequisites).

8.2 Set up communications between steam generator platform and data station as required. (Attachment 1 sign-off)

8.3 Install the remote manipulator into the steam generator primary head as required. (Attachment 1 sign-off)

8.4 Attach guide tube with flexible guide material between remote manipulator and the probe driver.

8.5 Interconnect the acquisition system as shown in Figure 1 and 3 described as follows:

8.5.1 Connect the monitor to the rear of the system processing unit (SPU) by using the appropriate cable and attaching it to the video card on the SPU.

8.5.2 Connect the mouse to the keyboard, then connect the keyboard to the SPU with the appropriate cable.

8.5.3 Connect the Eddynet Acquisition Module.

8.5.4 Connect the hard drive to the SPU with the small computer systems interface (SCSI) cable. (Required if the hard drive is separate from the SPU)

8.5.5 Connect the Optical Disc Drive to the SCSI connector on the hard drive with the SCSI cables. Terminate the SCSI bus by placing a terminator at the appropriate location.

8.5.6 Connect the Local Area Network (LAN) connector on the rear of the SPU to the LAN Interface Box with approved LAN cables. The MIZ-30 has an internal LAN Interface Box.

8.5.7 Connect the LAN Reset Box to the LAN Interface Box with approved LAN interconnect cables. The MIZ-30's LAN Reset Box connects to the MIZ-30. (RG-58 A/U type of equivalent).

8.5.8 Install Termination Caps on each end of the LAN at appropriate locations (if 10base2 cable is used).

8.5.9 Connect the LAN Interface Box to the RDAU using the appropriate (IEEE-488 type) connector and cables (Omit this step for MIZ-30). Interconnect the probe pusher controller to the RDAU.

8.5.10 An appropriate probe splitter/adaptor connected to the probe connector on the RDAU is used to adapt the test probe to the RDAU.

8.5.11 If data is to be spooled "send data" from the acquisition station to the analysis station, use appropriate networking device (HP Router or equivalent) along with LAN cable or Fiber-Optics cable to interconnect both systems. (Attachment 1 sign-off)

8.6 When a reference probe is required for absolute data attach the reference probe to the connector labeled 'ref'. The reference probe shall be placed in a reference standard. Extension cables may be used as required, typically less than 100' with equal

amounts connected to the test probe and reference probe.

8.7 Perform a functional check out to verify that the eddy current system if operating correctly. This can be achieved by recording a calibration standard and reviewing the data. (Attachment 1 sign-off)

9.0 EQUIPMENT OPERATION AND CALIBRATION:

The following will describe the typical equipment calibration sequence with the specific calibration technique requirements described in Appendix A thru C. The appropriate Appendix will be selected based on the particular type of inspection. The operator will be provided written instruction by the shift supervisor with the issue of a completed "Set Up Instruction" Form. See Exhibits B and B1.

9.1 Zetec Eddynet Data Acquisition System.

NOTE: HP-UX and EDDYNET files must be installed on the system hard drive before starting eddynet data acquisition. Refer to the appropriate Zetec Operation User Guide (Reference 3.3) for installation instructions.

9.1.1 Power up the CPU and select the appropriate bootable system code number per the designated system administrator (eg. P0, P1). Verify the correct time and date. The system administrator shall have input the proper system communication protocol. Polling the clusters should not be necessary. Answer 'Y' to search and remove cores. After the boot up sequence the login prompt will appear. Type the proper user number (eg. user1) as designated by the system administrator.

9.1.2 After login, the system will be in the X-Windows environment. The Eddynet menu will appear at the top of the screen.

9.1.3 Insert the optical storage disc into the optical disc drive. Insure that the optical storage disc is not write protected.

9.1.4 'Mount' the optical storage disc by using the 'mount widget.' With the mouse, open the mount widget by selecting File, Administration, and Mount/unmount.

9.1.5 Choose *Local* and select the scsi device and rod number to be mounted by clicking in the appropriate boxes. (Example: scsi150100 rod1)

9.1.6 Click on MOUNT R/W.

9.1.7 If the data is to be spooled from the acquisition station to the analysis station via a LAN, choose *Remote* and select the scsi device and rod number to be mounted by clicking in the appropriate boxes. Exit the mount widget by clicking *Quit*.

9.1.8 From the Eddy Menu, select Acquisition, and Setup Acquisition. Enter the LAN box serial number in the *LAN interface number* selection. Choose either MIZ-18 or MIZ-30 and setup the 4-hour clock if desired. Click on *Use* when finished.

9.1.9 Establish contact to the LAN Interface Hub by selecting Acquisition, Acquisition.

9.1.10 The Main Screen contains several boxes which when clicked on perform various functions. These include: Process Channels, Message Form, Summary Form, Zoom, Refresh, Next-Last Tube, Start Acquiring, File Functions, System Config and Print-FF Screen. Refer to the appropriate Zetec Operation Guidelines for information on using these functions.

9.1.11 Set up Eddynet acquisition system according to the appropriate Zetec Eddynet MIZ-18 or MIZ-30 Acquire Program User Guide. (Reference 3.3 MIZ-18 or 3.4 MIZ-30).

9.1.12 Change the acquisition setup parameters to the appropriate settings for the identification of system variables. e.g.; S/G designator, Row and Column designators, printer enable, printer type, etc.

9.1.13 Configure system frequencies and operating modes (absolute or differential) as required by the appendices for examination to be performed as directed by the shift supervisor. Changes to the test frequencies, sampling rate and probe pusher speed may be accomplished through the initiation of the Set Up Instruction Form (Exhibit B MIZ-18, B1 MIZ-30).

9.1.14 Pull the probe through the calibration standard and adjust spans and rotations for all channels as described in the appendix utilized in paragraph 9.1.13.

NOTE: Check the set up menu options to insure proper pull speeds and rotation speeds.

9.1.15 Complete the summary with the following plant specific information supplied by the shift supervisor and by documenting the equipment being utilized. Specific information for reporting CAL groups will be provided by cognizant data management personnel prior to starting data acquisition.

| | |
|---|---|
| Owner | Calibration Standard |
| Plant and Unit No. | S/N (S) |
| Date | Procedure/Revision No. |
| Component ID & Side | ET Operator Name/Cert. |
| Recording Tape No. | Level |
| (or equivalent) | Company Affiliation |
| Computer S/N | Tubing Size |
| Probe ID, Size and | RDAU S/N |
| Length | Length of Cables |
| | (as required) |

NOTE: When completing the line "ET Operator Name" use the operator's last name followed by the operator's initials. EXAMPLE: "JONES JR" For consistency, no punctuation should be used.

9.1.16 Record data from the calibration standard onto the recording media at the probe speed required for the examination as defined in the applicable appendix.

9.1.17 Complete the eddy current calibration sheet recording the appropriate information and calibration time (See Exhibit C).

10.0 PROBE SPEED ADJUSTMENT:

10.1 Verify the proper speed has been input from the proper appendix by checking *Display speeds* in the probe pusher menu. Insert the probe into the tube to a known position.

10.2 Retract the probe at test speed with acquisition system on, but not recording to the data storage device.

10.3 Use the applicable steam generator drawing dimensions for the distance between tube support structures.

10.4 Determine the travel time for the probe between two desired tube support structures using the strip chart display on the acquisition system marked at one second intervals.

NOTE: Eddynet acquisition will only display one second interval marks while in the acquire (*Start Acquiring*) mode. Marks will not display in the review mode. The analysis software will calculate the average probe speed. Questions should be addressed to analysis.

10.5 The rotation speed is verified (Eddynet only) in the Acquire window by clicking File, Check rotation and input the information requested.

10.6 Bobbin testing probe speed shall not exceed 24 in./sec. for MIZ-18 testing. Faster speed may be used for MIZ-30 testing provided the proper sample rate is achieved. Probe speed should be adjusted to approximately 12 in./sec. for testing row 1 and row 2 tubes, or as required by the appendix utilized in paragraph 9.0. Check the appropriate appendix for test speeds other than bobbin.

11.0 CALIBRATION VERIFICATION: (Interval/Span and Rotation Settings)

A calibration check must be recorded at the following intervals:

11.1 Within 4 hours of the previous calibration check.

NOTE: A four hour warning can be setup in the Acquisition Setup widget.

11.2 At the beginning and end of each calibration group.

11.3 Whenever test components are changed, loss of power, malfunction is suspected, or the operator deems it necessary.

11.4 The shift supervisor or a designee shall initial the appropriate section of the eddy current

calibration sheet verifying compliance of calibration.

11.5 If a discrepancy in calibration interval should occur in Section 11.1 - 11.3 the shift supervisor or an eddy current Level II or III shall identify the discrepancy on the eddy current calibration sheet. The ECT Level III shall initial indicating acceptance of the disposition.

11.6 In the event that calibrations cannot be performed because of building evacuations, equipment malfunctions, etc., a calibration shall be made upon reentry or repair/replacement and will suffice as the four hour calibration.

NOTE: Should the system be found to be out of calibration, re-calibration will be required (Out of calibration per ASME Section V Article 8 Appendix I section I-862). The re-calibration information shall be forwarded to the data analyst(s). The Data Analyst shall determine which tubes, if any, shall be reinspected.

12.0 EXAMINATION:

12.1 Position the manipulator at the location of the first tube.

12.2 Activate the acquisition computer system.

12.3 Properly identify tube location on the acquisition system.

NOTE: When using an SM10/2x manipulator with an inspection plan, the location is automatically input. Verify the proper location with the Eddy Current Examination Sheet.

12.4 Insert the probe into the tube to the desired elevation as defined by the Eddy Current Examination Sheets.

12.5 Retract the probe while recording the entire length of tube to be inspected on tape or equivalent recording medium. Take special care not to start the probe retraction or stop the data recording device too quickly (this may result in an incomplete examination). See the appropriate operating guidelines for details of operation.

12.6 Ensure the tubes to be tested are indicated as completed on the Eddy Current Examination Sheet. If

a tube or portion of a tube is not inspectable, note any apparent cause on the Eddy Current Examination Sheet and on the acquisition system message area.

The message area should be used to note any conditions which may arise, such as incomplete or obstructed tubes, tubes which are unreachable, operator changes, probe changes, etc.

12.7 Position the probe at the next tube to be examined.

12.8 Repeat paragraph 12.3 through 12.7 for each tube to be examined.

13.0 OPERATING PRACTICES:

13.1 The acquisition system has a message capability that is provided for recording information about the testing. Notations such as operator changes, probe changes and other description of testing should be included. (see 12.6)

13.2 During the examinations, cycling through the channels during data collection is recommended to ensure proper operation of all coils.

13.3 Care should be taken to ensure similar probes are used as reference probes to avoid an impedance mismatch.

13.4 The optical disks shall be labeled as directed by the cognizant data management personnel.

13.5 The S/G identification system will be a two digit number with the first digit indicating the S/G and the second digit indicating the inlet or outlet side of the generator eq. "S/G 11" = S/G #A on the inlet side eq. "S/G 20" = S/G #B on the outlet side, etc.

13.6 The row and line numbers shall be set to "Row 999 Col 999" for all calibration checks.

13.7 Typically whenever a calibration is required, three calibration pulls are recorded. Certain tests (eg. MRPC), may not require three calibration pulls due to factors, such as, radiation dose to platform worker, etc. The calibration should be review to ensure that a complete and acceptable recording has been made. In the event that the recording is incomplete or unacceptable due to probe snap, etc., another calibration shall be recorded. A minimum of one acceptable recording is required. In the event

that an acceptable recording cannot be made, the lead analyst shall be consulted for a disposition.

14.0 MANIPULATOR POSITION VERIFICATION:

14.1 Position verification shall be done upon the installation of the remote fixture and before relocation of the fixture in the generator. Verification for tube locations shall be recorded on examination sheets similar to Exhibit A. The position of the fixture shall be verified by sending the fixture to a known location in the generator. Once the operator has visually verified the correct tube location with the fixture camera (or with the tube sheet camera) and the computer read-out, the operator shall make an entry on the Examination Sheet (See Exhibit A) and a message made on the recording media. Verifications need only be made at required verifications points (see 14.2).

14.2 Position verification is required:

a. Prior to eddy current work in the generator.
b. At the beginning of each Zone and the bottom of an eddy current examination sheet.
c. If problems occur with the positioner.
d. Upon concluding eddy current work in the generator.

14.3 Position verification is recommended:

a. When returning to the tube sheet after lowering the arm to the manway.
b. When "breaking the arm" to the opposite side of the plenum.
c. Whenever the operator has doubt of the tube location.

NOTE: Position verifications are entered on the examination sheet(s). Care should be taken to insure operator knowledge of verification points when there is an operator change, shift change, or other similar situations.

14.4 In the instance where the location has been incorrectly identified and a position verification cannot be made from the last tube tested, all tubes tested from the last position verification recorded on the examination sheet must be reexamined.

15.0 RECORDING CRITERIA:

All data from the examination shall be recorded on the appropriate recording medium. The recording medium will contain at a minimum the information defined in paragraph 9.1.15.

16.0 EVALUATION:

The data analysis shall be conducted in accordance with references 3.6 and 3.7.

17.0 REPORTING CRITERIA:

The report of the inspection results supplied to the customer will contain the following at a minimum.

17.1 All detectable tube wall degradations.

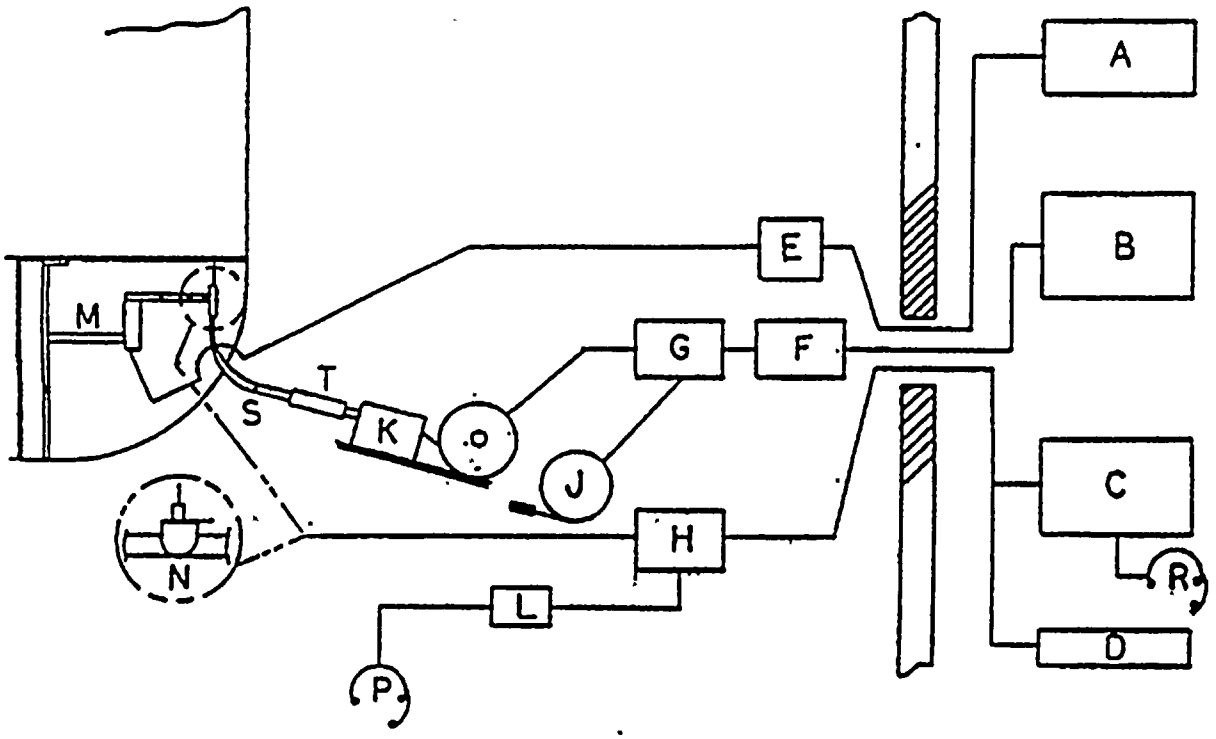
17.2 All detectable tube dents known to obstruct probe passage.

17.3 Any detectable loose part indication

17.4 Any additional conditions that the data analyst deems necessary.

FIGURE 1

TYPICAL EDDY CURRENT TEST EQUIPMENT SET-UP DIAGRAM




A - POSITIONER CONTROLS

B - COMPUTER ACQUISITION SYSTEM

C - AUDIO/VIDEO CONTROLS

D - VCR

E - POSITIONER RELAY BOX

F - PM-1or3/SM10/20 CONTROLLER

G - MIZ-18/MIZ-30

H - AUDIO/VIDEO JUNCTION BOX

J - REFERENCE PROBE

K - PROBE PUSHER W/TEST PROBE

L - AUDIO JUNCTION BOX

M - MANIPULATOR FIXTURE

N - VIDEO CAMERA

P - PLATFORM HEADSET

R - CONTROL STATION HEADSET

S - FLEXIBLE CONDUIT

T - CALIBRATION STANDARD

# FIGURE 2

## TYPICAL ASME CALIBRATION STANDARD

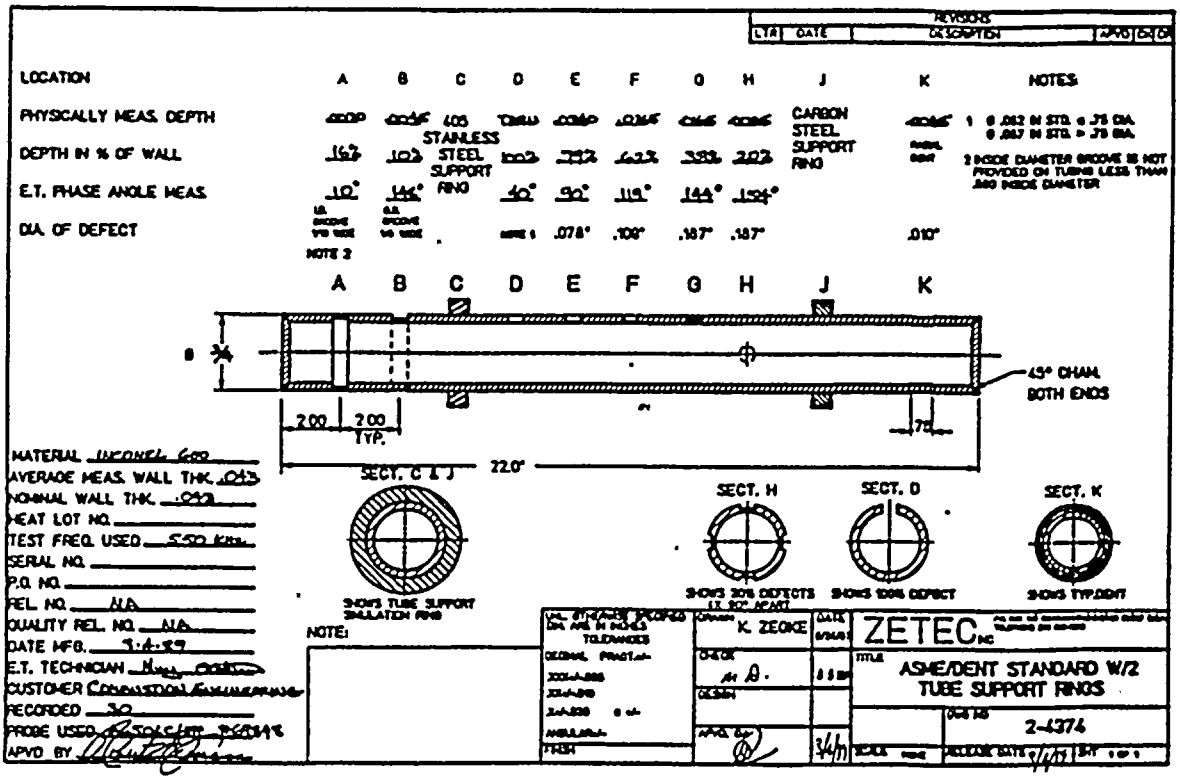


FIGURE 3

TYPICAL MIZ-18 INTERCONNECTION SCHEMATIC

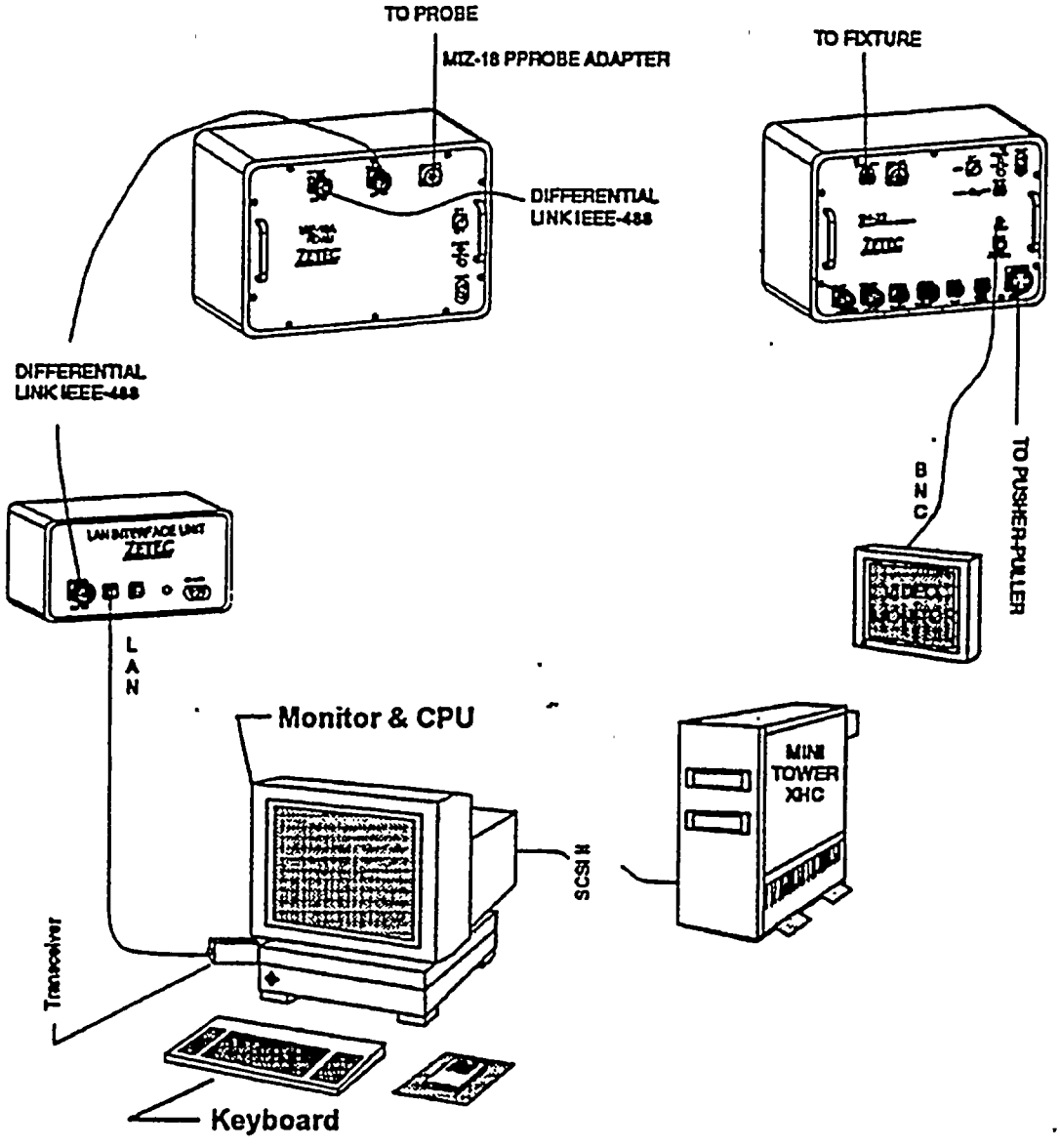
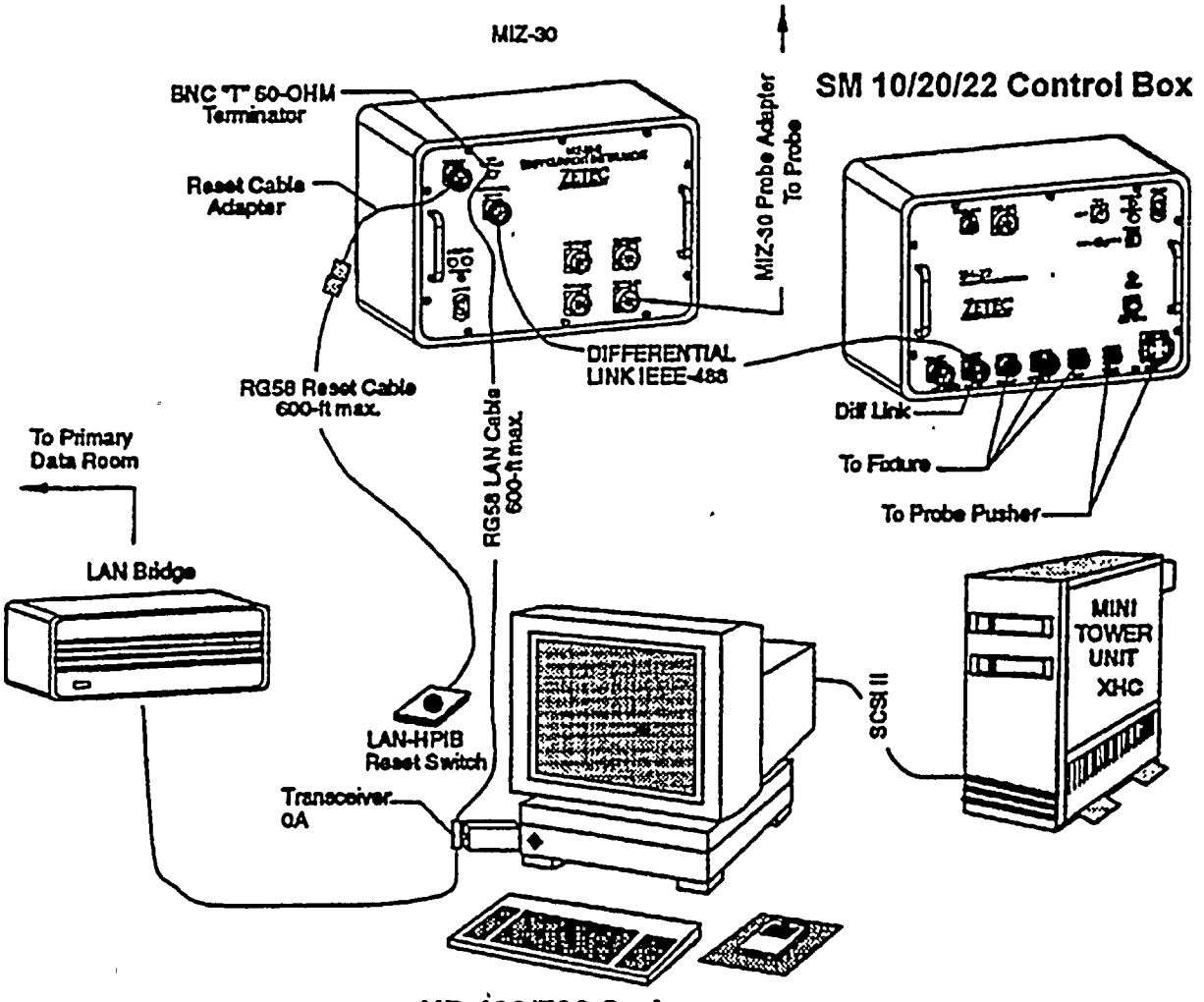


FIGURE 4

TYPICAL MIZ-30 INTERCONNECTION SCHEMATIC



# EXHIBIT A

## TYPICAL EDDY CURRENT EXAMINATION SHEET

COMBUSTION ENGINEERING EDDY CURRENT EXAMINATION SHEET

PAGE: 3

OWNER: C P & L
PLANT/UNIT: SHEARON HARRIS
S/G #
PROBE: A610MULC
FREQUENCY: 660/100/300/36 KHz
PROCEDURE: HNP-004 R0
ECT DESCRIPTION: Bobbin Full Length Exam
LEG: HOT
DATASET: SAMPLE1
ZONE:
TEST EXTENT: F/L

| ROW | COL | REQ EXT | OPER INIT | REEL | TESTED DATE | COMMENTS | | PREVIOUS EXAMINATION RESULTS DATE | CH | PROBE | LOCATION | VOLTS | DEG | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 4 | F/L | TB | 3#02 | 5-30-95 | | | | | | | | | |
| 15 | 4 | F/L | ✓ | | | | | | | | | | | |
| 16 | 4 | F/L | ✓ | | | | | | | | | | | |
| 18 | 5 | F/L | ✓ | | | | | | | | | | | |
| 17 | 5 | F/L | ✓ | | | | | | | | | | | |
| 16 | 5 | F/L | ✓ | | | | | | | | | | | |
| 15 | 5 | F/L | ✓ | | | | | 10/02/93 | 2 | A720MULC | 2H 21.6 | 2.8 | 157 | MBM |
| 14 | 5 | F/L | ✓ | | | | | | | | | | | |
| 13 | 5 | F/L | ✓ | | | | | | | | | | | |
| 12 | 5 | F/L | ✓ | | | | | | | | | | | |
| 11 | 5 | F/L | ✓ | | | | | | | | | | | |
| 10 | 5 | F/L | ✓ | | | | | | | | | | | |
| 9 | 5 | F/L | ✓ | | | | | | | | | | | |
| 8 | 5 | F/L | TB | | | | | | | | | | | |
| 7 | 5 | F/L | FB | | | | | 11/04/90 | 4 | A720MULC | 1C 27.4 | 5.2 | 87 | MBM |
| 6 | 5 | F/L | ✓ | | | | | | | | | | | |
| 5 | 5 | F/L | ✓ | | | | | | | | | | | |
| 4 | 5 | F/L | ✓ | | | | | | | | | | | |
| 3 | 5 | F/L | ✓ | | | | | | | | | | | |
| 2 | 5 | F/L | ✓ | | | | | | | | | | | |
| 1 | 5 | F/L | ✓ | | | | | | | | | | | |
| 1 | 6 | F/L | ✓ | | | | | | | | | | | |
| 2 | 6 | F/L | ✓ | | | | | | | | | | | |
| 3 | 6 | F/L | ✓ | | | | | | | | | | | |
| 4 | 6 | F/L | ✓ | | | | | 04/28/92<br>11/04/90 | 4<br>4 | A700SPRM<br>A720MULC | 3H 9.1<br>3H 8.8 | 10.9<br>10.1 | 109<br>276 | MBM<br>MBM |
| 5 | 6 | F/L | ✓ | | | | | | | | | | | |
| 6 | 6 | F/L | ✓ | | | | | | | | | | | |
| 7 | 6 | F/L | ✓ | | | | | 04/28/92 | 8 | A720MULC | CTS 0.5 | 7.0 | 156 | SLG |
| 8 | 6 | F/L | ✓ | | | | | | | | | | | |
| 9 | 6 | F/L | FB | | | PV | | | | | | | | |

Running Total of Exams: 74 This page: 30

EXHIBIT B

TYPICAL MIZ-18 SET UP INSTRUCTION FORM

**MULTI-FREQUENCY EDDY CURRENT INSPECTION**
**SET UP INSTRUCTION**
**MIZ-18A**

| SITE: | UNIT: | COMPONENT: | SIDE: HOT COLD | DATE: / / |
|---|---|---|---|---|
| PROBE: | | CALIBRATION STANDARD ASME: | OTHER: | (describe other) |
| PROCEDURE | | TEST PURPOSE: | | |

## MIZ-18A CONFIGURATION

NUMBER:
NAME:

SAMPLES PER SECOND:

| FREQ. SEQUENCE | | PROBE CHANNEL SELECT | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | COIL 1 | COIL 2 | COIL 3 | COIL 4 | COIL 5 | COIL 6 | COIL 7 | COIL 8 |
| 1 | KHz | | | | | | | | |
| 2 | KHz | | | | | | | | |
| 3 | KHz | | | | | | | | |
| 4 | KHz | | | | | | | | |

Special Notes to Operator/Analyst

See Appendix _____ for Setup Instruction Details

Prepared by: _____ Level _____ Date _____

Approved by: _____ Level _____ Date _____

# EXHIBIT B-1

## TYPICAL MIZ-30 SET UP INSTRUCTION FORM

**Multi - Frequency Eddy Current Inspection**
**Set up Instructions**
**MIZ-30**

| Site | Unit | Component S/G # | Side Hot Cold | Date / / |
|---|---|---|---|---|
| Probe Type | | Calibration Standard ( Circle or Describe Other ) ASME OTHER | | |
| Procedure | | Test Purpose | | |

**MIZ - 30 Configuration**

Number :
Name :
Samples Per Second:
Trig :

| | Board #1 | Board #2 | Board #3 | Board #4 | Board #5 | Board #6 | Board #7 | Board #8 |
|---|---|---|---|---|---|---|---|---|
| | Probe # | Probe # | Probe # | Probe # | Probe # | Probe # | Probe # | Probe # |
| | Drive A D B C | Drive A D B C | Drive A D B C | Drive A D B C | Drive A D B C | Drive A D B C | Drive A D B C | Drive A D B C |
| Drive polarity | | | | | | | | |
| Group number | | | | | | | | |
| Coil number | | | | | | | | |
| Freq #1 | timeslot #1 | | | | | | | |
| | Q : | | | | | | | |
| Freq #2 | timeslot #2 | | | | | | | |
| | Q : | | | | | | | |
| Freq #3 | timeslot #3 | | | | | | | |
| | Q : | | | | | | | |
| Freq #4 | timeslot #4 | | | | | | | |
| | Q : | | | | | | | |
| Freq #5 | timeslot #5 | | | | | | | |
| | Q : | | | | | | | |
| Freq #6 | timeslot #6 | | | | | | | |
| | Q : | | | | | | | |
| Freq #7 | timeslot #7 | | | | | | | |
| | Q : | | | | | | | |
| Freq #8 | timeslot #8 | | | | | | | |
| | Q : | | | | | | | |

Special notes to Operator / Analyst

See Appendix _____ for Setup instructions

Prepared by : _____ Level _____ Date _____

Approved by: _____ Level _____ Date _____

# EXHIBIT C

## TYPICAL EDDY CURRENT CALIBRATION SHEET

| ABB Combustion Engineering | Multi-Frequency Eddy Current Calibration Data Sheet | Disk # | Side |
|---|---|---|---|
| Owner | Site/Unit | Component | Leg | Date |
| MIZ-18A S/N- | Procedure | Defect Std. (1) | Additional Std. (2) |

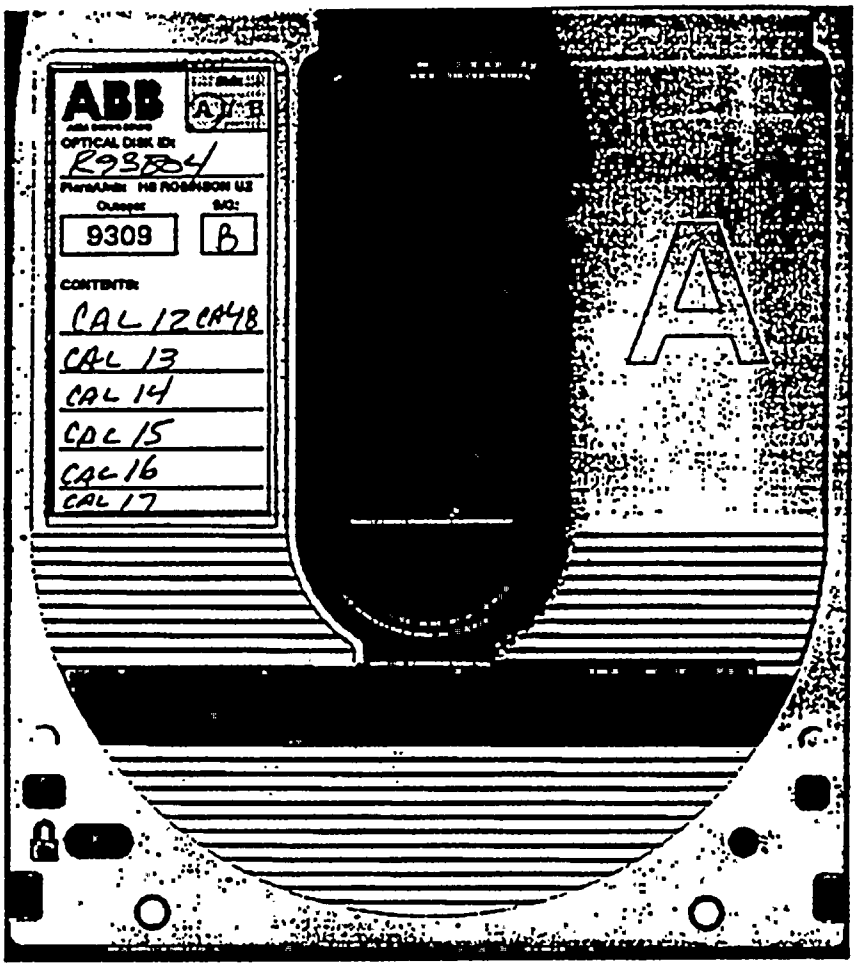
| *Cal | Date / Time | Row / Line | Standard Run | Comments | Examiner / Init/Level |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Additional Comments:

Shift Supervisor Final Review of Acceptance_____

# EXHIBIT D

## TYPICAL OPTICAL DISK LABEL



# EXHIBIT E

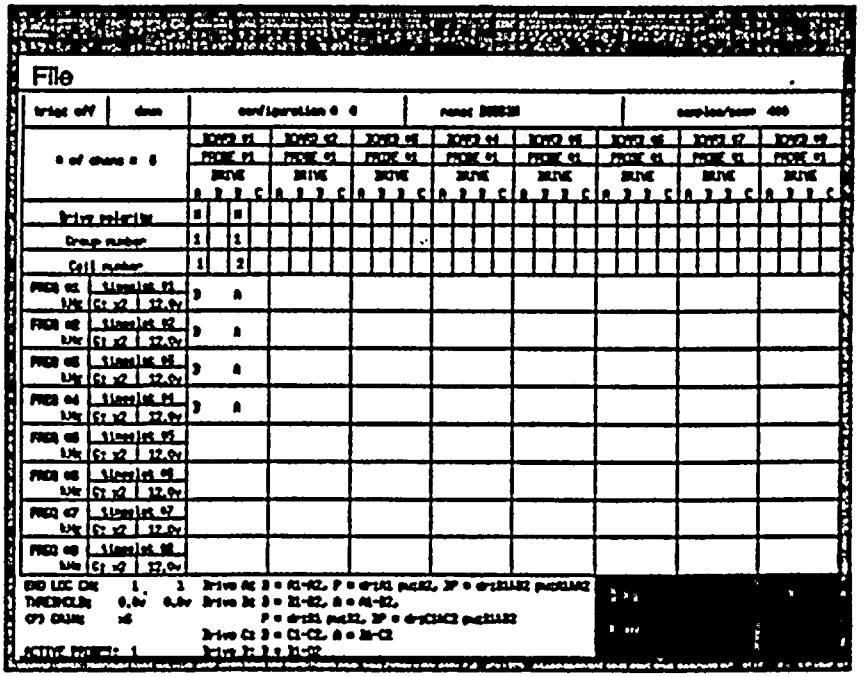
## MIZ-18 CONFIGURATION FOR BOBBIN PROBE

MIZ-18 Configuration

| NUMBER: NAME: 2-4 Pin | | SAMPLES per SEC: | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY SEQUENCE | | PROBE CHANNEL SELECT | | | | | | | |
| # | FREQUENCY* | COIL 1 | COIL 2 | COIL 3 | COIL 4 | COIL 5 | COIL 6 | COIL 7 | COIL 8 |
| 1 | 550 kHz | .... | | | | //// | | | |
| 2 | 100 kHz | .... | | | | //// | | | |
| 3 | 800 kHz | .... | | | | //// | | | |
| 4 | 35 kHz | .... | | | | //// | | | |

*. Frequencies selected are for example only.
.... differential internal reference
//// absolute eddy current reference

## MIZ-30 CONFIGURATION FOR BOBBIN PROBE



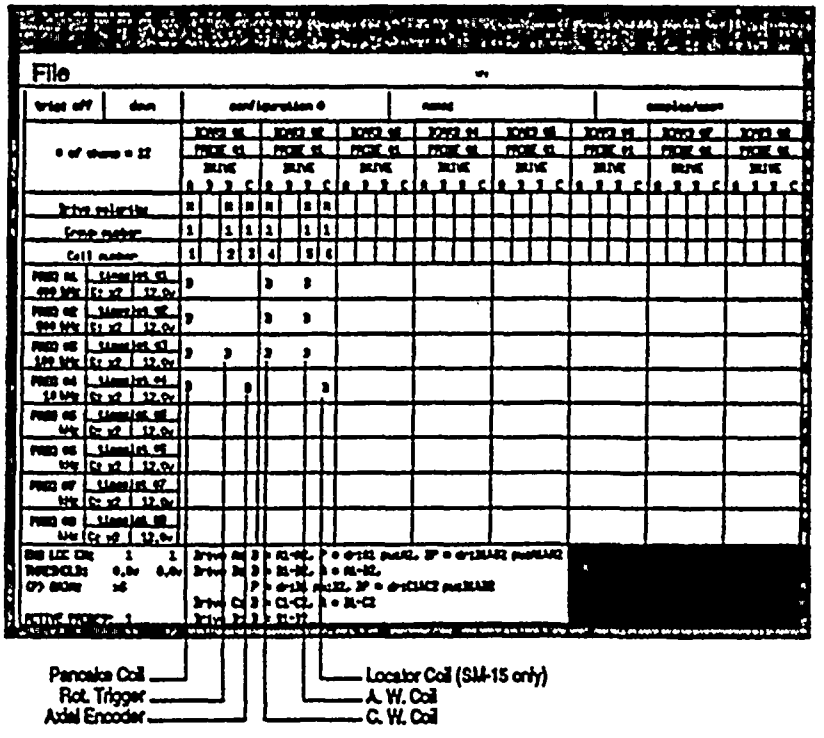
# EXHIBIT F

## MIZ-18 CONFIGURATION FOR ROTATING PROBE

| NUMBER:<br>NAME--: | | SAMPLES per SEC: | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY SEQUENCE | | PROBE CHANNEL SELECT | | | | | | | | | | | |
| # | FREQUENCY* | COIL 1 | COIL 2 | COIL 3 | COIL 4 | COIL 5 | COIL 6 | COIL 7 | COIL 8 | | | | |
| 1 | 400 kHz | .... | | | | XXXX | | ***** | | | | | |
| 2 | 600 kHz | .... | | | | XXXX | | ***** | | | | | |
| 3 | 100 kHz | .... | | | ##### | XXXX | | ***** | | | | | |
| 4 | 10 kHz | .... | | //// | | | | | | | | | |

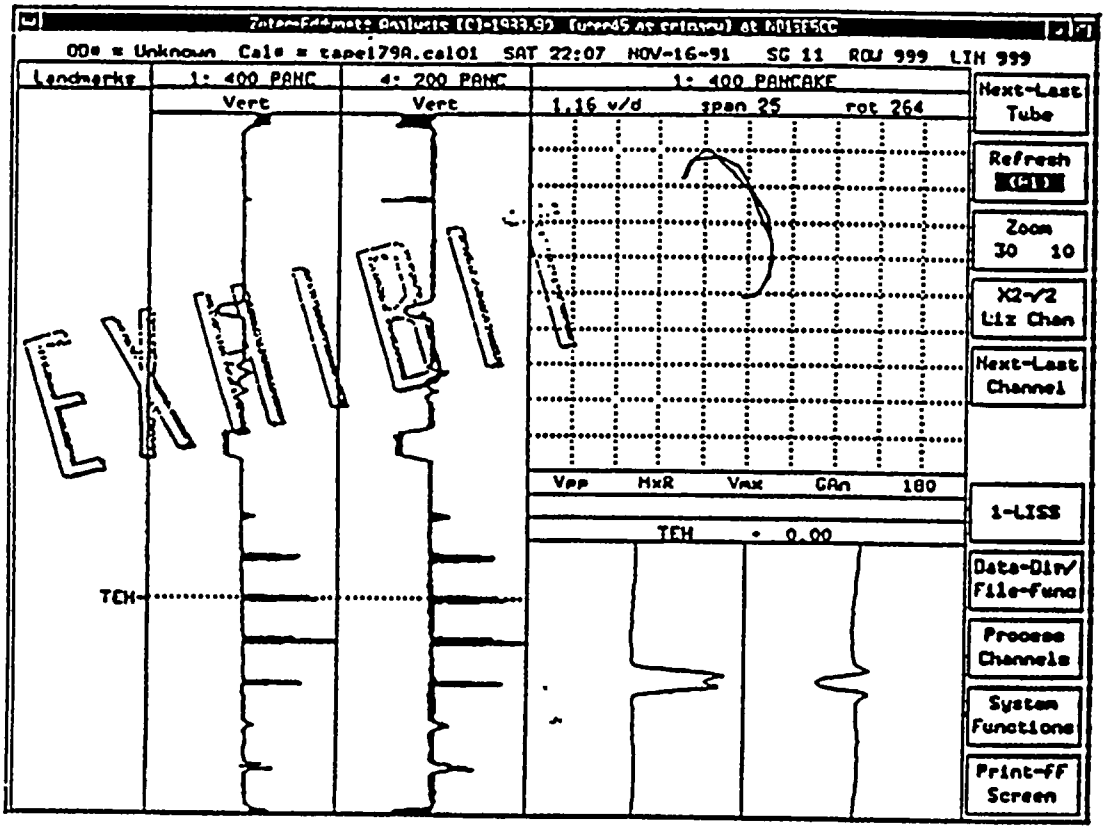
*. Frequencies selected are for example only.
.... absolute internal reference (differential internal reference option available)
//// optional encoder axial travel input
##### trigger pulse (one pulse per 360-degree rotation)
XXXX axial flaw detector coil
***** circumferential flaw detector coil

## MIZ-30 CONFIGURATION FOR ROTATING PROBE



# EXHIBIT G

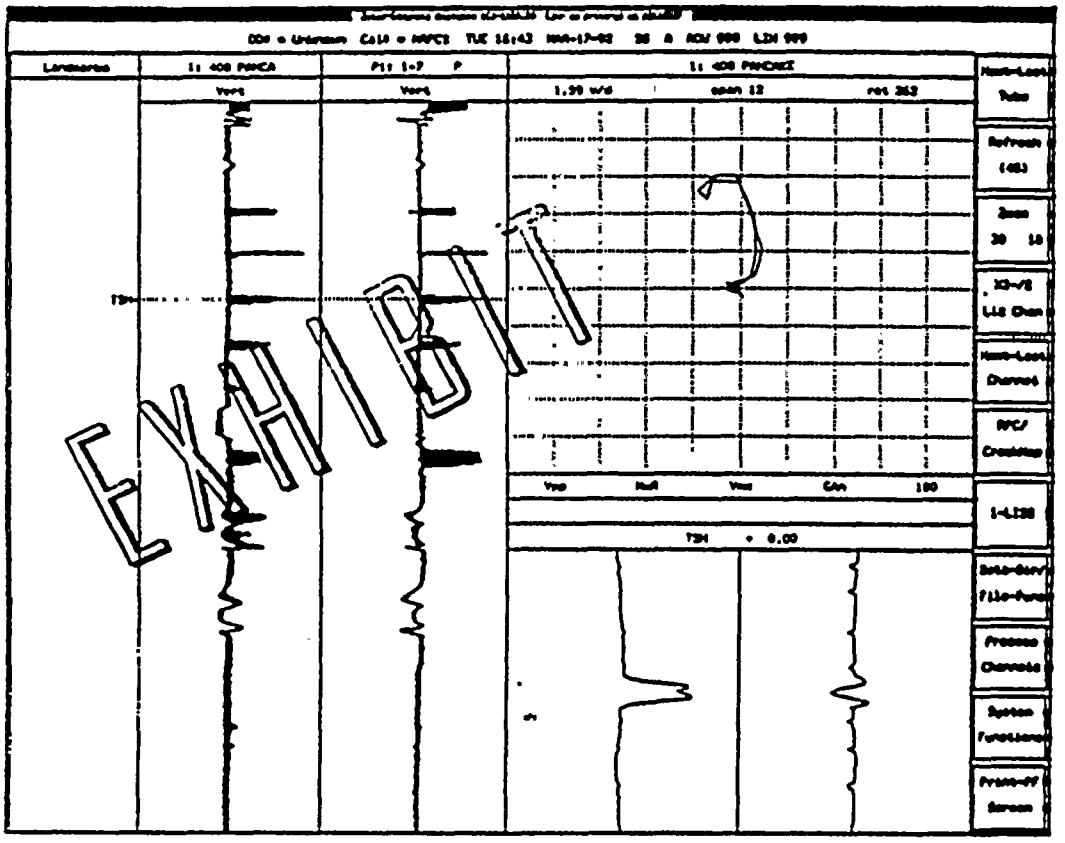
## ROTATING PROBE CALIBRATION INFORMATION




60% ASME flaw set with probe motion horizontal and flaw at 4 screen divisions

# EXHIBIT H

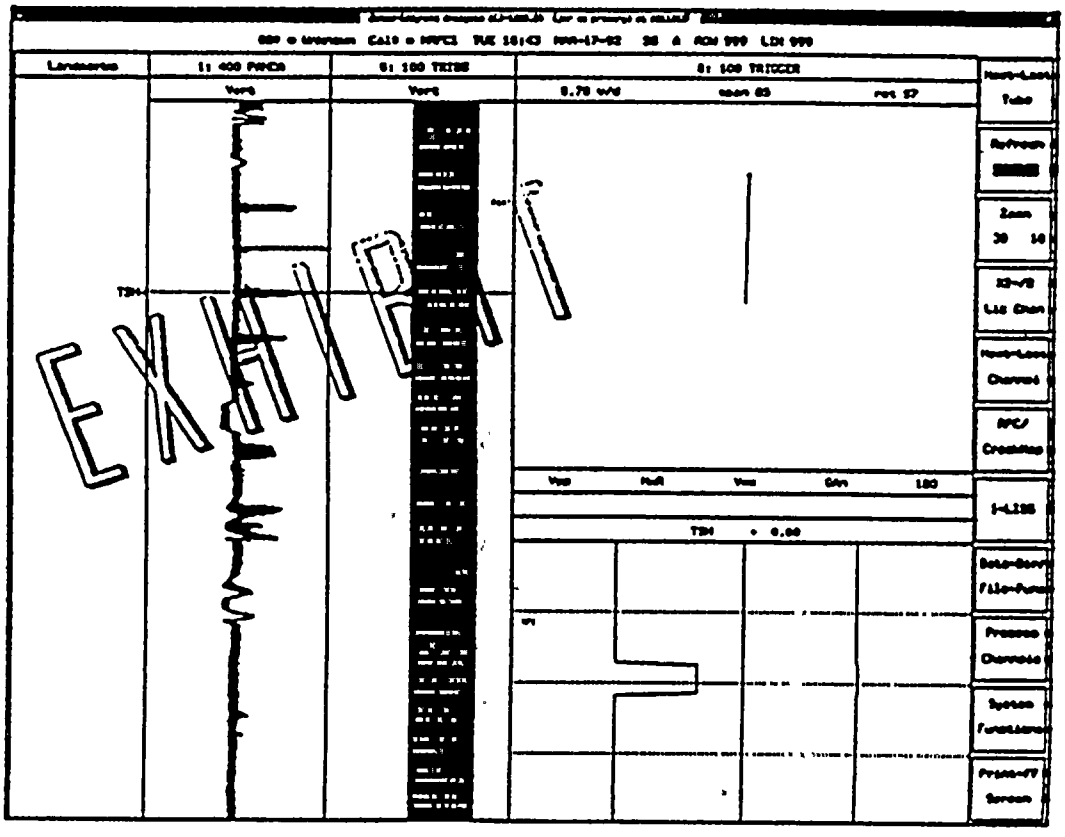
## ROTATING PROBE SLIP RING INFORMATION



60% O.D. flaw clearly evident above slip ring noise

# EXHIBIT I

## ROTATING PROBE PULSE INFORMATION




Rotation pulse set at approximately 90° with signal below screen saturation

# EXHIBIT J

## MIZ-18 CONFIGURATION FOR HIGH RESOLUTION BOBBIN PROBE

MIZ-18 Configuration

| NUMBER:<br>NAME-: 10 Pin | | SAMPLES per SEC: | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY SEQUENCE | | PROBE CHANNEL SELECT | | | | | | | |
| # | FREQUENCY* | COIL 1 | COIL 2 | COIL 3 | COIL 4 | COIL 5 | COIL 6 | COIL 7 | COIL 8 |
| 1 | 400 kHz | .... | | .... | | //// | | //// | |
| 2 | 270 kHz | .... | | .... | | //// | | //// | |
| 3 | 100 kHz | .... | | .... | | //// | | //// | |
| 4 | 600 kHz | .... | | .... | | //// | | //// | |

*. Frequencies selected are for example only.
.... differential internal reference
//// absolute external reference

## APPENDIX A

## BOBBIN COIL TEST PARAMETERS

I. Tubing

A. O.D. - 0.750"
B. Wall - 0.043" Nominal
C. Material - Inconel 600

II. Establish the test configuration as per Exhibit E using the following frequencies:

Frequency 1 - 550 kHz Differential and Absolute
Frequency 2 - 100 kHz Differential and Absolute
Frequency 3 - 800 kHz Differential and Absolute
Frequency 4 - 35 kHz Differential and Absolute

III. Set the sample rate to the appropriate number for a probe speed which will achieve at least 32 samples per inch.

IV. Probes - Typical

Normal Bobbin Program - A610 - A540[1] - MULC, SFRM, or as required

The above frequencies, mixes and probe requirements may be modified through initiation of Exhibit B - Set up Instruction Form by the cognizant ECT Level III.

The following conventions shall be used during data collection:

1. The rotation of all frequencies shall be the such that the 100% through wall hole is at 40° and differential channels form starting down and to the right, absolute channels form up and to the left.

2. Spans of differential channels shall be set such that the amplitude of the 100% through wall signal is at least 50% of screen height. Spans of absolute channels shall be set such that the tube support is not saturated and can be seen.

3. Span of low frequency (50-10 KHz) will be such that the support is below saturation.

4. Data Analyst will determine if tubes need to be retested.

---

[1]The probe with the largest practical fill-factor will be used, unless a restriction or other anomaly forces the use of smaller probes. If a restriction does not pass a .540" probe, it may be recommended to be taken out of service.

## APPENDIX B

## ROTATING PANCAKE COIL TEST

This examination employs a surface riding pancake coil which is rotated as it traverses the tube axis producing a helical scan. Flaw depths can be evaluated using a phase delay or amplitude curve and the indication topography presented in C-Scan graphics.

A. Set-up

1) Establish the test configuration as per Exhibit F using the following frequencies:

   Frequency 1 - 400 kHz
   Frequency 2 - 600 kHz
   Frequency 3 - 100 kHz
   Frequency 4 - 10 kHz

2) Set the sample rate to 400 samples per second.

3) Set the probe pusher reverse speed to 0.2 inches per second.

4) Set the probe head rotation speed to nominal 300 rpm.

5) Select lissajous presentation and strip chart presentations as instructed by the cognizant shift supervisor or ECT Level III.

   NOTE: The above test frequencies, sampling rate and probe pusher speed may be modified through initiation of Exhibit B by the cognizant ECT Level III.

B. Calibration

1) Certain probe motor units may require the slip ring assembly to wear in. This process takes approximately 5 to 10 minutes.

2) Withdraw the probe through the ASME or other standard including the tube support ring (as applicable).

3) Null the instrument in a non-defective area of the calibration standard.

4) Place the 60% ASME flaw in the display window.

5) Adjust the phases and spans of Coil 1 for Frequencies 1, 2, 3 and 4 such that with probe motion horizontal the response from the 60% ASME flaw is up with a span of 4 screen divisions (Exhibit G).

Note: When using 3 coil MRPC probe repeat step 5 for coil 5 and coil 7.

6) Place the 60% O.D. flaw in the display window. This signal should be clearly evident above slip ring noise and should resemble Exhibit H. If not, replace either the slip ring assembly or the probe wand.

7) Adjust the phase and span of the rotation pulse signal such that the rotation pulses go up first at approximately 90° and the signal is just below screen saturation (see Exhibit I).

8) Data analyst will determine if retests are necessary.

## APPENDIX C

## HIGH RESOLUTION BOBBIN SET-UP AND CALIBRATION

A. Set-Up

1) Establish the test configuration as per Exhibit J using the following frequencies:

   Frequency 1 - 400 kHz
   Frequency 2 - 270 kHz
   Frequency 3 - 100 kHz
   Frequency 4 - 600 kHz

2) Coils 1, 3, 5 and 7 should be turned on for all 4 frequencies.

3) Test sampling rate is to be set at 400 points per second.

4) Adjust probe pusher speed such the test pull speed is approximately 6 inches per second.

   NOTE: The above test frequencies, sampling rate and probe pusher speed may be modified through initiation of Exhibit B by the cognizant ECT Level III.

B. Calibration

1) Calibrate each coil using the ASME Standard on the pull.

2) Record signals of all ASME flaws and support ring for each coil.

3) Nulling is to take place in nominal defect for tubing.

4) An in-line calibration will consist of recording the MIZ-18 signals as the probe is pulled through standard and support ring for each of the four (4) coils. The calibration standard should be rotated approximately 90° to insure maximum response for each of the four (4) coils. This will be done at the beginning and end of each tape cartridge and, at a minimum, every four hours.

5) Probe motion should be set horizontal and the signal response from the O.D. grove should be approximately three screen divisions.

6) If the equipment is found to be out of calibration, it shall be recalibrated and noted as such on the calibration sheet.

7) Data analyst will determine if retest is necessary.

# ATTACHMENT 1

## PROCEDURE HNP-004 SIGN-OFF

Steam Generator: A / B / C Leg: HOT / COLD

1.0 Personnel Certifications/Qualifications (Section 4.0):

initial/date

1.1 Eddy Current Certifications: _____/_____

1.2 Eye Exams: _____/_____

2.0 Equipment: (MIZ-18, MIZ-30, PM-1, LAN Box, Manipulator, etc.):

| Model/Type | S/N | Cal. Due | Dates Used To - From |
|---|---|---|---|
| MIZ-18 | | | - |
| MIZ-30 | | | - |
| PM-1/PM-3 | | N/A | - |
| LAN Box | | N/A | - |
| Manipulator | | N/A | - |
| | | | - |
| | | | - |
| | | | - |
| | | | - |
| | | | - |
| | | | - |

3.0 Prerequisites met: initial/date

3.1 Equipment staging area approved (5.3): _____/_____

3.2 Steam Generator open at proper temp. <90°F and humidity (5.4): _____/_____

3.3 Secondary Side <120°F (5.5): _____/_____

3.4 Platform Staged (5.6):

3.4.1 Platform built: _____/_____

3.4.2 Lighting & power: _____/_____

3.4.3 Breathing air: _____/_____

3.4.4 Equipment air: _____/_____

3.5 Eddy Current Exam Sheets (5.8): _____/_____

3.6 Communication system set up (5.10): _____/_____

3.7 Manway doors installed: _____/_____

4.0 Calibration Standards (6.0):

| Cal. Std. S/N | Type | Verified |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

5.0 Eddy Current system set up (8.0) and operational check (9.0): _____/_____

5.1 Spooler operational (Eddynet): _____/_____

6.0 Manipulator installed: _____/_____

6.1 Position Verification (14.0): _____/_____

| Reason | Verification Location | Initial - Date |
|---|---|---|
| Installation | | - |
| After Equip. Change | | - |
| | | - |
| | | - |
| | | - |
| | | - |
| | | - |
| Before Removal | | - |

NOTE: All position verifications performed during eddy current testing shall be recorded on the appropriate Eddy Current Examination Sheet.

# ATTACHMENT 1

## PROCEDURE HNP-004 SIGN-OFF

Steam Generator: (A) / B / C  Leg: (HOT) / COLD

1.0 Personnel Certifications/Qualifications (Section 4.0):

initial/date

1.1 Eddy Current Certifications: D.Mabry 9/17/95

1.2 Eye Exams: DMaby 9/17/95

2.0 Equipment: (MIZ-18, MIZ-30, PM-1, LAN Box, Manipulator, etc.):

| Model/Type | S/N | Cal. Due | Dates Used To - From |
|---|---|---|---|
| MIZ-18 | | | - |
| MIZ-30 | 097 | 17-Aug-1996 | 9-18-95 - 9-23-95 |
| PM-1/PM-3 | 069 | N/A | 9-18-95 - 9-23-95 |
| LAN Box | | N/A | - |
| Manipulator | GENESIS 051 | N/A | 9-18-95 - 9-23-95 |
| | | | - |
| | | | - |
| | | | - |
| | | | - |
| | | | - |
| | | | - |

3.0 Prerequisites met: initial/date

3.1 Equipment staging area approved (5.3): SAS / 9-16-95

3.2 Steam Generator open at proper temp. <90°F and humidity (5.4): SAS / 9-16-95

3.3 Secondary Side <120°F (5.5): SAS / 9-16-95

3.4 Platform Staged (5.6):

3.4.1 Platform built: SAS / 9-16-95

3.4.2 Lighting & power: SAS / 9-16-95

3.4.3 Breathing air: N/A /

3.4.4 Equipment air: SAS / 9-17-95

3.5 Eddy Current Exam Sheets (5.8): QL / 9-18-95

3.6 Communication system set up (5.10): SAS / 9-17-95

3.7 Manway doors installed: SAS / 9-17-95

4.0 Calibration Standards (6.0):

| Cal. Std. S/N | Type | Verified |
|---|---|---|
| Z-14089 | RPC | SAS |
| Z-14090 | RPC | SAS |
| | | |
| | | |
| | | |

5.0 Eddy Current system set up (8.0) and operational check (9.0): QL / 9-18-95

5.1 Spooler operational (Eddynet): QL / 9-18-95

6.0 Manipulator installed: SAS / 9-17-95

6.1 Position Verification (14.0): DL / 9-18-95

| Reason | Verification Location | Initial - Date |
|---|---|---|
| Installation | 41/59 | DL - 9-18-95 |
| After Equip. Change | | - |
| | | - |
| | | - |
| | | - |
| | | - |
| | | - |
| Before Removal | 8/27 | MP - 9-23-95 |

NOTE: All position verifications performed during eddy current testing shall be recorded on the appropriate Eddy Current Examination Sheet.

# ATTACHMENT 1

## PROCEDURE HNP-004 SIGN-OFF

Steam Generator: (A) / B / C  Leg: HOT / (COLD)

1.0 Personnel Certifications/Qualifications (Section 4.0):

initial/date

1.1 Eddy Current Certifications: D.Maley 9/19/95 /

1.2 Eye Exams: D.Maley 9/19/95 /

2.0 Equipment: (MIZ-18, MIZ-30, PM-1, LAN Box, Manipulator, etc.):

| Model/Type | S/N | Cal. Due | Dates Used To - From |
|---|---|---|---|
| MIZ-18 | 056 | 24-Jan-96 | 9-18-95 - 9-23-95 |
| MIZ-30 | | | - |
| PM-1/PM-3 SM-20 | | N/A | - |
| LAN Box | 062 | N/A | 9-18-95 - 9-23-95 |
| Manipulator | SM-20 | N/A | 9-18-95 - 9-23-95 |
| | | | - |
| | | | - |
| | | | - |
| | | | - |
| | | | - |
| | | | - |

3.0 Prerequisites met: initial/date

3.1 Equipment staging area approved (5.3): PKL / 9-17-95

3.2 Steam Generator open at proper temp. <90°F and humidity (5.4): PKL / 9-17-95

3.3 Secondary Side <120°F (5.5): PKL / 9-17-95

3.4 Platform Staged (5.6):

3.4.1 Platform built: PKL / 9-17-95

3.4.2 Lighting & power: PKL / 9-17-95

3.4.3 Breathing air: PKL / 9-17-95

3.4.4 Equipment air: PKL / 9-17-95

3.5 Eddy Current Exam Sheets (5.8): SKB / 9-18-95

3.6 Communication system set up (5.10): PKL / 9-17-95

3.7 Manway doors installed: PKL / 9-17-95

4.0 Calibration Standards (6.0):

| Cal. Std. S/N | Type | Verified |
|---|---|---|
| Z 8711 | "Asme | JRL |
| Z 8715 | AVB | SKB |
| | | |
| | | |
| | | |

5.0 Eddy Current system set up (8.0) and operational check (9.0): MB / 9-18-95

5.1 Spooler operational (Eddynet): MB / 9-18-95

6.0 Manipulator installed: PKL / 9-17-95

6.1 Position Verification (14.0): MB / 9-18-95

| Reason | Verification Location | Initial - Date |
|---|---|---|
| Installation | MB 21,45 | MB - 9-18-95 |
| After Equip. Change | | - |
| | | - |
| | | - |
| | | - |
| | | - |
| | | - |
| Before Removal | R47 C59 | MB - 9-23-95 |

NOTE: All position verifications performed during eddy current testing shall be recorded on the appropriate Eddy Current Examination Sheet.

# ATTACHMENT 1

## PROCEDURE HNP-004 SIGN-OFF

Steam Generator: A / (B) / C  Leg: (HOT) / COLD

1.0 Personnel Certifications/Qualifications (Section 4.0):

initial/date

1.1 Eddy Current Certifications: D.Meloy 9/17/95 /

1.2 Eye Exams: D.Meloy 9/17/95 /

2.0 Equipment: (MIZ-18, MIZ-30, PM-1, LAN Box, Manipulator, etc.):

| Model/Type | S/N | Cal. Due | Dates Used To - From |
|---|---|---|---|
| MIZ-18 | ~~111~~ | | ~~9-18-95 -~~ S+S 9-24-95 |
| MIZ-30 | 089 | 8-14-96 | 9-18-95 - 9-23-95 |
| PM-1/PM-3 | 008 | N/A | 9-18-95 - 9-23-95 |
| ~~LAN Box~~ | ~~040~~ | ~~N/A~~ | ~~9-18-95 -~~ S+T 9-24-95 |
| Manipulator | CE-25 | N/A | 9-18-95 - 9-23-95 |
| | | | - |
| | | | - |
| | | | - |
| | | | - |
| | | | - |
| | | | - |

3.0 Prerequisites met: initial/date

3.1 Equipment staging area approved (5.3): PKL, 9-17-95

3.2 Steam Generator open at proper temp. <90°F and humidity (5.4): PKL, 9-17-95

3.3 Secondary Side <120°F (5.5): PKL, 9-17-95

3.4 Platform Staged (5.6):

3.4.1 Platform built: PKL, 9-17-95

3.4.2 Lighting & power: PKL, 9-17-95

3.4.3 Breathing air: PKL, 9-17-95

3.4.4 Equipment air: PKL, 9-17-95

3.5 Eddy Current Exam Sheets (5.8): SAS, 9-17-95

3.6 Communication system set up (5.10): PKL, 9-17-95

3.7 Manway doors installed: PKL, 9-17-95

4.0 Calibration Standards (6.0):

| Cal. Std. S/N | Type | Verified |
|---|---|---|
| Z-14091 | MRPC | JJP 9/18/95 |
| Z-14092 | MRPC | JJP 9/18/95 |
| | | |
| | | |
| | | |

5.0 Eddy Current system set up (8.0) and operational check (9.0): JRJ, 9-18-95

5.1 Spooler operational (Eddynet): JRJ, 9-18-95

6.0 Manipulator installed: SAS / 9-18-95

6.1 Position Verification (14.0): SAS / 9-18-95

| Reason | Verification Location | Initial - Date |
|---|---|---|
| Installation | 47, 51 | SAS - 9-18-95 |
| After Equip. Change | 12, 85 PLUG | SAS - 9-23-95 |
| | | - |
| | | - |
| | | - |
| | | - |
| | | - |
| Before Removal | 12/85 PLUG | SAS - 9-23-95 |

NOTE: All position verifications performed during eddy current testing shall be recorded on the appropriate Eddy Current Examination Sheet.

# ATTACHMENT 1

## PROCEDURE HNP-004 SIGN-OFF

Steam Generator: A / (B) / C  Leg: HOT / (COLD)

1.0 Personnel Certifications/Qualifications (Section 4.0):

initial/date

1.1 Eddy Current Certifications: D.Meloy 9/17/95 /

1.2 Eye Exams: D.Meloy 9/17/95 /

2.0 Equipment: (MIZ-18, MIZ-30, PM-1, LAN Box, Manipulator, etc.):

| Model/Type | S/N | Cal. Due | Dates Used To - From |
|---|---|---|---|
| MIZ-18 | 111 | 7-31-96 | 9-18 - 9-23-95 |
| MIZ-30 | NA | NA | 9-18 - 9-23-95 |
| PM-1/PM-3 | | N/A | 9-18 - 9-23-95 |
| LAN Box | 040 | N/A | 9-18 - 9-23-95 |
| Manipulator | SM-20 | N/A | 9-18 - 9-23-95 |
| SM 10/20 Box | 134 | | 9-19 - 9-23-95 |
| | | | - |
| | | | - |
| | | | - |
| | | | - |
| | | | - |

3.0 Prerequisites met: initial/date

3.1 Equipment staging area approved (5.3): PKL / 9-18-95

3.2 Steam Generator open at proper temp. <90°F and humidity (5.4): PKL / 9-18-95

3.3 Secondary Side <120°F (5.5): PKL / 9-18-95

3.4 Platform Staged (5.6):

3.4.1 Platform built: PKL / 9-18-95

3.4.2 Lighting & power: PKL / 9-18-95

3.4.3 Breathing air: PKL / 9-18-95

3.4.4 Equipment air: PKL / 9-18-95

3.5 Eddy Current Exam Sheets (5.8): JRL / 9-18-95

3.6 Communication system set up (5.10): PKL / 9-18-95

3.7 Manway doors installed: PKL / 9-18-95

4.0 Calibration Standards (6.0):

| Cal. Std. S/N | Type | Verified |
|---|---|---|
| ASME Z 8712 | ASME | MB |
| AVB Z 8716 | AVB | MB |
| | | |
| | | |
| | | |

5.0 Eddy Current system set up (8.0) and operational check (9.0): MB / 9-18-95

5.1 Spooler operational (Eddynet): MB / 9-18-95

6.0 Manipulator installed: PKL / 9-19-95

6.1 Position Verification (14.0): MB / 9-19-95

| Reason | Verification Location | Initial - Date |
|---|---|---|
| Installation | R21 Col 45 | MB - 9-18-95 |
| After Equip. Change | | - |
| | | - |
| | | - |
| | | - |
| | | - |
| | | - |
| Before Removal | R11 C 30 | MB - 9-23-95 |

NOTE: All position verifications performed during eddy current testing shall be recorded on the appropriate Eddy Current Examination Sheet.

# ATTACHMENT 1

## PROCEDURE HNP-004 SIGN-OFF

Steam Generator: A / B / (C) Leg: (HOT) / COLD

1.0 Personnel Certifications/Qualifications (Section 4.0):

initial/date

1.1 Eddy Current Certifications: D.Rodes 9/17/95

1.2 Eye Exams: D.Rodes 9/17/95

2.0 Equipment: (MIZ-18, MIZ-30, PM-1, LAN Box, Manipulator, etc.):

| Model/Type | S/N | Cal. Due | Dates Used To - From |
|---|---|---|---|
| MIZ-18 | | | - |
| MIZ-30 | 094 | 8-17-96 | 9-18-95 - |
| PM-1/PM-3 | 007 | N/A | 9-18-95 - |
| LAN Box | | N/A | - |
| Manipulator | 24 | N/A | 9-18-95 - |
| | | | - |
| | | | - |
| | | | - |
| | | | - |
| | | | - |
| | | | - |

3.0 Prerequisites met: initial/date

3.1 Equipment staging area approved (5.3): JRJ / 9-18-95

3.2 Steam Generator open at proper temp. <90°F and humidity (5.4): JRJ / 9-17-95

3.3 Secondary Side <120°F (5.5): JRJ / 9-18-95

3.4 Platform Staged (5.6):

3.4.1 Platform built: JRJ / 9-18-95

3.4.2 Lighting & power: JRJ / 9-18-95

3.4.3 Breathing air: JRJ / 9-18-95

3.4.4 Equipment air: JRJ / 9-18-95

3.5 Eddy Current Exam Sheets (5.8): JRJ / 9-18-95

3.6 Communication system set up (5.10): JRJ / 9-18-95

3.7 Manway doors installed: JRJ / 9-18-95

4.0 Calibration Standards (6.0):

| Cal. Std. S/N | Type | Verified |
|---|---|---|
| 14093 GT-A | MRPC | CTS |
| 14094 GT-B | MRPC | CTS |
| | | |
| | | |
| | | |

5.0 Eddy Current system set up (8.0) and operational check (9.0): JCJ / 9-19-95

5.1 Spooler operational (Eddynet): JRJ / 9-19-95

6.0 Manipulator installed: JRL, 9-18-95

6.1 Position Verification (14.0): JRL, 9-18-95

| Reason | Verification Location | Initial - Date |
|---|---|---|
| Installation | 23/32 | JRL - 9-18-95 |
| After Equip. Change | | - |
| | | - |
| | | - |
| | | - |
| | | - |
| | | - |
| Before Removal | 49/56 | DBF - 9/23/95 |

NOTE: All position verifications performed during eddy current testing shall be recorded on the appropriate Eddy Current Examination Sheet.

# ATTACHMENT 1

## PROCEDURE HNP-004 SIGN-OFF

Steam Generator: A / B / (C) Leg: HOT / (COLD)

1.0 Personnel Certifications/Qualifications (Section 4.0):

initial/date

1.1 Eddy Current Certifications: D.Meleg 9/17/95

1.2 Eye Exams: D.Meleg 9/17/95

2.0 Equipment: (MIZ-18, MIZ-30, PM-1, LAN Box, Manipulator, etc.):

| Model/Type | S/N | Cal. Due | Dates Used To - From |
|---|---|---|---|
| MIZ-18 | 072 | 7-31-96 | 9-19-95 - |
| MIZ-30 | | | - |
| PM-1/PM-3 | | N/A | - |
| LAN Box | 024 | N/A | 9-19-95 - |
| Manipulator | SM-20 | N/A | 9-19-95 - |
| SM-20 Box | 120 | N/A | 9-19-95 - |
| | | | - |
| | | | - |
| | | | - |
| | | | - |
| | | | - |

3.0 Prerequisites met: initial/date

3.1 Equipment staging area approved (5.3): SAS / 9-18-95

3.2 Steam Generator open at proper temp. <90°F and humidity (5.4): SAS / 9-18-95

3.3 Secondary Side <120°F (5.5): SAS / 9-18-95

3.4 Platform Staged (5.6):

3.4.1 Platform built: SAS / 9-18-95

3.4.2 Lighting & power: SAS / 9-18-95

3.4.3 Breathing air: N/A /

3.4.4 Equipment air: SAS / 9-18-95

3.5 Eddy Current Exam Sheets (5.8): SAS / 9-18-95

3.6 Communication system set up (5.10): SAS / 9-18-95

3.7 Manway doors installed: SAS / 9-18-95

4.0 Calibration Standards (6.0):

| Cal. Std. S/N | Type | Verified |
|---|---|---|
| Z-9047 | ASME | SAS |
| Z-9052 | AUB | SAS |
| | | |
| | | |
| | | |

5.0 Eddy Current system set up (8.0) and operational check (9.0): SAS / 9-19-95

5.1 Spooler operational (Eddynet): SAS / 9-19-95

6.0 Manipulator installed: SSS / 9-19-95

6.1 Position Verification (14.0): SSS / 9-19-95

| Reason | Verification Location | Initial - Date |
|---|---|---|
| Installation | 22, 73 | SSS - 9-19-95 |
| After Equip. Change | | - |
| | | - |
| | | - |
| | | - |
| | | - |
| | | - |
| Before Removal | R8 C30 | MB - 9-23-95 |

NOTE: All position verifications performed during eddy current testing shall be recorded on the appropriate Eddy Current Examination Sheet.

Project No.: _____

# EDDY CURRENT DATA ANALYSIS PROCEDURE

# EVALUATION OF WESTINGHOUSE STEAM GENERATOR TUBING

Carolina Power & Light Co.

Shearon Harris

ABB COMBUSTION ENGINEERING NUCLEAR OPERATIONS
1201 Riverfront Parkway
Chattanooga, TN 37402

APPROVED BY: _____ DATE: 8-2-95
Cognizant Supervisor

APPROVED BY: _____ DATE: 8-1-95
T. U. Bipes
Level III

APPROVED BY: _____ DATE: 8/2/95
J. D. Ford
Quality Assurance

TABLE OF CONTENTS


| SECTION | TITLE |
|---|---|
| 1.0 | OBJECTIVE |
| 2.0 | REFERENCES |
| 3.0 | PERSONNEL REQUIREMENTS |
| 4.0 | EQUIPMENT |
| 5.0 | AREA OF INTEREST |
| 6.0 | EVALUATION OF DATA |
| 7.0 | SIGNAL FORMATION |
| 8.0 | SIZING MEASUREMENTS |
| 9.0 | VOLTAGES |
| 10.0 | AXIAL POSITION LOCATION |
| 11.0 | DDA-4 DISC FORMAT INFORMATION |
| 12.0 | RE-EXAMINATION |
| 13.0 | CONFIRMATION OF PLUGGABLE INDICATIONS |
| 14.0 | DATA CONTROL |
| 15.0 | RECORDING CRITERIA |
| 16.0 | REPORTING CRITERIA |

| | |
|---|---|
| FIGURE 1 | TYPICAL EQUIPMENT INTERCONNECT SCHEMATIC |
| FIGURE 2 | LIST OF APPROVED DDA-4 NOTATIONS |
| FIGURE 3 | TYPICAL 3-POINT FIT CURVE |
| FIGURE 4 | PHASE ANGLE MEASUREMENTS |
| FIGURE 5 | TYPICAL DDA-4 FINAL REPORT FORMAT |

ATTACHMENT A CUSTOMER SPECIFIC DATA ANALYSIS REQUIREMENT

## 1.0 OBJECTIVE

This procedure will establish a set of guidelines to be utilized by the eddy current Data Analyst with the intent of providing a consistent method for reporting the eddy current results. THIS PROCEDURE IS NOT INTENDED TO BE UTILIZED BY AN INDIVIDUAL WHO HAS NOT HAD PROPER TRAINING IN THE EVALUATION OF EDDY CURRENT DATA. This procedure may be superseded in its entirety or in part by client specific analysis guidelines.

## 2.0 REFERENCES

2.1 ABB Combustion Engineering Nuclear Operations Quality Assurance Manual, QAM-100, latest revision.

2.2 ABB Combustion Engineering Nuclear Operations Quality Assurance Procedures Manual, QAM-101, latest revision.

2.3 Zetec Eddynet System Operating Guides.

2.4 Procedure for the control of Eddy Current examination data for the personal computer (PC) Data Base System, HNP-006, latest revision.

2.5 Procedure for multifrequency eddy current examination of nonferromagnetic steam generator tubing using MIZ-18A equipment, HNP-004, latest revision.

2.6 ASME Code Case N-401-1, use of digital equipment.

## 3.0 PERSONNEL REQUIREMENTS

3.1 The evaluation of the results of the eddy current examination must be conducted by a Data Analyst qualified to at least ET Level II with specific training for the evaluation of data from nonferromagnetic steam generator tubing.

3.2 Each person performing Data Analysis governed by this procedure shall be certified in accordance with SNT-TC-1A 1984 Edition or equivalent. Combustion Engineering personnel shall be certified in accordance with Combustion Engineering written Procedure QAP 2.4 contained in Reference 2.2.

If data analysts are supplied for primary or secondary data review by the purchaser, the purchaser will be responsible for their certification. In the instance when C-E utilized a subcontractor for primary or secondary data review, C-E will be responsible for certification either by examination to the requirements of QAP 2.4 or by auditing and accepting the subcontractor(s) written practice.

3.3 The Analyst shall be responsible for evaluating the data and reporting the results of the examination.

3.4 The independent data analyst (if used) shall be responsible for evaluating the data provided by the data controller.

## 4.0 EQUIPMENT

The equipment required to analyze the eddy current examination data includes but is not limited to the following:

4.1 HP 400/700 Series Computer or equivalent.

4.2 Zetec Analysis software Revision 27 or later.

4.3 Supply of magneto-optical disks or applicable media.

4.4 Appropriate printer or equivalent device (optional).

4.5 Appropriate interconnect cables, power cords and peripherals.

## 5.0 AREA OF INTEREST

The evaluation of data shall include all information recorded on storage media per the requirements of the Data Acquisition operating procedure in use or as specified by the client.

## 6.0 EVALUATION OF DATA

6.1 The data evaluation shall be conducted by viewing the lissajous pattern and the appropriate strip chart presentations/Terrain plots on the computer screen for the entire recorded length of each tube. Any abnormal signals will be investigated for determination of location and percent through wall dimension (% TWD) as practical. Attachment A, Client Specific Data Analysis Requirements contains specific direction for analyzing data.

6.2 The screening frequencies utilized for the data analysis shall be the optimum defect detection frequencies for the size and wall thickness of the tubing being inspected. These frequencies will be determined by the lead data analyst and documented on Attachment A, Client Specific Data Analysis Requirements. No Field Change Notice (FCN) is required for additions or deletions to Attachment A. Signatures by the ET Level III and the client representative will represent concurrence of the specific requirements.

NOTE: As work progresses, Attachment A's shall be completed as required. The revision number shall be changed in the appropriate section of the Attachment A form.

6.3 If the Analyst determines that a condition exists that precludes accurate data analysis, the analyst will submit a list of tubes that have been affected by this condition and those tubes may be retested if required.

6.4 Interpretation of test results shall be conducted by certified eddy current data analysts. Test results are interpreted using calibration curves generated from information obtained by passing a test probe through a calibration standard manufactured from a piece of material of the same alloy, nominal outside diameter and nominal wall thickness as the tubing in the steam generator containing known, machined, or natural discontinuities ranging from 100% through wall to 20% through wall from the O.D. or as required.

6.5 The data shall be analyzed using any or all the recorded information necessary to determine the

nature and severity of all detectable indications, as required.

6.6 All indications analyzed will be categorized using the recommended DDA-4 Notation. These codes are inclusive, but shall not be limited to the listing located in Figure 2.

6.7 When the signal of interest is interfered with by a support structure, sludge, dent, noise, or other unwanted responses, a multi-frequency mix may be used to aid in evaluation of the signal. These indications will be evaluated using the appropriate sizing frequency and mixes as needed.

6.8 When the signal of interest is interfered with by a support structure, noise, or other indications, including signals of very low voltage, one or more of the following techniques may be utilized to improve the accuracy of classification and sizing.

6.8.1 Other frequencies
6.8.2 Mixes
6.8.3 Special techniques

6.8.3.1 Rotating Eddy Current Probes
6.8.3.2 Magnetic Bias Probes
6.8.3.3 8 x 1 Probes
6.8.3.4 Ultrasonic Inspection
6.8.3.5 D Coils or Segment Bobbin Coil Probes
6.8.3.6 Other

**NOTE: Free span flaw like indications, regardless of amplitude or phase angle, should be subjected to the above signal enhancing techniques. There will be no voltage or phase threshold for flaw like indication quantification.**

## 7.0 SIGNAL FORMATION

The initial direction of the signal formation supplies important information about the indication type to the data analyst. Signal formation may be determined by strip chart recordings or by CRT display. Signal phase must be set to a known standard prior to initiation of the data analysis.

7.1 Relevant indications in the differential mode shall be phased such that known flaws in the calibration standard form (negative) initially. Relevant absolute signals shall be phased such that flaws in the calibration standard form upward (positive) initially.

7.2 Non-relevant indications in the differential mode will normally form upward (positive) initially. Non-relevant indications in the absolute mode will normally form downward (negative) initially.

7.3 The data analyst shall be cognizant of the fact that a real flaw (relevant indication) will have appropriate phase and voltage correlation at various frequencies. However no voltage or phase threshold should be used to disqualify an indication from further evaluation.

## 8.0 PHASE ANGLE MEASUREMENTS

8.1 All phase angle measurements will be compared to the relevant calibration curve to determine percent through wall, utilizing a 3 point fit curve. This curve shall be constructed utilizing the

as-built dimension of the calibration standard and actual phase angle or amplitude data obtained from passing the test probe through the calibration standard. (See Figure 3 for a typical curve). The 4.1 curve supplied with the DDA-4 Data Analysis Software will only be utilized if specified in the Customer Specific Data Analysis Requirements.

8.2 Phase angle of an indication must be determined by the proper selection of angle points.

8.3 Indications that return to calibration point (null point) and have a definite straight line transition between peaks shall be called from straight line peaks. Figure 4.

8.4 Any indication that deviates from the calibration point (null point) shall be called from amplitude peak to peak points. Figure 4.

## 9.0 SIZING MEASUREMENTS

9.1 The "set-volts" sizing capability of the DDA-4 should be set a given voltage peak-to-peak on the calibration standard 20% flat bottom holes at the primary frequency (550 kHz). This voltage should then be saved and stored to all other channels.

9.2 The lower the frequency, the more the signal penetration, but the smaller the phase separation. Therefore, the lower frequencies are mainly used for detection not sizing. Low frequencies may be used for sludge, loose parts detection, etc.

## 10.0 AXIAL POSITION LOCATION

All indications representing tube wall degradation shall be recorded with reference to a known structure, i.e., tube support plates, tubesheets, anti-vibration bars.

10.1 Determine from as-built drawing, (preferred) design drawings or client supplied information the actual distance between support members.

10.2 Calibrate the axial position indicator as described in the System Operating Guides.

10.3 TSP (tube support plate) reference locations shall be conducted using the center of the support as the zero (0) reference point.

## 11.0 DDA-4 FORMAT INFORMATION

All information pertaining to analyst final report format is described below.

11.1 The analysis report identification will be entered as directed by data management. Parameters should be discussed and mutually agreed prior to examination.

11.2 Data base software parameters require the generator designator to be the first digit in the "SG" column of the report. The second digit should represent the leg from which the tube is inspected. A "1" is used for the 'hot' side and a "0" for the 'cold' side. Be sure to change the "SG" code if client specific requirements for data acquisition are different.

11.3 All notation information of tubes shall be entered in the % column of the analyst final report. Any tube requiring retesting shall contain the letter "R" as the first letter of the three letter code entered in the % TWD column of the report as shown in Figure 2.

11.4 Data analyst shall enter in the extent tested column of analyst final report format, the area of the tube actually tested to the nearest support member actually recorded. The order of the extent tested column is determined by the direction and extent of the data recording during the data acquisition. The first S/G member noted by the data analyst will identify first on the extent tested column. The last S/G member noted by the data analyst (if utilized) will be identified second in the extent tested column (typically CTE or HTE, cold tube end, hot tube end, etc.)

EXAMPLE: A tube being tested from the cold leg to the hot leg tube end shall be entered as CTEHTE. An optional extent would be CTE if the beginning location is not utilized.

11.5 When the analyst final report is completed, the data analyst(s) will sign the report. (See Figure 5).

11.6 The analyst should verify the supplement type and revision number of the analysis supplement in the summary section of the analyst report as required by supplementary guidelines.

## 12.0 RE-EXAMINATIONS

All tubes that require re-examination as a direct result of the evaluation of the data shall be identified by the data analyst. The data analyst is responsible for supplying the row/column number and an explanation for why the re-examination is requested.

## 13.0 CONFIRMATION OF PLUGGABLE INDICATION

Confirmation of tubes identified for removal from service are usually conducted after completion of the initial eddy current examination or as requested by the client. The intent of this confirmation examination is to verify the indication exists and the data is repeatable in the tube identified to be removed from service. Pluggable limits will be set by plant technical specifications.

13.1 A typical procedure for accomplishing the confirmation is to re-test the tube in question and verify the location of the flaw and tube identification. The data analyst shall then enter the three-letter acronym "PID" into the analyst final report.

13.2 In the event that the "positive identification" examination does not confirm the tube location, resolution is required. Upon completion of the resolution process, the correct tube number shall be noted and all previous data shall be corrected accordingly.

## 14.0 DATA CONTROL

The lead data management operator shall be responsible for data control of the magnetic tape, oscillographs, printouts, disks, etc. These items shall be turned over to the client upon completion of the examination. Data control shall be in compliance with procedure HNP-006, titled "PROCEDURE FOR CONTROL OF EDDY CURRENT DATA FOR USE WITH MULTIFORTH OR EDDYNET ACQUISITION SYSTEMS".

## 15.0 RECORDING CRITERIA

All indications evaluated to be one of the items identified in Figure 2 recommended DDA-4 notations shall be recorded by the appropriate method. Client specific recording requirements shall augment Figure 2.

## 16.0 REPORTING CRITERIA

All reportable indications shall be reported to the client on a regular basis. The final report of the inspections results supplied to the client will contain the following at a minimum. Client reporting requirement shall augment this procedure.

16.1 All tube wall degradations shall be reported.

16.2 All detectable tube dents shall be evaluated.

16.3 Any additional condition(s) or abnormalities that the data analyst deems necessary to report shall be reported.

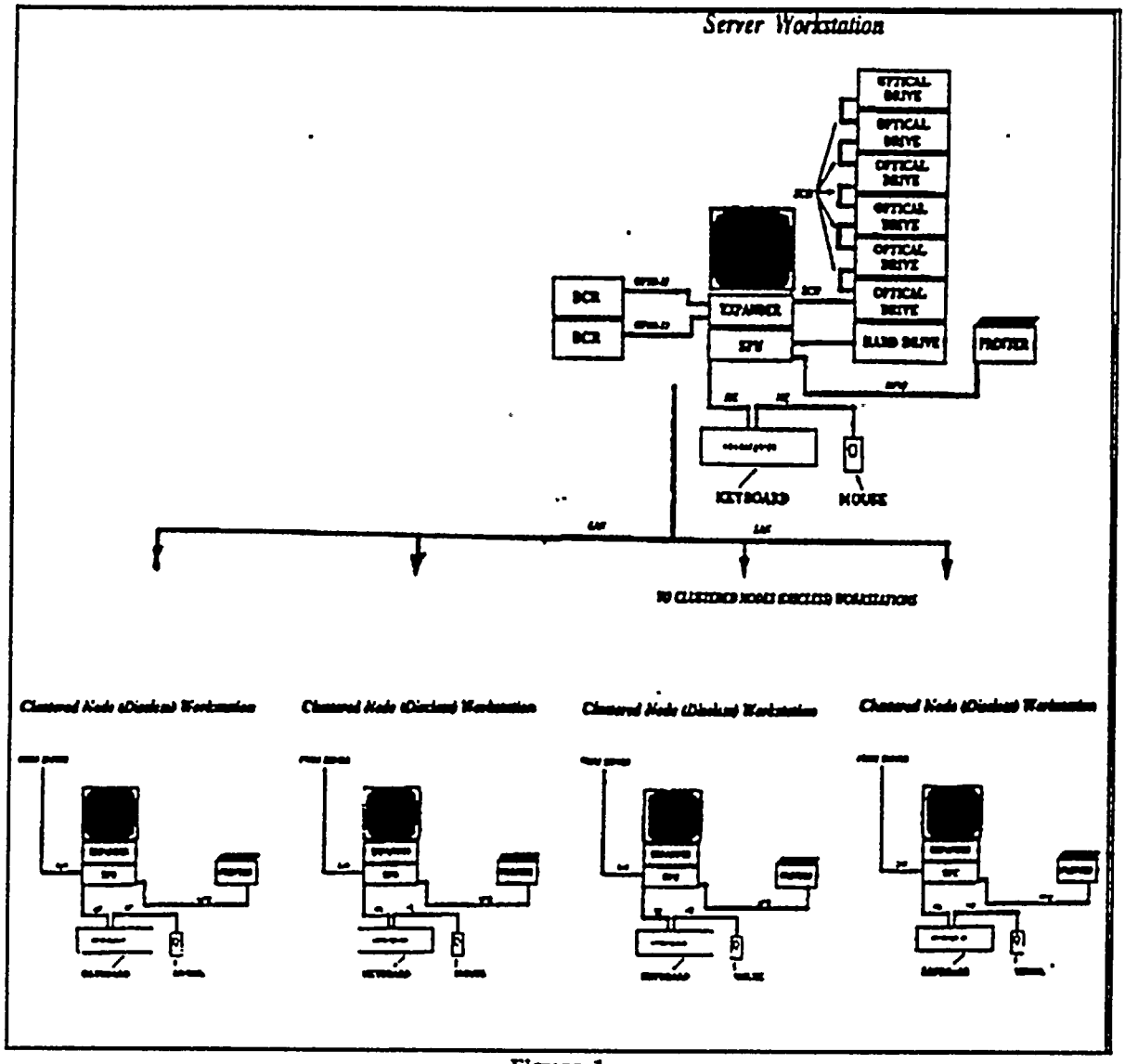

Server Workstation
OPTICAL DRIVE
OPTICAL DRIVE
OPTICAL DRIVE
OPTICAL DRIVE
OPTICAL DRIVE
OPTICAL DRIVE
SCSI
SCSI
SCSI
EXPANDER
SPU
RAID DRIVE
PRINTER
KEYBOARD
MOUSE
LAN
LAN
Clustered Node (Diskless) Workstation
Clustered Node (Diskless) Workstation
Clustered Node (Diskless) Workstation
Clustered Node (Diskless) Workstation

Figure 1

| NOTATION | DESCRIPTION |
|---|---|
| ADI | ABSOLUTE DRIFT INDICATION |
| ADR | ABSOLUTE DRIFT |
| BLANK | NO INDICATION (NDD) |
| BLG | BULGE |
| CUD | COPPER DEPOSIT |
| DEP | DEPOSIT (NON-COPPER) |
| DNT | DENT |
| DRI | DISTORTED ROLL INDICATION |
| DRT | DISTORTED ROLL TRANSITION |
| DSI | DISTORTED SUPPORT PLATE INDICATION |
| DSS | DISTORTED SUPPORT SIGNAL (NO INDICATION) |
| DTS | DISTORTED TUBESHEET SIGNAL |
| DTI | DISTORTED TUBESHEET INDICATION |
| IDV | INSIDE DIAMETER VARIATION |
| INF | INDICATION NOT FOUND |
| INR | INDICATION NOT RECORDABLE |
| LAR | LEAD ANALYST REVIEW |
| LPI | LOOSE PART(S) WITH INDICATION |
| NQI | NON QUANTIFIABLE INDICATION |
| NSY | NOISY TUBE |
| NTE | NO TUBESHEET EXPANSION |
| OBS | OBSTRUCTED TUBE |
| OVR | OVER ROLL ABOVE TOP OF TUBE SHEET (TTS) |
| OXP | OVER EXPANSION |
| PID | POSITIVE IDENTIFICATION |
| PLG | PLUG |
| PLP | POSSIBLE LOOSE PART(S) |
| PTE | PARTIAL TUBESHEET EXPANSION |
| PVN | PERMEABILITY VARIATION |
| RBD | RETEST BAD DATA |
| RES | RESTRICTED TUBE (WITH CURRENT PROBE SIZE) |
| RFX | RETEST FIXTURE |
| RNC | RETEST TUBE NUMBER CHECK |
| RND | RETEST NO DATA |
| RPI | RETEST FOR POSITIVE INDICATION |
| RTI | RETEST TUBE INCOMPLETE |
| SLG | SLUDGE |
| SLV | SLEEVE |
| SAI | SINGLE AXIAL INDICATION |
| MAI | MULTIPLE AXIAL INDICATIONS |
| SCI | SINGLE CIRCUMFERENTIAL INDICATION |
| MCI | MULTIPLE CIRCUMFERENTIAL INDICATIONS |
| MBM | MANUFACTURING BUFF MARK |

FIGURE 2
LIST OF THREE-LETTER NOTATIONS

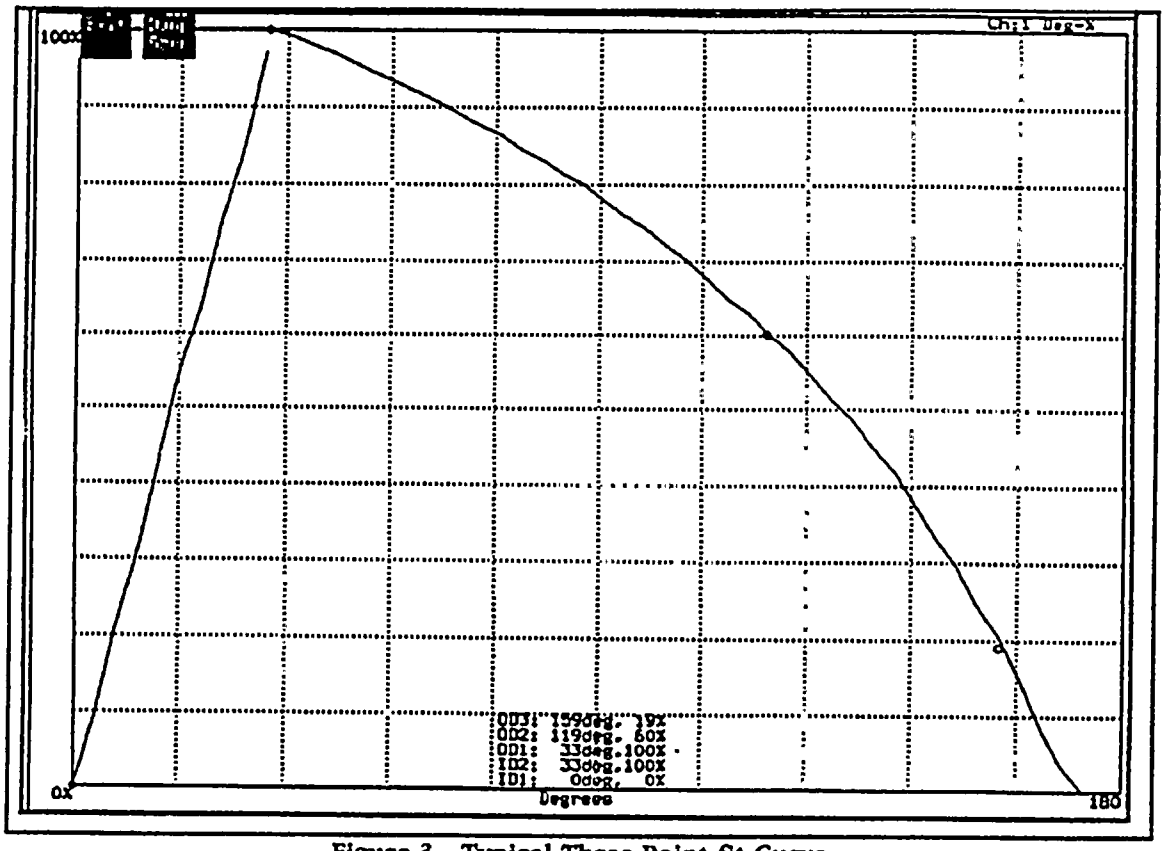
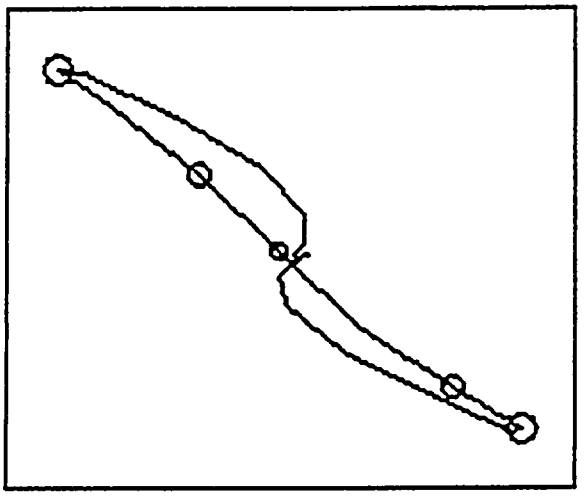



**Figure 3 - Typical Three-Point fit Curve**



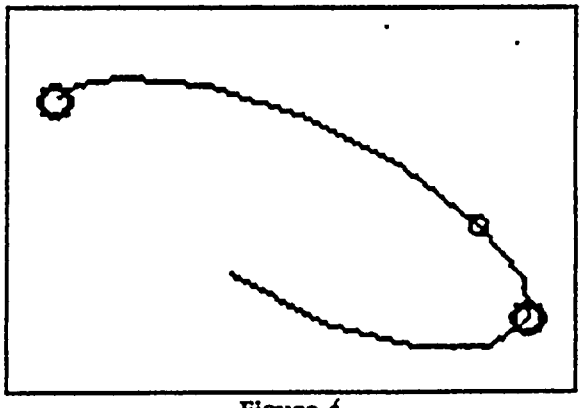


Figure 4

```
Sep 18 12:40 1991  /rod3/resolution/tape001A.cal01/gat5028.res Page 1


File=resolution/tape001A.cal01  User=gat5028  Date=9/18/91 12:40
Disc Label = DkDB_A05
    TERMING GA     AC01          A510XULC        DB_A05     09/17/91
 20   62    1                                              UTELTE
 20   63    1                                              UTELTE
 20   64    1                                              UTELTE
 20   65    1                                              UTELTE
 20   66    1                                              UTELTE
 20   67    1                                              UTELTE
 20   68    1                                              UTELTE
 20   69    1                                              UTELTE
 20   70    1                                              UTELTE
 20   71    1                                              UTELTE
 20   72    1                                              UTELTE
 20   73    1                                              UTELTE
 20   74    1                                              UTELTE
 20   75    1                                              UTELTE
 20   78    1                                              UTELTE
 20   79    1                                              UTELTE
 20   80    1                                              UTELTE
 20   81    1                                              UTELTE
 20   82    1                                              UTELTE
 20   83    1  0.35  77  35  17 015      +  0.00            UTELTE
 20   84    1                                              UTELTE
 20   85    1                                              UTELTE
 20   86    1  0.36  78 S/N  17 013      +  0.18            UTELTE
 20   87    1                                              UTELTE
 20   88    1                                              UTELTE
 20   89    1                                              UTELTE
 20   90    1                                              UTELTE
 20   91    1                                              UTELTE
 20   92    1                                              UTELTE
 20   93    1                                              UTELTE
 20   94    1                                              UTELTE
 20   95    1                                              UTELTE
 20   96    1                                              UTELTE
 20   97    1                                              UTELTE
 20   98    1                                              UTELTE
 20   99    1                                              UTELTE
 20  100    1                                              UTELTE
 20  101    1                                              UTELTE
 20  102    1                                              UTELTE
 20  103    1                                              UTELTE
 20  104    1 11.30 170 DNG   3 UTSF     + 16.89            UTELTE
 20  105    1                                              UTELTE
 20  106    1                                              UTELTE
 20  107    1                                              UTELTE
 20  108    1                                              UTELTE
 20  109    1  1.53 120 MBM   3 006      + 31.37            UTELTE
 20  110    1                                              UTELTE
 20  111    1  2.96 123 MBM   3 008      +  1.74            UTELTE
 20  111    1  0.90  78 S/N  17 008      -  0.24            UTELTE
 20  112    1  1.16 115 MBM   3 015      + 13.61            UTELTE
                              END TAPE
```

Figure 5 - Typical Data Report

See Steam Generator ECT Data Analysis Guideline

C-E ET LEVEL III DATE CUSTOMER REPRESENTATIVE CONCURRENCE DATE

Attachment A
Data Sheet Documenting
Customer Specific Data Analysis Requirements

# STEAM GENERATOR

# EDDY CURRENT

# INTERPRETATION GUIDELINES

Carolina Power & Light Company

Shearon Harris Nuclear Plant

Revision 1

Prepared by: _____ Date: 9-6-95
ECT Level III

Approved by: _____ Date: 9/12/95

Approved by: _____ Date: 9/14/95

## Table of Contents


| Section | Title | Page |
|---|---|---|
| 1.0 | Scope | 1 |
| 2.0 | References | 2 |
| 3.0 | Definitions | 3 |
| 4.0 | Personnel Qualifications and Responsibilities | 7 |
| 5.0 | General Information | 11 |
| 6.0 | Bobbin Probe Calibration & Evaluation | 19 |
| 7.0 | Bobbin Probe Recording Requirements & Acronyms | 47 |
| 8.0 | Bobbin Probe Resolutions | 52 |
| 9.0 | Single Coil MRPC Probe Calibration & Evaluation | 59 |
| 10.0 | Three Coil MRPC Probe Calibration & Evaluation | 71 |
| 11.0 | MRPC Probe Recording Requirements & Acronyms | 84 |
| 12.0 | MRPC Probe Resolutions | 93 |


### Appendices


| | | |
|---|---|---|
| A. | Supplemental Westinghouse plant Information | 105 |
| B. | Computer Data Screening | 115 |
| C. | Performance Demonstration | 117 |

## Section 1.0
## Scope

The scope of this Steam Generator Eddy Current Analysis Guideline is to provide the qualified Analyst with the optimum methods of recognizing and reporting eddy current data collected from the Shearon Harris steam generator inspection.

These Guidelines will assure that:

1) The most appropriate analysis practices are used

2) Data is analyzed and recorded in a consistent and repeatable manner.

3) The validity and accuracy of the results are optimum.

In conjunction with this document, training data and documentation are available for each of the test methods.

## Section 2.0
## References

2.1 EPRI NP-6201, Rev. 3, PWR Steam Generator Examination Guidelines.

2.2 Zetec Eddynet Global Menu & Administrative Functions User Guide - EN-138

2.3 Zetec Eddynet Analysis User Guide - EN-101-EM

## Section 3.0
## Definitions

**Anti-Vibration Bar:**

A structure placed between the tubes in the u-bend section used to minimize vibration of the tube bundle.

**Base Frequency (ies):**

Individual frequencies used to configure the test system. Any combination of these may be mixed during analysis to eliminate unwanted interference from signals generated from events such as copper deposits.

**Bulge Signal:**

An expansion of the tube from the inside outward, as occurs at the top of the tubesheet region, can cause these signals. They are, for the most part, horizontal in phase and initiate in an opposite direction to Dent signals.

**Chatter Signal:**

Chatter signals can occur in a tube at any location and typically appear as uniform horizontal noise signals. Pilgering, during the manufacturing process, can cause these signals.

**Copper:** (as in secondary side copper, copper corrosion, copper chloride, and copper chloride attack)

The presence of copper in the steam generator is due to the corrosion of copper-based materials within the balance-of-plant heat exchangers such as condensers and feedwater heaters. Copper, when coupled with the appropriate faulted secondary side chemistry, works to promote denting, SCC, and pitting.

**Defect:**

A tube wall loss condition which exceeds the predetermined minimum structural requirements plus the allowance for growth between refueling outages. Repair is required prior to operation. The Plant's Technical Specification describes this as a wall loss of greater than or equal to 40 percent.

**Denting:**

Plastic deformation of tubes typically resulting from the buildup of carbon steel support plate corrosion products (Magnetite) in the tube-to-tube support plate annuli and at the top of the tubesheet.

**Dent Signal:**

A signal caused by a reduction of the nominal tube diameter, as occurs at tube supports which experience denting. They are, for the most part, horizontal in phase and initiate in an opposite direction to Bulge signals. (With phase set according to this guideline, dents will initiate to the left on the primary channel, or primary mix channel.)

**Distorted Roll Indication (DRI):**

An indication associated with the upper tubesheet expansion. Evidence on 550 KHz and the 3-frequency mix. These indications are sometimes attributed to circumferential cracks.

**Distorted Signal:**

An indication with poor definition and depth evaluation correlation between frequencies, which is believed to be caused by a flaw equal to or greater than 40 percent through wall.

**Distorted Tubesheet Signal:**

A typical tubesheet signal which forms abnormally and is suspected to be due to a flaw condition which is coincident with a dent located at or just above the top of the tubesheet region. This condition requires the use of a special 3-frequency mix for analysis.

**False Positive:**

A signal which displays the characteristics of a typical flaw indication, but which is actually caused by the combined signals from other features in the generator such as deposits, sludge, expansion transition, bends, secondary structures, or manufacturing marks.

**Final Report:**

The report produced by each data analyst which provides the results of the data analysis for each tube examined.

**Flaw (or Degradation):**

A condition which represents a deviation from the as designed structure: Flaw conditions can be created during manufacturing, transportation, installation, and service. many common flaws are not considered "defects" requiring repair, but their indication signals may require measurement such that changes or growth can be monitored as a preventative maintenance measure.

**Incomplete Test:**

This is when a tube or tubes are not inspected to the predetermined extent as stated in the approved inspection program for a given outage.

**Intergranular Attack:**

This is a general term denoting the corrosive attack of grain boundaries in Inconel 600 with no preferential (stress-related) orientation.

**Magnetite:**

Carbon steel corrosion products located in the tube-to-tube support annuli. Magnetite forms the bulk of the sludge pile.

**No Distinguishable Discontinuity:**

Defines the tube as having no signal responses which meet the minimum reporting criteria for indications established by the Data Interpretation Guidelines.

**Tube Noise:**

Any undesired signal or signals that may obscure for interpretation, those signals that are of interest. It may be generated from electrical variations, from specimen dimensional variations, or material property variations.

**Obstructed Tube:**

This designation is given to a tube which will not allow a probe with a diameter of .540 inches or smaller to pass to a given location. Tubes which contain obstructions in the straight section of tubes in the plenum of probe entry will be removed from service.

**Permeability:**

Permeability describes the intrinsic willingness of material to conduct magnetic flux lines. Signals, due to permeability variations (PVN), may go up or down first and typically do not show normal phase correlation between the different frequencies as would degradation. Most PVN indications at Shearon Harris are eliminated by magnetically biased test probes.

**Pitting:**

Localized attack on tubing resulting from nonuniform corrosion rates caused by the formation of local corrosion cells.

**Restriction:**

This designation is assigned to the location in a tube which the tube geometry prevents the passage of an eddy current probe.

**Setup Span:**

A minimum span requirement for analysis software which is based upon the calibration standard signal size and which assures a proper lissajous presentation to meet the intent of ASME Section XI sensitivity requirements.

**Sludge:**

This is a buildup of material on top of the tubesheet resulting from corrosion products. This material is considered undesirable because it can act as a concentrating environment for aggressive chemical impurities and it cuts down heat transfer surface area.

**Stress Corrosion Cracking:**

Cracking of stressed tubes, without reference to a causative chemical agent.

**Threshold:**

A level of some indication characteristic (i.e. voltage, depth) above or below which it is possible to clearly distinguish it from noise requiring it to be reported.

**Unresolved Signal:**

An indication which cannot be resolved as being caused by either a flaw or a non-flaw condition.

**Retest:**

The Data Analyst may request a retest of a tube if it is felt that such a test would provide additional information necessary to assess the condition of the tube. Retests may be requested for conditions such as lower than acceptable signal to noise ratios or incomplete tests.

**Wastage:**

Secondary side corrosion caused by chemical attack from residues concentrated in low flow areas such as under the sludge pile.

## Section 4.0
## Personnel Qualification Requirements and Responsibilities

### 4.1 Qualification Requirements

This section discusses the requirements which personnel must meet in order to evaluate the steam generator tube eddy current examination results at Shearon Harris.

4.1.1 The evaluation of the results of the eddy current examinations must be conducted by personnel certified to a minimum of Level II with specific training for the evaluation of data from nonferromagnetic steam generator tubing.

4.1.2 Each person performing data analysis will be certified in accordance with the employer's written practice and approved by Carolina Power & Light Company.

4.1.3 The Data Analyst shall have successfully passed a practical examination specific to the Shearon Harris steam generators.

### 4.2 Responsibilities

This section discusses and defines the analyst hierarchy and analyst responsibilities.

4.2.1 Senior Analyst

One individual will be selected as the Senior Analyst. The Senior Analyst is responsible for:

4.2.1.1 Evaluating eddy current data in a manner consistent with the analysis guidelines presented herein.

4.2.1.2 Modifying the analysis guidelines during the inspection - with the concurrence of the utility - to accommodate new or unanticipated circumstances. The Analyst Guidelines Change Form, in Figure 4.1, should be used to document modifications to the Guidelines. The Analyst Guidelines Change Acknowledgement Form, Figure 4.2, should be used to document Analyst acknowledgment of the modifications.

4.2.1.3 Making the other data Analysts aware of any and all modifications to the analysis guidelines.

4.2.1.4 The Senior Analyst may also assume the role of a Lead Analyst or Analyst.

4.2.2 Lead Analyst

Each shift will have two Lead Analysts; one for primary analysis and one for secondary analysis. The Lead Analyst is responsible for:

4.2.2.1 Evaluating eddy current data in a manner consistent with the analysis guidelines presented herein.

4.2.2.2 Alerting the Senior Analyst to conditions present in the data which are not addressed by the analysis guidelines.

4.2.2.3 Resolving discrepancies identified between Analysts in a manner defined by Section 8.0

4.2.3 Analyst

The Analyst (Primary or Secondary) is responsible for :

4.2.3.1 Evaluating eddy current data in a manner consistent with the analysis guidelines presented herein.

4.2.3.2 Alerting the Lead Analyst to conditions present in the data which are not addressed by the analysis guidelines.

4.2.3.3 Submitting a Final Report that is complete and free of editorial errors.

## ANALYST GUIDELINES CHANGE FORM

**Description of Change:**

**Reason for Change:**

**Technical Basis:**

**Authorization:**

**Senior Analyst** _____ **Date:** _____

**Shearon Harris Engineer** _____ **Date:** _____

Figure 4.1 - Analyst Guidelines Change Form

## ANALYST GUIDELINES CHANGE ACKNOWLEDGMENT FORM

**Description of Change:**

**Effective Date of Change:** _____

| Analyst Signature | Date | Analyst Signature | Date |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Figure 4.2 - Analyst Guidelines Change Acknowledgment Form

# Section 5.0
# General Information

## 5.1 Steam Generator Design

The general design of the steam generator is shown in figure 5.1. The SG's were built by Westinghouse and the plant started operations in 1987. There are 3 SG's each having 4578 tubes. The tubes are mill annealed Inconel 600 with dimensions of 0.75" OD x 0.043" wall thickness. Supports include carbon steel drilled supports; eight on the hot leg side and eleven on the cold leg side and anti-vibration bars in the u-bend section.

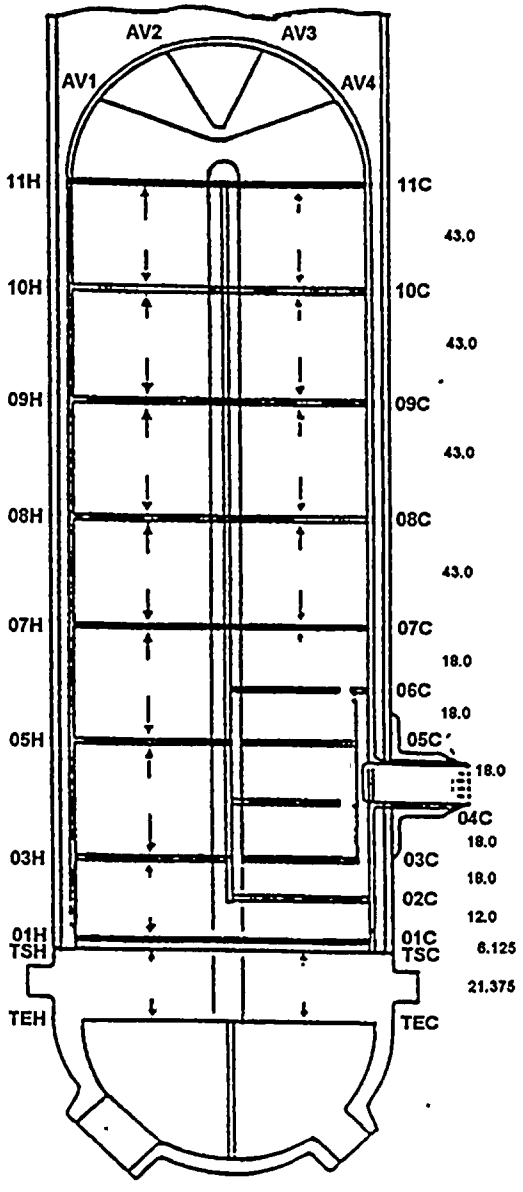



Figure 5.1

The tube sheet is drilled on a square pitch with 1.0625" spacing. Each tube is edentified by a row and column number; there are 49 rows and 114 columns in each steam generator. Figure 5.2 shows a typical tube sheet map. Full depth rolls were used during generator fabrication to expand tubes within the tube sheet.

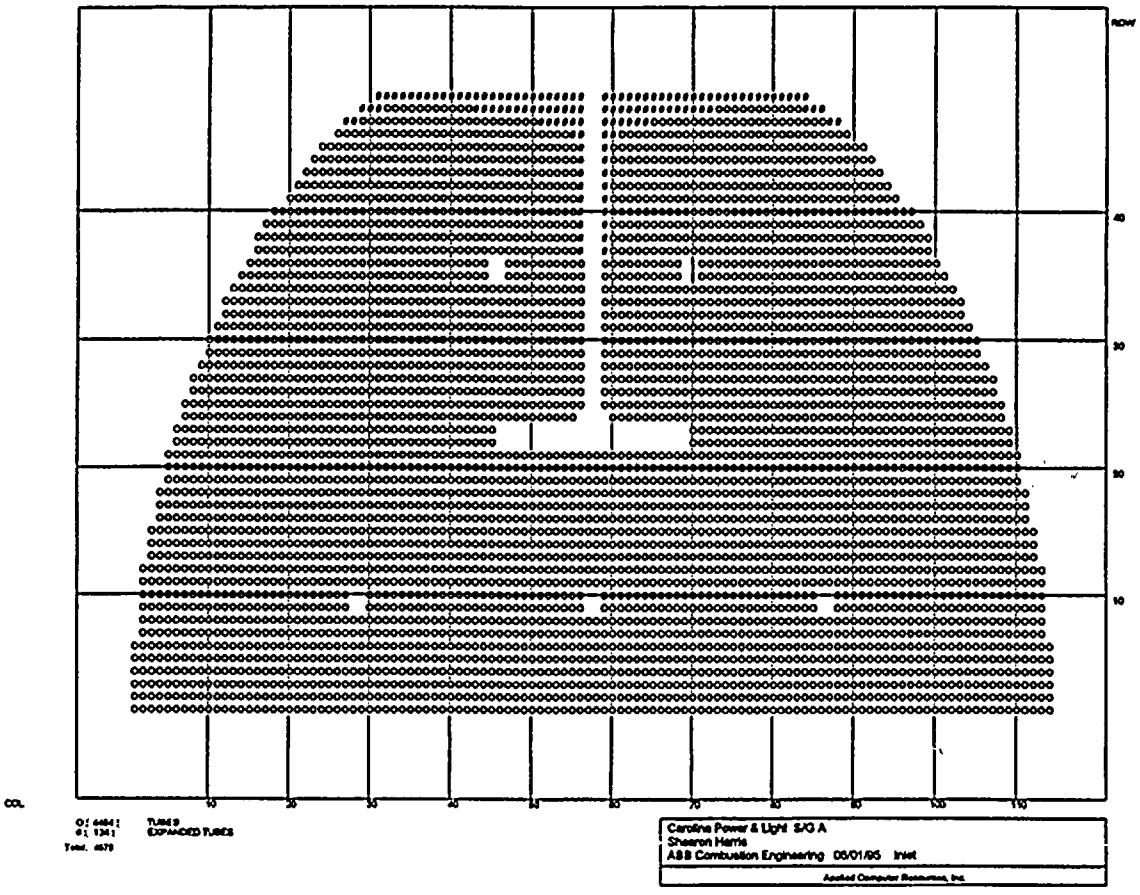



**Figure 5.2**
**Tubesheet Map including Expanded Tubes**

To minimize wear in the pre-heater section, the tubing at the 2nd and 3rd tube support intersections on the cold leg were hydraulically expanded into the support plate baffles. The expansion was only performed on the peripheral tubes in the pre-heater area. Figure 5.2 also shows the tubes that were expanded in each steam generator.

## 5.2 Operating Experience

A listing of operating Westinghouse plants with Model D and E steam generators is shown in Figure 5.3[1]. There are several mechanisms that affect Model D steam generators: Preheater wear, AVB wear, and primary water stress corrosion cracking (PWSCC) in the tube sheets and row 1 u-bends. Some units have experienced secondary side IGA/SCC at hot leg support plates and in the hot leg sludge pile. A few plants have also experienced circumferential SCC at the top of the hot leg tube sheets.

[1]Table taken from the Steam Generator Eddy Current Data Analysis Performance Demonstration Review Material, June 1993 with June 1994 revisions.

| Plant | Comm. Ops | Model | Mfr | Loops | # Tube /SG | Thinning | Wear | IGA/SCC | PWSCC | Pitting | Fatigue | Denting |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ringhals 3 | 9/81 | D3-2 | W | 3 | 4674 | | x(1,6) | x(2) | x(3,7) | | | |
| Almaraz 1 | 10/81 | D3-1 | W | 3 | 4674 | | x(1,6) | x(2) | x(3) | | | x |
| McGuire 1 | 12/81 | D2-1 | W | 4 | 4674 | | x(1,6) | x(2,3, 6) | x(3,7) | | | x |
| Krsko | 1/83 | D4-2 | W | 2 | 4578 | | x(1,6) | x(2) | x(3) | | | |
| Asco 1 | 9/83 | D3-1 | W | 3 | 4674 | | x(1) | x(2,3) | x(3) | | | x |
| Ringhals 4 | 11/83 | D3-1 | W | 3 | 4674 | | x(1,6) | x(2) | x(3,7) | | | |
| Summer | 1/84 | D3-1 | W | 3 | 4674 | | x(1,6) | x(2) | x(3,7) | | | |
| Almaraz 2 | 2/84 | D3-2 | W | 3 | 4674 | | x(1,6) | x(2) | x(3,7) | | | |
| McGuire 2 | 3/84 | D3-1 | W | 4 | 4674 | | x(1,6) | x(2,6) | x(3,7) | | | |
| Angra 1 | 12/84 | D3-1 | W | 2 | 4674 | | x(1) | x(2,3) | x(3) | x(4) | | x(5) |
| Catawba 1 | 6/85 | D3-2 | W | 4 | 4674 | | x(1) | x(2) | x(3,7) | | | |
| Doel 4 | 6/85 | E1 | C | 3 | 4864 | | x(1,6) | x(2,3, 4) | x(3) | | | |
| Byron 1 | 9/85 | D4 | W | 4 | 4578 | | x(1) | x(2) | x(7) | | | |
| Tihange 3 | 9/85 | E1 | C | 3 | 4864 | | x(1,6) | x(2,3) | x(3) | | | |
| Asco 2 | 2/86 | D3-2 | W | 3 | 4674 | | x(1) | x(2,3) | x(3) | | | x |
| Catawba 2 | 8/86 | D5 | W | 4 | 4530 | | x(1) | | x(3) | | | |
| Sheeron Harris 1 | 5/87 | D4-1 | W | 3 | 4578 | | x(1) | | x(3) | | | |
| Byron 2 | 8/87 | D5 | W | 4 | 4530 | | x(1) | | | | | |
| Braidwood 1 | 6/88 | D4 | W | 4 | 4578 | | x(1) | x(2) | | | | |
| South Texas 1 | 8/88 | E2 | W | 4 | 4851 | | x(1,6) | | | | | |
| Braidwood 2 | 10/88 | D5 | W | 4 | 4530 | | x(1) | | | | | |
| South Texas 2 | 6/89 | E2 | W | 4 | 4851 | | x(1) | | | | | |
| Commanche Peak 1 | 8/90 | D4-2 | W | 4 | 4578 | | | | | | | |

Notes:
(1) AVB's
(2) Tube support plates
(3) Expansion transitions
(4) Sludge pile
(5) SCC diagnosed at dents
(6) Baffle-plates
(7) Inner row U-bends

Figure 5.3

### 5.2.1 Shearon Harris Damage Mechanisms

Wear at the AVB intersections

Wear at the Preheater intersections

**AVB Wear**

First discovered during the initial inservice examination in August/September 1988.

**Preheater Wear**

First discovered during the second inservice examination in October 1989.

**Miscellaneous**

Loose Parts damage - leaker outage in 1990 (two tubes affected)

### 5.2.2 Shearon Harris Repair History

1983 Seven Tubes Plugged During Fabrication

1985 Four Tubes Plugged During Fabrication

1988 First Inservice - Seven Tubes Plugged for AVB wear, one for a restriction, one for an over-expansion, and one for a >40% indication at 11H support.

1989 Second Inservice - One Tube plugged for AVB wear, one for a cold leg support indication >40% and one for a hot leg support indication >40%

1990 Leaker Outage - Two tubes plugged for loose part wear.

1991 Third Inservice - One tube plugged for AVB wear and three tubes plugged for suspected PWSCC

1992 Fourth Inservice - Two tubes plugged after tube pull

1994 Fifth Inservice - Three tubes plugged for suspect indications, four tubes plugged after removal of previous Westinghouse plugs.

## 5.3 Reporting Requirements

5.3.1 All indications of tube wall degradation detected with the bobbin probe shall be reported, other than wear at AVB and Preheater intersections, which need not be reported until the depth estimate exceeds 10%.

5.3.2 The voltage, phase angle, percent through wall and axial position above the center of the nearest support shall be reported for each flaw. The tube support distance measurements in Figure 5.1 shall be used to establish the axial distance.

5.3.3 The sign convention used to designate flaw location is always positive except: if the flaw is located within the tubesheet, if the flaw is located between the center and bottom of the tube support or if a test is incomplete and an indication lies beyond the last completed intersection in the opposite plenum.

5.3.4 The tested extent of each tube shall be reported to include the last support tested.

5.3.5 All dents greater than 5 volts (550 KHz diff. bobbin) free-span or 5 volts at a support structure (550/100 diff. bobbin) shall be reported.

5.3.6 Incomplete test extents shall be reported with the exact location where the probe stops. This shall be done on a best effort basis.

5.3.7 Sludge heights shall be reported as directed by the Utility representative on selected tubes.

## 5.4 Probe Speed Verification

5.4.1 The probe speed should be checked by the Analyst on the first tube of each calibration group and the first tube following a probe change.

5.4.2 The desired withdrawal speed for the bobbin test is 22 to 24 inches per second, unless otherwise stated in the acquisition procedure or other approved documentation.

5.4.3 Probe speed may be checked using the appropriate software method as outlined in the Eddynet operator manual. If probe speed should be verified manually, the following procedure may be used:

5.4.3.1 Establish the axial scale between two supports or other landmarks. (i.e., 02C to 03C is 18 inches)

5.4.3.2 Set the software to manual locate, and position the cursor centered on the first landmark.

5.4.3.3 Initiate the first landmark by mouse clicking and sliding until the appropriate landmark appears.

5.4.3.4 Position at the next landmark and click and hold the right mouse button to adjust the scale to the correct setting.

5.4.3.5 Right click in the Landmarks label and the probe speed should be indicated in the lissajous box.

5.4.3.6 Should the speed fall below 22 inches per second or exceed 24 inches per second, the Analyst should notify the Lead Analyst.

## 5.5 Calibration Standards

5.5.1 Calibrations require the use of the as-built dimensions to set analysis calibration curves. If other standards are utilized, be sure to use the correct as-built drawings.

## 5.6 Equipment/Software Requirements

The analysis of digital ECT data is accomplished with the use of computer programs (software) and computer systems (hardware). Programs and computers may be utilized which are the equivalent or superior to those listed below if there is no diminution in the capabilities to detect, measure and record flaw indications.

### 5.6.1 Computer Analysis Programs

Zetec Eddynet Version 27 or later
Other Approved Software

### 5.6.2 Hardware

HP 400/700 series computer with graphics display
Appropriate LAN hardware for interconnection
Appropriate Hard disk drives, optical media storage drives and other equipment as required by the current software version. Requirements for file servers and workstations may vary slightly.

# Section 6.0
# Bobbin Probe Calibration and Evaluation

## 6.1 Probe Description and Frequency Selection

### 6.1.1 Probe Description

The probes used for the inspection are standard bobbin coil probes, with coil spacing and widths of .060" permitting detection of incipient damage mechanisms. The .540", .560", .580" and .610" diameter probes provide fill factors of 66%, 71%, 76% and 84% respectively.

A .610" diameter magnetic u-bend long cone probe (A610MULC) is used to test large diameter rows. Probes of .560" and .580" diameter spring-flex ring magnet (A560SFRM, A580SFRM) are used to test small diameter rows. Other probes may be used as approved by CP & L.

### 6.1.2 Frequency Selection

The current frequency selection for bobbin probes is as follows:

550 KHz differential and absolute
800 KHz differential and absolute
100 KHz differential and absolute
35 KHz differential and absolute

The purpose of each test frequency is as follows:

#### 6.1.2.1 **550 KHz differential**

This is the inspection frequency used to satisfy the ASME code requirement for the "basis frequency.". The basis frequency "provides responses from the 20% flat bottom holes and the 100% through-the-wall hole references in the calibration tube standard that have a phase angle difference between 50 deg. and 120 deg."

#### 6.1.2.2 **550 KHz absolute**

Used as a mix component

#### 6.1.2.3 **100 KHz differential**

Used as a mix component and confirmation channel

#### 6.1.2.4 **100 KHz absolute**

Used for sludge height measurements, a mix component and for indication confirmation.

6.1.2.5 **800 KHz differential**

This frequency is a component of the primary copper mix and the three frequency mix.

6.1.2.6 **800 KHz absolute**

This data is recorded in the event that an absolute three frequency mix is desired, or other high frequency information such as profiling.

6.1.2.7 **35 KHz differential**

Used for CDS and support structure location

6.1.2.8 **35 KHz absolute**

Used for location of support structures and sludge height measurements

6.1.3 Mix for Carbon Steel Support Suppression

6.1.3.1 **Mix #1 - 550/100 Differential**

This mix is displayed on the CRT strip chart and is used to detect/size flaws at carbon steel support structures.

6.1.3.2 **Mix #2 - 550/100 Absolute**

This mix is used for absolute signals near carbon steel structures.

6.1.4 Mix for Dent/Transition & Carbon Steel Suppression

6.1.4.1 **Mix #3 - 550/800/100 Differential**

Used to screen support structures & Top of the Tubesheet

## 6.2 Calibration

*Note - Some graphic displays may use 400KHz instead of 550Khz. These graphics are for illustration only, and do not affect actual data displays.

6.2.1 Load the ASME calibration run into RAM.

6.2.2 **550 KHz differential**

6.2.2.1 Place the 100 percent through wall hole in the window. See figure 6.1

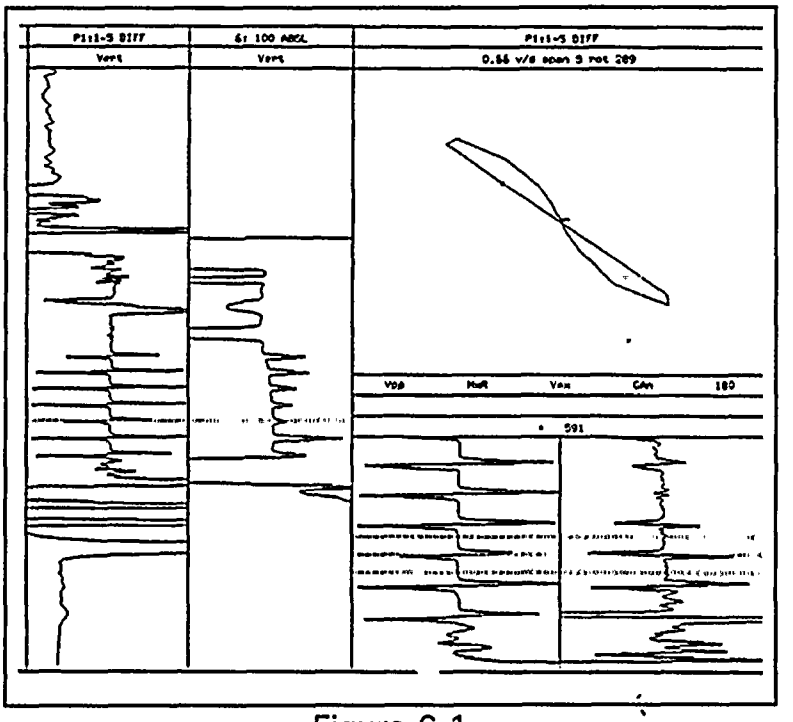


Figure 6.1

100% Through-wall hole - ASME Standard

6.2.2.2 Rotate the transition signal to approximately zero degrees. See figure 6.2

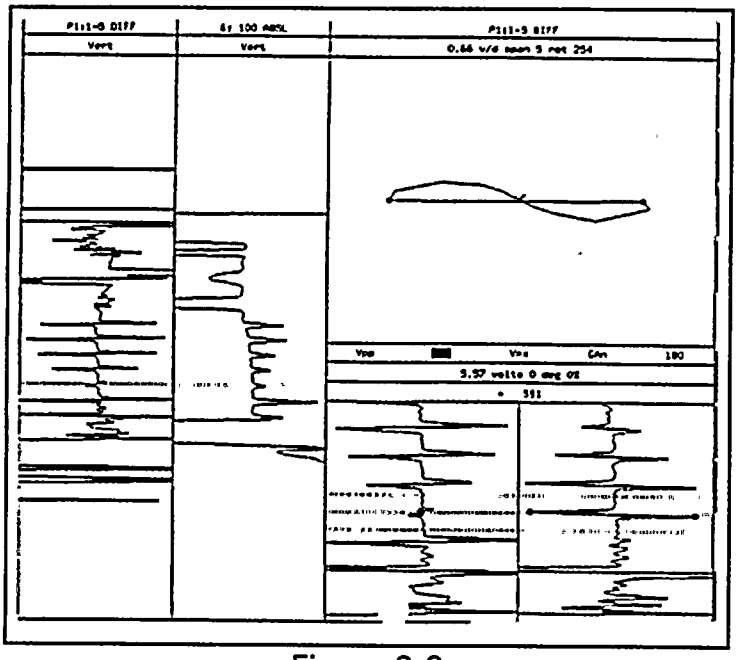


Figure 6.2
Transition signal at zero degrees

6.2.2.3 Adjust the signal span to approximately six grid divisions. See figure 6.3

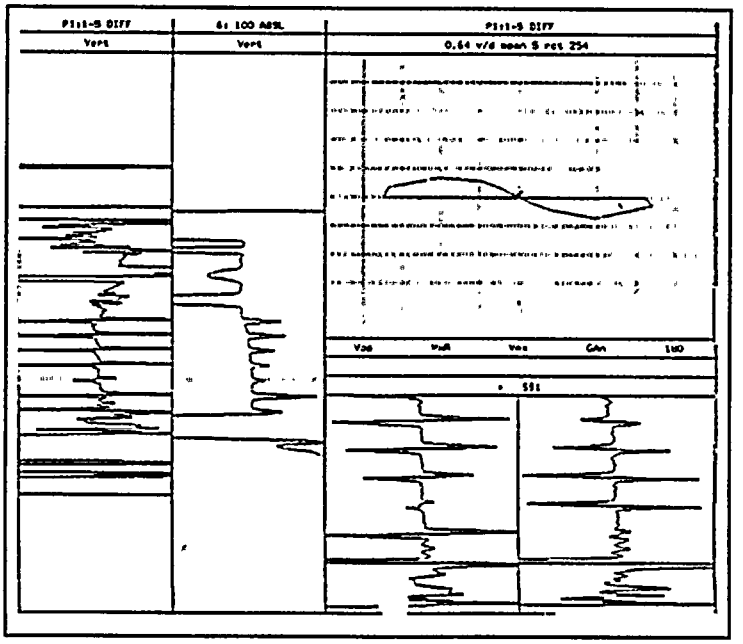


Figure 6.3
Span to ~6 grid divisions

6.2.2.4 Rotate the transition signal to 40° ±2°. See figure 6.4

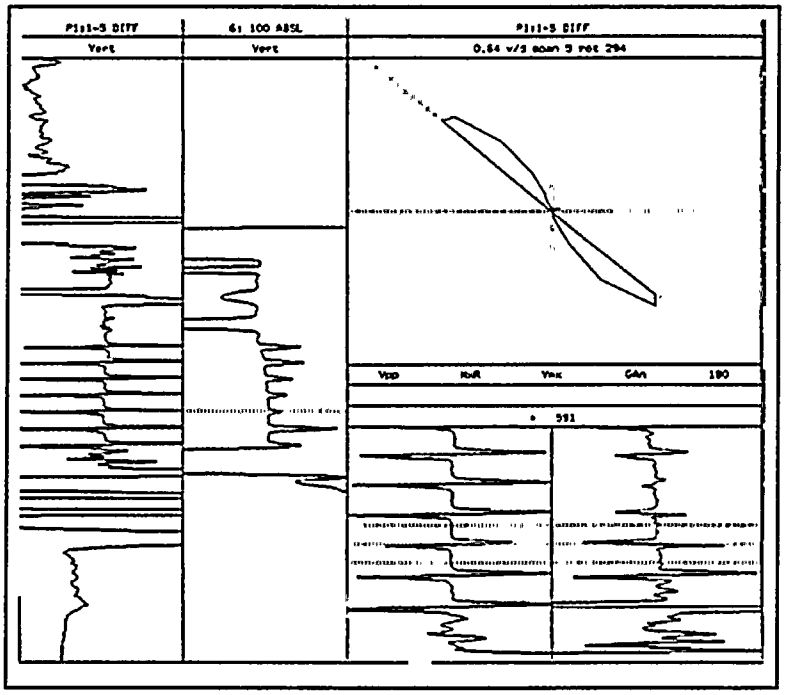


Figure 6.4

Transition signal to 40°

6.2.2.5 Establish the phase versus depth curve using the actual values for the 100, 60, and 20% O.D. flaws. Use the maximum rate of the transition to define the phase angle.

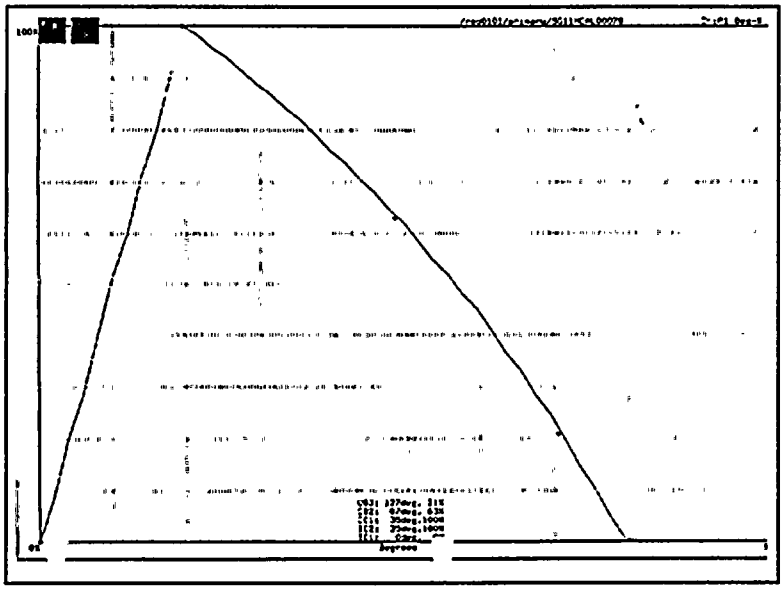


Figure 6.5

Typical Calibration curve

6.2.2.6 Probe motion typically lies at 1° to 5°. See figure 6.6

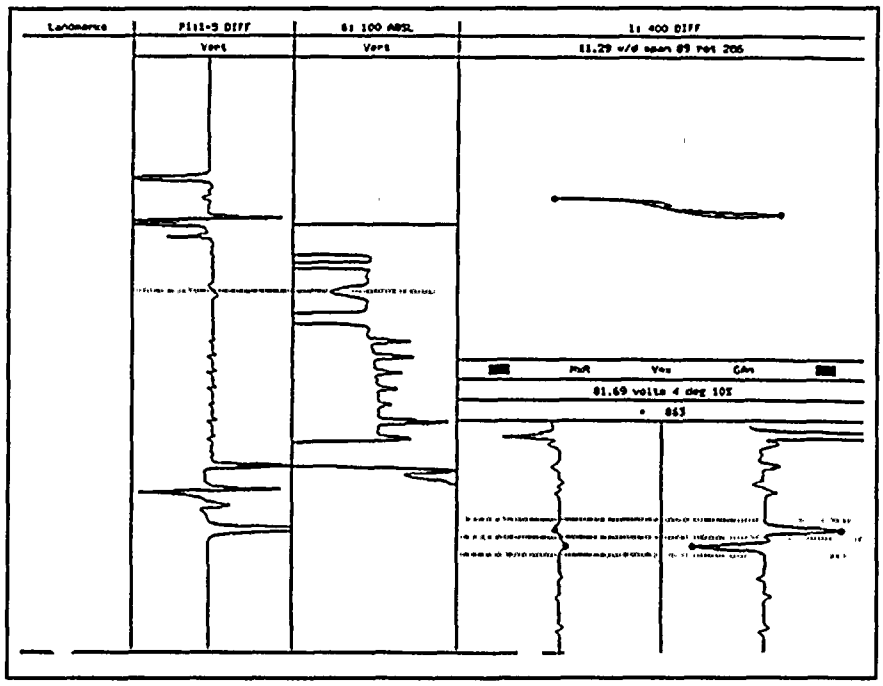


Figure 6.6

Probe motion signal

6.2.3 550 KHz Absolute

6.2.3.1 Place the dent from the ASME standard in the window.

6.2.3.2 Adjust the phase such that the initial signal excursion is to the right at 180 ±5°.

6.2.3.3 Place 4 x 20% ASME flat bottom holes in the window.

6.2.3.4 Set the span such that the signal occupies approximately 2 grid divisions. See figure 6.8

6.2.3.5 Observe that the ASME flaw signals go up and are not saturated on the screen.

6.2.3.6 See paragraph 6.2.14 for setting volts.

6.2.4 100 KHz differential

Repeat steps 6.2.2.1 through 6.2.2.5. **Peak to peak is normally used to define the phase angle.

### 6.2.5 100 KHz absolute

Repeat steps 6.2.3.1 through 6.2.3.6.

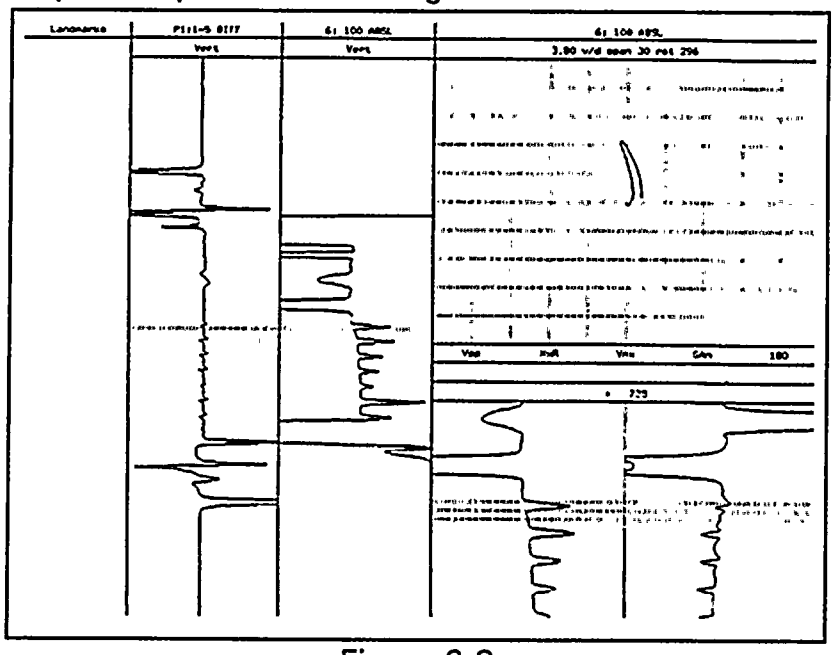


Figure 6.8
Set span of 4 x 20% ASME FBH to 2 grids

### 6.2.6 800 KHz differential

6.2.6.1 Place the 100% throughwall hole in the window.

6.2.6.2 Rotate the transition signal to approximately zero degrees.

6.2.6.3 Adjust the span such that the entire signal occupies 5 to 6 grid divisions.

6.2.6.4 Rotate the dent signal horizontal at 180° ± 2°; the 100% flaw may be 20 to 40 degrees.

### 6.2.7 800 KHz absolute

6.2.7.1 Place the dent from the ASME standard in the window.

6.2.7.2 Adjust the phase such that the initial signal excursion is to the right at 180° ±5°.

6.2.7.3 Place 4 x 20% ASME FBH's in the window.

6.2.7.4 Set the span such that the signal occupies 1 to 2 grid divisions. See figure 6.9.

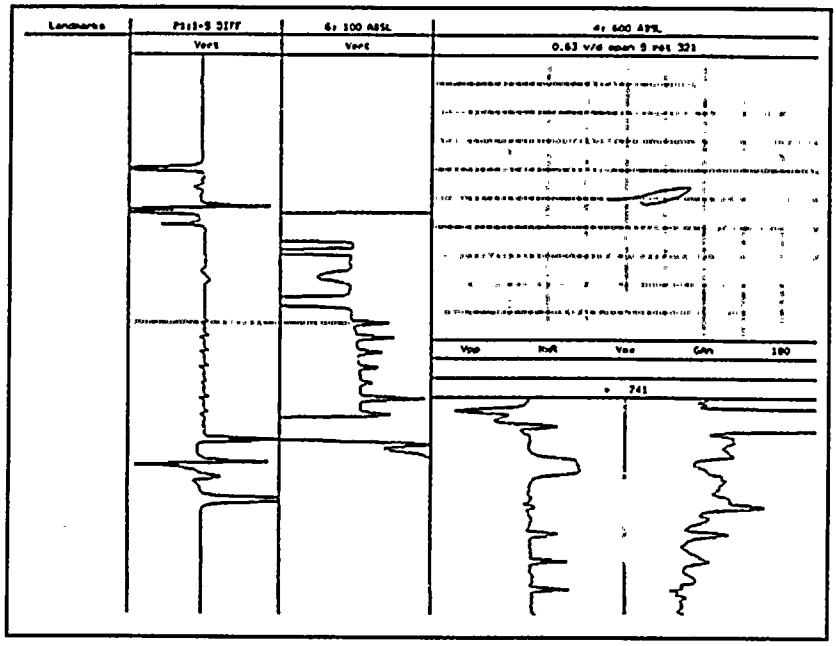


Figure 6.9
Set span of 4 x 20% ASME FBH to 1-2 div.

6.2.7.5 Observe that the ASME flaw signals go up and are not saturated on the screen. **No voltage requirement.

6.2.8 **35 KHz differential**

6.2.8.1 Place the tube support ring in the window.

6.2.8.2 Adjust the phase such that the initial excursion is up to the right.

6.2.8.3 Adjust the span such that the entire signal occupies approximately six grid divisions. See figure 6.10.

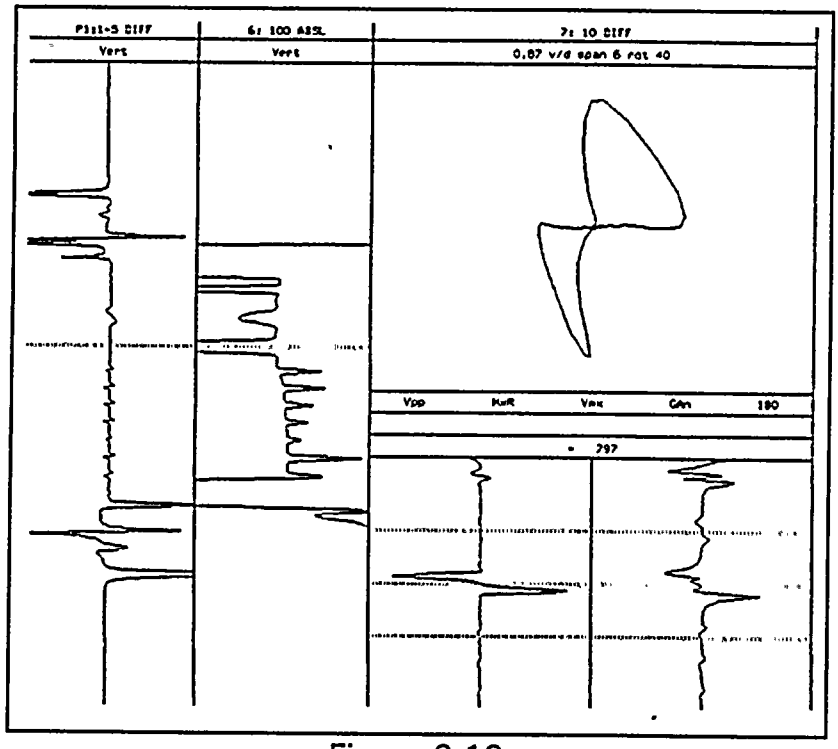



Figure 6.10
Support Ring on 35 KHz differential

6.2.9 **35 KHz Absolute**

6.2.9.1 Place the tube support ring in the window.

6.2.9.2 Adjust the phase such that the initial signal excursion is vertical starting downward.

6.2.9.3 Adjust the span such that the entire signal occupies 3 to 4 grid divisions. See figure 6.11.

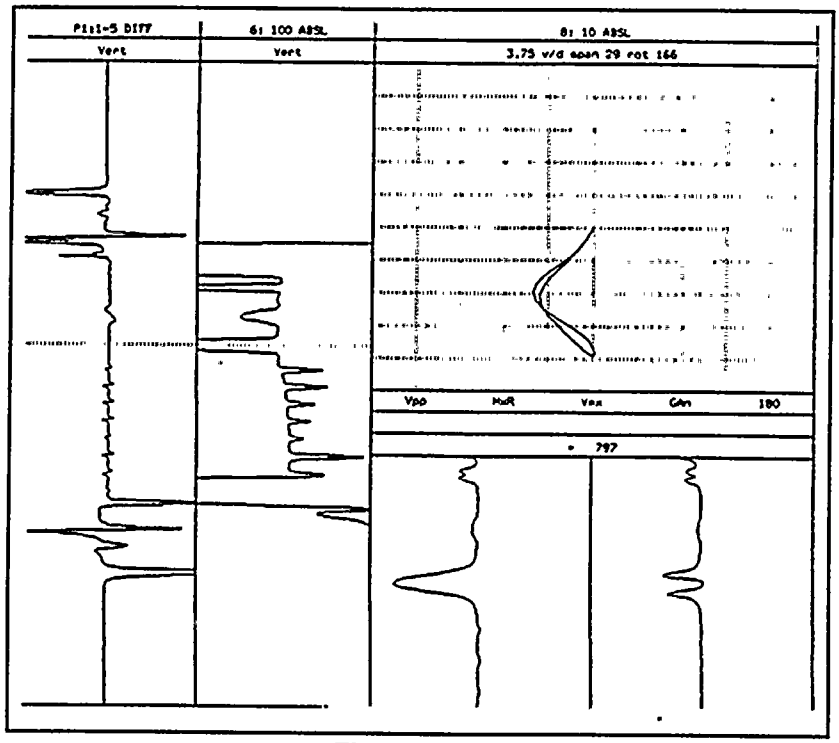



Figure 6.11

Support ring on 35 KHz absolute

### 6.2.10 Mix 1 - 550/100 Khz Differential (tube support suppression)

6.2.10.1 Select the 550 and 100 KHz differential channels (Channels 1 and 5[2]) from the process channels menu. Be sure the "keep channel" is set to the 550 KHz channel. Proceed to the "Adjust Mix" menu.

6.2.10.2 Null the instrument between flaws in the ASME standard. See figure 6.12.

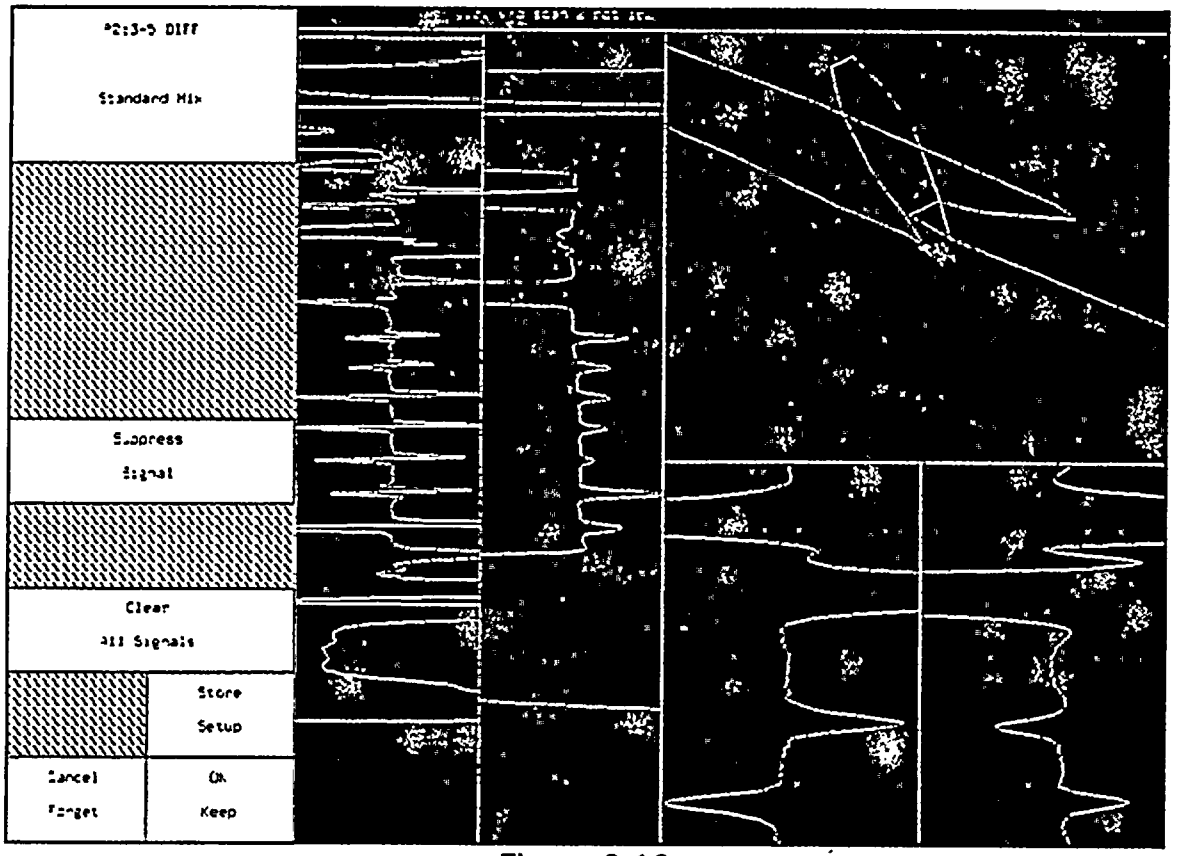



Figure 6.12
Null point for support suppression

[2]Channels other than 1 and 5 may be used if a different frequency array is utilized. See the Senior analyst for details.

6.2.10.3 Place tube support ring in the window. Allow only the TSP signal between the cursers. See figure 6.13.

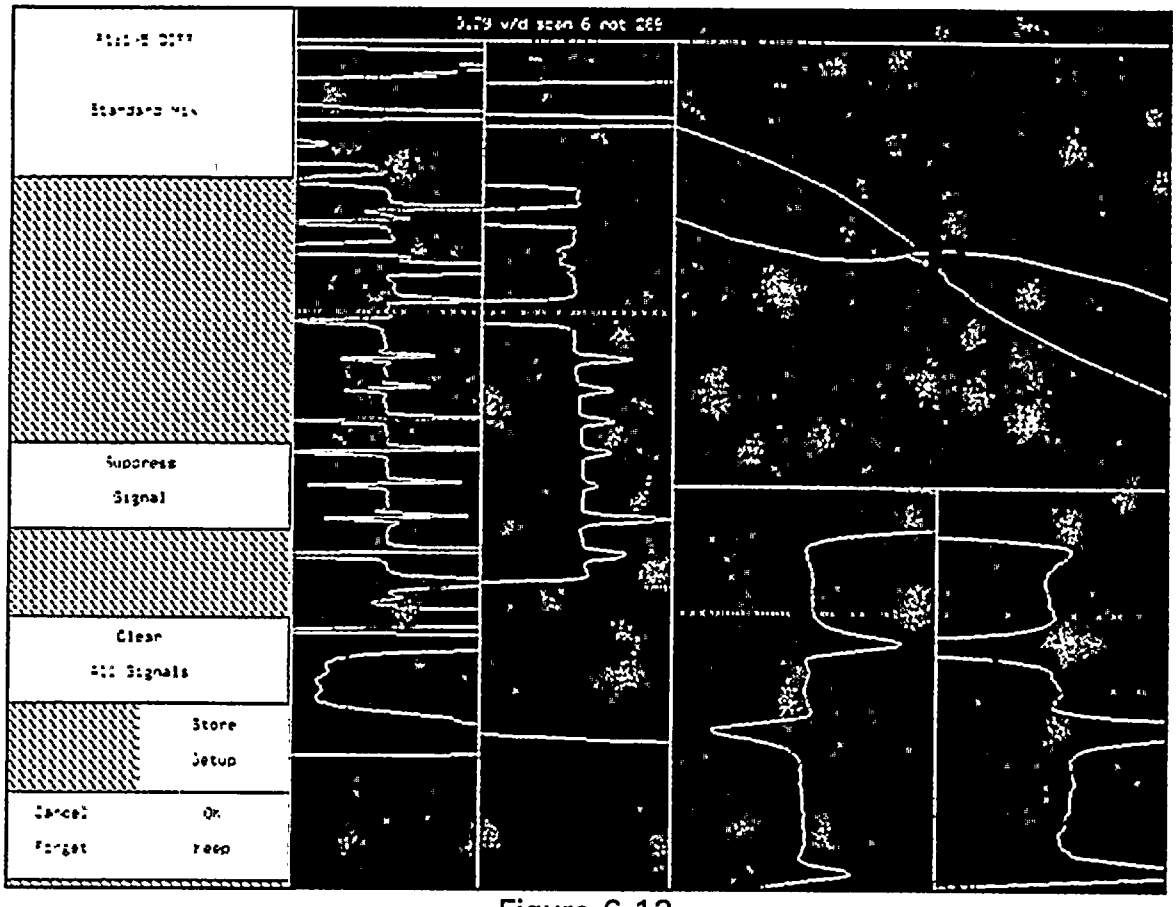



Figure 6.13
Support Ring Signal in Window

6.2.10.4 Mix on the TSP signal. Exit by selecting "OK keep".

6.2.10.5 Place the 100% through wall hole in the window

6.2.10.6 Rotate the transition to approximately zero degrees.

6.2.10.7 Adjust the span such that the entire signal occupies five grid divisions. Make note of the numeric span value. This is the setup span.

6.2.10.8 Rotate the display such that noise (or a dent signal) is horizontal.

6.2.10.9 Establish a phase versus depth curve using the actual values for the 100%, 60% and 20% O.D. flaws. Peak-to-Peak is normally used to define the phase angle. See figure 6.14

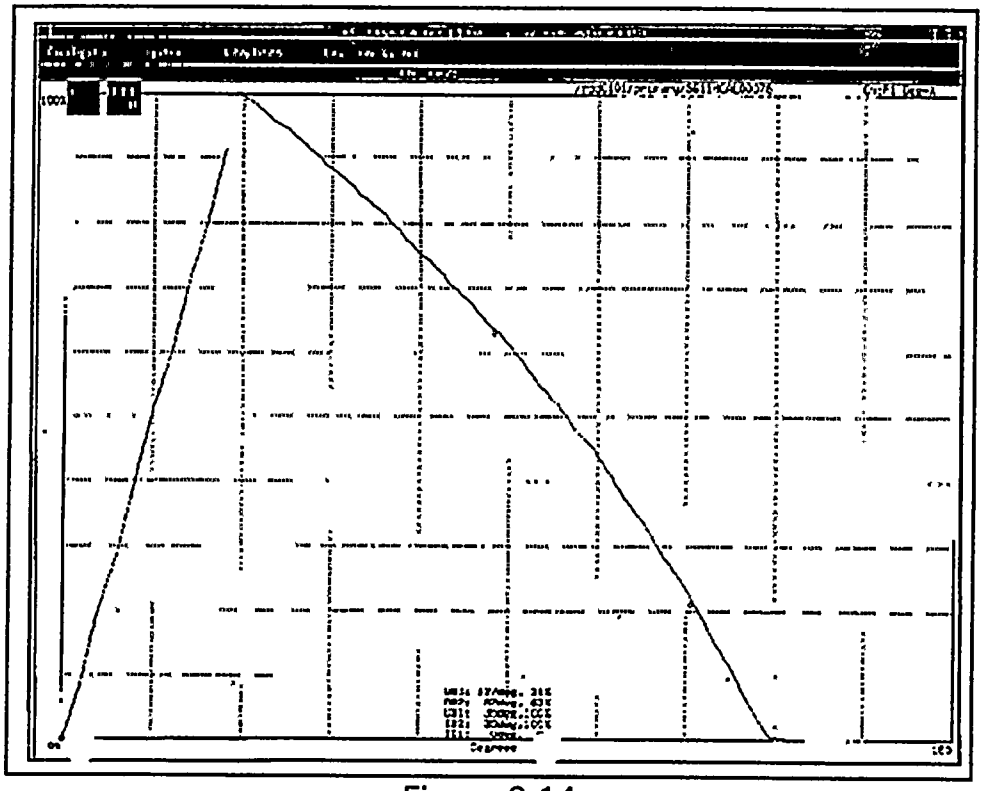


Figure 6.14
Calibration curve for 400/100 KHz Mix

### 6.2.11 Mix 2 - 550/100 KHz Absolute (Carbon Steel Suppression)

6.2.11.1 Select the 550 and 100 KHz absolute channels with the "keep channel" on the 550 KHz channel. Proceed to "Adjust mix". Null the instrument between flaws in the ASME standard. See figure 6.18.

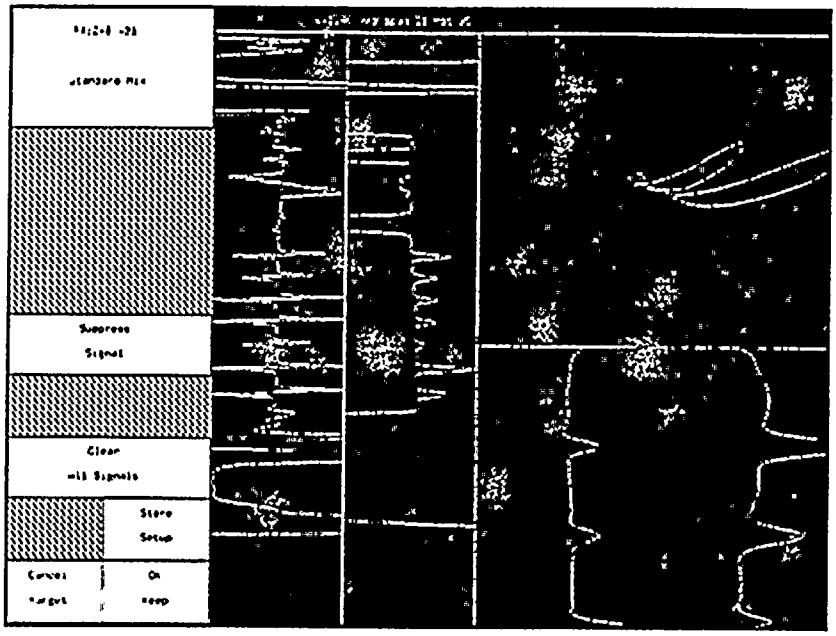


Figure 6.18
Null between flaws on the ASME standard

6.2.11.2 Place the tube support ring in the window. Allow only the TSP signal between the cursers. See figure 6.19.

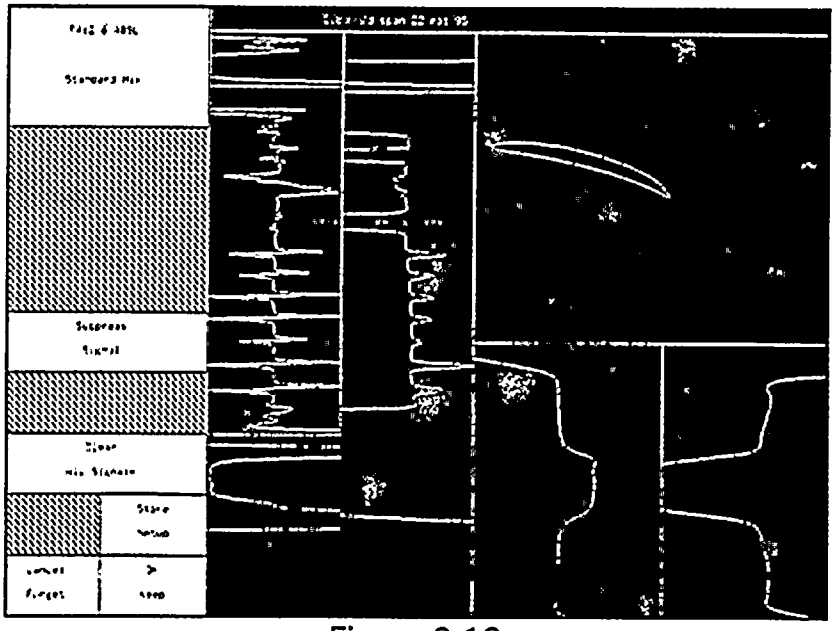


Figure 6.19
Carbon steel support ring signal in window.

6.2.11.3 Mix on the TSP signal. Exit by selecting "OK keep".

6.2.11.4 Place the dent from the ASME standard in the window[3].

6.2.11.5 Adjust the phase such that the initial signal excursion is to the right at 180 ±5°. See figure 6.20.

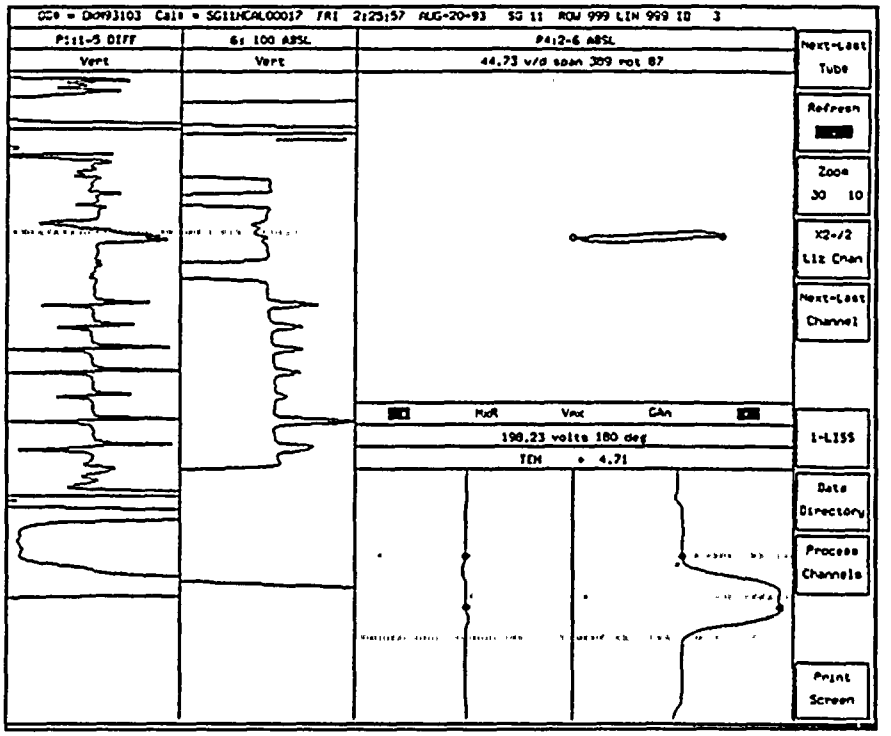



Figure 6.20
ASME dent to 180 degrees

6.2.11.6 Place the 4 x 20% ASME flaw in the window.

[3]Rotate noise horizontal if a dent signal is not available.

6.2.11.7 Set the span such that the signal occupies 2 grid divisions. See figure 6.21.

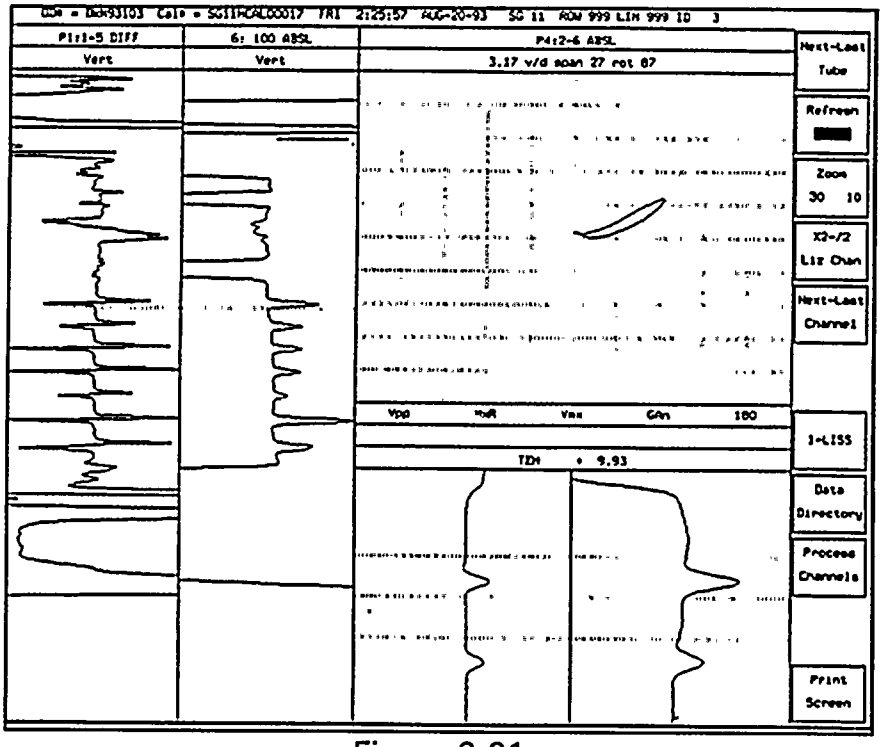
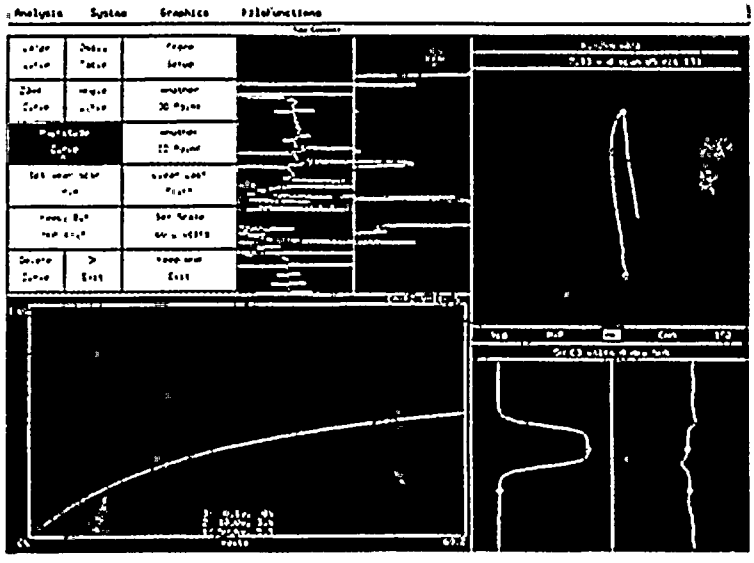



Figure 6.21
Setting span of 4 x 20% ASME flaw to 2 div.

6.2.11.8 Establish a voltage amplitude versus depth curve (V-Max) using the actual values of the wear scar flaws from the calibration standard. Be sure to set voltage parameters before establishing your calibration curve (see section 6.2.14).



### 6.2.12 Mix 3 - 550/800/100 KHz Differential (Dent & Carbon steel suppression)[if used]

The desired mix output is one in which there is a minimum of 40° phase separation between the 60% and 20% O.D. flaws with a minimum vertical residual from the simulated tube support ring, copper ring and radial dent. The following step should be performed to establish a proper mix #3.

6.2.12.1 Select the 550, 800 and 100 KHz differential channels with the "keep channel" being the 550 KHz channel. By selecting more than two frequencies, the software will automatically enter into a multi-frequency mix (turbo mix) mode. Proceed to "Adjust Mix".

6.2.12.2 Select "Clear All Signals" to clear the mix processor.

6.2.12.3 Using the cursor, select a clean section of the standard and null the response.

6.2.12.4 Scroll to the 100% ASME flaw and place it alone in the window.

6.2.12.5 Select "Save Signal" to save the response into the mix buffer.

6.2.12.6 Repeat the last step for all ASME flaws; 100% - 20%.

6.2.12.7 Scroll to the carbon steel support signal and place it alone in the window.

6.2.12.8 Select "Suppress Signal" to suppress the support signal.

6.2.12.9 Repeat the last step for the ASME dent signal[4]. See figure 6.16.

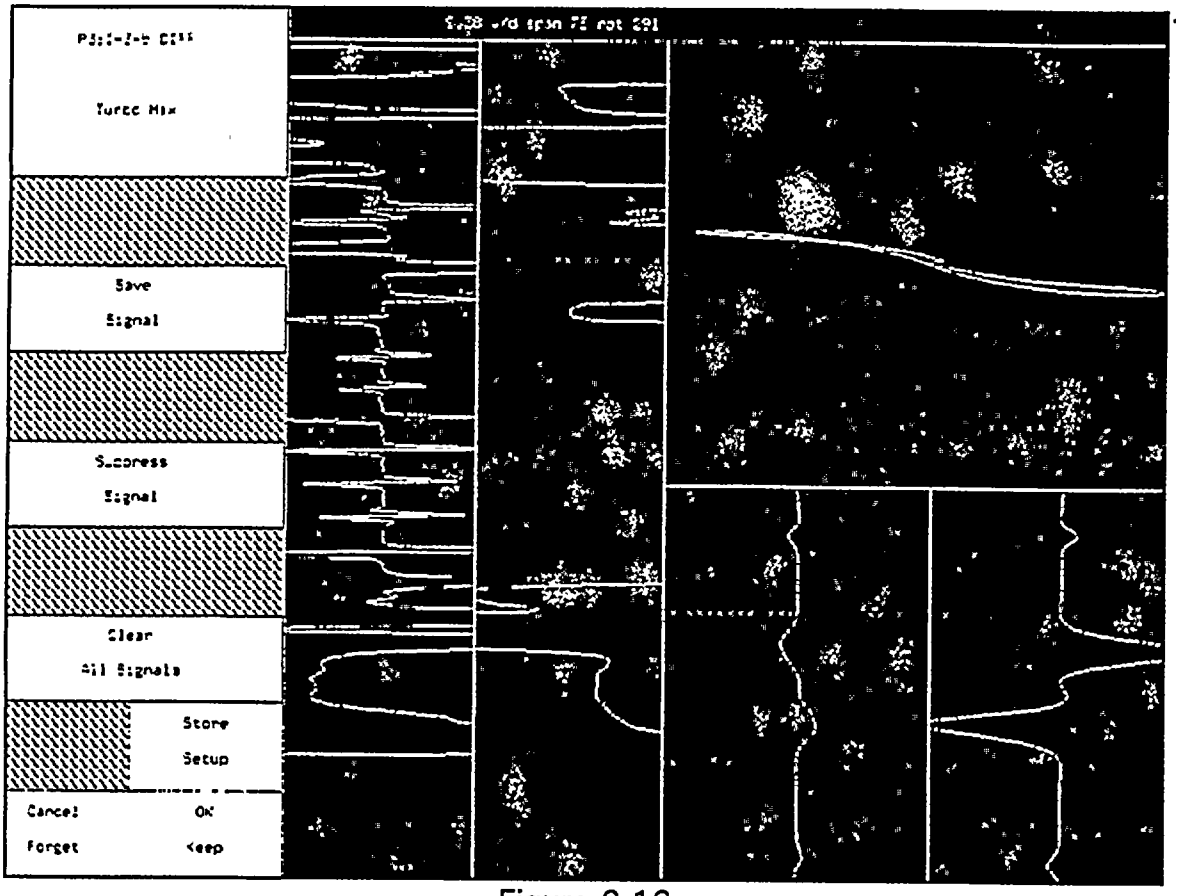



Figure 6.16
Dent signal in window for "Turbo" mix

6.2.12.10 Set the span of the 60% flaw to 4 screen divisions peak-to-peak.

6.2.12.11 Set the Dent/Transition residual horizontal. (The 60% flaw starting down and vertical.)

[4]If the dent is not available, keep the current mix output, play in an actual tube of data, and use the top-of-tubesheet transition. See the Senior Analyst for details.

6.2.12.12 Establish a phase versus depth curve[5] using the actual values of the 60%, 40% and 20% ASME flaws from the calibration standard. The max-rate of the transition should be used to define the phase angle of the signals. See figure 6.17.

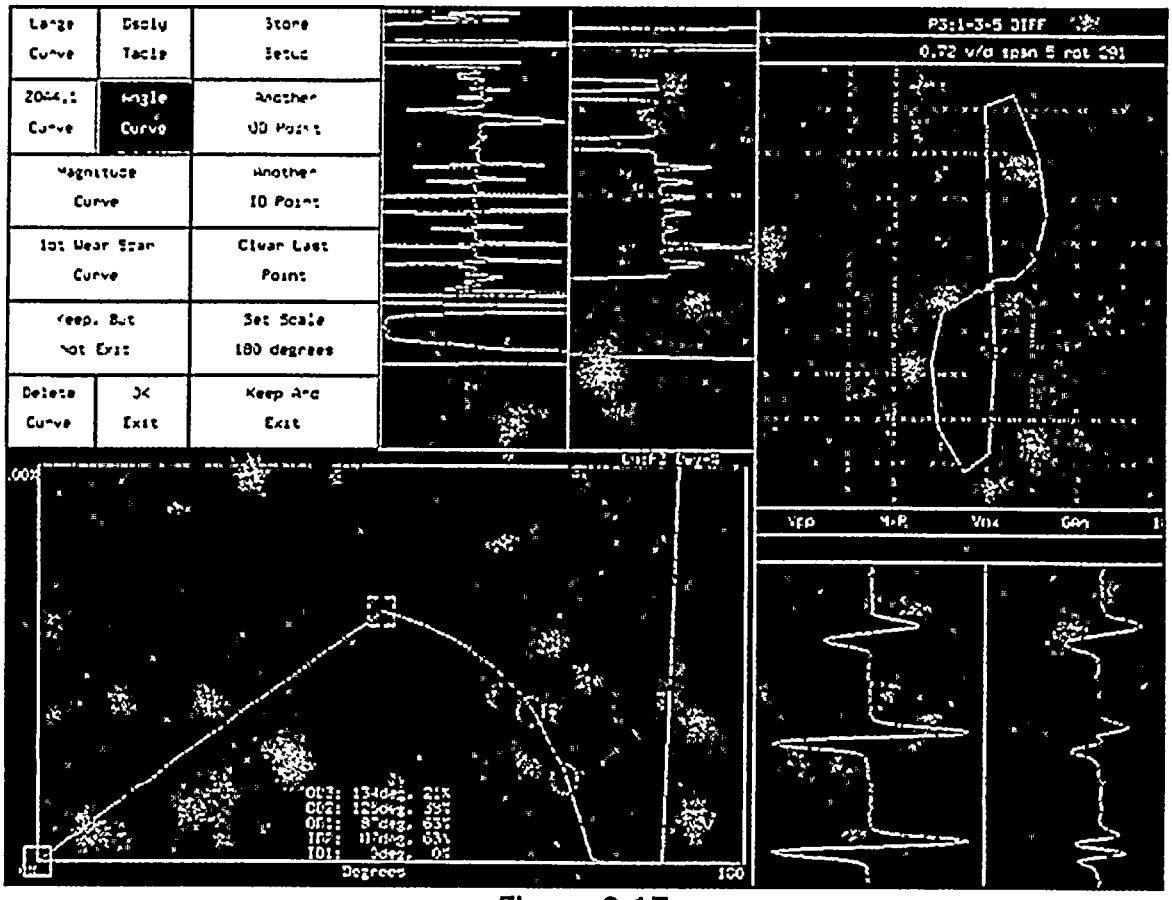



Figure 6.17

Calibration curve for Mix 3

[5]A phase versus depth curve may not be required if the mix is used for information only, and not for sizing. Verify this with the Senior Analyst.

### 6.2.14 Setting Voltages

*Note: Voltage settings should be established before any voltage related parameters are finalized, such as locating parameters, volt curves, etc.

6.2.14.1 Select channel 1 (550 KHz differential) and place the ASME standard 4 x 20% signal in the window.

6.2.14.2 Select Peak-to-Peak to set the voltage measurement feature. See figure 6.22.

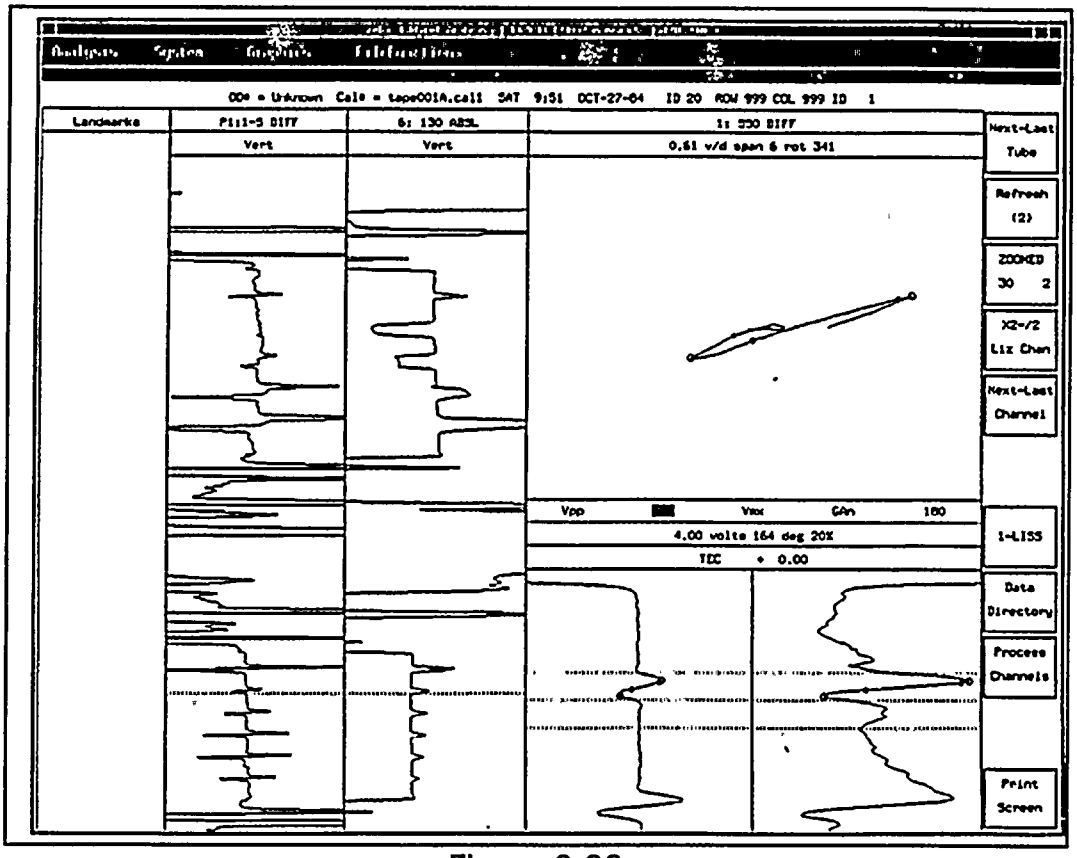



Figure 6.22
Voltage set up for ASME standard

6.2.14.3 Proceed to the "Set Voltages" menu.

6.2.14.4 Click and hold the mouse in the "Enter Volts" selection until the voltage reading is approximately 4.00 volts. Save the voltage value using the "Save This Value" option, then select "Store to All" to store the voltage and normalize the remaining channels.

6.2.14.5 Store your setup at this point[6].

### 6.2.15 Miscellaneous Setup parameters

6.2.15.1 Determine where the "results" files will be stored and select the proper location in the "operator selectables" section.

6.2.15.2 Other selections in "operator selectables" must be selected, such as which leg you are testing from, expanded chart length, number of extent letters, etc. See the Senior analyst for details.

6.2.15.3 The appropriate landmarks table must be used for automatic support location abilities. Insure you have selected the proper table and locating options. Figure 6.23 shows some typical settings for most steam generators.

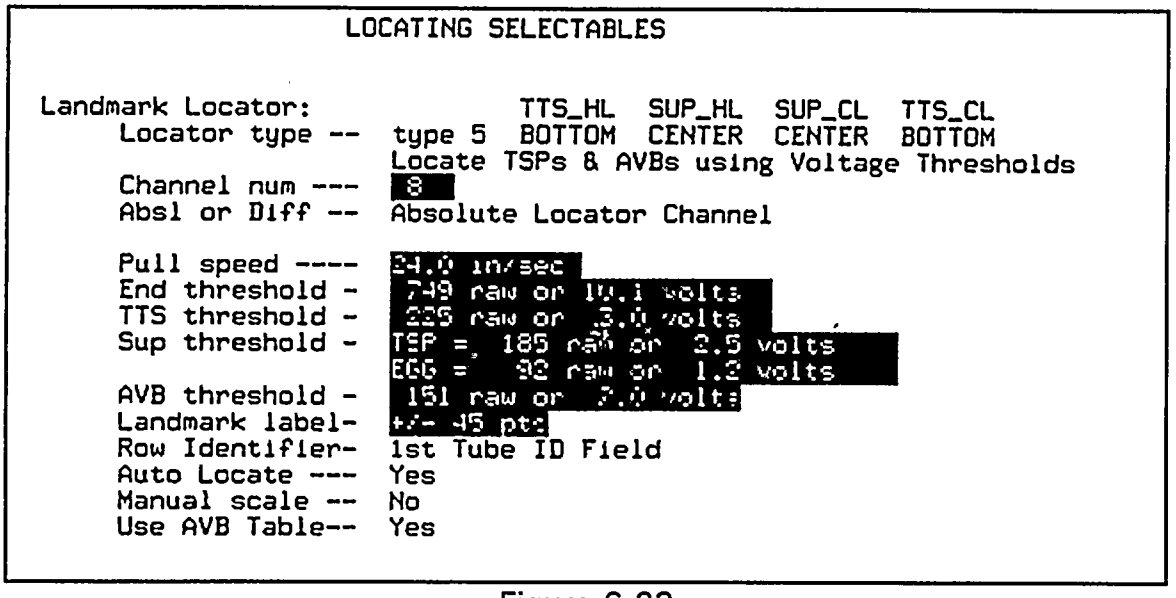



Figure 6.23
Locating Parameters

[6]Storing your setup often is recommended during the establishment of your setup variables.

## 6.2.16 Full Length Bobbin examination Test Calibration Parameters

| BOBBIN FULL-LENGTH ANALYSIS SUMMARY | | | | | | | |
|---|---|---|---|---|---|---|---|
| DIFFERENTIAL CHANNELS | | | | | | | |
| Channel | 1 | 3 | 5 | 7 | Mix 1 | Mix 3 | |
| Span | 5-6 div | 5-6 div | 5-6 div | 5-6 div | 5-6 div | 4-5 div | |
| Phase | 40 deg | 40 deg | 40 deg | vertical | PM horiz. | PM horisz | |
| Cal Std | 100% ASME | 100% ASME | 100% ASME | Support ring | 100% ASME | 60% ASME | |
| Curve | Degree | N/A | Degree | N/A | Degree | [Degree] | |
| Volts | 20% - 4v | Norm. | Norm. | Norm. | Norm. | Norm. | |
| ABSOLUTE CHANNELS | | | | | | | |
| Channel | 2 | 4 | 6 | 8 | Mix 2 | | |
| Span | 2 div | 2 div | 2 div | 4 div | 2 div | | |
| Phase | PM horiz. | PM horiz. | PM horiz. | vertical | PM horiz. | | |
| Cal Std. | 4 x 20% | 4 x 20% | 4 x 20% | Support ring | 4 x 20% | | |
| Curve | N/A | N/A | N/A | N/A | Volt/VMax | | |
| Volts | Norm. | Norm. | Norm. | Norm. | Norm. | | |

DATA SCREENING

**Left Strip Chart: CH Mix 1 Vert** **Right Strip Chart: CH 6 Vert** **Liss.: CH 1**

Notes:
Above spans are a minimum
Voltage normalized to channel 1
Mix 1 = 550/100 Diff support mix
Mix 2 = 550/100 Abs. support mix copper mix
Mix 3 = 550/800/100 Diff support/dent mix

RECORDING REQUIREMENTS

Graphics: Generated by Resolution unless otherwise indicated

Recording:

Channel 1: Degradation
Mix 1: Degradation (support influenced), PVN
Mix 2: Degradation (wear)
Mix 3: Distorted TTS/Dented indications

Table 6.1
Bobbin Coil Analysis Parameters

## 6.3 EVALUATION

### 6.3.1 General Evaluation Requirements

The guidelines address specific regions of the SG where flaws are known to have occurred. However, all of the data for the other examined regions of the tube is to be analyzed using standard analysis practices. Initial screening of the data will be performed at the setup spans. The use of setup spans for initial screening of the data is meant to maximize the detection of large flaws by the Analyst. The Analyst may use lower span settings as needed for a complete analysis of the data.

The regions of the SG which are addressed with specific analysis methods include:

- the top of the tubesheet
- the tube supports and baffle structures
- the anti-vibration bars (AVB)

**Evaluation of the top of the tubesheet** - Two types of flaws are known to occur at or above the top of the tubesheet, OD corrosion and primary side stress corrosion cracking. In the absence of deposits on the tube OD, the data is scrolled observing the 550 KHz lissajous. In the presence of deposits the data is scrolled observing the Mix 1 (550/100 KHz support mix). Take care to examine the entire tube entry signal at the set up span for distorted signals indicative of cracking. At present the bobbin probe has been unable to detect ID cracking at the top of the tubesheet. Any detection has been based upon MRPC testing. OD corrosion is presently non-occuring at Shearon Harris top of tubesheet/sludge pile area, but should be screened for.

**Evaluation of the Tube Supports** - OD cracking has been known to occur at the tube supports. In the absence of dents the data is scrolled observing the Mix 1 (550/100 KHz support mix). In the presence of dents the data is scrolled observing Mix 3 (550/800/100 KHz support/dent suppression mix). Mechanical wear and fretting have been detected at the cold leg support baffles at Shearon Harris. The 500/100 KHz absolute mix is used to scroll the baffle supports.

**Evaluation of Anti-Vibration Bars (AVB's)** - Mechanical fretting and wear have occured at the AVB's at Shearon Harris. The data is scrolled using the Mix 2 (550/100 KHz support mix).

**Free Span Flaws** are not shown in the Guidelines, but are to be recorded in accordance with section 7.

### 6.3.2 Evaluation of the Top of Tubesheet

The following figures give examples of evaluations in the sludge pile region.

6.3.2.1 This example shows a large indication just below the top of tubesheet transition. Due to its size and clarity, it is most likely PWSCC in the axial direction.

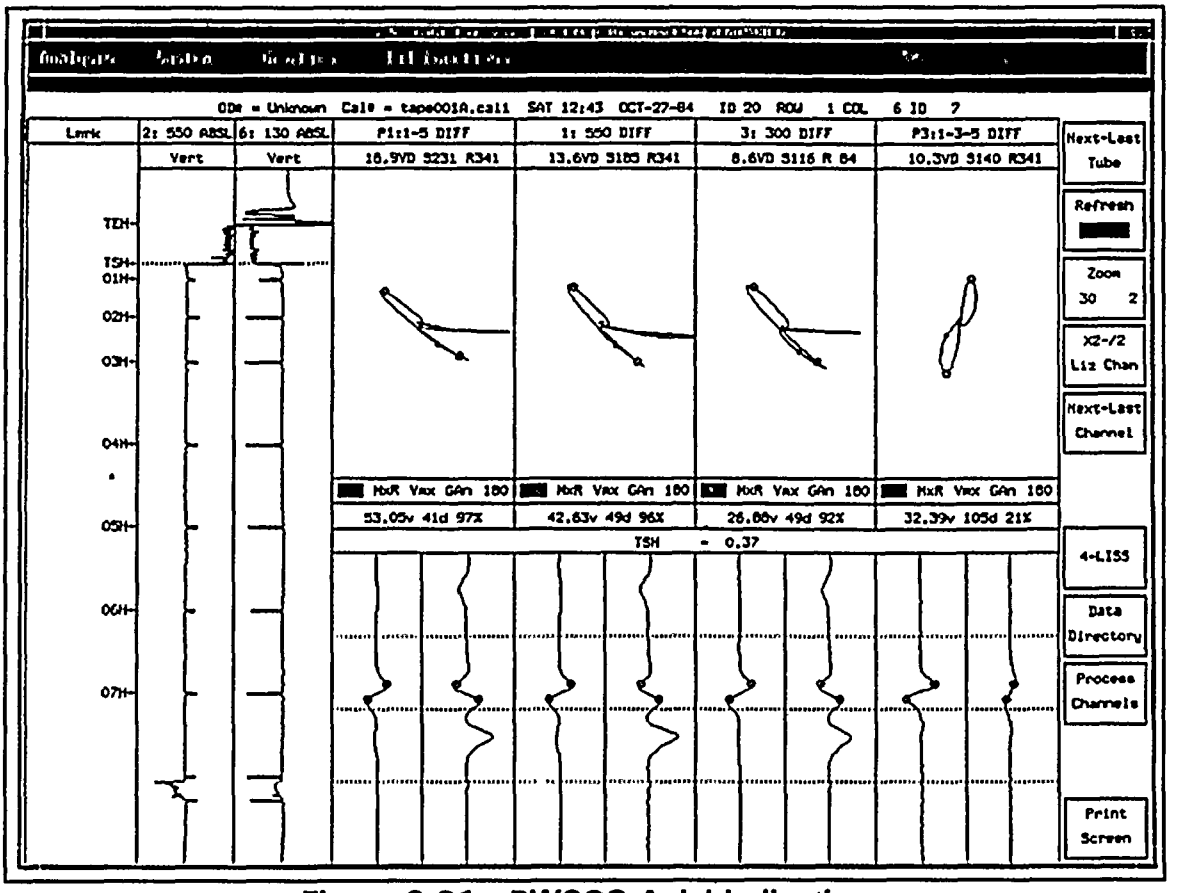



**Figure 6.31 - PWSCC Axial Indication**

6.3.2.2 Other indications may be present lower in the tubesheet, or at the tube roll transition.

### 6.3.3 Evaluation of the Tube Supports

6.3.3.1 A flaw is detected on either the 550 KHz, 100 KHz or the strip charts. Change the lissajous to 550 or 800 KHz absolute and observe whether there is a dent component (horizontal) to the signal.

6.3.3.2 Change the lissajous to Mix 1 and scroll the flaw. Place the measuring points on the flaw. If a clear transition is apparent on the 550 KHz differential channel, it may be used to measure the flaw. (If a dent was detected as in the previous paragraph, change to Mix 3 and use max-rate.)

Figure 6.32 shows an example of an indication near the edge of hot leg support no. 1. This is an unknown mechanism, but may be due to a loose part.

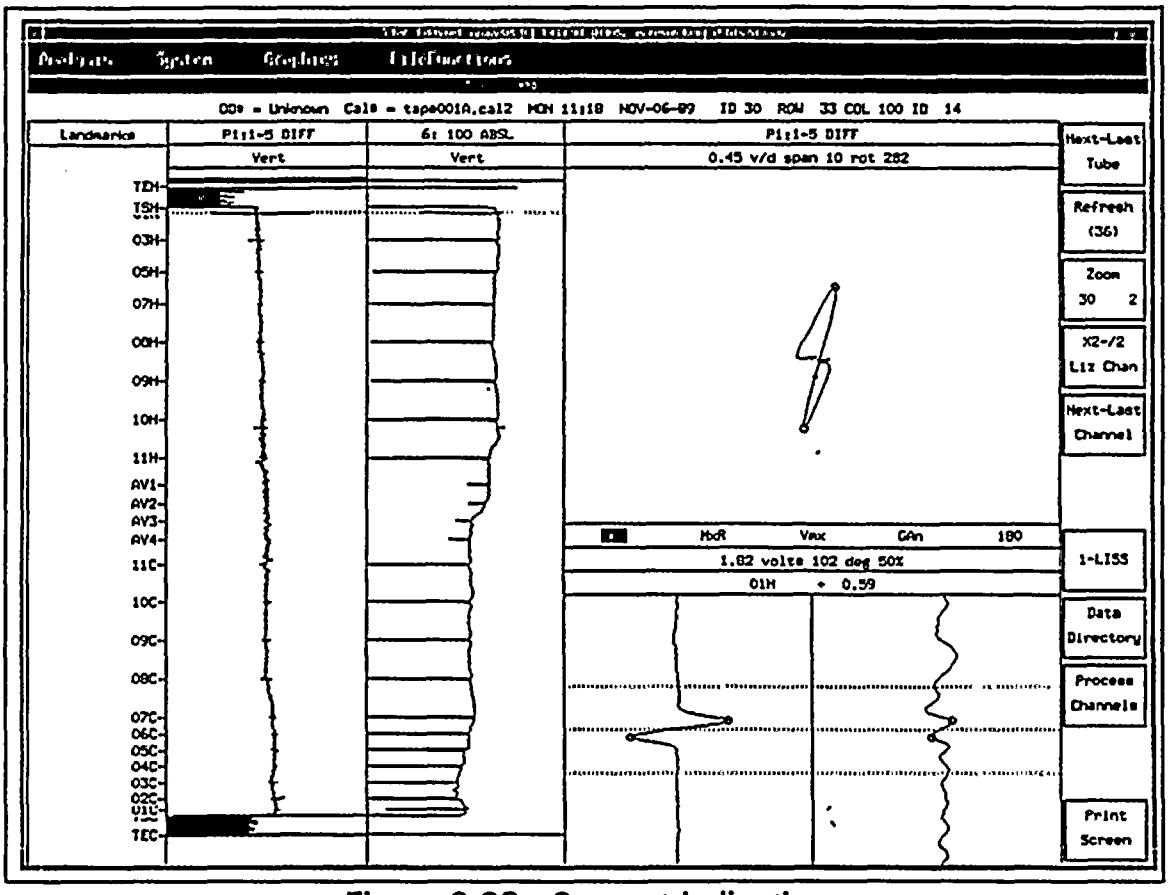



**Figure 6.32 - Support Indication**

6.3.3.3 If a clear transition is not apparent, the indication may still require recording for review by the Lead Analyst for flaw history comparison or further evaluation. Record the flaw on the Mix 1 channel with a NQI in the percent field.

### 6.3.4 Evaluation of AVB's and Cold Leg Baffles

The following figures give examples of evaluations in the Anti-Vibration Bar and Cold Leg Baffle areas:

6.3.4.1 A flaw is detected with the 500 KHz differential or 550/100 differential mix channel. Wear or fretting flaws are considered to be volumetric, and therefore are measured using a voltage or volumetric depth curve (mix P2). Figure 6.33 shows an example of an AVB flaw measured with mix 2.

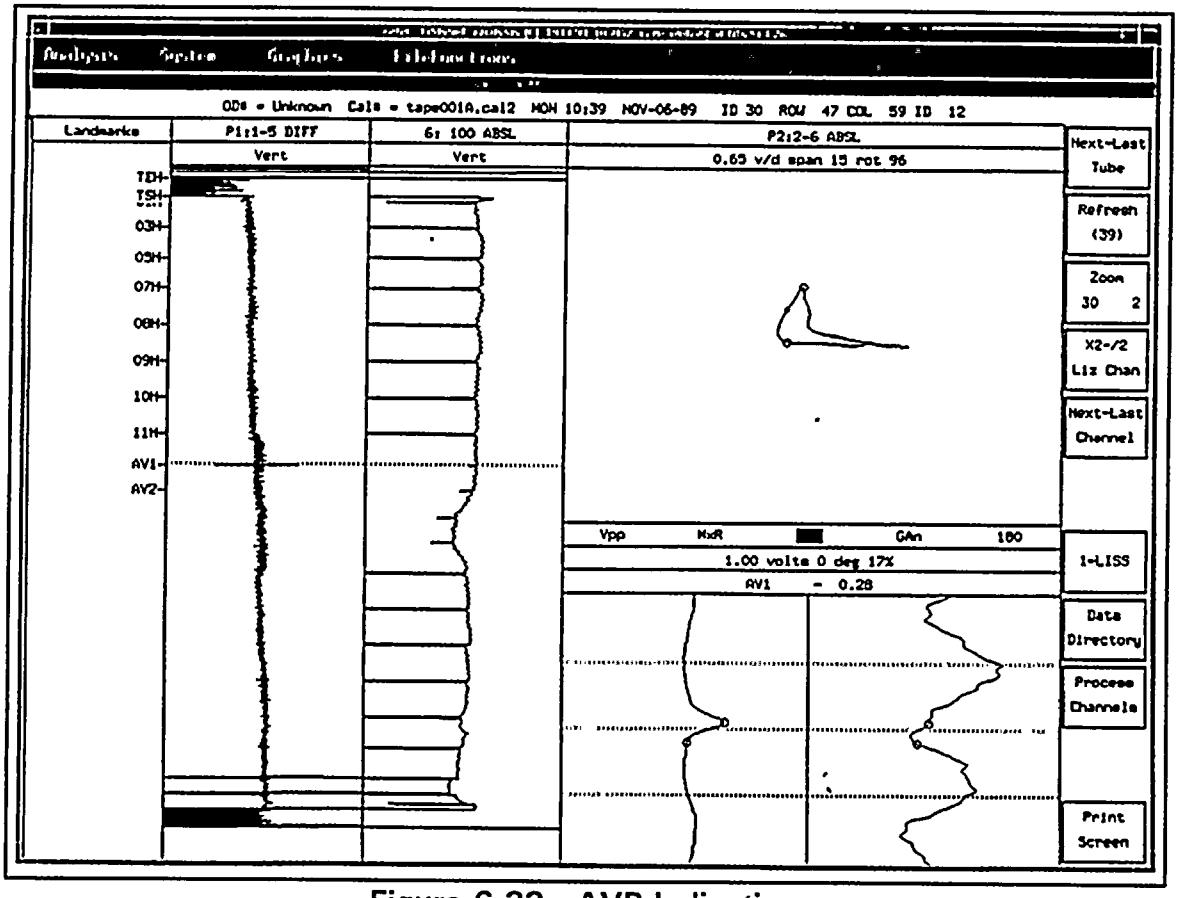



**Figure 6.33 - AVB Indication**

6.3.4.2 Likewise, indications at the cold leg baffle supports in the pre-heater region have been known to wear due to the turbulent flow in this region. An example of baffle wear is shown in figure 6.34.

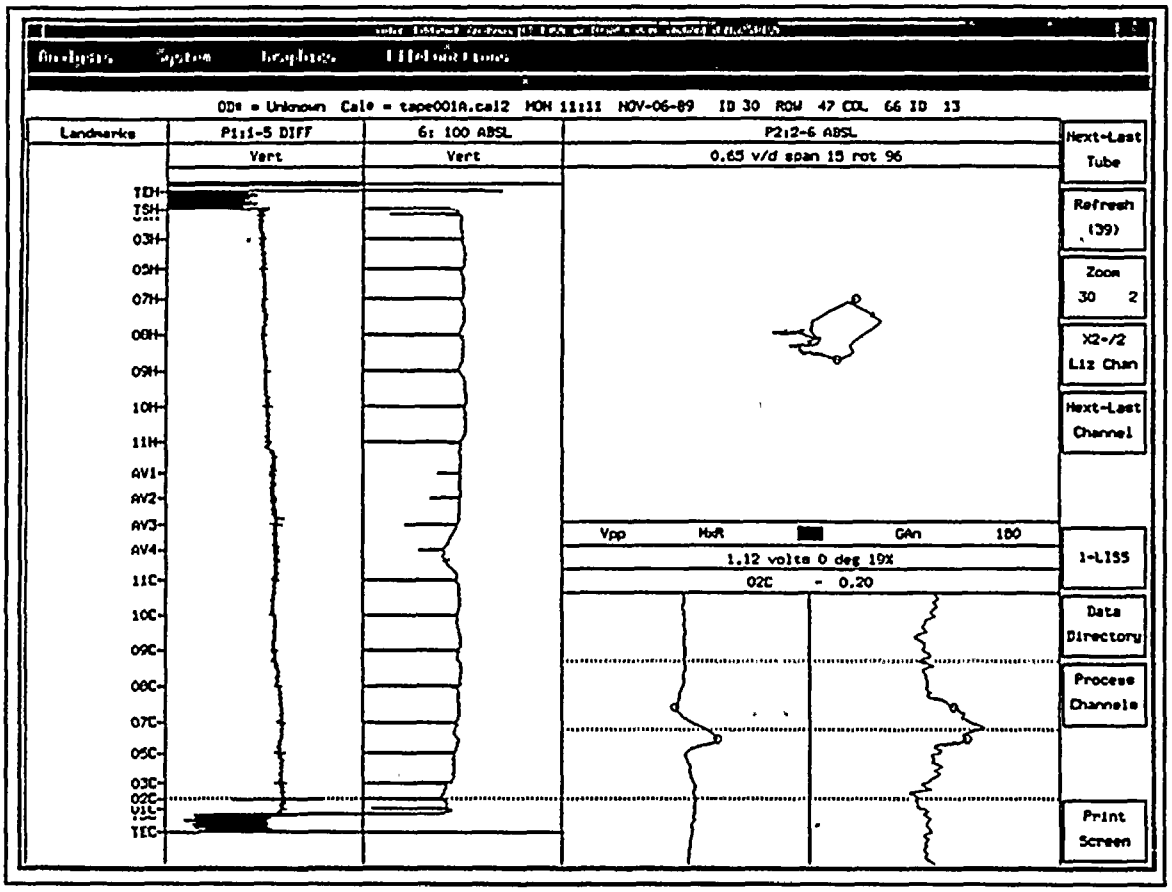



**Figure 6.34 - Cold leg Baffle Wear scar**

6.3.4.3 To prevent wear at suspect tubes in the preheater baffles, supports number 02C and 03C have been mechanically rolled into the baffle plate (see section 5 for tubesheet map). This roll produces a large bulge-like signal, and should not be confused with a dent or other flaws. See figure 6.35 for an example of a roll expanded area.

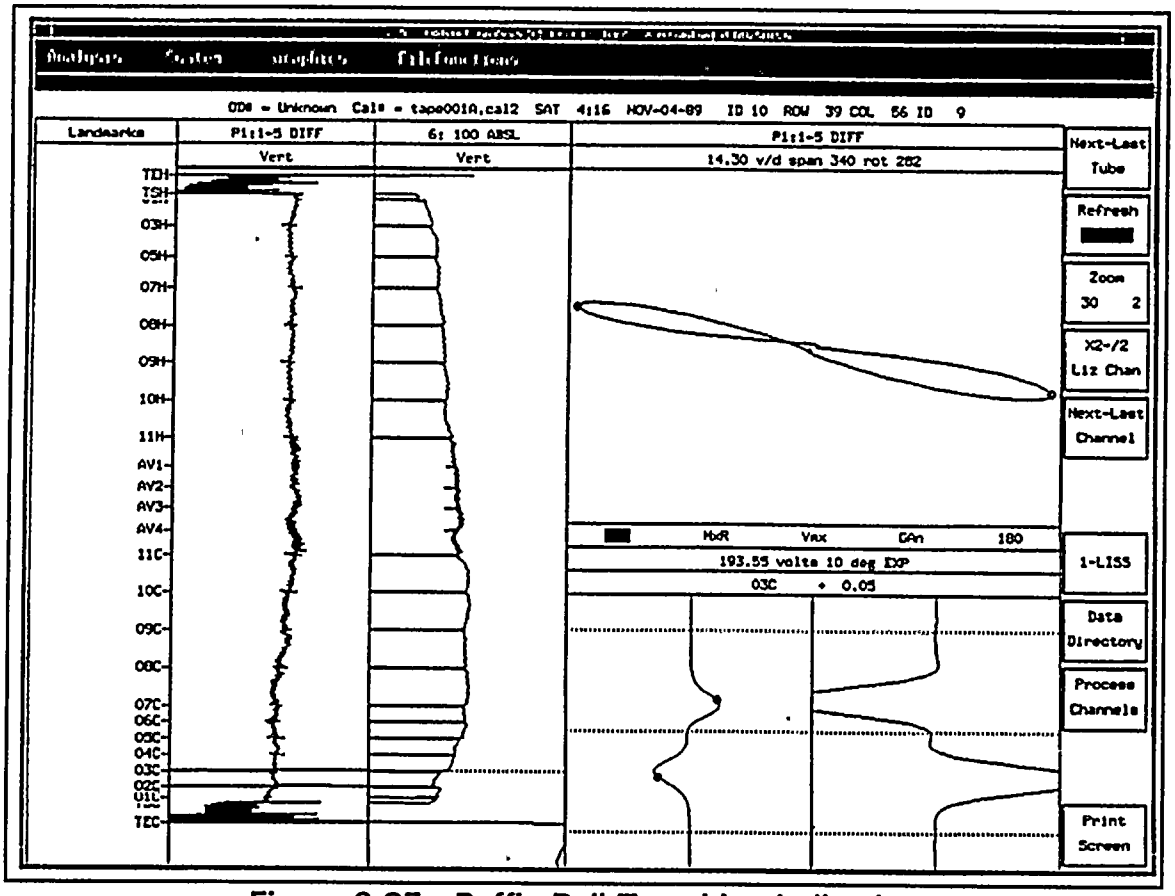



**Figure 6.35 - Baffle Roll Transition Indication**

## Section 7.0

## Bobbin Probe Recording Requirements & Acronyms

### 7.1 Final Report

The following information (subject to changes by data management) will be recorded in the final report section of the data analysis program.

7.1.1 The Header information should be recorded using the report builder software in Eddynet. The Header should contain the **probe** designation, **calibration** number, **analyst** name and level, and the **date**. Unless otherwise specified, the date field should be the date the data is analyzed, which may differ from the acquired date due to shift changes, etc. A fourth line may be used to designate other information such as the **optical disk** label, as directed by data management. See figure 7.1.

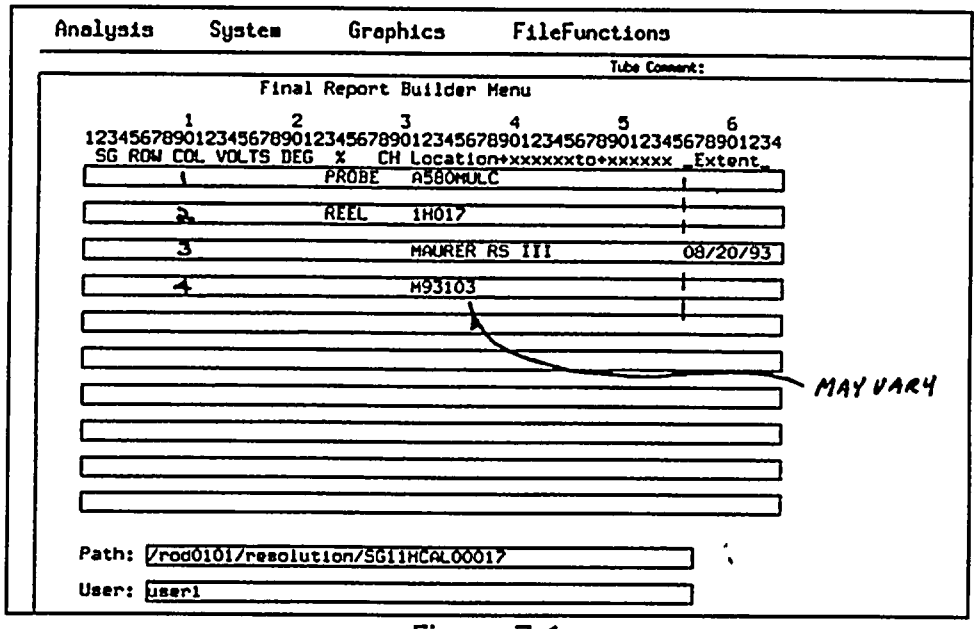



Figure 7.1

Final Report Header Format example

7.1.2 For each tube evaluated with no indications an entry must be made that contains the SG ID (from Acquisition), Row, Line and Extent.

7.1.3 For each indication evaluated an entry must be made that includes the SG ID, Row, Line, Volts, Degrees, Percent depth or acronym, Location and Extent.

7.1.4 For any restricted or incomplete tubes, the correct retest (R__ code) acronym should be placed in the percent column, and the last tested extent in the Extent column.

7.1.5 No blank lines should appear on the report.

7.1.6 Messages may be inserted within the body of the report as required. The Analyst's signature and data shall accompany every page of the printed report. See figure 7.2.

```
Aug 04 16:50 1995      /rod0102/.../B3052.res      Page 1


File=resolution/tape001A.cal2  User=B3052  Date=8/4/95 16:50
Disc Label = Unknown
                                   A610MULC
                                   AH001
                                   BIPES TU III                07/05/95
                                   H95001
 10  39  56 179.8    9 EXP  17 02C     +  0.00                 TECTEH
 10  39  56 189.8    9 EXP  17 03C     +  0.00                 TECTEH
 10  40  59 136.7    7 EXP  17 02C     +  0.00                 TECTEH
 10  40  59 172.3    7 EXP  17 03C     +  0.00                 TECTEH
 10  40  59   0.36   0  19  18 AV4     +  0.06                 TECTEH
 10  40  58                                                    TECTEH
 10  40  56                                                    TECTEH
 30  47  66   1.07   0  36  18 02C     +  0.00                 TECTEH
 30  33 100   1.80 103  51  17 01H     +  0.94                 TECTEH
 30  32  99                                                    TECTEH
 30  32  98                                                    TECTEH
```

Thomas C Brian III 7-5-95

Figure 7.2

Example Final Report Printout

## 7.2 Computer Graphics

Computer graphics format will be finalized at the beginning of the analysis project. Graphic formats may change due to changing outage parameters, software requirements, etc. Typically, the Analyst's assigned to the resolution process will generate the computer graphics needed for the final report.

## 7.3 Reporting Acronyms

The acronyms listed below are used in the percent column of the Final Report to describe a particular condition. Other acronyms may be used as directed by the Senior Analyst or Utility representative.

| Acronym | Condition |
|---|---|
| ADR | Absolute Drift - A 100 KHz absolute baseline drift in the positive vertical plane. |
| APT | Absolute Positive Trace - An abrupt indication evidenced only on absolute channels. |
| Blank | No Detectable Degradation (NDD). |
| BLG | Bulge |
| CUD | Copper Deposit |
| DNT | Dent indication |
| DRI | Distorted Roll Indication - indicates a distorted roll transition signal at the top of the tubesheet. |
| EXP | EXPanded tube - this indicates the location of an expansion at the second or third cold leg support in the baffle region. |
| IDV | Inside Diameter Variation |
| INF | Indication Not Found - previously reported indication is not found during the current analysis. |
| INR | Indication Not Reportable - previously reported indication is not recordable according to the present guideline parameters. |
| LAR | Lead Analyst Review - This notation is used by the Analyst when an indication is found which is not specifically addressed in the Guidelines. The Lead Analyst is required to review data from all indications designated LAR by the Analyst. |
| NQI | Non-Quantifiable Indication - This notation is used to record an indication which may be indicative of a flaw but does not show good frequency correlation or is distorted. |

This flag will indicate to the lead analyst that history should be reviewed for this tube, or further evaluation may be required, possibly with alternative examination techniques.

OBS Obstructed - Used only as a final call when the smallest allowable probe diameter will not pass the location.

PID Positive Identification - Used to verify a pluggable location. Usually performed during a subsequent examination of a flaw indication.

PLG Plug location.

PLP Possible Loose Part - foreign object on secondary side

POS Possible Indication - for Resolution Review

PTE Partial Tube Expansion

PVN Permeability Variation - Reported at >3 volts when using a magnetic bias probe.

RBD Retest Bad Data - No Extent Required

REC Retest Encode problem - used when conflicting information is found regarding tube identification - No Extent Required

RES Retest for Restriction - Extent Required

RND Retest No Data present - No Extent Required

RFX Retest for Fixture - Fixture is blocking the tube - No Extent Required

RIC Retest Tube Incomplete - Extent Required

SLG Sludge location - used when measuring sludge heights.

## 7.4 Data Anomalies

The Analyst should be aware of data quality anomalies which may occur during the acquisition of eddy current data. Certain equipment failures, electrical noise interference, etc., can cause data which is unacceptable and must be re-acquired. The following figures show several examples of data anomalies which should be flagged as RBD or Retest for Bad Data.

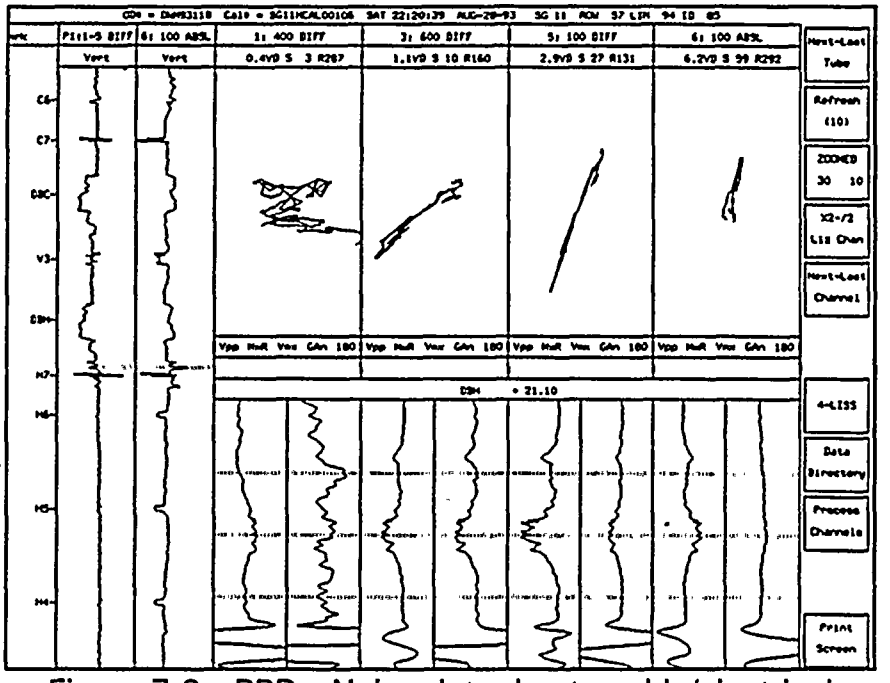


Figure 7.3 - RBD - Noisy data due to cable/electrical

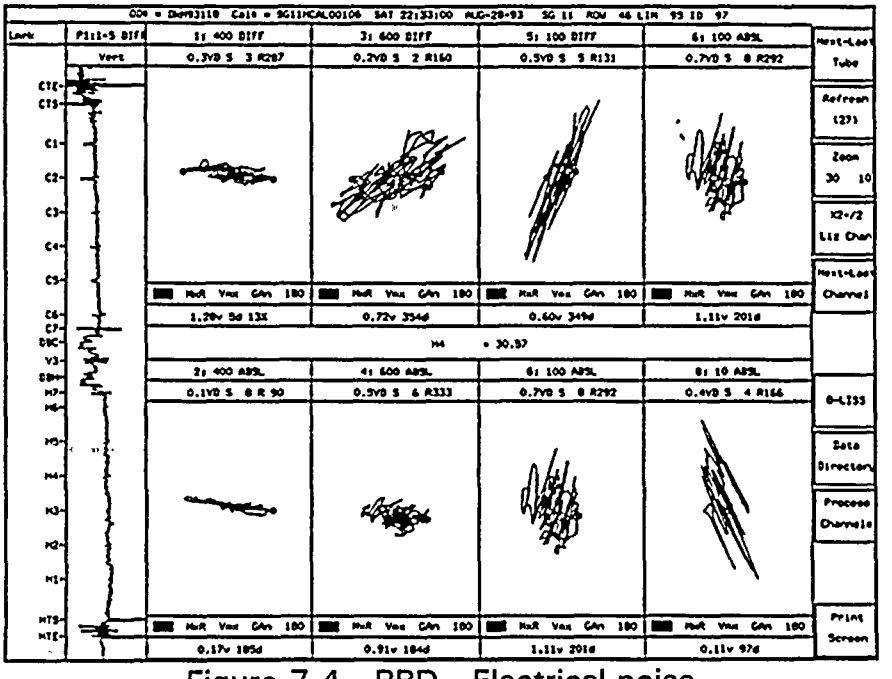


Figure 7.4 - RBD - Electrical noise

## Section 8.0

## Bobbin Probe Resolutions

### 8.1 Conditions Requiring Resolution

8.1.1 If either the Primary or Secondary Analyst or both reports a **flaw indication as greater than or equal to 40% through wall**, a Lead Analyst shall review the data tape, resolve the discrepancy or verify the results and document and sign off on the results of this review.

8.1.2 If either the Primary or Secondary Analyst or both reports an unresolved signal indication, the Lead Analyst shall review the bobbin test data tape, determine the nature of the indication, (i.e. flaw, no flaw, dent, etc.) size the indication (if a flaw), document and sign off on the results of the review. If the indication cannot be classified as a non-flaw, it shall be considered to be a flaw, and sized accordingly, except as discussed below

If definitive rotating probe ECT data is available, the Senior Analyst, or his designated Lead Analyst may use this data to resolve the status of the unresolved indication signal.

If definitive data from other special tests (e.g. Ultrasonics, Liquid Penetrant) are available, this data may be used to resolve the status of the unresolved signal indication.

8.1.3 If either the Primary or Secondary Analyst reports a **flaw indication between 20 and 39 percent through wall**, not reported by the other, or if the difference in estimated flaw depth between the two analyses (primary and secondary) exceeds 10 percent, the Lead Analyst shall review the data, resolve the discrepancy, document and sign off on the results of the review.

8.1.4 If, during the course of the resolution review, a Lead Analyst overrules <u>any</u> defect call (i.e., changes a repairable call by the Primary Analyst, Secondary Analyst, or both to a non-repairable call), or changes an unresolved signal indication to a $<40\%$ through wall flaw or to no flaw, then the reason for overruling shall be recorded. The Lead Analyst must then analyze all data from that tube for additional defects. A second Lead Analyst is required to review the pertinent data and acknowledge his concurrence by signing the Final Report.

When concurrence between the two Lead Analysts cannot be reached, the most conservative resolution of the discrepancy shall be taken.

In either case, both Lead Analysts are required to sign the Final Report.

8.1.5 Other discrepancies such as inconsistent extent of test, inconsistent calibration identification, etc., shall be resolved by data review if necessary. All resolutions and data modifications should be performed by Lead Analysts, except as defined in paragraph 8.1.6.

8.1.6 The Senior Analyst may designate types of "Administrative" errors which the Primary or Secondary Analysts or the Lead Data Management Operator/Systems Administration personnel will be allowed to resolve.

8.1.7 Table 8.1 provides a listing of error conditions.

8.1.8 Table 8.2 provides a listing of discrepancy conditions.

## 8.2 Resolution Documentation

The following steps shall be used in resolving errors and discrepancies between Primary and Secondary analysis results:

8.2.1 The analyst will correct errors by using the Resolution analysis selection of the Eddynet software. Results and the final report will be generated separately from the Primary or Secondary results, although the Primary or Secondary report may be appended for non-resolved calls.

8.2.2 A "Compare Report" will be issued by the Eddynet compare program, or other approved vendor data management software listing discrepant conditions. This report will be used to document the Lead Analyst edits to the Final Report.

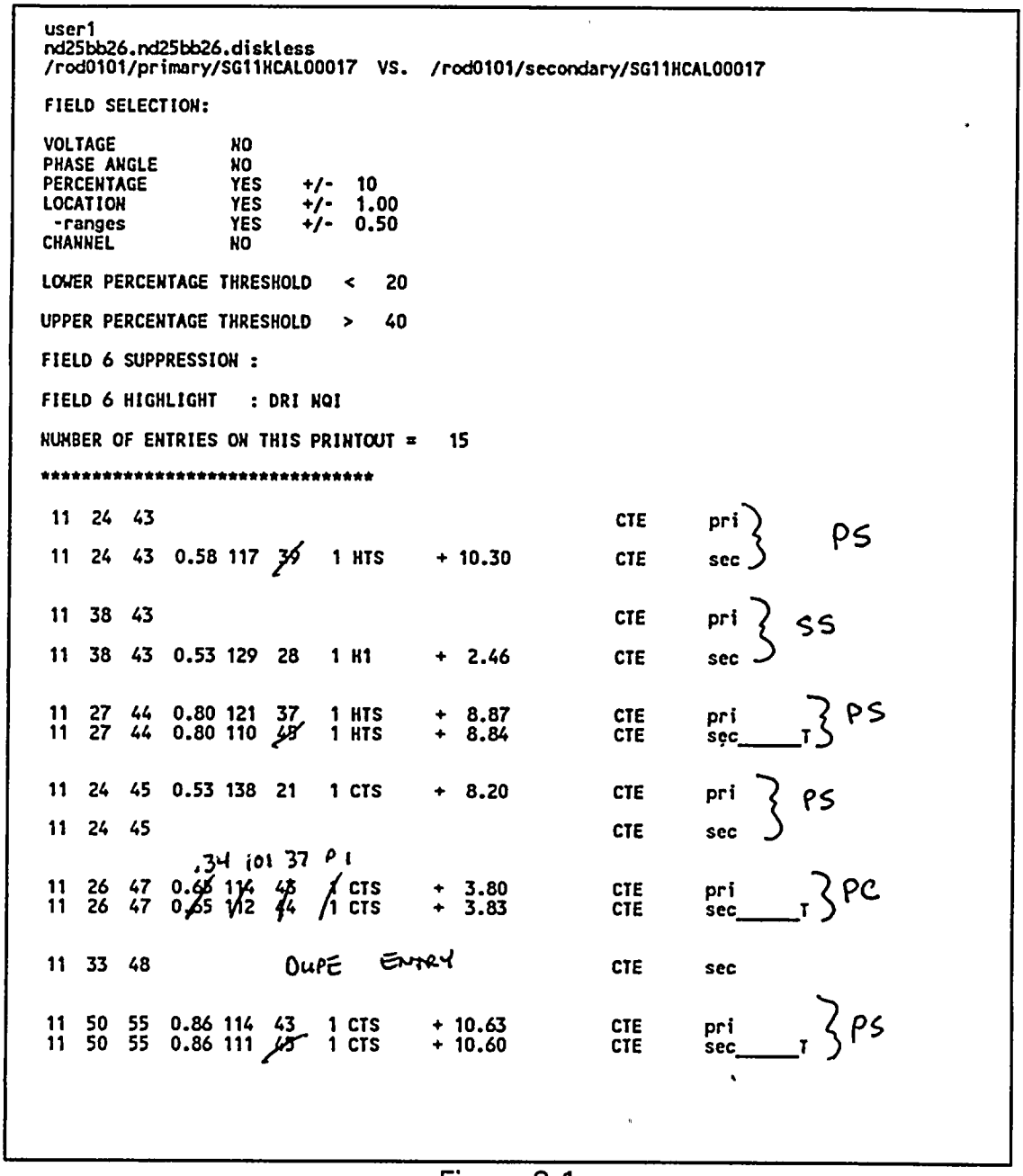
8.2.3 If no discrepant conditions occur between Primary and Secondary analysis, there may be no compare report generated.

8.2.4 The Lead Analyst will use the appropriate data and compare reports when resolving discrepancies.

8.2.5 The Lead Analyst will indicate when the Primary or Secondary or both analysis results are accepted without resolution be annotating the compare report with "PS" for primary call stands or "SS" for secondary call stands.

8.2.6 If the Primary or Secondary call is correct except for a change of one or more parameters in the call, the annotation "PC" for primary call change or ".SC" for secondary call change may be used.

8.2.7 The Lead Analyst shall annotate "FC" for Final resolution Call if the resolved answer is different from the Primary Analyst, Secondary Analyst or both. See figure 8.1 for an example of a typical compare report.



```
user1
nd25bb26.nd25bb26.diskless
/rod0101/primary/SG11HCAL00017  VS.  /rod0101/secondary/SG11HCAL00017

FIELD SELECTION:

VOLTAGE          NO
PHASE ANGLE      NO
PERCENTAGE       YES    +/-  10
LOCATION         YES    +/-  1.00
 -ranges         YES    +/-  0.50
CHANNEL          NO

LOWER PERCENTAGE THRESHOLD   <   20

UPPER PERCENTAGE THRESHOLD   >   40

FIELD 6 SUPPRESSION :

FIELD 6 HIGHLIGHT   : DRI NQI

NUMBER OF ENTRIES ON THIS PRINTOUT =   15

**********************************

 11  24  43                                              CTE     pri  } PS
 11  24  43  0.58 117  39   1 HTS     + 10.30           CTE     sec  }

 11  38  43                                              CTE     pri  } SS
 11  38  43  0.53 129  28   1 H1      +  2.46           CTE     sec  }

 11  27  44  0.80 121  37   1 HTS     +  8.87           CTE     pri  } PS
 11  27  44  0.80 110  48   1 HTS     +  8.84           CTE     sec_____T }

 11  24  45  0.53 138  21   1 CTS     +  8.20           CTE     pri  } PS
 11  24  45                                              CTE     sec  }

                .34 101 37 P1
 11  26  47  0.66 114  43   1 CTS     +  3.80           CTE     pri  } PC
 11  26  47  0.65 112  44   1 CTS     +  3.83           CTE     sec_____T }

 11  33  48          DUPE ENTRY                          CTE     sec

 11  50  55  0.86 114  43   1 CTS     + 10.63           CTE     pri  } PS
 11  50  55  0.86 111  45   1 CTS     + 10.60           CTE     sec_____T }
```

Figure 8.1

Typical Primary/Secondary Analysis Compare Report

8.2.8 The Lead Analyst should thoroughly review <u>all</u> available data on each tube for which a discrepancy is identified. All results should be listed under the Lead Analyst's name in the Resolution final report.

8.2.9 As specified in section 7, if the 1st Lead Analyst dispositions a greater than 40% flaw or undefined type signal to a less than 40% flaw, a 2nd Lead Analyst must review the data. The second Lead Analyst acknowledges his concurrence by signing the Final Report.

Whenever concurrence in resolution cannot be reached, the most conservative call shall be retained. If the result is that a ≥40% or an undefined type indication is resolved to less than 40%, the reason must be specified on the Discrepancy Compare Report.

8.2.10 A Lead Analyst may not act as the 1st Analyst in resolving his own analysis results if he also acted as an Analyst (Primary or Secondary) for a particular calibration group. He may, however, assume the role of a 2nd Lead Analyst during resolution.

TABLE 8.1

## DATA RECORDING ERROR CONDITIONS

1. The reported steam generator identification is something other than "1", "2" or "3".
2. The SG identification does not agree with the SG identification code in the calibration number.
3. The reported tube does not exist
4. The reported row number is something other than 1 through 49.
5. The reported column number is something other than 1 through 114.
6. Missing probe or calibration designation
7. The reported flaw location is beyond the reported extent of the test.
8. Extents of test and flaw elevations which do not conform with the fact that there are eleven tube supports and four AVB's in the Shearon Harris Steam Generators.
9. The reported test extent is incorrect.
10. The extent of test in not reported.
11. Tubes reported as restricted or incomplete which do not have a corresponding extent of test.
12. Use of a three-letter reporting acronym with no established definition.
13. The final report header is not in the correct columns.
14. A plugged tube is reported as tested.

Table 8.2

## RECORDING DISCREPANCIES BETWEEN DATA ANALYSIS

1. Flaw wall loss estimates differ by more than 10% through wall.

2. Either the Primary Analyst or Secondary Analyst or both reports a flaw as greater than or equal to 40% through wall.

3. Either the Primary Analyst or Secondary Analyst or both reports an anomalous indication (i.e., NQI, DRI, etc.) in which the data suggests a reasonable probability that a flaw exists.

4. One Analyst reports a tube not reported by the other Analyst.

5. One Analyst reports a flaw indication not reported by the other analyst, but is greater than the lower threshold limit.

   NOTE: Flaw locations reported by primary and secondary analysts must be within 1.0 inches of each other to be considered the same flaw.

6. The reported test extents are not in agreement.

7. The reported calibration identifications are not in agreement.

8. The reported steam generator identifications are not in agreement.

9. The reported probe entry sides are not in agreement.

10. The three-letter reporting acronyms are not in agreement.

## 8.3 Resolution Reporting

The resolution final report will be generated when all resolutions from the compare report are complete. The resolution header should contain the same information as the Primary or Secondary Analyst as indicated in section 7.

8.3.1 The Lead analyst should log in to the Eddynet software using the "RESOLUTION" analyst function. This process allows the compare process to be activated, and allows editing of the primary and secondary results into the resolution or "final" results.

8.3.2 Edits will be made during the compare process as documented in section 8.2.

8.3.3 When all compare edits are completed, the final report should be generated using the "BUILD REPORT" menu. The Lead analyst should select "APPEND PRIMARY" and "REPORT ALL USERS" to insure all entries are built into the report, including un-edited primary results[7].

8.3.4 The Lead analyst should check all entries on the compare report vs. the compiled final report to insure all resolutions were addressed.

8.3.5 The final report shall be signed by the Lead Analyst. If a resolution required another Lead Analyst, a second signature shall be included on the final report.

[7]If special circumstances arise, Secondary results may be appended rather than Primary. The Senior Analyst should be contacted for any changes.

## Section 9.0

## SINGLE COIL MRPC PROBE CALIBRATION AND EVALUATION

### 9.1 Probe Description

The Single Coil U-bend probe is used to examine the U-bend radius of the steam generator tubes. Section 10 describes 3-coil MRPC coil data for the straight sections of the tubes.

The MRPC probe used for these examinations is shown in figure 9.1. The probe designation is B580MRPCPH[8] (Pancake coil 0.115" diameter - 580 = .580" diameter probe) This device is rotated by a motorized "wand" which provides a "trigger" signal after each revolution. Axial translation of the probe through the tube is done by a probe pusher with speeds down to as low as 0.1"/sec. The result is a helical scan of the tube area of interest with a pitch of about 0.030".

It is very important that the calibration standard runs and the test runs are performed at the same rotational and axial translation speeds. Failure to do so will cause errors in axial position and flaw length measurements. Data Analysts should check all calibration runs and periodically check tube tests for consistency of test speeds.

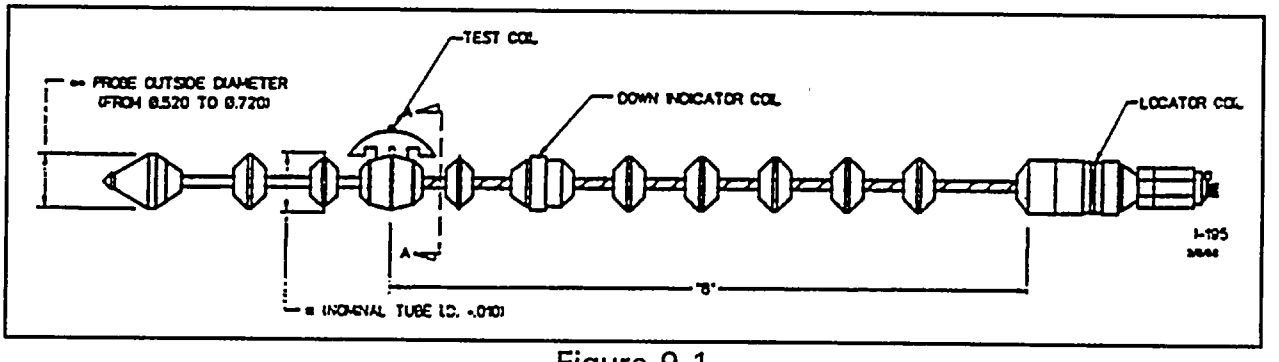



Figure 9.1

Single Coil MRPC probe head

Note: Some graphics used in this section may be from three-coil data including other frequencies/mixes, however, setup for the pancake coil of the three-coil data is the same as a single coil pancake probe, and graphic displays will be similar.

[8]Other probe sizes may be used if required, but will follow a similar probe designation scheme.

## 9.2 Frequency Applications

### 9.2.1 400 KHz

9.2.1.1 This is the optimum frequency for plotting terrain maps and clip plots. This frequency has an optimum phase separation for the ASME flaws. It is not adversely affected by deposits on the OD of the tube.

9.2.1.2 This is the primary frequency used for plotting the lissajous signal from which the voltage, phase angle and depth are reported.

### 9.2.2 600 KHz

9.2.2.1 This frequency may be used for data evaluation and signal confirmation.

9.2.2.2 This frequency is also used as a secondary plotting channel.

### 9.2.3 100 KHz

9.2.3.1 This frequency may be used for data evaluation and signal confirmation.

### 9.2.4 10 KHz

9.2.4.1 This frequency is used for structure location.

## 9.3 Calibration

### 9.3.1 Span and Rotation Settings

9.3.1.1 Load the calibration standard into RAM.

9.3.1.3 Rotate the displays for each pancake coil (coil 1) so probe noise is horizontal. You will note that this process may need to be repeated for each tube, as tube noise is not always consistent.

9.3.1.3 Rotate the low frequency (10 KHz) channel so the carbon steel support structures[9] move in vertical fashion when encountered.

9.3.1.4 Note the trigger channel (square pulse signal) which will be used to adjust operator parameters for the C-scan display.

9.3.1.5 Find the largest of the 60% Flat bottom hole signals, and place it alone in the window. See figure 9.2.

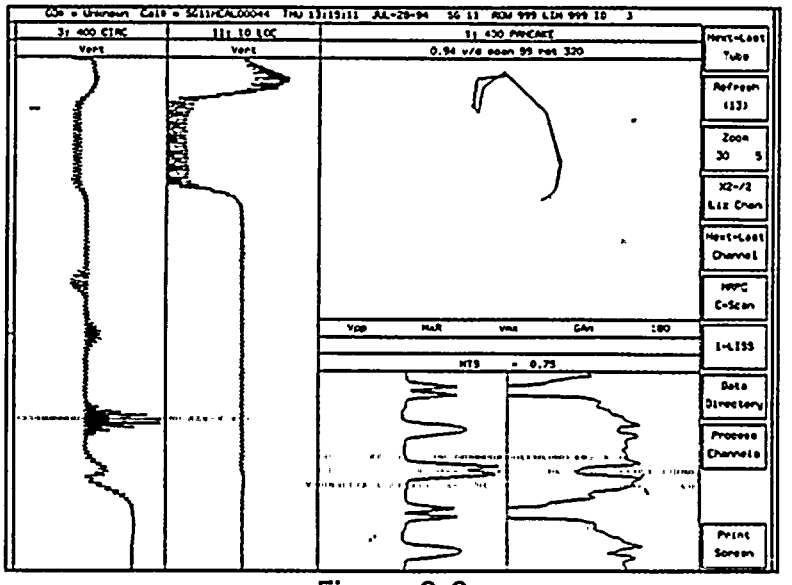


Figure 9.2
60% FBH in window

9.3.1.6 Adjust the span so the signal occupies 4-5 grid divisions. Repeat this step for all applicable pancake coils.

### 9.3.2 Axial Measurement Scale

[9]Depending on the actual calibration standard used, other signals may be used for setting axial scale as required. The Senior analyst or designee will provide acutal drawings and settings to use.

9.3.2.1 Using the manual locating option, set the zero point by placing the cursor on the first reference point, and selecting a support structure in the landmarks column using the left mouse button.

9.3.2.2 Scroll to the next signal with a known scale, and adjust the scale reading by clicking and dragging the right mouse button in the landmarks column. Store your settings with the file save function.

In figure 9.2, the scale is set between the 4 x 20% flaws and the 100-60-40 flaws which are 0.75" away.

### 9.3.3 Voltage Setting

9.3.3.1 To set voltage, scroll the largest signal of the 60% FBH (as in step 9.3.1.5) and set peak-to-peak points.

9.3.3.2 As in bobbin coil examination, go to the "Set Volt Units" menu and adjust the voltage to **5.00 volts.** Save and store this setting to all coils which will normalize the voltage. See figure 9.3.

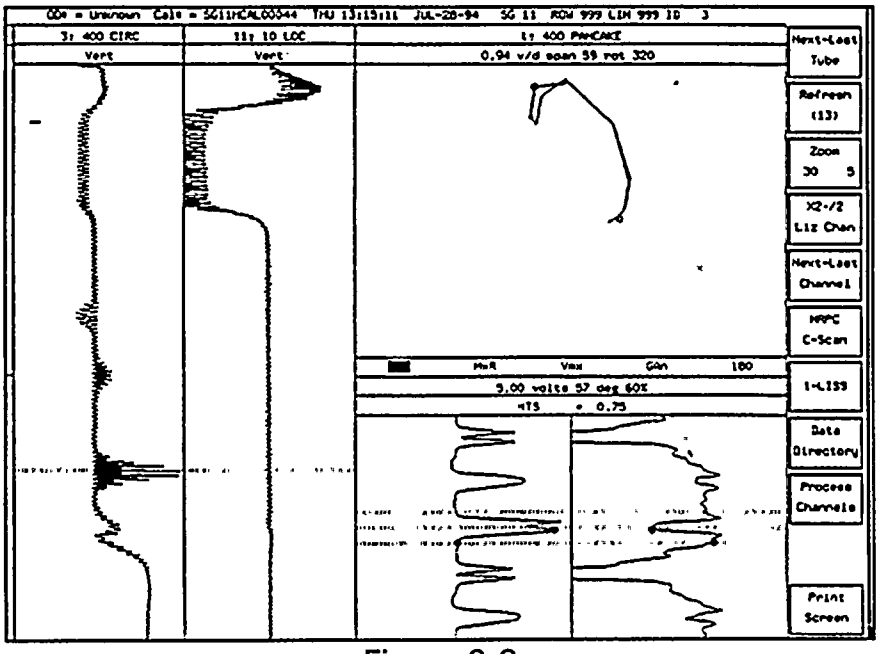



Figure 9.3
Setting 400 KHz pancake coil to 5.00 volts

### 9.3.4 Calibration Curves

9.3.4.1 Set a three-point calibration curve with the 400 KHz channel utilizing the 100 - 60 - 40% flaws in the calibration standard. Use the actual values from the as-built drawing for the values.

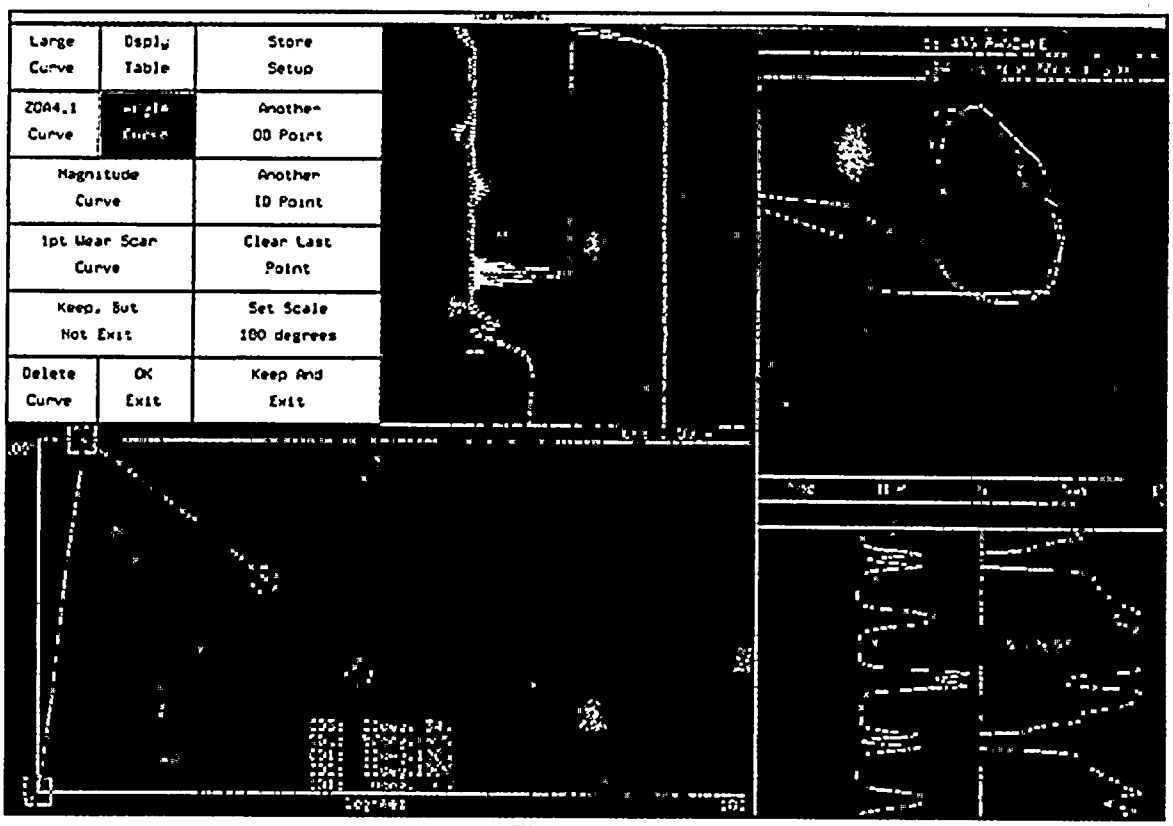



Figure 9.4
Calibration curve for 400 KHz Pancake coil

### 9.3.5 Down Locator Coil

9.3.5.1 If a down-locator coil is utilized, adjust the display for a positive vertical deflection from the four responses.

9.3.5.2 Adjust the span so the largest of the down-locator signals is within screen saturation.

### 9.3.6 Set Up Terrain Mapping

The first step in setting the terrain mapping parameters has been accomplished by setting the axial scale.

9.3.6.1 Select the MRPC menu and proceed to "User Select" to select several MRPC parameters.

9.3.6.2 Adjust the trigger channel to that which was noted earlier in this section.

9.3.6.3 Auto trigger and Same Channel may be selected as the Analyst desires.

9.3.6.4 Tubing diameter should be set to 0.664", representing the ID of the tube. See figure 9.5

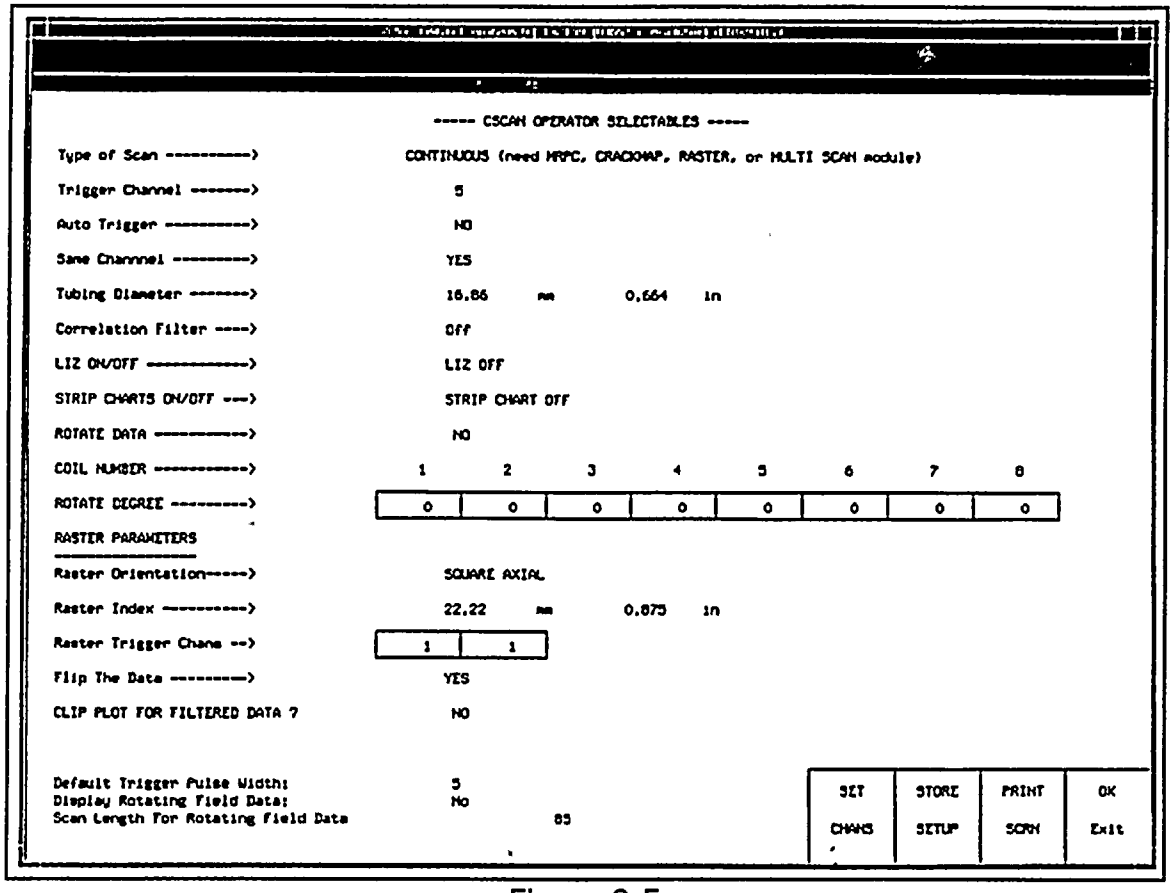



Figure 9.5
MRPC terrain plot set-up parameters

9.3.6.5 The "Rotate Data" function should be disabled for single coil operation.

9.3.6.6 Return to the C-scan display and adjust the cursor and window to encompass a section of the standard which contains several flat bottom holes.

9.3.6.7 Adjust the X rotation to 70, and the Z rotation to 315. These values may change depending on specific plot parameters.

9.3.6.8 Select "CIC/AXL CSCAN" to display a terrain plot of the desired area. An acceptable plot should be displayed. See figure 9.6.

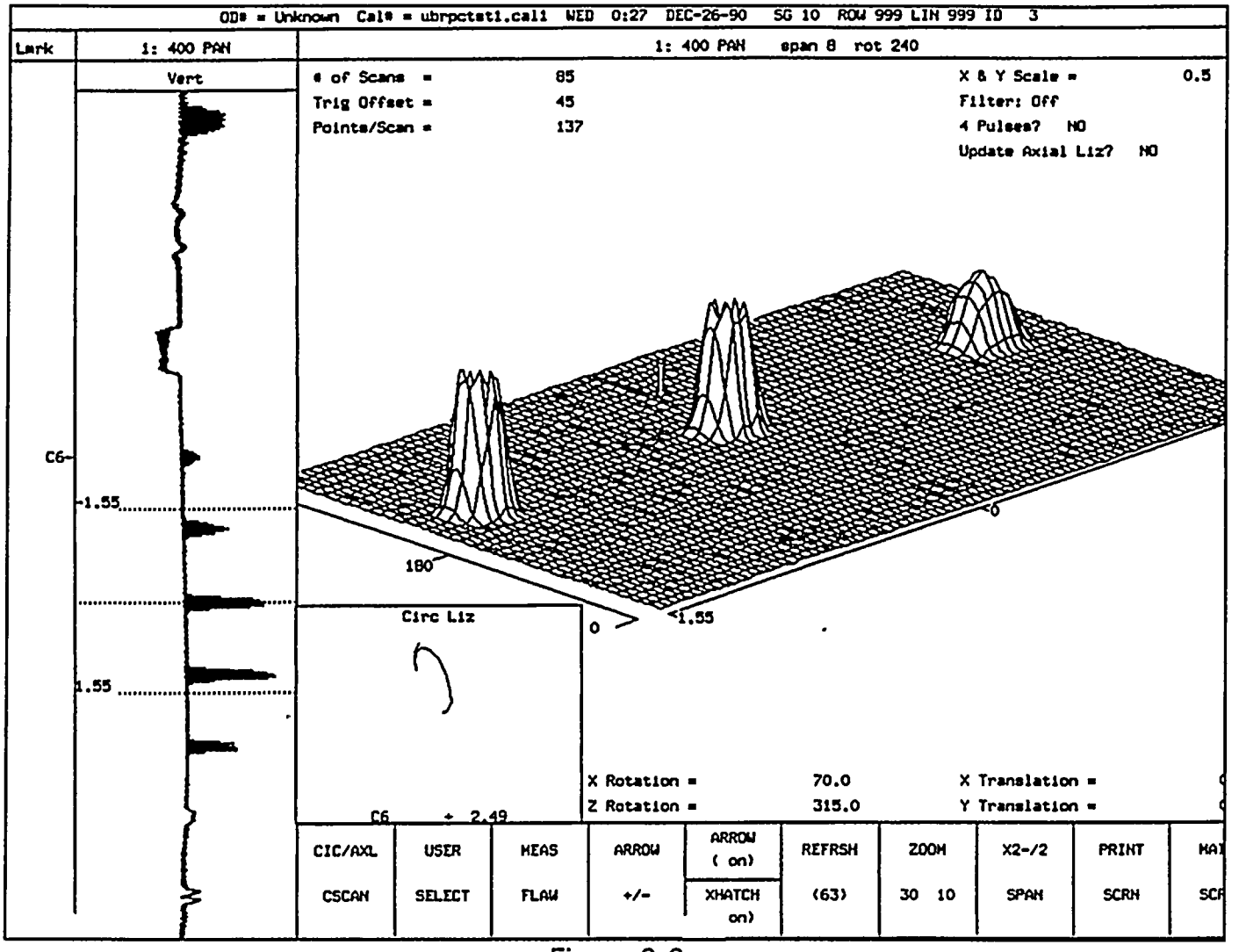



Figure 9.6

Example C-Scan Terrain plot of calibration standard

### 9.3.7 Clip Plot Set up

9.3.7.1 Select the "MEAS FLAW" menu.

9.3.7.2 Select "ADJUST CLIP" in the "0" box to adjust the clip level.

9.3.7.3 Click and drag the threshold line until the base line of the standard is slightly exceeded. See figure 9.7.

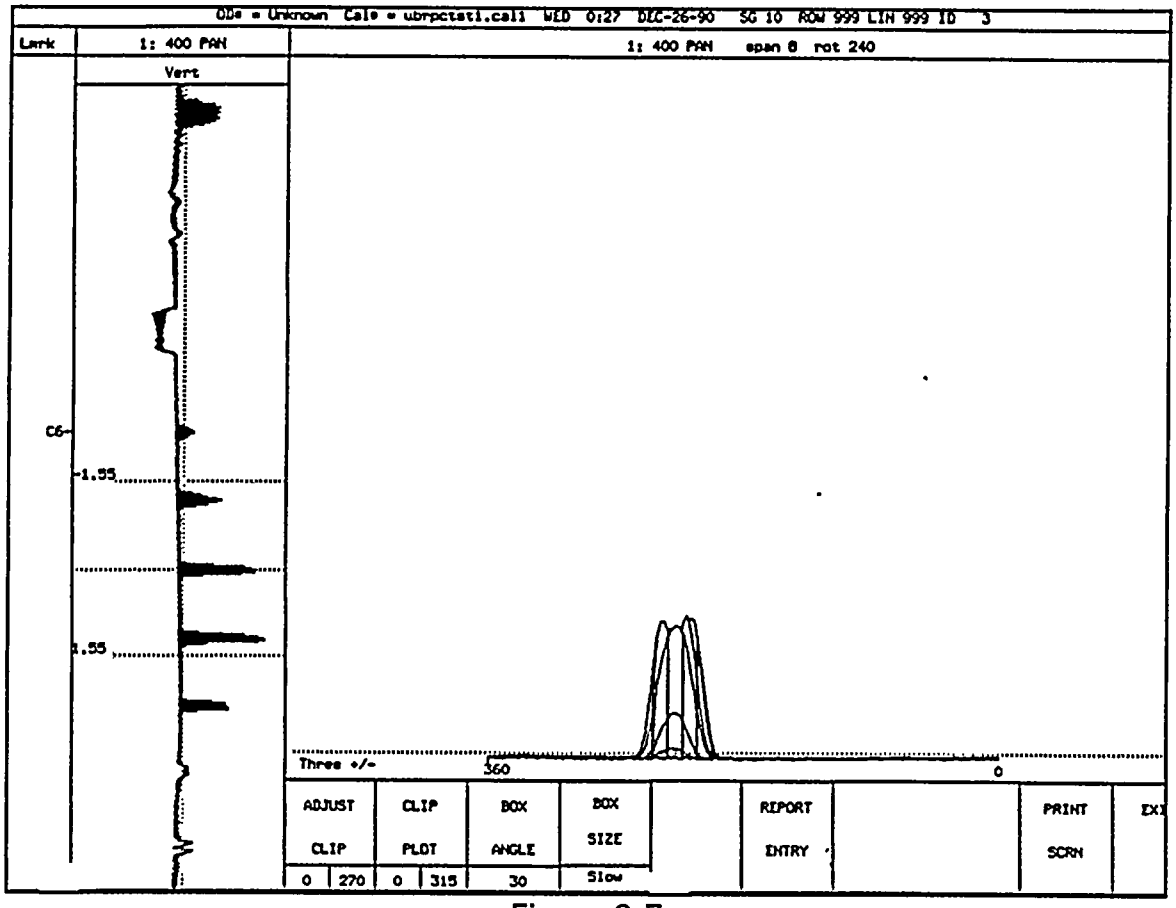



Figure 9.7

Adjustment of Clip Plot Threshold level

9.3.7.4 Select "CLIP PLOT" in the "0" box to display the clipped plot. This menu is also used to adjust a display box used to approximate indication size. This feature will not be discussed at this time. See figure 9.8.

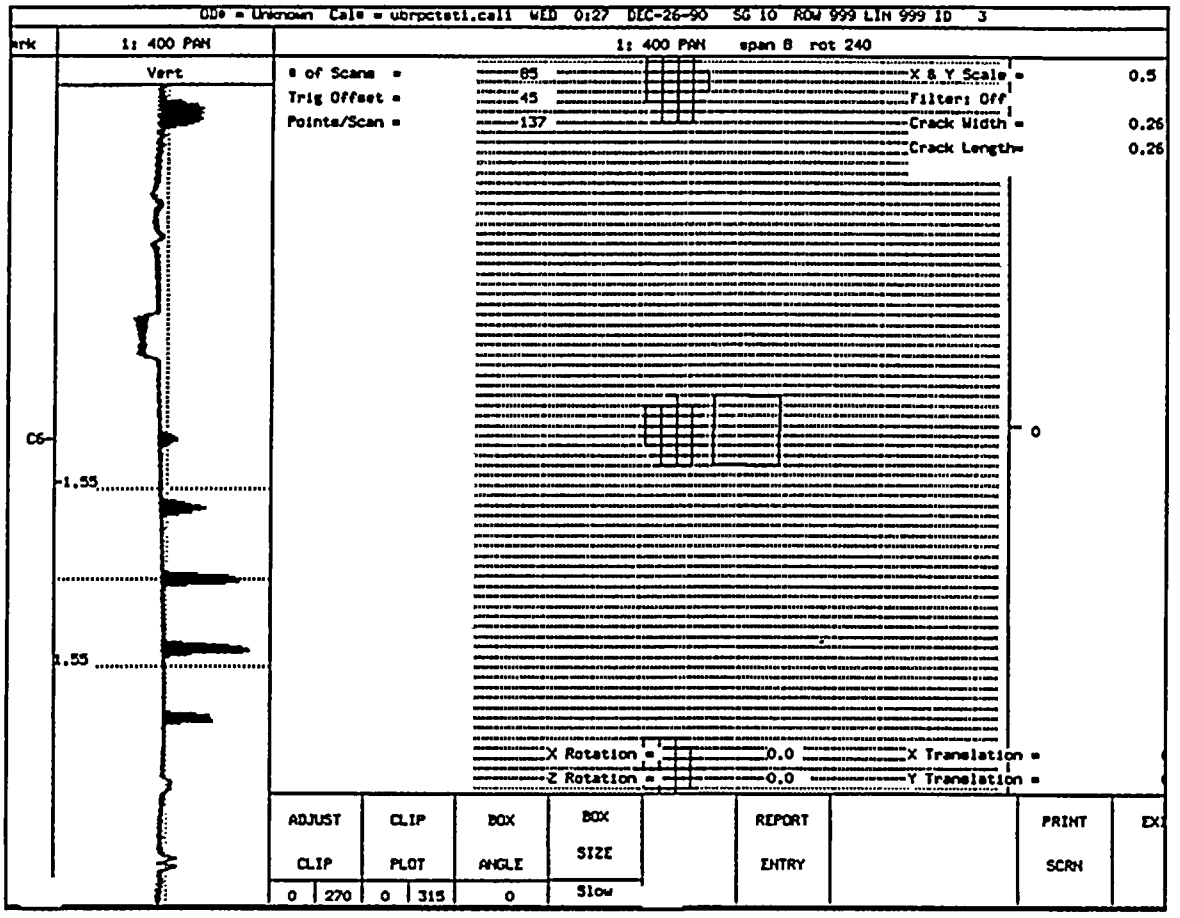



Figure 9.8

Clip Plot of ASME FBH's

The displays should appear round and uniform. If this is not the case, axial scale and tube diameter setting should be verified. Adjustment of the axial scale may be necessary for a desirable clip plot.

## 9.4 DATA SCREENING

All data observed on the strip charts and the lissajous will be evaluated. **A terrain plot of the entire strip chart will be performed to insure full evaluation of the entire length of data and area of interest.**

### 9.4.1 Strip Charts

9.4.1.1 Set the left strip chart to 400 KHz vertical and the right strip chart to 100 KHz vertical. Both of these should be at the set-up spans established previously.

9.4.1.2 If span settings seem inappropriate, consult the Senior Analyst for alternate setting acceptance.

### 9.4.2 Lissajous

9.4.2.1 Set the lissajous to 400 KHz at the set-up span established previously. Final report values for voltage, depth, and axial position will be taken from this channel.

### 9.4.3 Use of Filters

9.4.3.1 A band-pass or other approved filtering method may be used to assist in flaw detection, however, initial screening must be accomplished without their use. IN no case shall any measurements be taken from filtered data without permission from the Senior Analyst. See Table 9.1 for Single Coil MRPC set-up parameter summary.

## 9.5 EVALUATION

9.5.1 Initial Screening of the data will be performed at set-up span settings.

9.5.2 Check the 100 or 10 KHz strip chart for the presence of support structures and locate them manually with the appropriate names. See figure 9.9

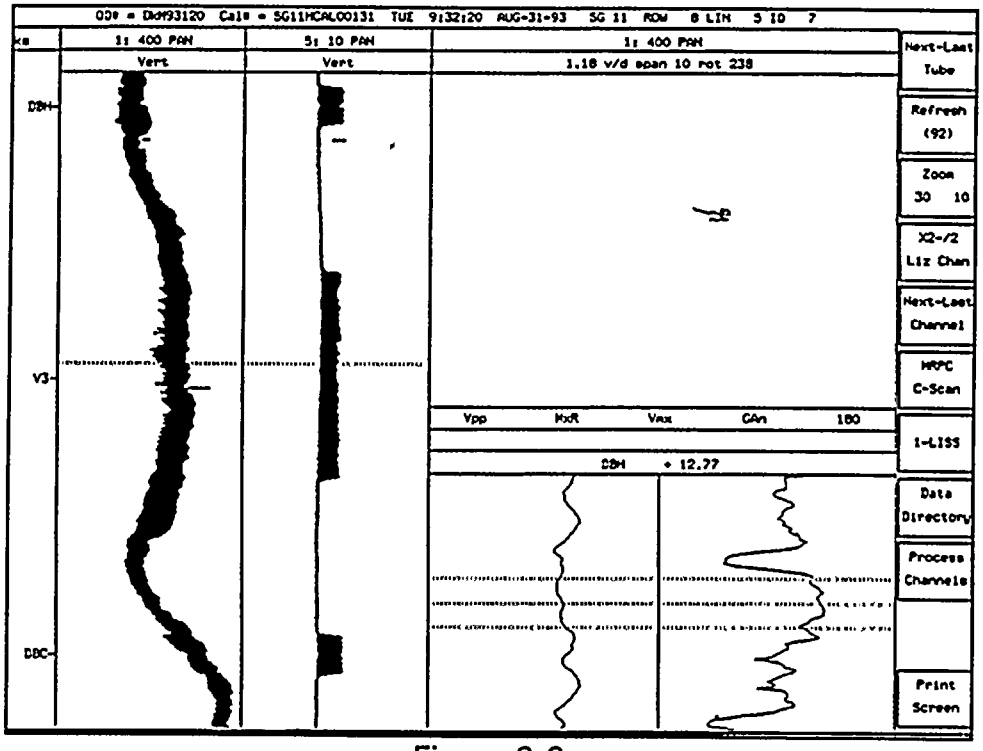



Figure 9.9
Locating structures

**9.5.3 A terrain plot of the entire strip chart will be performed to insure full evaluation of the entire length of data and area of interest.**

9.5.4 Suspect indications should be evaluated using lissajous, terrain plots and clip plots in order to determine whether the signal is of a flaw or deposit origin.

9.5.5 Record all indications in accordance with section 11.

## 9.5.6 Single Coil MRPC Examination Calibration Parameters

| MRPC SINGLE-COIL ANALYSIS SUMMARY | | | | | | | |
|---|---|---|---|---|---|---|---|
| CHANNELS | | | | | | | |
| Channel | 1 | 2 | 3 | 4 | 5 | | |
| Span | 5-6 div | 5-6 div | 5-6 div | 5-6 div | 2-3 div | | |
| Phase | PM Horiz | PM Horiz | PM Horiz | vertical | vertical | | |
| Cal Std | 60% ASME | 60% ASME | 60% ASME | Trigger | support ring | | |
| Curve | Degree | N/A | N/A | N/A | N/A | | |
| Volts | 60% - 5v | Norm. | Norm. | N/A | Norm. | | |

DATA SCREENING

**Left Strip Chart: 400 KHz PAN Vert** **Right Strip Chart: 100/10 KHz Vert** **Liss.: CH 1 (400 KHz)**

Notes:
Above spans are a minimum for initial screening
Voltage normalized to channel 1

RECORDING REQUIREMENTS

Graphics: Generated by Resolution unless otherwise indicated

Recording:

Channel 1: Degradation, NQI, POS

Table 9.1

Single Coil Analysis Parameters

## Section 10.0

## THREE COIL MRPC PROBE CALIBRATION AND EVALUATION

### 10.1 Probe Description

The three-coil probe is used to examine the straight sections of the SG tubes, however, three-coil probes may be used for bend areas also.

The three-coil probe used for these examinations is shown in figure 10.1. This device rotates the three coil probe head with pancake, axial wound and cicumferentially wound coils, and marks each revolution with a trigger signal. Axial translation of the probe through the SG tube is done by a probe pusher. The net result of the simultaneous axial and circumferential probe translations is a helical scan with a pitch of about 0.040 inches.

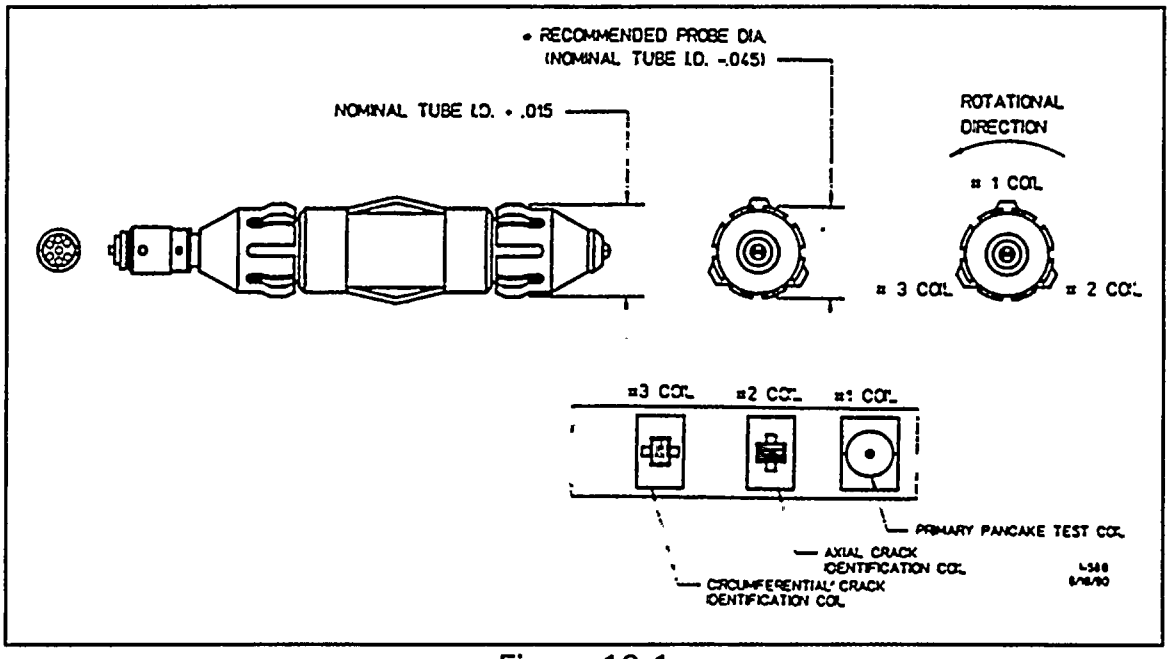



Figure 10.1
Three coil MRPC probe head

It is very important that the calibration standard runs and test runs are performed at the same rotational and axial translation speeds. Failure to do so will cause errors in axial position and flaw length measurements. Data Analysts should check all calibration runs and periodically check tube tests for consistency and speed.

## 10.3 Frequency Applications

### 10.3.1 400 KHz

10.3.1.1 This is the optimum frequency for plotting terrain maps and clip plots. This frequency has an optimum phase separation for the ASME flaws. It is not adversely affected by deposits on the OD of the tube.

10.3.1.3 This is the primary frequency used for plotting the lissajous signal from which the voltage, phase angle and depth are reported.

### 10.3.3 600 KHz

10.3.3.1 This frequency may be used for data evaluation and signal confirmation.

10.3.3.3 This frequency is also used as a secondary plotting channel.

### 10.3.3 100 KHz

10.3.3.1 This frequency may be used for data evaluation and signal confirmation.

### 10.3.4 10 KHz

10.3.4.1 This frequency is used for structure location.

## 10.4 Calibration

### 10.4.1 Span and Rotation Settings

10.4.1.1 Load the calibration standard into RAM.

10.4.1.3 Rotate the displays for each pancake coil (coil 1) so probe noise is horizontal. Rotate the displays for the axial[10] coil (coil 5) and circ. coil (coil 7) so probe motion noise is horizontal.

10.4.1.3 Rotate the low frequency (10 KHz) channel so the carbon steel support structures move in vertically when encountered.

10.4.1.4 Note the trigger channel (square pulse signal) which will be used to adjust operator parameters for the C-scan display. The channel number will be required for terrain plot set-up.

10.4.1.5 Find the largest of the 60% Flat bottom hole signals (hits), and place it alone in the window using the 400 KHz pancake coil. See figure 10.2.

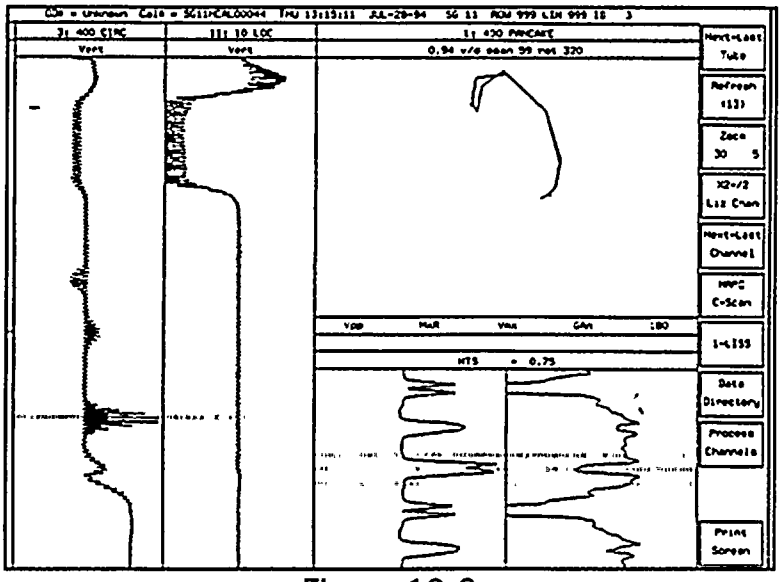


Figure 10.2
60% FBH in window (400 KHz PAN)

10.4.1.6 Adjust the span so the signal occupies 4-5 grid divisions. Repeat this step for all applicable pancake coils.

---

[10]For the remainder of this section, "axial coil" refers to a circumferentially wound coil which is sensitive to axial flaws, and the "circ. coil" refers to an axially wound coil which is sensitive to circumferential flaws.

10.4.1.7 Change to the 400 KHz axial coil.

10.4.1.8 Adjust the span so the signal occupies 4-5 grid divisions. Repeat this step for all applicable pancake coils.

### 10.4.2 Axial Measurement Scale

Use the 10 KHz pancake coil for axial measurement to structures; if calibration standard indications are used for scale setting, use a higher frequency pancake coil to locate the indications.

10.4.2.1 Using the manual locating option, set the zero point by placing the cursor on the first reference point, and selecting a support structure in the landmarks column using the left mouse button.

10.4.2.2 Scroll to the next signal with a known scale, and adjust the scale reading by clicking and dragging the right mouse button in the landmarks column. Store your settings with the file save function.

In figure 10.2, the scale is set between the 4 x 20% flaws and the 100-60-40 flaws which are 0.75" away.

### 10.4.3 Voltage Setting

Use the 400 KHz pancake coil to set initial voltage.

10.4.3.1 To set voltage, scroll the largest signal of the 60% FBH (as in step 10.4.1.5).

10.4.3.2 As in single coil examination, go to the "Set Volt Units" menu and adjust the voltage to **5.00 volts.** Save and store this setting to all pancake coils which will normalize the voltage for the pancake coil. See figure 10.3.

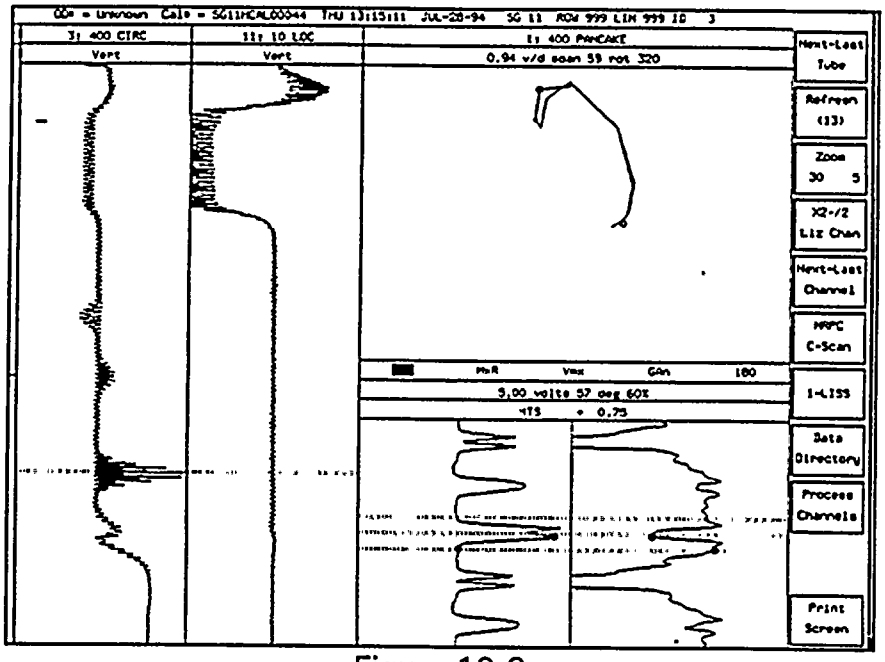



Figure 10.3
Setting 400 KHz pancake coil to 5.00 volts

10.4.3.3 Repeat step 10.4.3.2 for the axial coil and circumferential coil.

### 10.4.4 Calibration Curves

10.4.4.1 Set a three-point calibration curve with the 400 KHz pancake coil channel utilizing the 100 - 60 - 40% flaws in the calibration standard. Use the actual values from the as-built drawing for the values. See figure 10.4.

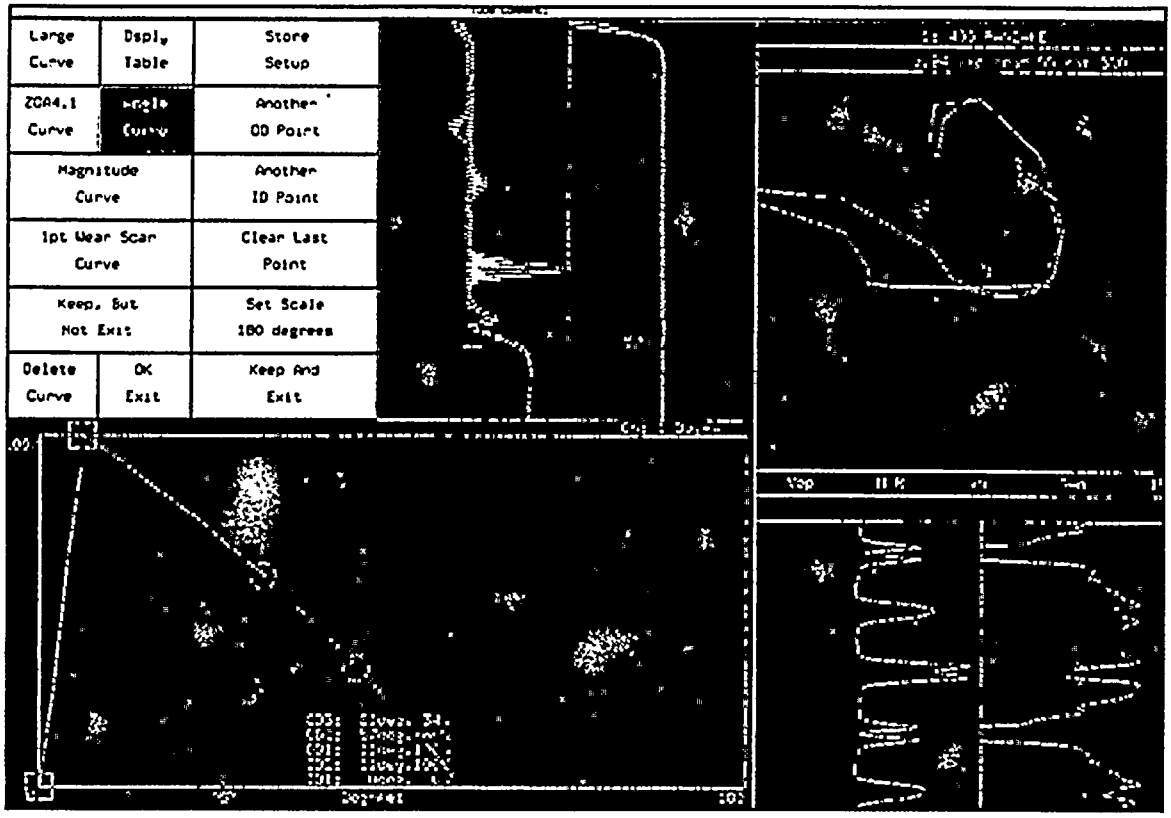



Figure 10.4
Calibration curve for 400 KHz Pancake coil

### 10.4.5 Set Up Terrain Mapping

The first step in setting the terrain mapping parameters has been accomplished by setting the axial scale.

10.4.5.1 Select the MRPC menu and proceed to "User Select" to select several MRPC parameters.

10.4.5.2 Adjust the trigger channel to that which was noted earlier in this section.

10.4.5.3 Auto trigger and Same Channel may be selected as the Analyst desires.

10.4.5.4 Tubing diameter should be set to 0.664", representing the ID of the tube. See figure 10.5

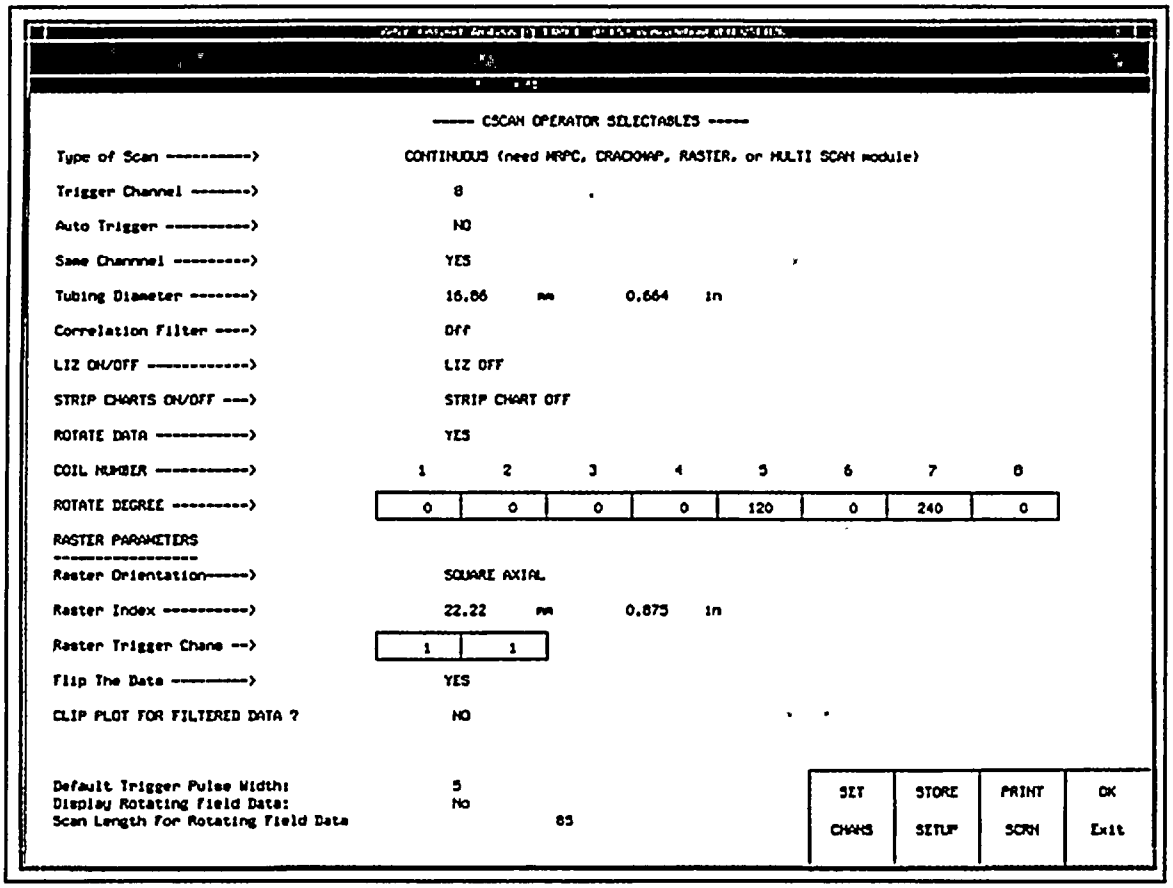



Figure 10.5
MRPC terrain plot set-up parameters

10.4.6.5 The "Rotate Data" function should enabled for three coil operation. This allows efficient comparison between coils without the physical 120 degree offset.

10.4.6.6 Return to the C-scan display and adjust the cursor and window to encompass a section of the standard which contains several flat bottom holes.

10.4.6.7 Adjust the X rotation to 70, and the Z rotation to 315. These values may change depending on specific plot parameters.

10.4.6.8 Select "CIC/AXL CSCAN" to display a terrain plot of the desired area. An acceptable plot should be displayed. See figure 10.6.

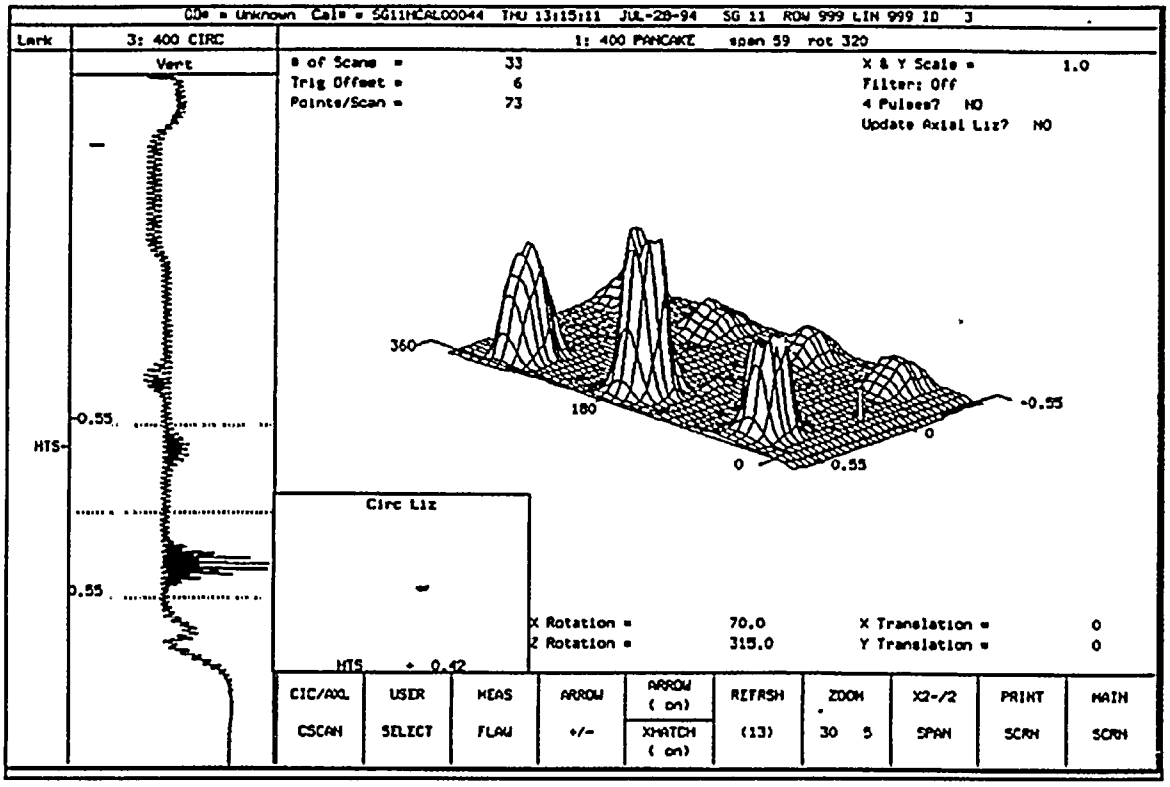



Figure 10.6

Example C-Scan Terrain plot of calibration standard

### 10.4.7 Clip Plot Set up

Use the 400 KHz pancake coil for initial set-up.

10.4.7.1 Select the "MEAS FLAW" menu.

10.4.7.2 Select "ADJUST CLIP" in the "0" box to adjust the clip level.

10.4.7.3 Click and drag the threshold line until the base line of the standard is slightly exceeded. See figure 10.7.

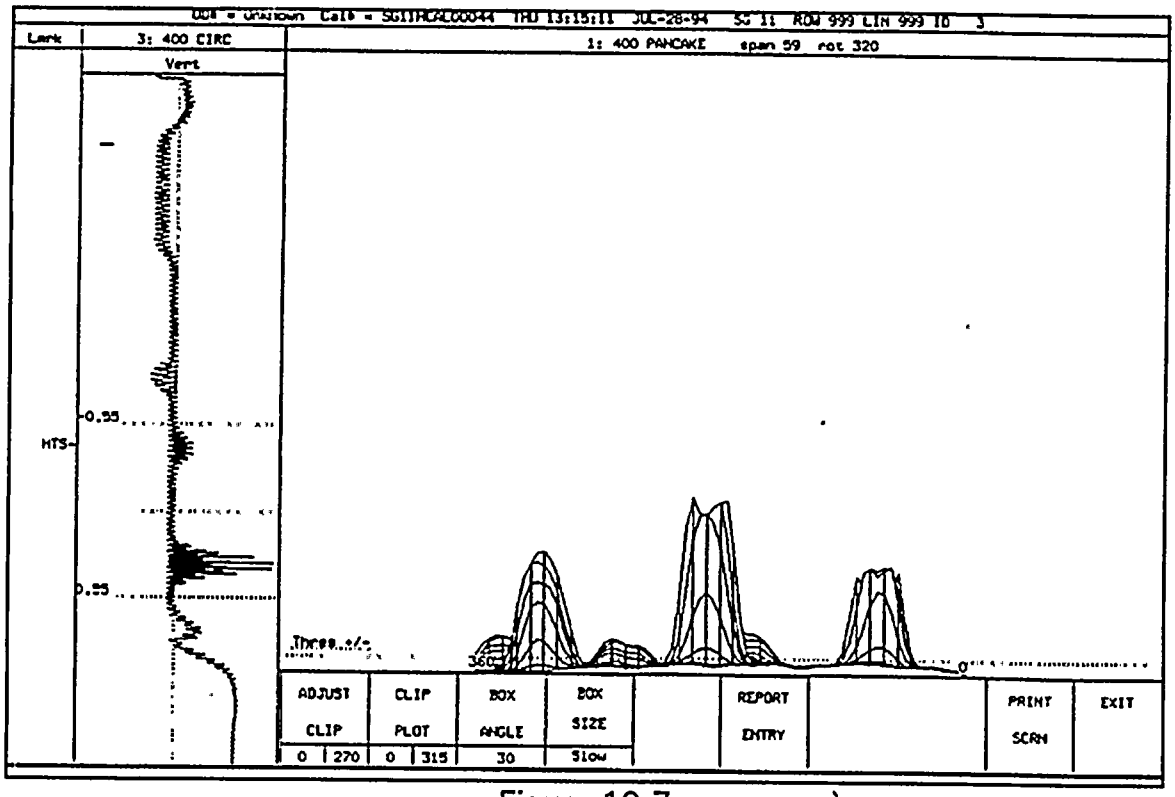



Figure 10.7

Adjustment of Clip Plot Threshold level

10.4.7.4 Select "CLIP PLOT" in the "0" box to display the clipped plot. This menu is also used to adjust a display box used to approximate indication size. See figure 10.8.

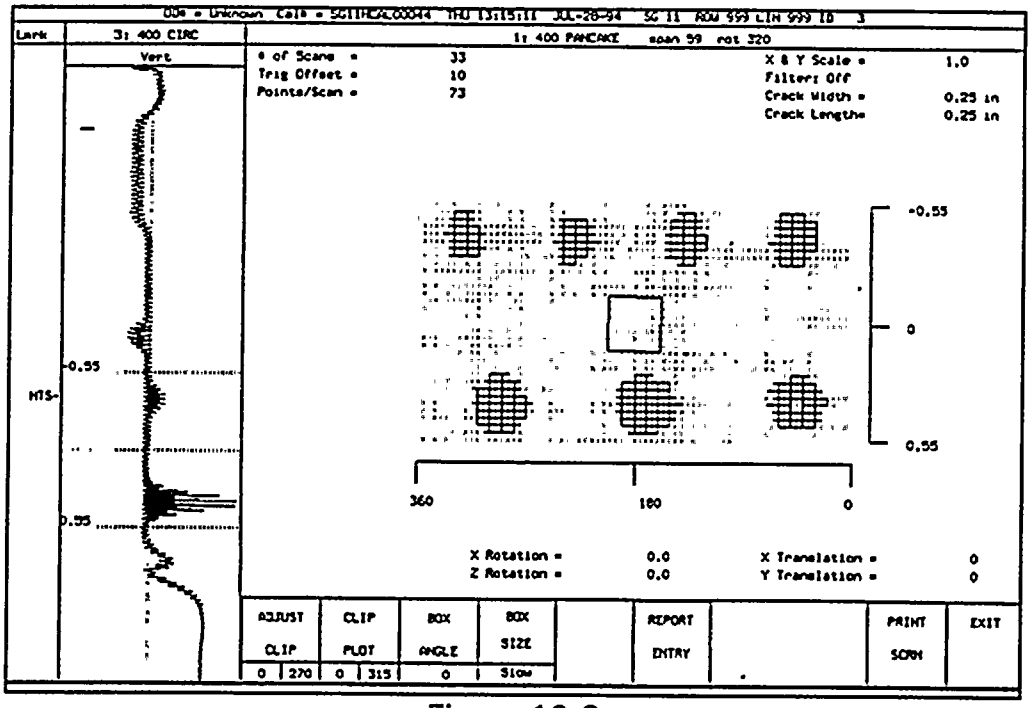



Figure 10.8

Clip Plot of ASME FBH's

The displays should appear round and uniform. If this is not the case, axial scale and tube diameter setting should be verified. Adjustment of the axial scale may be necessary for a desirable clip plot.

## 10.5 DATA SCREENING

All data observed on the strip charts and the lissajous will be evaluated. **A terrain plot of the entire strip chart will be performed to insure full evaluation of the entire length of data and area of interest.**

### 10.5.1 Strip Charts

10.5.1.1 Set the left strip chart to 400 KHz PAN vertical and the right strip chart to 100 KHz PAN vertical. Both of these should be at the set-up spans established previously.

10.5.1.2 If span settings seem inappropriate, consult the Senior Analyst for alternate setting acceptance.

### 10.5.2 Lissajous

10.5.2.1 Set the lissajous to 400 KHz PAN at the set-up span established previously. Final report values for voltage, depth, and axial position will be taken from this channel.

### 10.5.3 Use of Filters

10.5.3.1 A band-pass or other approved filtering method may be used to assist in flaw detection, however, initial screening must be accomplished without their use. *In no case* shall any measurements be taken from filtered data without permission from the Senior Analyst. See Table 10.1 for a summary of Single Coil MRPC set-up parameters.

## 10.6 EVALUATION

10.6.1 Initial Screening of the data will be performed at set-up span settings.

10.6.2 Check the 100 or 10 KHz strip chart for the presence of support structures and locate them manually with the appropriate names. See figure 10.9 for a typical Top-of-Tubesheet location.

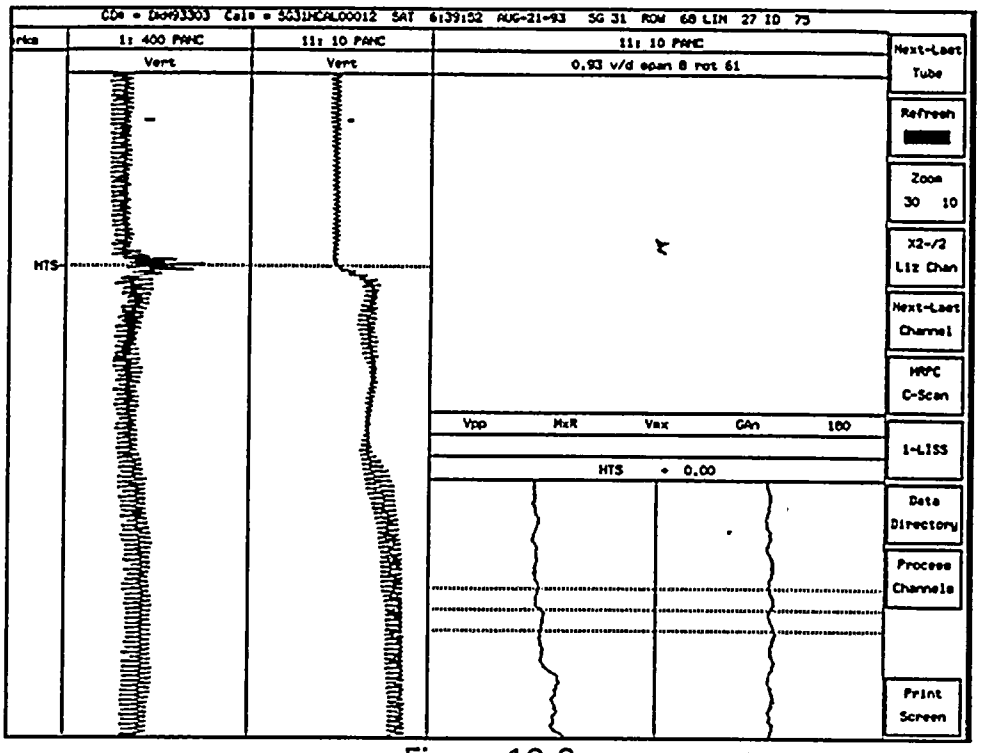



Figure 10.9
Locating structures

10.6.3 **A minimum of a pancake coil terrain plot of the entire strip chart will be performed to insure full evaluation of the entire length of data and area of interest Subsequent terrain plots with other frequencies and coils may be used to augment analysis.** See Appendix A for further details.

10.6.4 Suspect indications should be evaluated using lissajous, terrain plots and clip plots in order to determine whether the signal is of a flaw or deposit origin.

10.6.5 Record all indications in accordance with section 11.

## 10.6.6 Three - Coil MRPC Examination Calibration Parameters

| MRPC THREE - COIL ANALYSIS SUMMARY | | | | | | | |
|---|---|---|---|---|---|---|---|
| CHANNELS | | | | | | | |
| Channel | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Span | 5-6 div | 5-6 div | 5-6 div | 5-6 div | 5-6 div | 5-6 div | 5-6 div |
| Phase | PM Horiz | PM Horiz | PM Horiz | PM Horiz | PM Horiz. | PM Horiz | PM Horiz |
| Cal Std | 60% ASME | 60% ASME | 60% ASME | 60% ASME | 60% ASME | 60% ASME | 60% ASME |
| Curve | Degree | N/A | N/A | N/A | N/A | N/A | N/A |
| Volts | 60% - 5v | 60% - 5v | 60% - 5v | Norm. CH 1 | Norm. CH 2 | Norm. CH 3 | Norm. CH 1 |
| CHANNELS | | | | | | | |
| Channel | 8 | 9 | 10 | 11 | Mix 1 | | |
| Span | 4 div | 5-6 div | 5-6 div | 2 div | 5-6 div | | |
| Phase | vertical | PM Horiz | PM Horiz | CS Vert | PM Horiz | | |
| Cal Std | Trigger | 60% ASME | 60% ASME | Support ring | 60% ASME | | |
| Curve | N/A | N/A | N/A | N/A | N/A | | |
| Volts | N/A | Norm. CH 2 | Norm. CH 3 | N/A | Norm. CH 1 | | |

DATA SCREENING

**Left Strip Chart: 400 KHz PAN Vert** **Right Strip Chart: 100/10 KHz PAN Vert** **Liss.: CH 1 (400 KHz)**

Notes:
Above spans are a minimum for initial screening
Voltage normalized for each coil

RECORDING REQUIREMENTS

Graphics: Generated by Resolution unless otherwise indicated

Recording:

Channel 1: Degradation, NQI, POS

Table 10.1

Three -Coil Analysis Parameters

SECTION 11.0

MRPC Probe Recording Requirements and Acronyms

## 11.1 RECORDING NDD RESULTS

Tubes having no recordable indications are considered NDD tubes.

11.1.1 Graphic printouts will be generated as directed by the Lead or Senior Analysts.

11.1.3 Record a NDD result in the final report. Be sure to enter the proper extent according with the established recording format.

## 11.3 RECORDING FLAW INDICATIONS - SINGLE COIL - U-BEND DATA

*All suspect flaw-like signals shall be recorded* for further evaluation by the resolution team(s). If the data Analyst (Primary or Secondary) is unsure of a signal, orientation, etc., a POS acronym may be used to insure the indication is evaluated further.

11.3.1 Graphic printouts will be generated as directed by the Lead or Senior Analysts. See figures 11.1 - 11.3 for example graphics of single-coil MRPC displays.

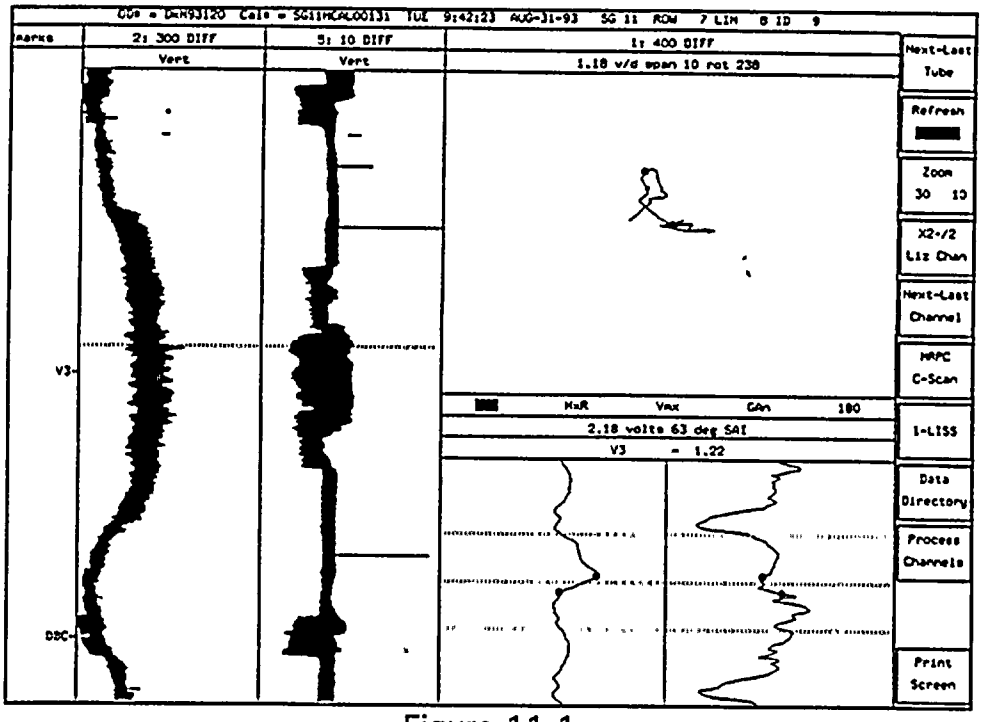



Figure 11.1
Example SAI Lissajous

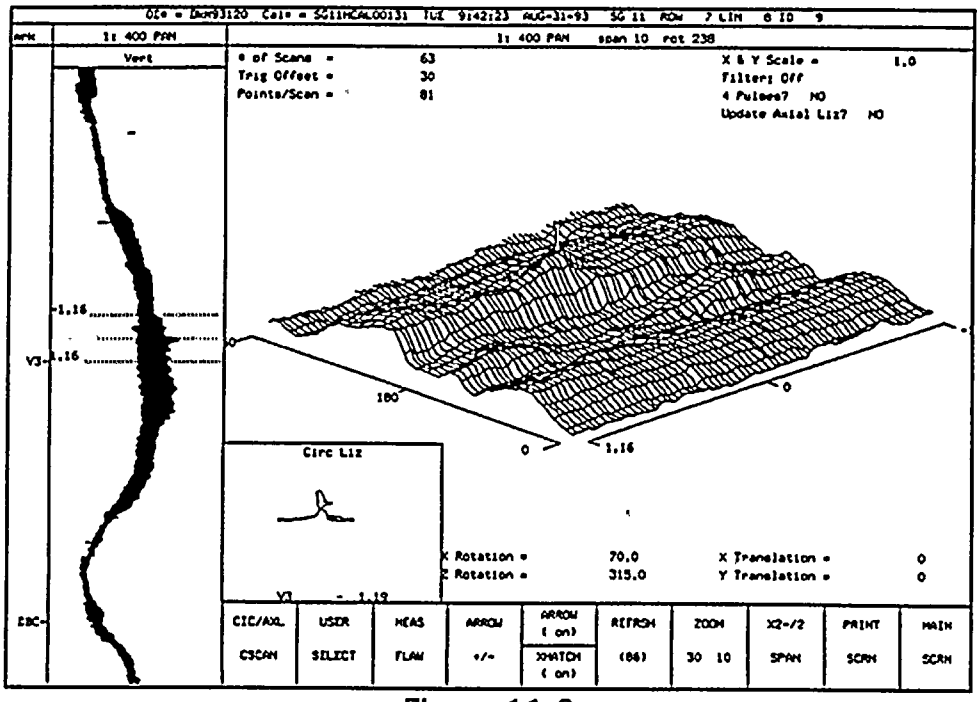



Figure 11.2
Sample SAI Terrain Map

11.3.2 Record the 400 KHz peak-to-peak results into the report, insuring the proper location, voltage and extent. See figure 11.3.

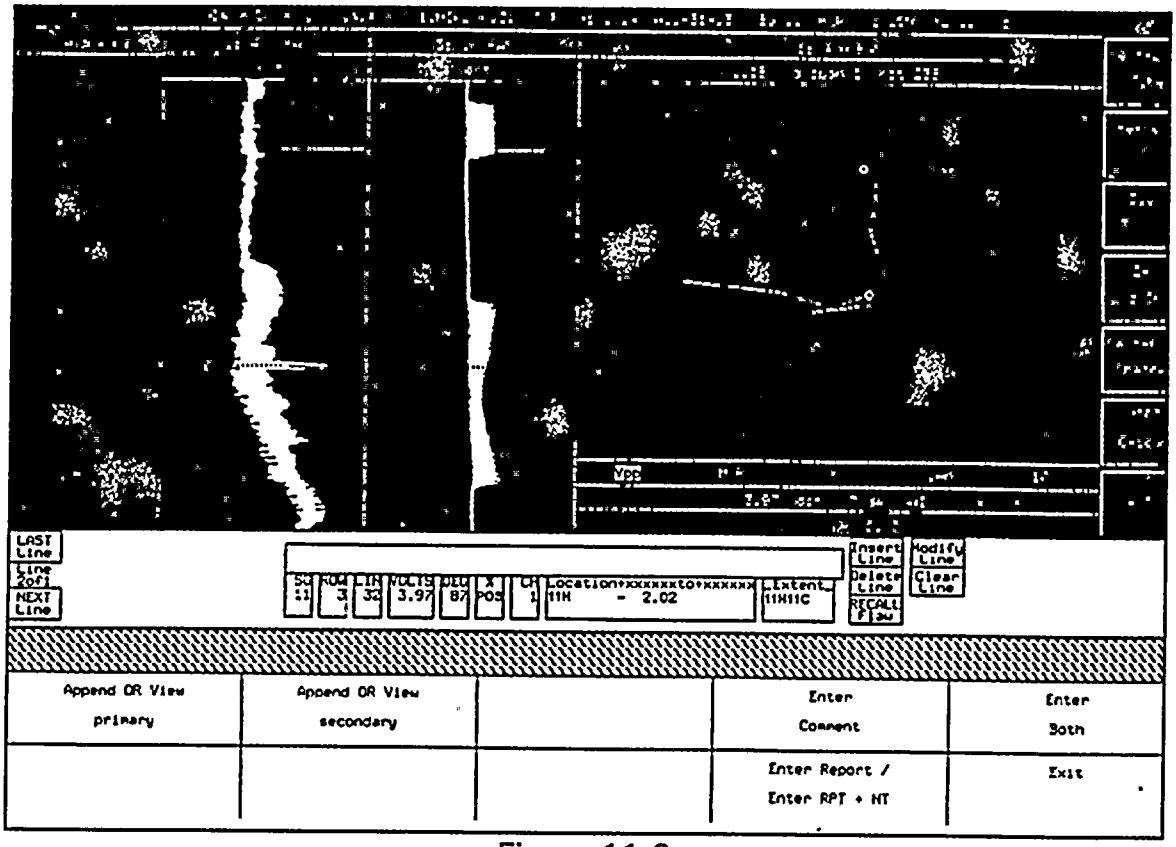



Figure 11.3
Example report entry for SAI flaw

11.3.3 Change the "%" column to the appropriate "POS", etc.

11.3.4 If multiple axial indications are located along the same plane, record the largest indication using "POS" in the "%" column.

11.3.5 Multiple axial indications along the axis of the tube should be recorded separately using "POS".

## 11.4 RECORDING FLAW INDICATIONS - THREE COIL - Top-of-Tubesheet DATA

*All suspect flaw-like signals shall be recorded* for further evaluation by the resolution team(s). If the data Analyst (Primary or Secondary) is unsure of a signal, orientation, etc., a POS acronym may be used to insure the indication is evaluated further. See Appendix A for further details.

11.4.1 Graphic printouts will be generated as directed by the Lead or Senior Analysts. See figures 11.4 - 11.9 to follow.

11.4.2 Record the 400 KHz peak-to-peak results into the report, insuring the proper location, voltage and extent.

11.4.3 Change the "%" column to "POS".

11.4.4 If multiple circumferential indications are located along the same plane, record the largest indication using "POS" in the "%" column.

11.4.5 Multiple circumferential indications along the axis of the tube should be recorded separately using "POS".

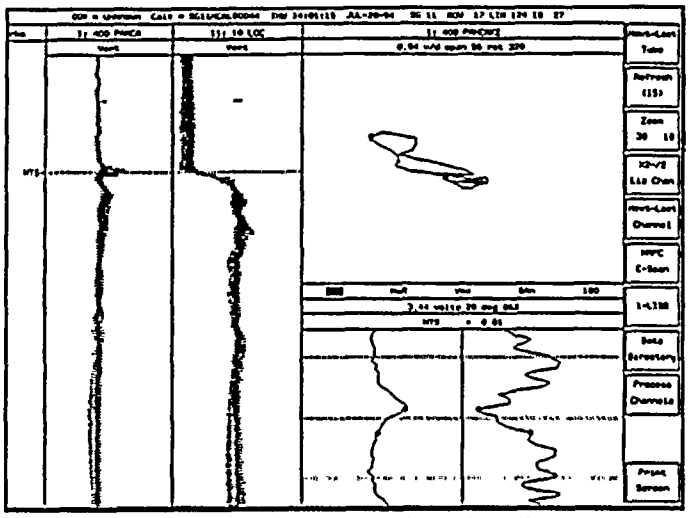


Figure 11.4 - Pancake Lissajous

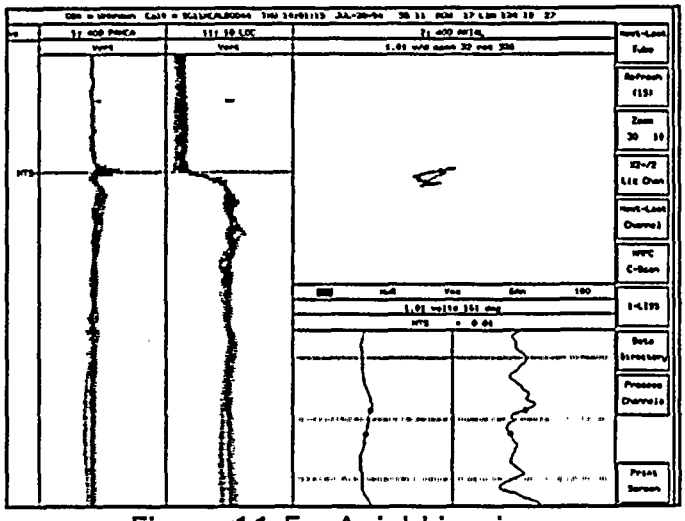


Figure 11.5 - Axial Lissajous

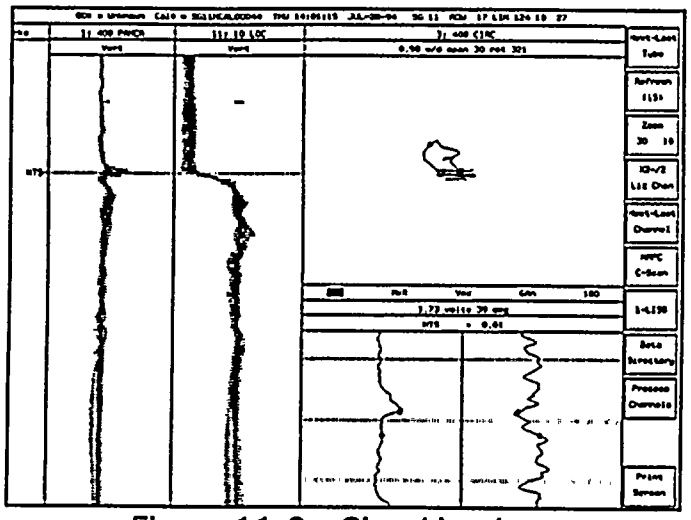


Figure 11.6 - Circ. Lissajous

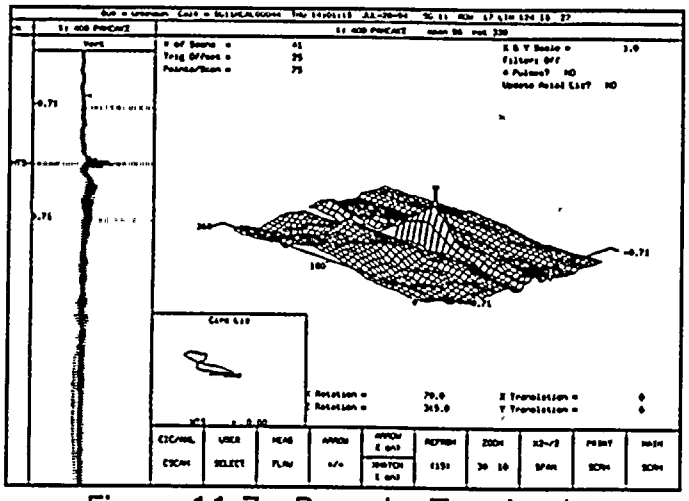


Figure 11.7 - Pancake Terrain plot

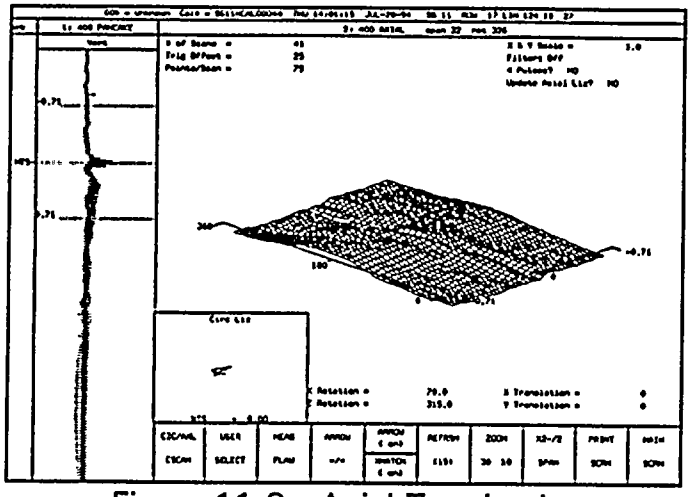


Figure 11.8 - Axial Terrain plot

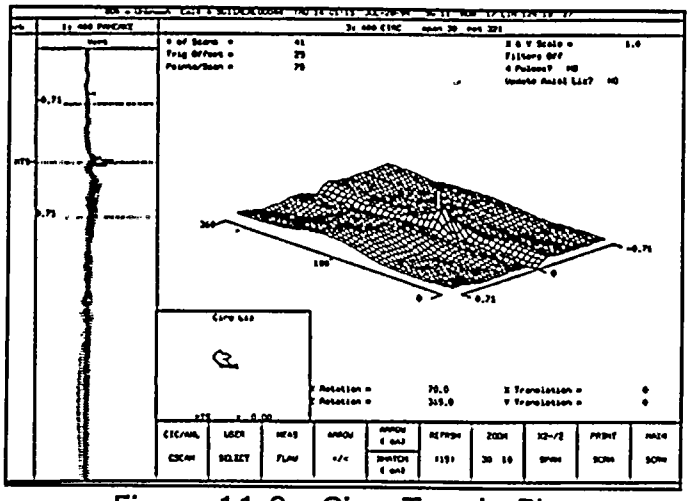


Figure 11.9 - Circ. Terrain Plot

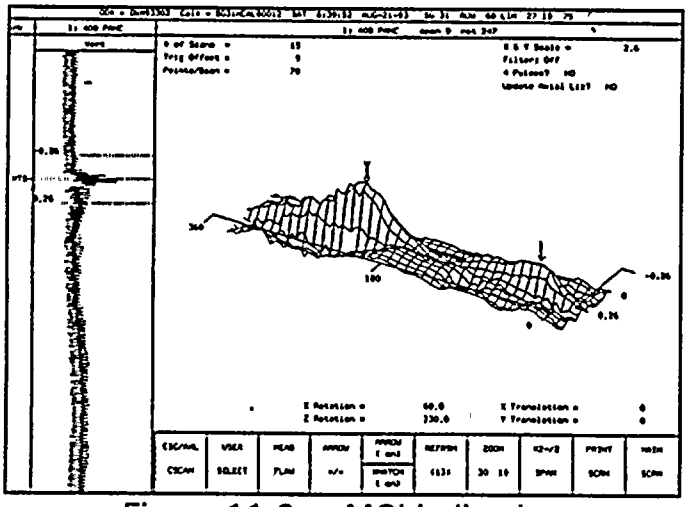


Figure 11.9c - MCI indication

## 11.5 RECORDING FLAW INDICATIONS - THREE COIL - Support Intersection DATA

*All suspect flaw-like signals shall be recorded* for further evaluation by the resolution team(s). If the data Analyst (Primary or Secondary) is unsure of a signal, orientation, etc., a NQI acronym may be used to insure the indication is evaluated further.

11.5.1 Graphic printouts will be generated as directed by the Lead or Senior Analysts. See figures 11.10 - 11.16 to follow.

11.5.2 Record the 400 KHz peak-to-peak results into the report, insuring the proper location, voltage and extent.

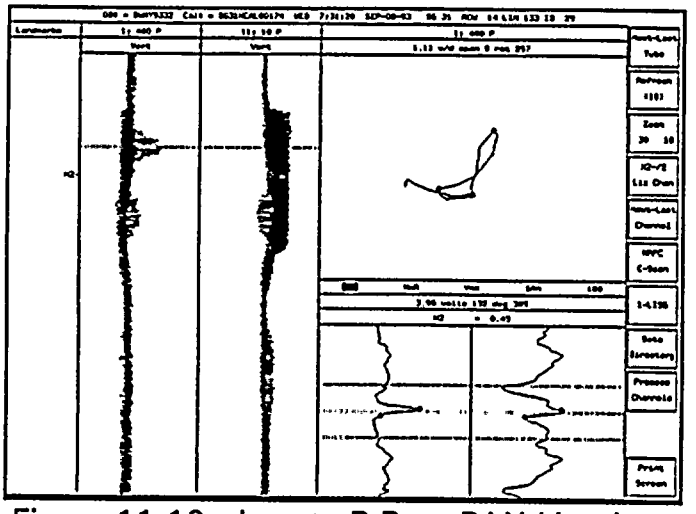


Figure 11.10 - Locate P-P on PAN Lissajous

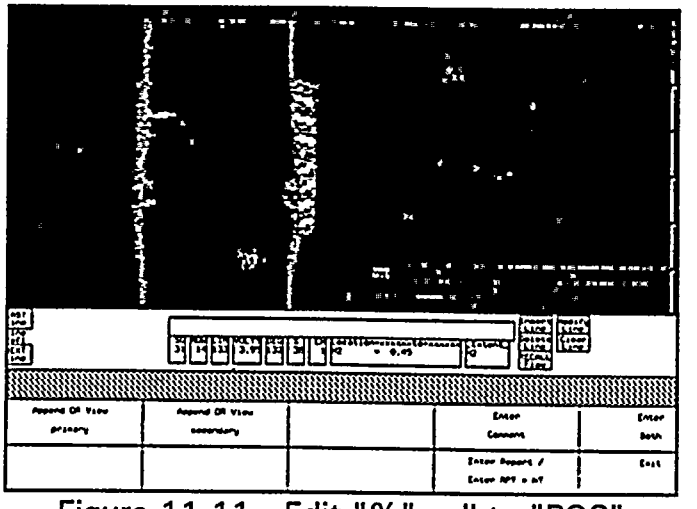


Figure 11.11 - Edit "%" call to "POS"

11.5.3 Change the "%" column to the appropriate "POS", "SAI", "MAI", etc.

11.5.4 If multiple axial indications are located along the same plane, record the largest indication using "POS" or "MAI" in the "%" column.

11.5.5 Multiple axial indications along the axis of the tube should be recorded separately using "POS" or "SAI".

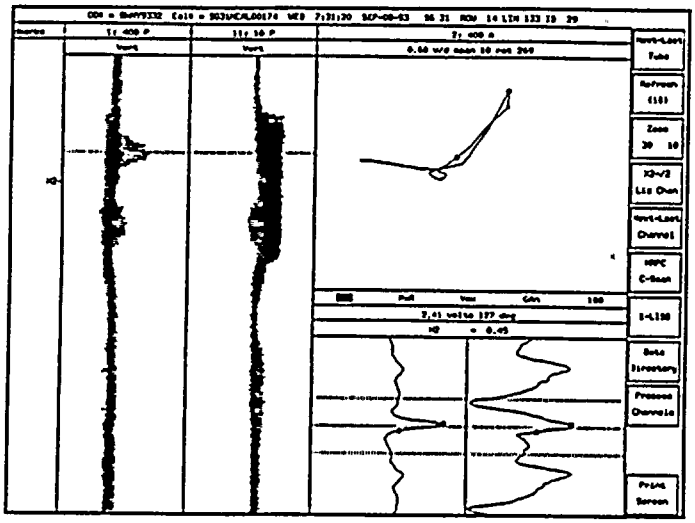


Figure 11.12
Axial Lissajous for Support Flaw

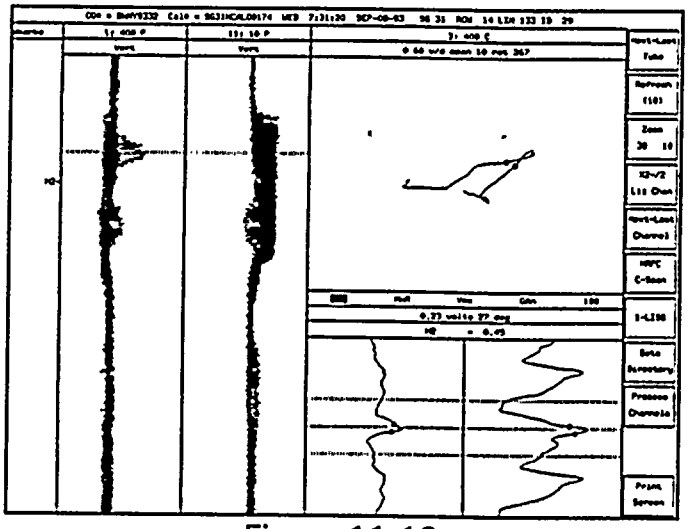


Figure 11.13
Circ. Lissajous for Support Flaw

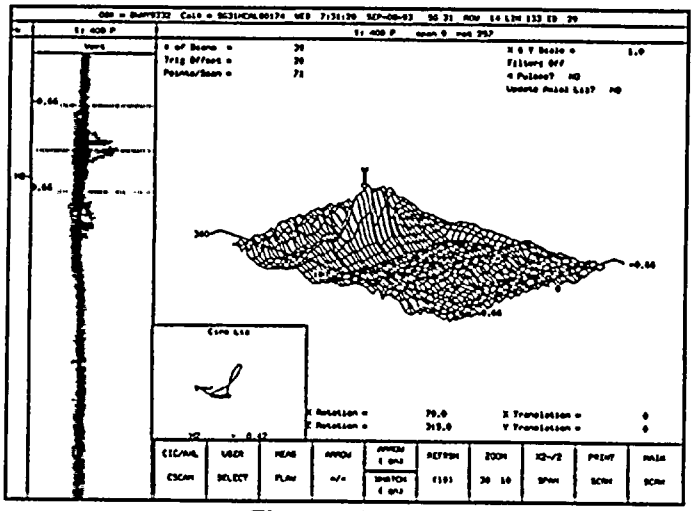


Figure 11.14
Pancake Terrain Plot of Support Flaw

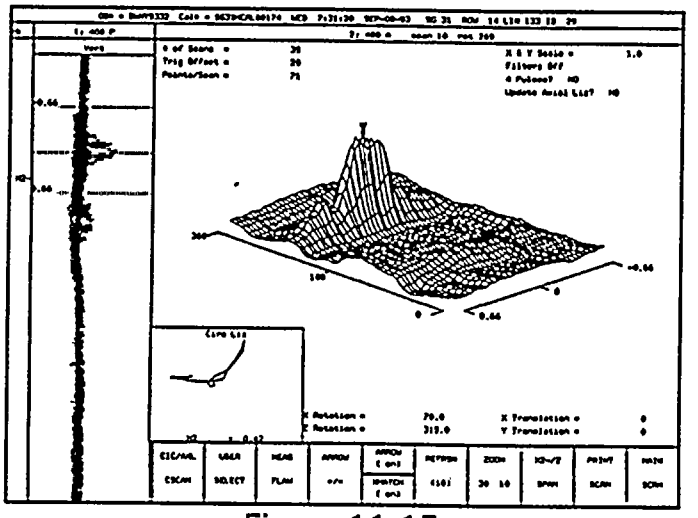


Figure 11.15
Axial Terrain Plot of Support flaw

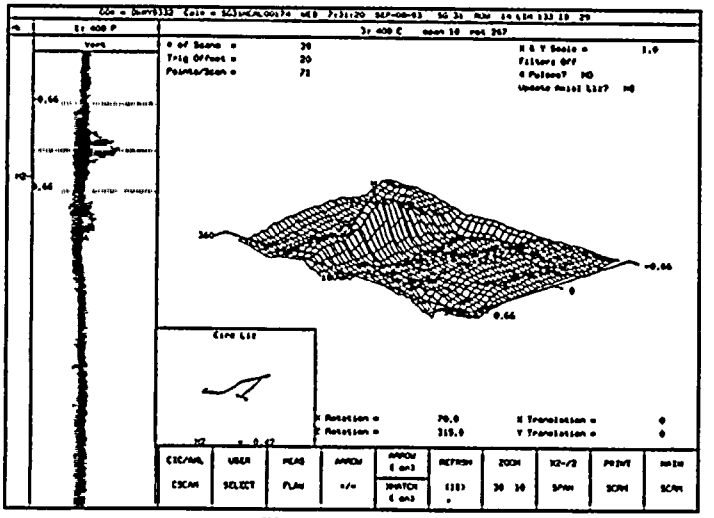


Figure 11.16
Circ. Terrain Plot of Support Flaw

## 11.6 Final Report

The following information (subject to changes by data management) will be recorded in the final report section of the data analysis program.

11.6.1 The Header information should be recorded using the report builder software in Eddynet. The header should contain the same information as for bobbin data. See section 7.1 for details.

11.6.2 For each tube evaluated with no indications an entry must be made that contains the SG ID (from Acquisition), Row, Line and Extent.

11.6.3 For each indication evaluated an entry must be made that includes the SG ID, Row, Line, Volts, Degrees, Percent depth or acronym, Location and Extent.

11.6.4 For any restricted or incomplete tubes, the correct retest (R__ code) acronym should be placed in the percent column, and the last tested extent in the Extent column.

11.6.5 No blank lines should appear on the report.

11.6.6 Messages may be inserted within the body of the report as required. The Analyst's signature and data shall accompany every page of the printed report. See figure 7.2.

## 11.7 Reporting Acronyms

The acronyms listed below are used in the percent column of the Final Report to describe a particular condition for MRPC results. Other acronyms may be used as listed in the Bobbin Probe Section (7.2) or as directed by the Senior Analyst or Utility representative.

| Acronym | Condition |
|---|---|
| SAI | Single Axial Indication |
| MAI | Multiple Axial Indication - more than one indication in the same axial plane |
| SCI | Single Circumferential Indication |
| MCI | Multiple Circumferential Indication - more than one indication in the same circumferential plane |
| POS | POSsible Indication - Used to flag an indication for Lead Analyst review |
| PIT | Acronym to describe a volumetric indication indicating a pit-type flaw |

## 11.8 Data Anomalies

The Analyst should be aware of data quality anomalies which may occur during the acquisition of eddy current data. Certain equipment failures, electrical noise interference, etc., can cause data which is unacceptable and must be re-acquired. The following figures show several examples of data anomalies which should be flagged as RBD or Retest for Bad Data.

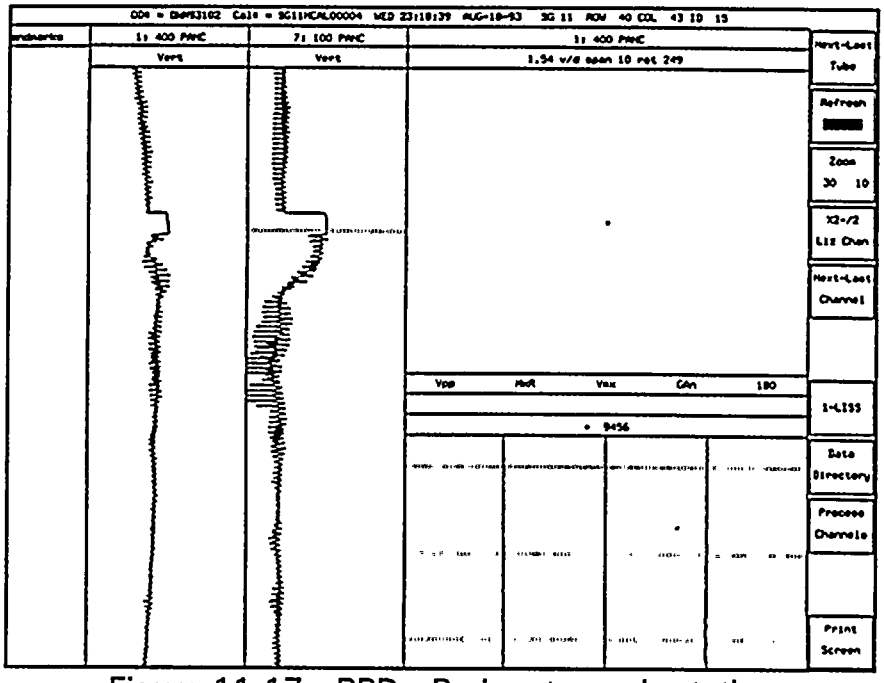



Figure 11.17 - RBD - Probe stopped rotating

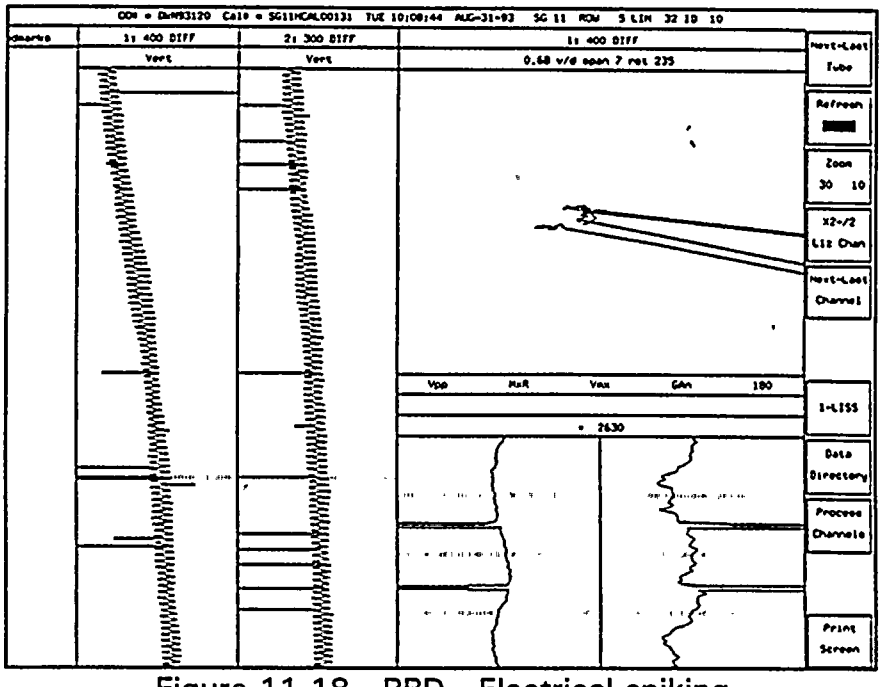



Figure 11.18 - RBD - Electrical spiking

# SECTION 12.0

# MRPC PROBE RESOLUTIONS

## 12.1 Conditions Requiring Resolution

12.1.1 If either the Primary or Secondary Analyst or both reports a **flaw indication as SAI, MAI, SCI, MCI, POS, NQI or LAR,** a Lead Analyst shall review the data tape, resolve the discrepancy or verify the results and document and sign off on the results of this review.

12.1.2 If either the Primary or Secondary Analyst or both reports an unresolved signal indication, the Lead Analyst shall review the bobbin test data tape, determine the nature of the indication, (i.e. flaw, no flaw, geometry, etc.) size the indication (if a flaw), document and sign off on the results of the review. If the indication cannot be classified as a non-flaw, it shall be considered to be a flaw, and sized accordingly, except as discussed below

If definitive data from other special tests (e.g. Ultrasonics, Liquid Penetrant) are available, this data may be used to resolve the status of the unresolved signal indication.

12.1.3 If, during the course of the resolution review, a Lead Analyst overrules <u>any</u> defect call (i.e., changes a repairable call by the Primary Analyst, Secondary Analyst, or both to a non-repairable call), or changes an unresolved signal indication to a <40% equivalent through wall flaw or to no flaw, then the reason for overruling shall be recorded. The Lead Analyst must then analyze all data from that tube for additional defects. A second Lead Analyst is required to review the pertinent data and acknowledge his concurrence by signing the Final Report.

When concurrence between the two Lead Analysts cannot be reached, the most conservative resolution of the discrepancy shall be taken. In either case, both Lead Analysts are required to sign the Final Report.

12.1.5 Other discrepancies such as inconsistent extent of test, inconsistent calibration identification, etc., shall be resolved by data review if necessary. All resolutions and data modifications should be performed by Lead Analysts, except as defined in paragraph 8.1.6.

12.1.6 The Senior Analyst may designate types of "Administrative" errors which the Primary or Secondary Analysts or the Lead Data Management Operator/Systems Administration personnel will be allowed to resolve.

12.1.7 Table 12.1 provides a listing of error conditions.

12.1.8 Table 12.2 provides a listing of discrepancy conditions.

## 12.2 Resolution Documentation

The following steps shall be used in resolving errors and discrepancies between Primary and Secondary analysis results:

12.2.1 The analyst will correct errors by using the Resolution analysis selection of the Eddynet software. Results and the final report will be generated separately from the Primary or Secondary results, although the Primary or Secondary report may be appended for non-resolved calls.

12.2.2 A "Compare Report" will be issued by the Eddynet compare program, or other approved vendor data management software listing discrepant conditions. This report will be used to document the Lead Analyst edits to the Final Report.

12.2.3 If no discrepant conditions occur between Primary and Secondary analysis, there may be not compare report generated.

12.2.4 The Lead Analyst will use the appropriate data and compare reports when resolving discrepancies.

12.2.5 The Lead Analyst will indicate when the Primary or Secondary or both analysis results are accepted without resolution be annotating the compare report with "PS" for primary call stands or "SS" for secondary call stands.

12.2.6 If the Primary or Secondary call is correct except for a change of one or more parameters in the call, the annotation "PC" for primary call change or "SC" for secondary call change may be used.

12.2.7 The Lead Analyst shall annotate "FC" for Final resolution Call if the resolved answer is different from the Primary Analyst, Secondary Analyst or both. See figure 12.1 for an example of a typical compare report.

```
Dec 14 15:22 1994      /tmp/.../       Page 1


 ser1
nd25bb26.nd25bb26.diskless
/rod0101/primary/SG31HCAL00173  VS.  /rod0101/secondary/SG31HCAL00173

FIELD SELECTION:

VOLTAGE            NO
PHASE ANGLE        NO
PERCENTAGE         YES    +/-  10
LOCATION           YES    +/-  0.50
 -ranges           YES    +/-  0.50
CHANNEL            YES    No Tolerance

LOWER PERCENTAGE THRESHOLD   <   20

UPPER PERCENTAGE THRESHOLD   >   40

FIELD 6 SUPPRESSION :

FIELD 6 HIGHLIGHT    : SAI MAI SCI MCI POS NQI LAR

NUMBER OF ENTRIES ON THIS PRINTOUT =    7

*********************************

 31   6 113                                                    C6      pri
 31   6 113  2.47 205 SAI   1 V3      +  1.96                 C6      sec

 31   6 123  1.49 160 PID   1 V3      +  0.67                 C6      pri
 31   6 123  5.87   0 SAI   1 V3      +  1.40                 C6      sec

 31   6 127                                                    C6      pri
 31   6 127  1.70 125 SAI   1 V3      +  3.04                 C6      sec
 31   6 127 21.21  15 SAI   1 V3      -  2.39                 C6      sec
```

PS

SS

SC

Figure 12.1

Typical Primary/Secondary Analysis Compare Report

12.2.8 The Lead Analyst should thoroughly review <u>all</u> available data on each tube for which a discrepancy is identified. All results should be listed under the Lead Analyst's name in the Resolution final report.

12.2.9 As specified in section 7, if the 1st Lead Analyst dispositions a greater than 40% flaw or undefined type signal to a less than 40% flaw, a 2nd Lead Analyst must review the data. The second Lead Analyst acknowledges his concurrence by signing the Final Report.

Whenever concurrence in resolution cannot be reached, the most conservative call shall be retained. If the result is that a ≥40% or an undefined type indication is resolved to less than 40%, the reason must be specified on the Discrepancy Compare Report.

12.2.10 A Lead Analyst may not act as the 1st Analyst in resolving his own analysis results if he also acted as an Analyst (Primary or Secondary) for a particular calibration group. He may, however, assume the role of a 2nd Lead Analyst during resolution.

TABLE 12.1

## DATA RECORDING ERROR CONDITIONS

1. The reported steam generator identification is something other than "1", "2" or "3".
2. The SG identification does not agree with the SG identification code in the calibration number.
3. The reported tube does not exist
4. The reported row number is something other than 1 through 49.
5. The reported column number is something other than 1 through 114.
6. Missing probe or calibration designation
7. The reported flaw location is beyond the reported extent of the test.
8. Extents of test and flaw elevations which do not conform with the fact that there are eleven tube supports and four AVB's in the Shearon Harris Steam Generators.
9. The reported test extent is incorrect.
10. The extent of test in not reported.
11. Tubes reported as restricted or incomplete which do not have a corresponding extent of test.
12. Use of a three-letter reporting acronym with no established definition.
13. The final report header is not in the correct columns.
14. A plugged tube is reported as tested.

Table 12.2

## RECORDING DISCREPANCIES BETWEEN DATA ANALYSIS

1. Either the Primary Analyst or Secondary Analyst or both reports a flaw as SAI, MAI, SCI, MCI or LAR.

2. Either the Primary Analyst or Secondary Analyst or both reports an anomalous indication (i.e., NQI, POS, etc.) in which the data suggests a reasonable probability that a flaw exists.

3. One Analyst reports a tube not reported by the other Analyst.

   NOTE: Flaw locations reported by primary and secondary analysts must be within 0.5 inches of each other to be considered the same flaw.

4. The reported test extents are not in agreement.

5. The reported calibration identifications are not in agreement.

6. The reported steam generator identifications are not in agreement.

7. The reported probe entry sides are not in agreement.

8. The three-letter reporting acronyms are not in agreement.

## 12.3 Resolution Reporting

The resolution final report will be generated when all resolutions from the compare report are complete. The resolution header should contain the same information as the Primary or Secondary Analyst as indicated in section 7.

12.3.1 The Lead analyst should log in to the Eddynet software using the "RESOLUTION" analyst function. This process allows the compare process to be activated, and allows editing of the primary and secondary results into the resolution or "final" results.

12.3.2 Edits will be made during the compare process as documented in section 12.2.

12.3.3 When all compare edits are completed, the final report should be generated using the "BUILD REPORT" menu. The Lead analyst should select "APPEND PRIMARY" and "REPORT ALL USERS" to insure all entries are built into the report, including un-edited primary results[11].

12.3.4 The Lead analyst should check all entries on the compare report vs. the compiled final report to insure all resolutions were addressed.

12.3.5 The final report shall be signed by the Lead Analyst. If a resolution required another Lead Analyst, a second signature shall be included on the final report.

[11]If special circumstances arise, Secondary results may be appended rather than Primary. The Senior Analyst should be contacted for any changes.

## 12.4 Resolution of Three-Coil Indications

The three-coil probe offers information valuable in resolving indications which are difficult to quantify due to extraneous noise of various types. This section is intent to be a guide to assist the Lead Analyst in resolving certain three-coil data indications.

As indicated in the SG History in the forepart of this document, similar plants have experienced PWSCC Circumferential cracking at the top-of-tubesheet transition. Because of the geometry of the tube transition, edge of the tubesheet itself, and other secondary side phenomena, possible ID indications are sometimes difficult to detect and quantify. The following examples should assist the Lead Analyst in data resolution.

12.4.1 A Circumferential ID indication will appear on the Lissajous display of the Pancake coil and Circumferential coil, but should be diminished on the Axial coil. See figures 12.2 - 12.4

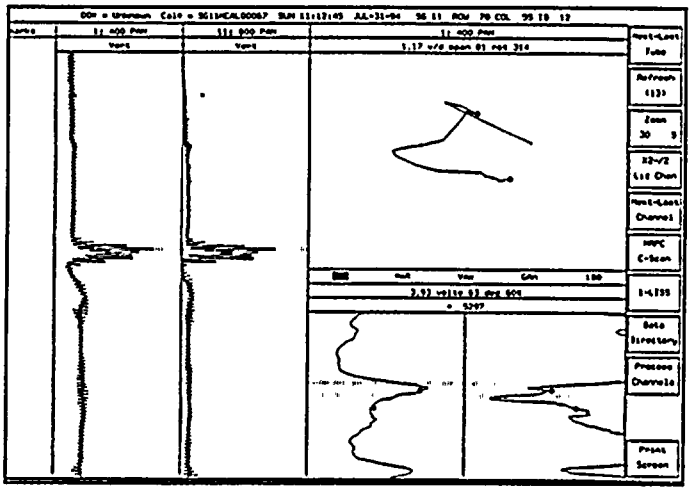


Figure 12.2 - Circ. Crack - 400 KHz PAN Lissajous

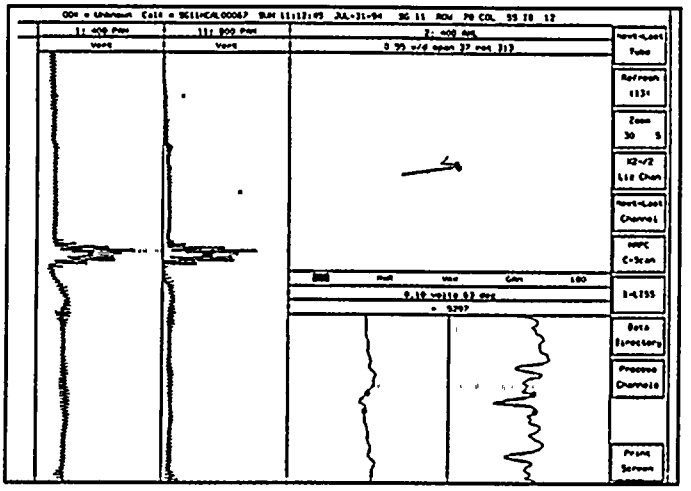


Figure 12.3 - Circ. Crack - 400 KHz AXL Lissajous

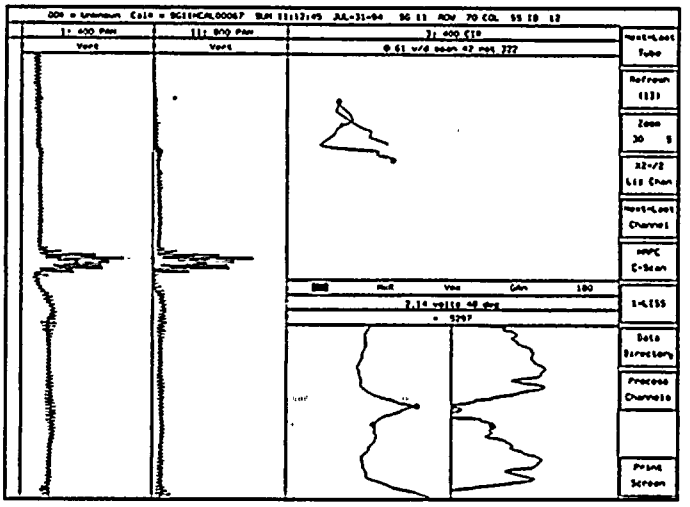


Figure 12.4
Circ. Crack - 400 KHz Circ. Lissajous

12.4.2 Likewise utilizing the terrain plot, the same relation as described in paragraph 12.4.1 is true. See figures 12.5 - 12.7.

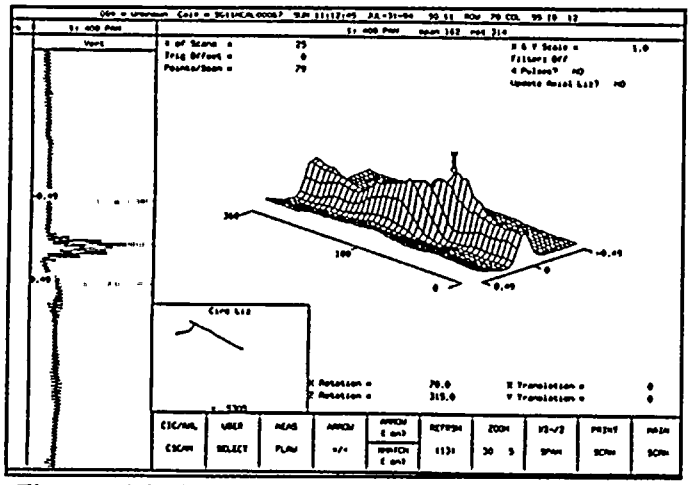


Figure 12.5 - Circ. Crack - PAN Terrain plot

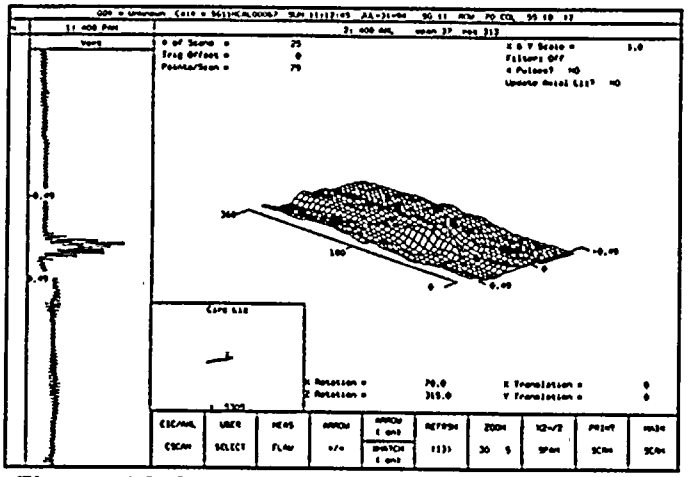


Figure 12.6 - Circ. Crack - AXL Terrain plot

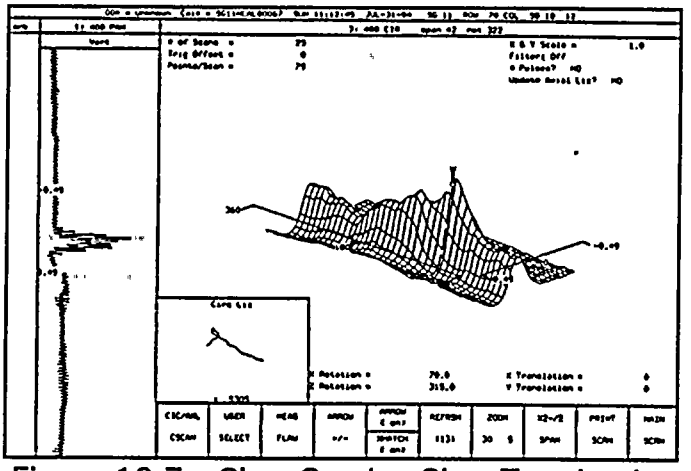


Figure 12.7 - Circ. Crack - Circ. Terrain plot

With other indications, the 3-coil relationship is not as defined. Other parameters must be used to define a flaw-like signal from geometry or other anomalies. One method which gives a good indication the signal is indeed a crack versus geometry, is to compare the voltage ratio between the circumferential coil and the axial coil. It is important that the correct voltage set-up is used to validate the results of this method.

12.4.3 After verifying the correct voltage set-up for the calibration group the Analyst is resolving, scroll the indication for the largest signal on the pancake coil.

12.4.4 With the coil rotation enabled (coil 5 at 120 and coil 7 at 240), go to the axial coil and note the voltage peak-to-peak. If the correct data points are not highlighted by the measuring points, reset to the proper data points.

12.4.5 Repeat step 12.4.4 for the circ. coil. If the voltage of the circ. coil is at least 2/1 between that of the axial coil, it is evident that the indication is likely to be a flaw, and not geometry. See figures 12.8 - 12.9.

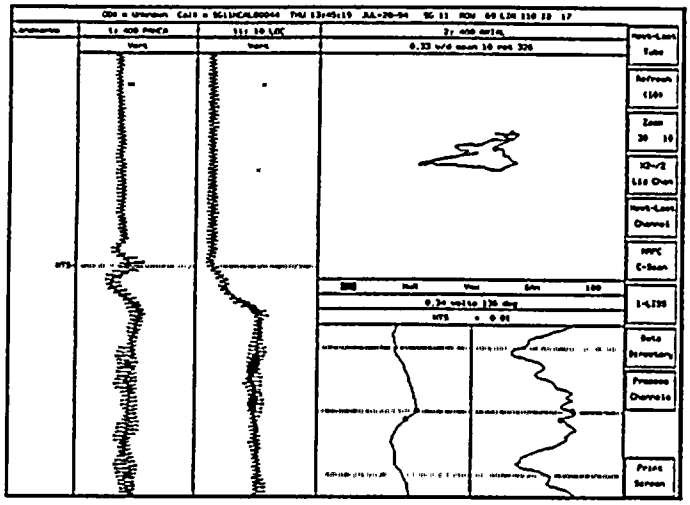


Figure 12.8
Axial voltage of potential Circ. indication

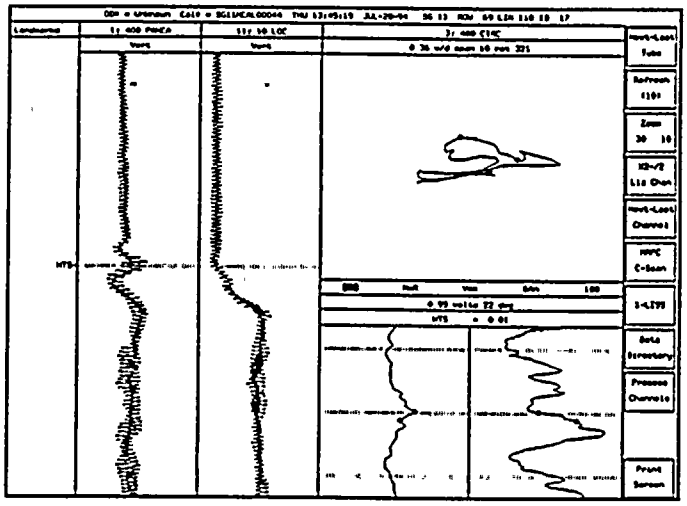


Figure 12.9
Circ. voltage of potential Circ. Indication

Figure 12.8 shows a voltage of 0.34v on the axial lissajous, and figure 12.9 shows a voltage of 0.95v. This is a ratio of approximately 3/1.

Another method to assist in determining the validity of an indication, is to view the terrain plots; PAN, AXL & CIR for the indication in question. If the circumferential terrain plot is well defined, or shows a "rough edge" rather than a smooth transition, it is likely the indication is from a crack and not geometry.

12.4.6 Set the span settings to reference spans set during calibration, or insure the axial and circumferential coil spans are somewhat equal if reference spans are inappropriate.

12.4.7 View the PAN, AXL, and CIR terrain plots. If the PAN and CIR plot show a defined crack-like signal, and the AXL does not, you may determine the indication to be a flaw, and not geometry. See figures 12.10 - 12.12.

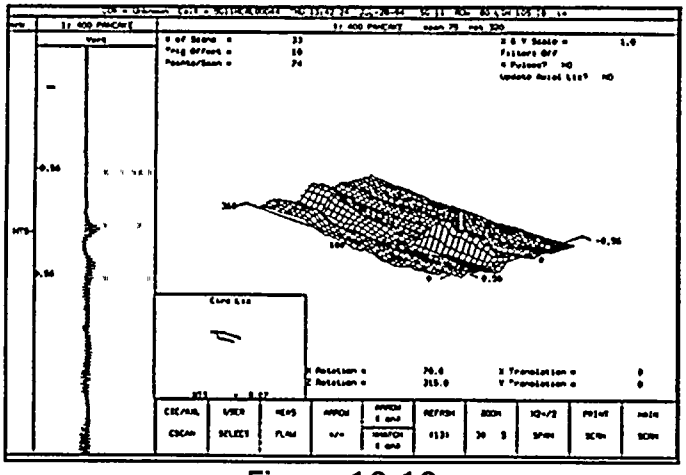


Figure 12.10
PAN Terrain Plot

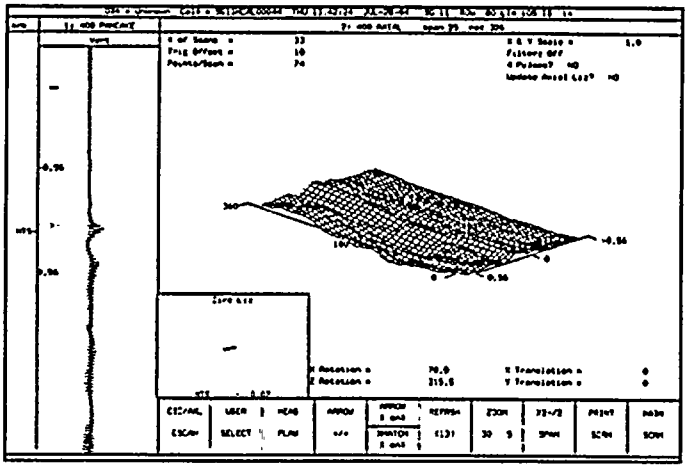


Figure 12.11
AXL Terrain plot

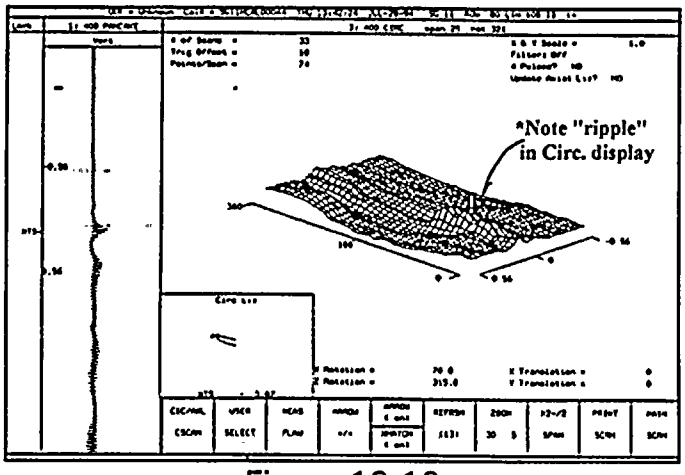



Figure 12.12
CIR Terrain Plot

12.4.8 Historical data for indications should be reviewed to determine if a change has occurred. If no apparent change has occurred, and the indication is minimal with a poor voltage ratio and display, it can be determined the indication is geometry or another anomaly.

# APPENDICES

A. Supplemental Westinghouse plant Information

B. Computer Data Screening

C. Performance Demonstration

# APPENDIX A

## SUPPLEMENTAL WESTINGHOUSE PLANT INFORMATION

Substantial effort has been put into this guideline to insure a complete analysis of the eddy current data for detection steam generator degradation as early as possible. In the past, this has not always been achievable, due to rapid flaw growth and other extenuating circumstances.

**It is imperative that all suspect indications be reviewed. If the analyst is unsure of any indication, it should be brought to the attention of the Lead or Senior analyst for further disposition.**

The following examples show an indication from a plant which was not recorded during a scheduled inspection. The Indication grew rapidly and leaked under an in-situ hydro test. Even though the indication did not follow normal frequency phase correlation between channels, and no response on the mix channel, it grew into a recordable indication before the next scheduled cycle inspection. The analyst must use other information present in the data to disposition such an indication. This information is present as follows:

Figure A1 shows the 400 KHz Pancake coil indication during it's final stages, prior to leak testing and subsequent plugging. This indication is a circumferential crack at the top-of-tubesheet roll transition.

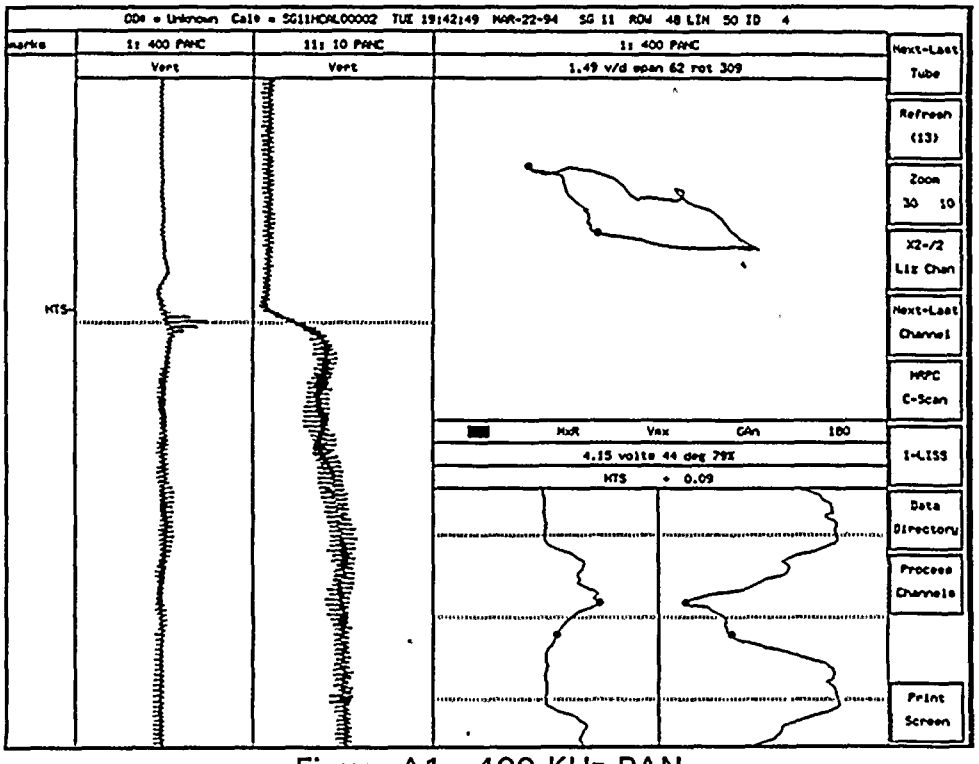



Figure A1 - 400 KHz PAN

Figure A2 - A3 show the Axial and Circumferential lissajous display of the same indication in Figure A1. Note the relation between the three coils.

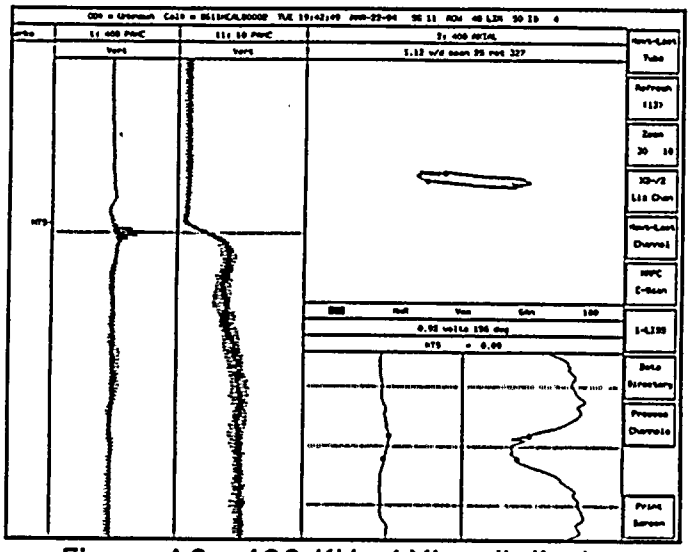


Figure A2 - 400 KHz AXL coil display

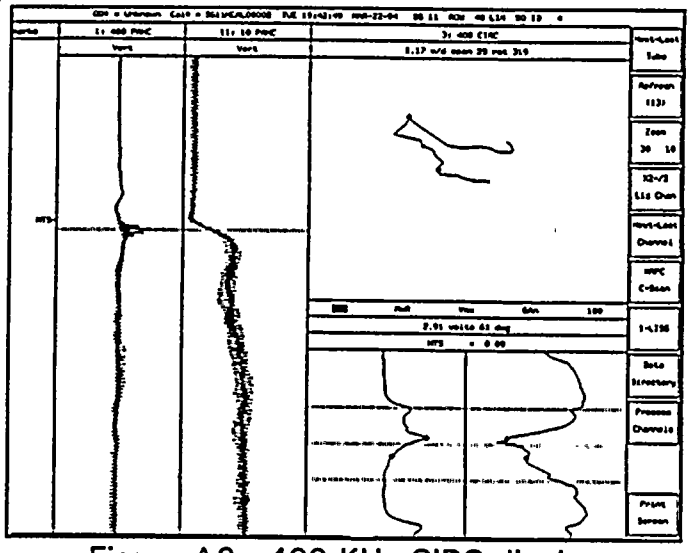


Figure A2 - 400 KHz CIRC display

Figure A4 shows the frequency phase relation between the pancake coils for the same indication in figures A1 - A3. Note the signal on the mix channel also.

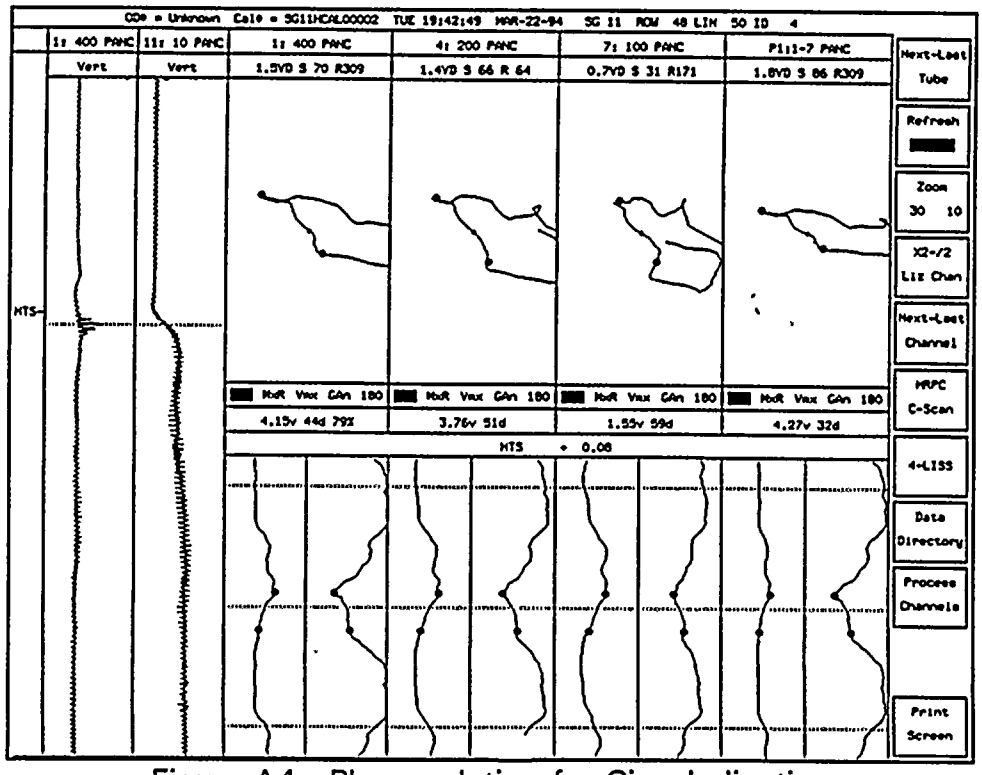



Figure A4 - Phase relation for Circ. Indication

Figures A5 - A7 show the Terrain plot for the indication shown in Figures A1 - A4. Note the relationship between coils for the Circumferential indication.

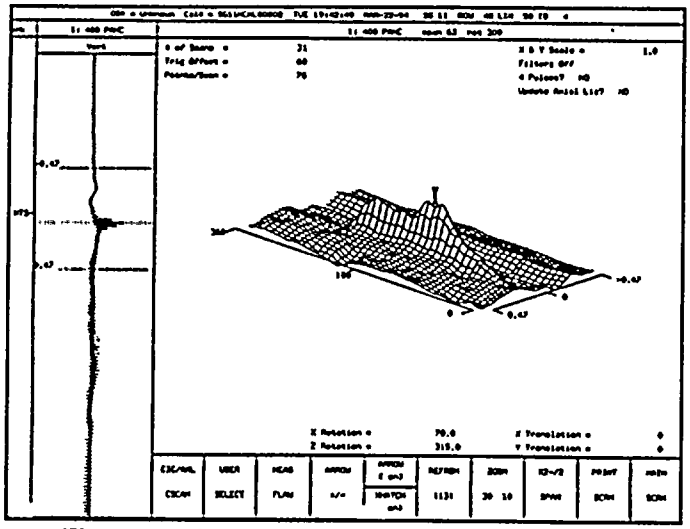


Figure A5 - 400 Khz PAN Terrain plot

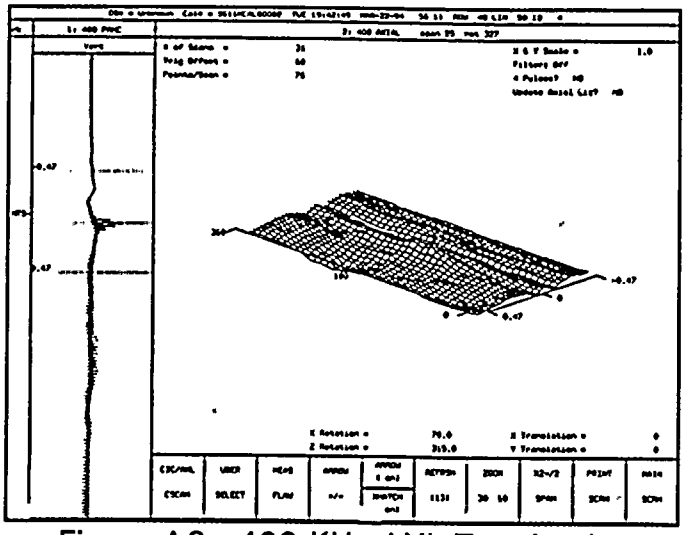


Figure A6 - 400 KHz AXL Terrain plot

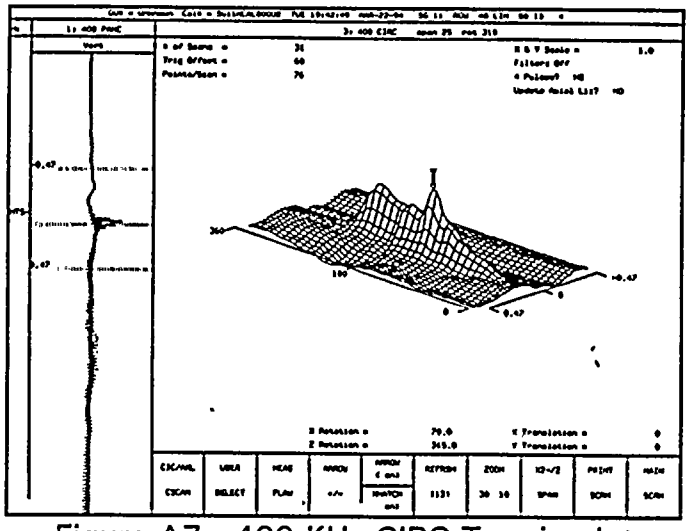


Figure A7 - 400 KHz CIRC Terrain plot

Figure A8 - A10 shows the Lissajous display for the same indication during the previous inspection outage in which it was not recorded. Note the diminished display and ambiguity of the signal on the three coils.

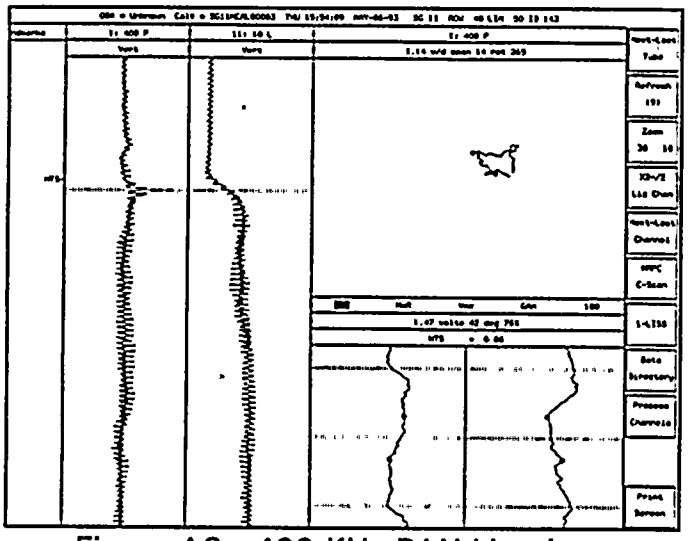


Figure A8 - 400 KHz PAN Lissajous

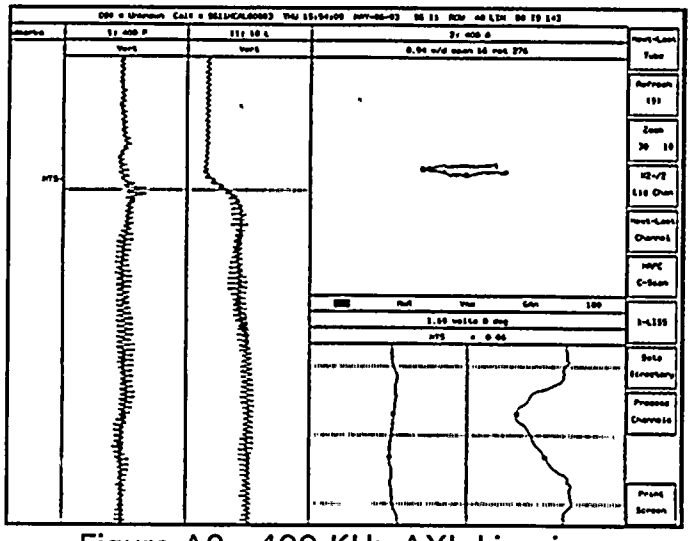


Figure A9 - 400 KHz AXL Lissajous

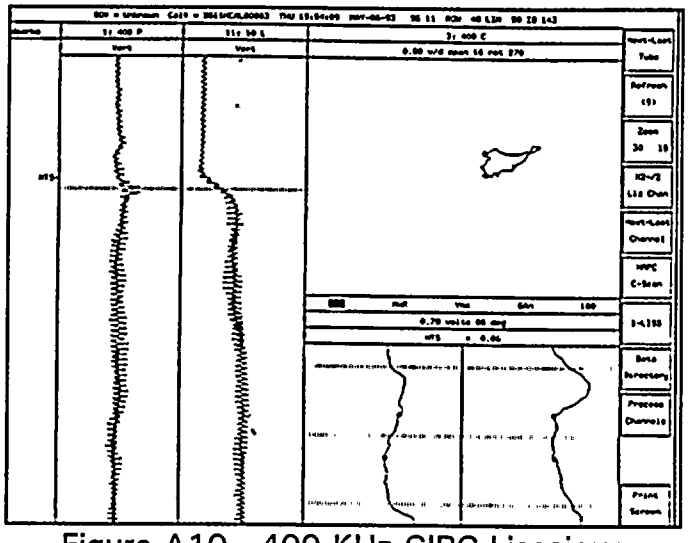


Figure A10 - 400 KHz CIRC Lissajous

Similar signals are noted in the area above the top-of-tubesheet, which are assumed to be deposit indications.

Figure A11 shows a poor correlation between pancake coil frequencies, and literally no indication on the mix channel. This type signal may lead the analyst to believe the indication is a deposit, geometry, or combined non-flaw signal.

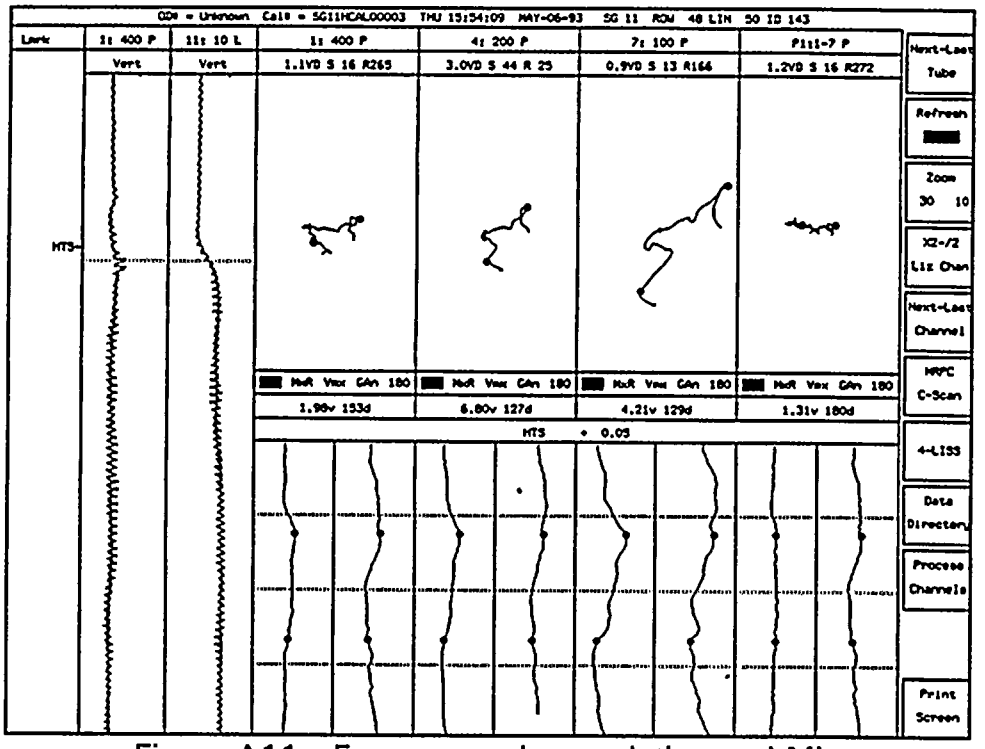



Figure A11 - Frequency phase relation and Mix

Figure A12 shows the Terrain plot of the pancake coil mix channel, indicating a non-flaw signal.

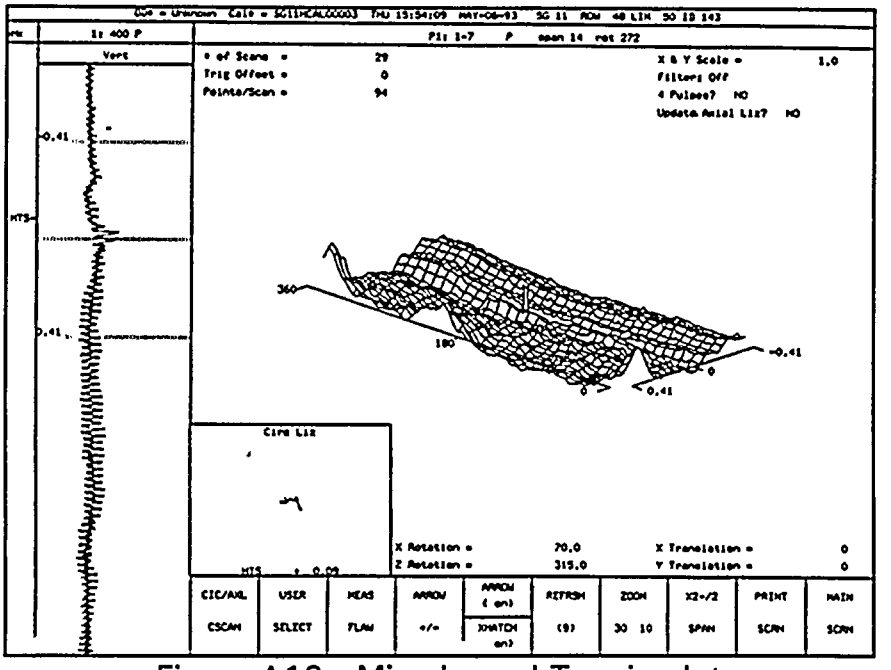


Figure A12 - Mix channel Terrain plot

The next figures show an indication which was resolved as non-reportable during a regular refuel outage. Less than one year later, the flaw had grown significantly. It is important to report this type of flaw signal at its early stages.

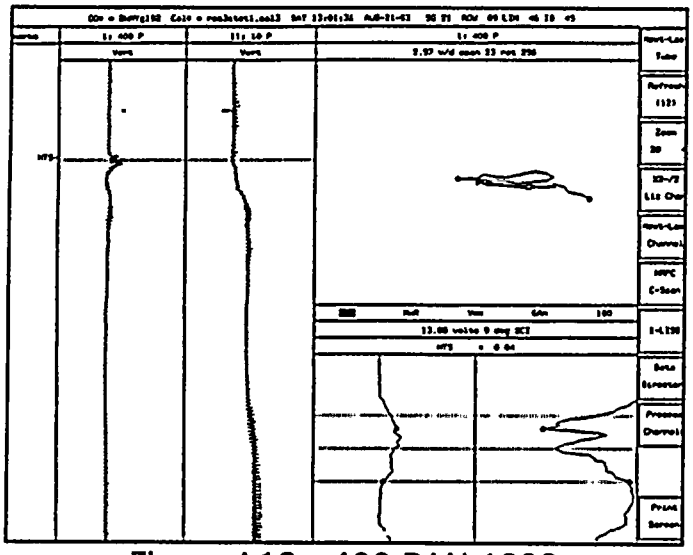


Figure A13 - 400 PAN 1993

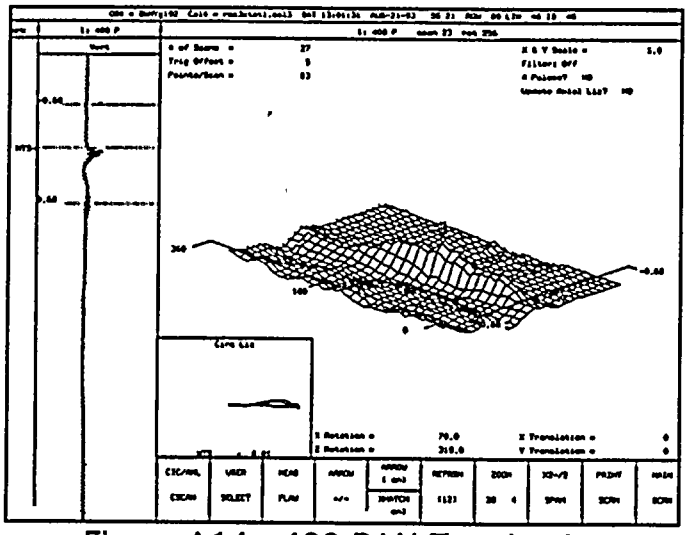


Figure A14 - 400 PAN Terrain plot

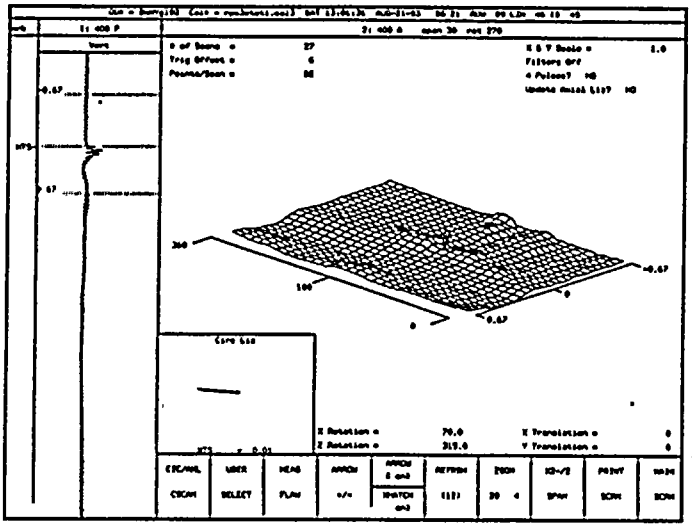


Figure A15 - 400 AXL Terrain plot

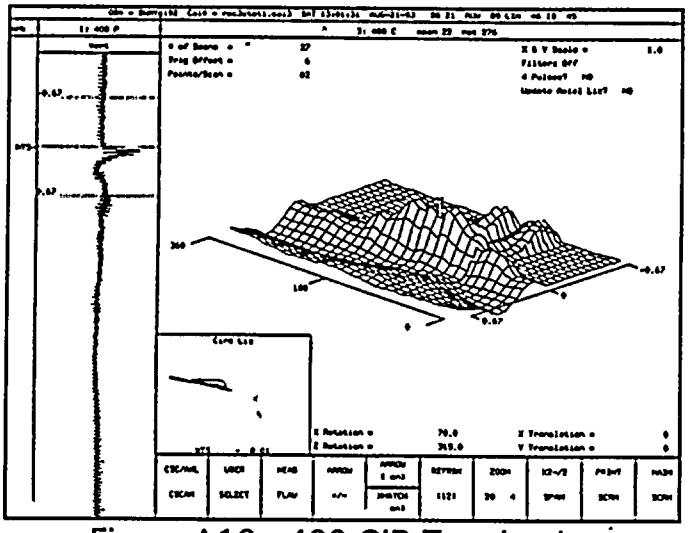


Figure A16 - 400 CIR Terrain plot

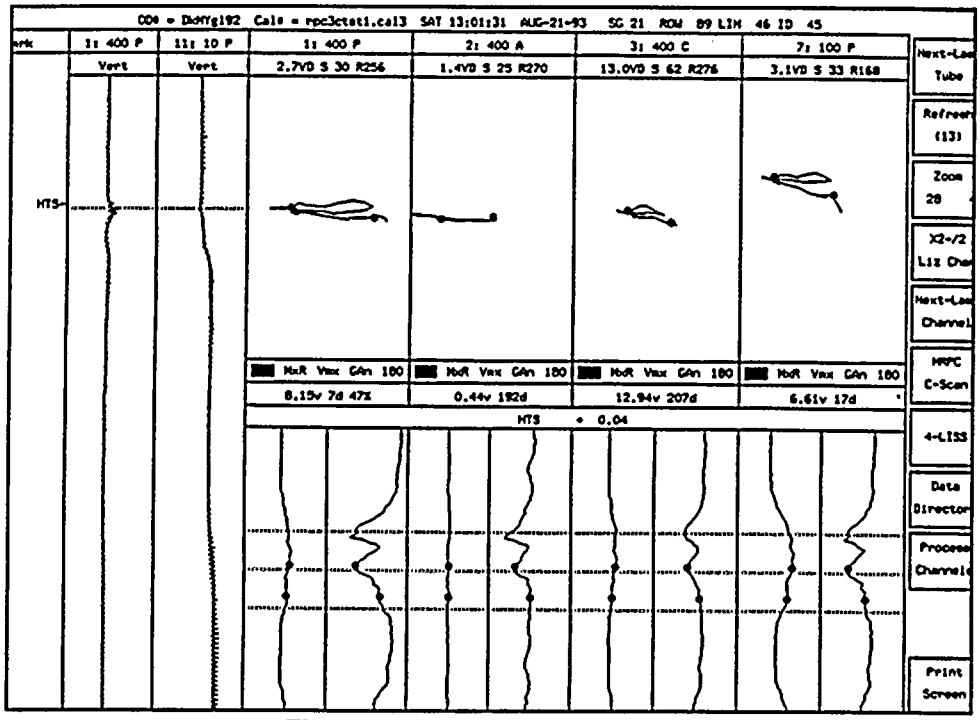



Figure A17 - 4 LISS display

The next set of figures is the same flaw less than one year later. This shows a much larger signal, and the need to report the indication as soon as it is detectable.

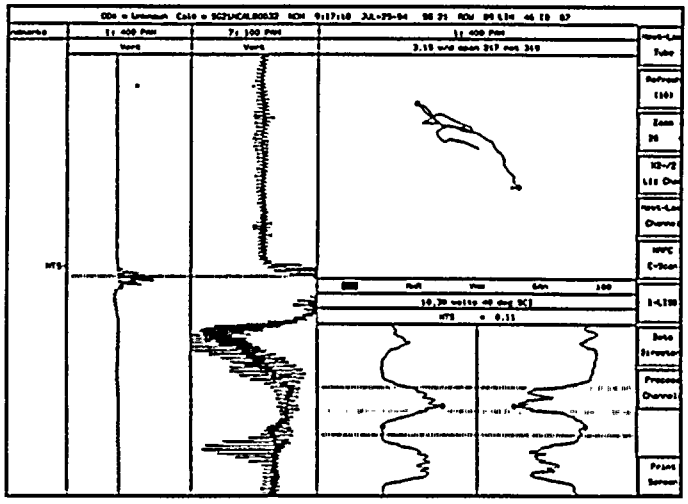


Figure A18 - 400 PAN Lissajous

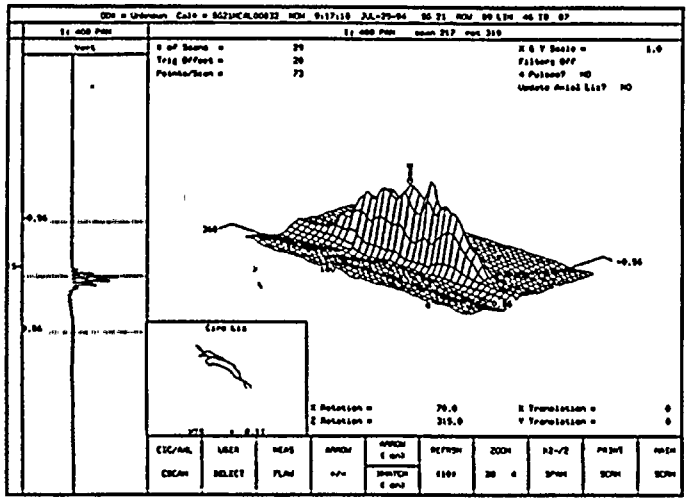


Figure A19 - 400 PAN Terrain plot

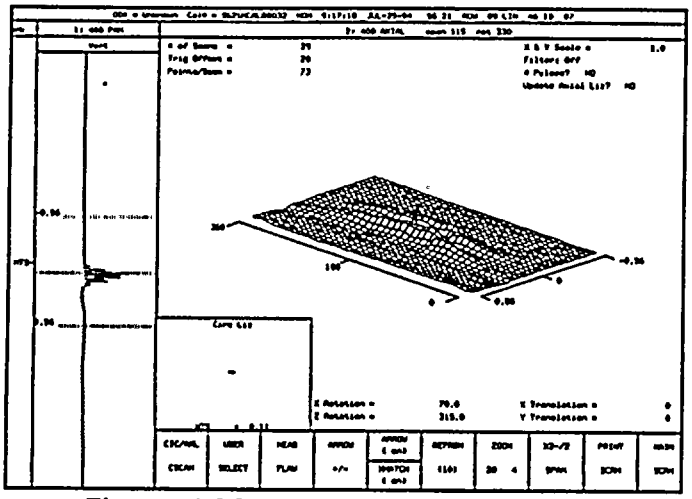


Figure A20 - 400 AXL Terrain plot

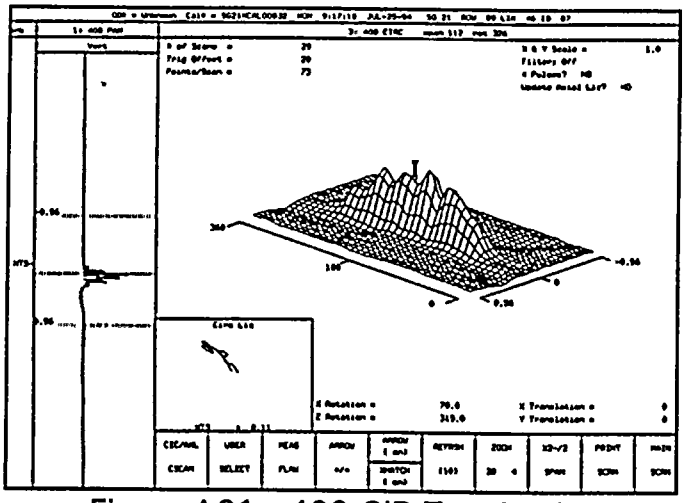


Figure A21 - 400 CIR Terrain plot

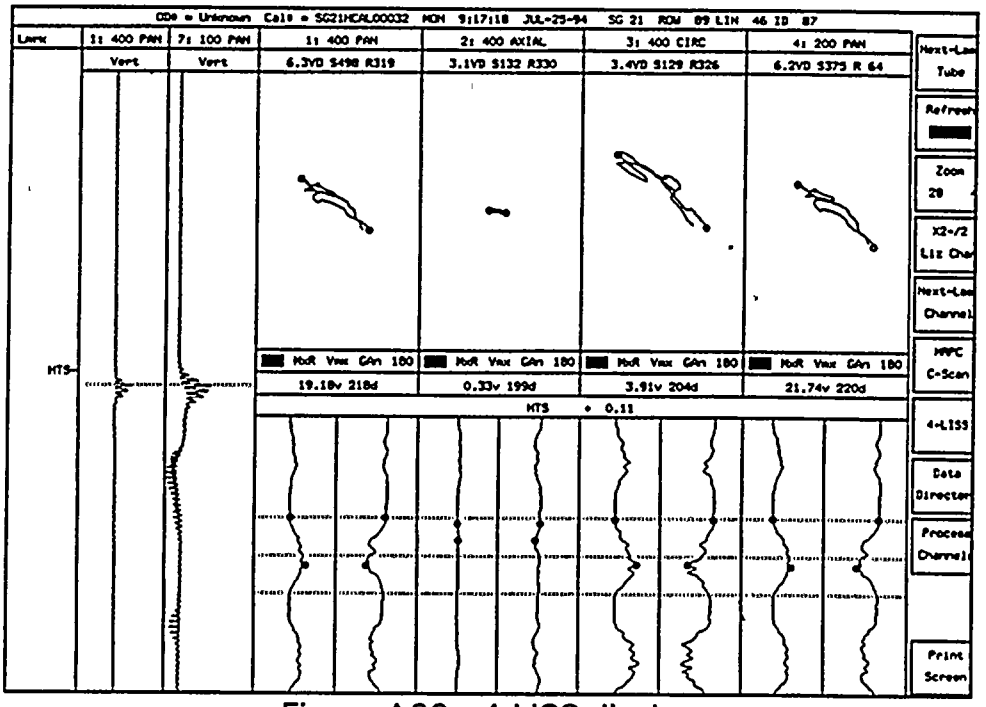



Figure A22 - 4 LISS display

The span settings for the previous plots were adjusted to fit on the display. You will note a large difference between the latter graphics and the original graphics for the same indication. The size is not only much larger, but the increase in phase angle is also apparent.

Because of the previous information shown, it is possible for the analyst to conclude the indication is not reportable. However, as previously mentioned, this indication rapidly became a reportable pluggable flaw. The analyst must use other information to review the indication to insure it is reported, therefore allowing the Lead analysts to review the indication using historic as well as other information to disposition the indication.

Upon reviewing the Terrain plots for the indication in question, the analyst will clearly see a "ridge" indication, following the circumference of the tube, in the expansion transition. This type of indication, although diminished as it is, should be reported for further disposition. See Figures A23 - A25.

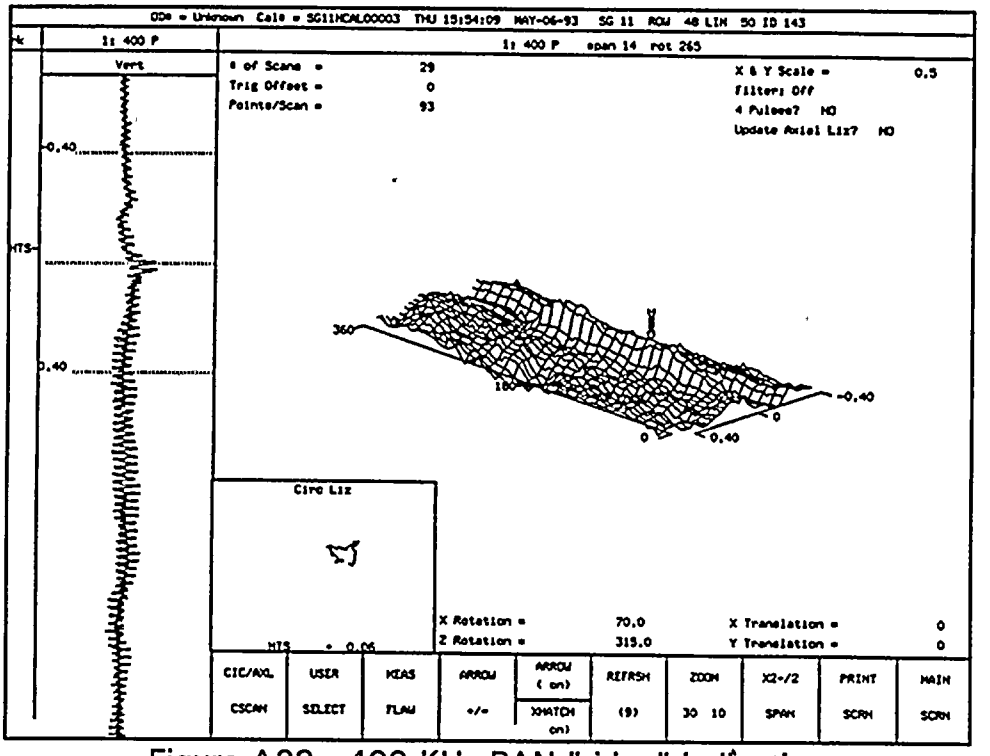


Figure A23 - 400 KHz PAN "ridge" indication

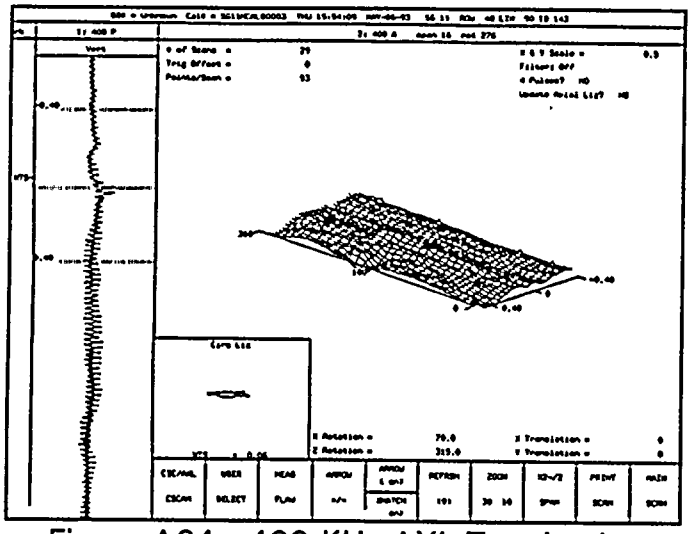


Figure A24 - 400 KHz AXL Terrain plot

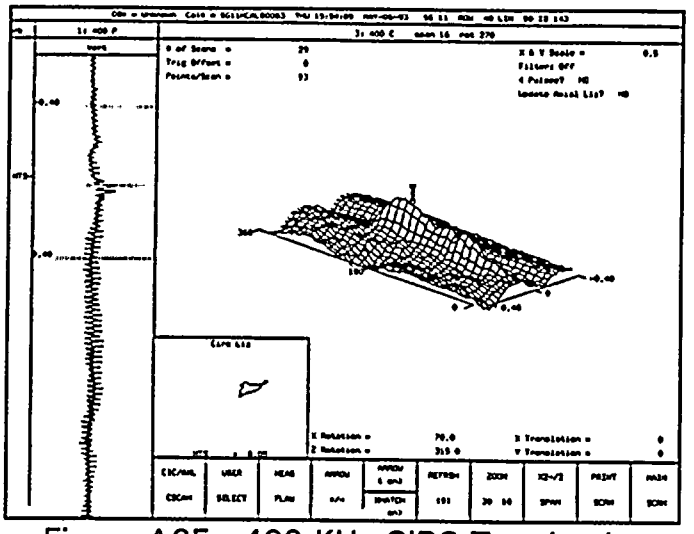


Figure A25 - 400 KHz CIRC Terrain plot

Given this information and graphic examples, the analyst should apply this technique to analyze the top-of-tubesheet area of the Shearon Harris steam generators. Other information and examples may be presented in the Performance Demonstration practice and examination data.

# APPENDIX B

## COMPUTER DATA SCREENING

Computer Data Screening (CDS) is a method of enhancing the eddy current data analysis of bobbin data by automating the steam generator tube flaw signal analysis, final report creation, and graphics dump output. The CDS system is operated by an Analyst who is familiar with both flaw and nonflaw eddy current signals from the Shearon Harris steam generators. The Analyst continues to establish the analysis variables as per the Shearon Harris Data Interpretation Guidelines. In addition, a set of CDS variables called the CDS Sorts must be established through a qualification program using Shearon Harris eddy current data. The sorts will allow flaw calls to be confirmed and may point out the need to adjust the sort parameters based upon the current condition of the steam generator tubes. In practice, one Analyst may operate multiple CDS systems simultaneously. The benefits of CDS include: the elimination of the effects of Analyst fatigue, consistent test results which can be duplicated and the use of <u>all</u> appropriate frequencies and mixes on each and every signal.

It is not the purpose of this section of the Shearon Harris Data Interpretation Guidelines to duplicate the Eddynet Operation Guide (Zetec, Inc.) or to train the Analyst in the use of CDS. Analysts performing CDS at Shearon Harris should be familiar with the contents of the CDS portion of the operating guide and the operation of the CDS system.

### I System & Software

Eddynet CDS software is currently a part of the Eddynet package which is installed on the system file server. Appropriate software modules or licensing must be maintained in order to used the CDS portion of the software. Any system which utilizes the entire Eddynet software package should be applicable to run the CDS portion, providing the licensing stipulations are met as discussed.

### II Analysis Variables

Analysis variables are established for each data section in accordance with the Shearon Harris Steam Generator Eddy Current Data Interpretation Guidelines. Additional mix channels may need to be added to supplement the CDS sort criteria. Mixes may be added to the primary or secondary analyst responsibilities to insure consistency and ease of implementation.

### III CDS Sorts

The CDS sorts are part of the computer program instructions to perform the data screening. Sorts will be established during a rigorous qualification using actual Shearon Harris eddy current data. CDS sorts must be approved by the utility prior to use in screening Shearon Harris steam generator data.

A log book of CDS sorts should be established to control changes or revisions to the sort parameters. No changes shall be made to the sort parameters unless they are verified by system qualification and utility approval. All changes should be logged in and disseminated to all CDS system operators.

## IV Operating Steps

At this time the operating steps for CDS are not established. Approved operating steps, CDS sorts and other documentation will be provided supplement to this appendix.

# APPENDIX C

## ANALYST PERFORMANCE DEMONSTRATION

To be accepted as a Data Analyst for Shearon Harris steam generator eddy current data, the Analyst must successfully complete a performance demonstration for both bobbin and mrpc data. A review of the Data Analysis Guidelines and practice data will be required before completing the performance demonstration.

The Senior Analyst should be contacted before beginning preparation for the performance demonstration, to insure the latest revisions to the guideline, data or other documentation is in place. During the data analysis of the actual steam generator outage data, the Analyst should be aware of any changes made to the Guideline and acknowledge those changes or revisions.

A copy of the practice data, data results, graphic displays and setup variables will be provided, along with a copy of the most recent version of the analysis guidelines.

## ANALYST GUIDELINES CHANGE FORM 1.1

Description of Change:

1. Add three-letter code DMR to list of MRPC codes
   Add three-letter code MBM for buff mark indications

2. Emphasize certain Guideline parameters per Utility instruction

Reason for Change:

1. In order to disposition bobbin calls which require MRPC inspection, a three letter code is needed to finalize calls which have no MRPC indication.

   In order to disposition indications which are considered buff mark indications, a three-letter codes is required.

2. Emphasis of certain Guideline parameters is required to insure that the analysis is performed in a consistent precise manner.

Technical Basis:

1. When dispositioning a bobbin call with MRPC inspection, the database will need a MRPC call to "close" the indication. If there is no MRPC indication (flaw or defect reportable) DMR will be used to Disposition the MRpc data.

   To disposition an indication which is found to be a buff mark, there is currently no three-letter code in the guideline.

2. To clarify certain points in the Guideline, a supplemental attachment will be used to emphasize points the analysts should be aware of.

Authorization:

Senior Analyst _____ Date: 9-17-95

Shearon Harris Engineer _____ Date: 9-17-95

Figure 4.1 - Analyst Guidelines Change Form

## ANALYST GUIDELINES CHANGE ACKNOWLEDGMENT FORM 1.1

**Description of Change:**

See Analyst Guidelines Change Form 1.1

**Effective Date of Change:** September 17, 1995

| Analyst Signature | Date | Analyst Signature | Date |
|---|---|---|---|
| | 9-17-95 | | |
| | 9/17/95 | | |
| | 9/17/95 | | |
| | 9-17-95 | | |
| | 9-17-95 | | |
| | 9-17-95 | | |
| | 9-17-95 | | |
| | 9-17-95 | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Figure 4.2 - Analyst Guidelines Change Acknowledgment Form

## ANALYST GUIDELINES CHANGE ACKNOWLEDGMENT FORM 1.1

**Description of Change:**

**See Analyst Guidelines Change Form 1.1**

**Effective Date of Change:** September 17, 1995

| Analyst Signature | Date | Analyst Signature | Date |
|---|---|---|---|
| | 9-16-95 | | |
| | 9/16/95 | | |
| | 9/17/95 | | |
| | 9/17/95 | | |
| | 09/17/95 | | |
| | 09/17/95 | | |
| | 09/17/95 | | |
| | 09/17/95 | | |
| | 09/17/95 | | |
| | 09/17/95 | | |
| | 9/17/95 | | |
| | 9/18/95 | | |
| | 9/18/95 | | |
| | 9/18/95 | | |

Figure 4.2 • Analyst Guidelines Change Acknowledgment Form

Lynchburg

## ANALYST GUIDELINES CHANGE ACKNOWLEDGMENT FORM 1.1

**Description of Change:**

See Analyst Guidelines Change Form 1.1

**Effective Date of Change:** September 17, 1995

| Analyst Signature | Date | Analyst Signature | Date |
|---|---|---|---|
| Jonathan M Parrish | 9/17/95 | | |
| John C. Elmi | 9/17/95 | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Figure 4.2 - Analyst Guidelines Change Acknowledgment Form

09/18/95 09:08 ☎804 832 0604 B & W SPIS ☑002

## ANALYST GUIDELINES CHANGE ACKNOWLEDGMENT FORM 1.1

Jessica

**Description of Change:**

**See Analyst Guidelines Change Form 1.1**

**Effective Date of Change:** September 17, 1995

| Analyst Signature | Date | Analyst Signature | Date |
|---|---|---|---|
| | 17/SEPT/95 | | |
| | 18/SEPT/95 | | |
| | 18/SEP/95 | | |
| | 9/18/95 | | |
| | 9/18/95 | | |
| | 9/18/95 | | |
| | 9/18/95 | | |
| | 9/18/95 | | |
| | 9/18/95 | | |
| | 9/18/95 | | |
| | | | |
| | | | |
| | | | |
| | | | |

Figure 4.2 - Analyst Guidelines Change Acknowledgment Form

SHEARON HARRIS ANALYSIS GUIDELINE HIGHLIGHTS
SEPTEMBER 17, 1995 - RFO-6

The following information is intended to be enhancements to the Analysis Guideline already issued for this inspection. Some items are simply points of clarification not specifically covered in the Guideline.

**ANALYSTS (Primary & Secondary)**

* Both Primary and Secondary will report <u>all</u> indications, including dents, permeability variations, copper, etc. [Dents GE 5.0 volts]

* When reporting a bobbin indication not specifically addressed in the Guideline, use the three letter code NQI. This may be used at any location in the S/G, including the top-of-tubesheet, or support intersections.

* When reporting a MRPC indication that is not clearly a SCI, MCI, SAI or MAI, use a POS code to indicate a POSsible indication.

* Currently the Inspection Plan includes:

  - 100% of the Hot Leg TTS MRPC 3-coil delta probe
  - 20% of the S/G F/L bobbin exam except straight section of rows one and two on cold side only
  - All previous indications (list provided) as listed in the RFO-5 inspection report (Westinghouse). **All previous indications must be addressed. IF the indication is present but not reportable, use INR and include the location as listed on the history printout. IF the indication is not found, use INF and include the indication location as listed on the history printout.**
  - MRPC inspection of 20% of the dented indications greater than five volts, emphasizing the hot leg indications
  - MRPC inspection of 20% of the cold-leg pre-heater expansion transitions (02C and 03C) in one steam generator (to be decided by the utility after preliminary inspection results are in).

* When performing MRPC analysis, be sure to view the strip charts, lissajous, and terrain plot of **all data recorded.** The terrain plots should include at a minimum the 400 KHz pancake, axial and circumferential channels.

* Set up your 4-liss display as shown on the next page and store to your set-up file. Also insure your MRPC setup is stored with the set-up parameters as indicated in the Guideline.

## RESOLUTION/LEAD ANALYSIS

* Currently, any NQI or >39% indication reported by resolution analysis will be included on a list to the Utility for MRPC disposition. Other indications may also be included as required.

* Resolution graphics will be required for the following:

1. All previous indication tubes, including INF and INR

2. All "new" indications regardless of depth. (% through wall)

3. All MRPC indications which are reportable or DMR.

Graphics for bobbin calls:

One 4-liss display with the left strip chart on P1, the right strip chart on 100 KHz absolute, the lissajous from left to right on P1, 550 KHz diff, 100 KHz diff and P2.

Graphics for MRPC calls:

One 4-liss display with the left strip chart on 550 KHz PAN, the right strip chart on 10 KHz PAN, the lissajous from left to right on 400 Pan, 400 Axl, 400 Cir and 100 Pan (or as req'd)

One terrain plot of the 400 Pan coil showing the lissajous screen in the lower left corner. Other terrain plots may be generated as required.

# PROCEDURE FOR CONTROL OF EDDY CURRENT DATA FOR USE WITH MULTIFORTH OR EDDYNET ACQUISITION SYSTEMS

CAROLINA POWER AND LIGHT COMPANY
SHEARON HARRIS

HNP-006

ABB COMBUSTION ENGINEERING NUCLEAR OPERATIONS
CHATTANOOGA, TENNESSEE
WINDSOR, CONNECTICUT

PREPARED BY: A. P. Putnam DATE: 8-4-95
A. P. Putnam
Field Service Technician

APPROVED BY: K. Gann FOR DATE: 8/4/95
J. D. Ford
Quality Assurance

APPROVED BY: Donna W. Bain III FOR DATE: 8-4-95
H. L. Labieniec
Manager, Primary Support Technology

REVISION: 0

DATE: 07/12/95

TABLE OF CONTENTS


| SECTION | TITLE |
|---|---|
| 1.0 | OBJECTIVE |
| 2.0 | REFERENCES |
| 3.0 | PERSONNEL REQUIREMENTS |
| 4.0 | PRECAUTIONS AND PREREQUISITES |
| 5.0 | SEQUENCE OF OPERATIONS |
| 6.0 | VERIFICATION OF COMPLETION |
| 7.0 | REPORTING CRITERIA |
| 8.0 | DATA MANAGEMENT SHIFT LOG |
| 9.0 | DATABASE SETUP VERIFICATION AND PERFORMANCE DEMONSTRATION |
| 10.0 | EDDYNET SYSTEM ADMINISTRATION |

## TABLE OF CONTENTS

## TABLE OF FIGURES


| FIGURE | TITLE |
|---|---|
| FIGURE 1 | EXAMPLE ANALYSIS TRACKING LOG (DM-1) |
| FIGURE 2 | EXAMPLE DATA MANAGEMENT/EDDYNET FILE TRACKING LOG (DM-2) |
| FIGURE 3 | EXAMPLE DATA MANAGEMENT/EDDYNET EDIT TRACKING FORM (DM-3) |
| FIGURE 4 | EXAMPLE TEST PLAN VERIFICATION OF COMPLETION (DM-4) |
| FIGURE 5 | EXAMPLE DATA MANAGEMENT SHIFT LOG SHEET (DM-5) |
| FIGURE 6 | EXAMPLE SETUP VERIFICATION SHEET (DM-6) |
| FIGURE 7 | EXAMPLE DATABASE PERFORMANCE EVALUATION FORM (DM-7) |
| FIGURE 8 | EXAMPLE SYSTEM ADMINISTRATION CONTROL LOG (SA-1) |
| FIGURE 9 | EXAMPLE SYSTEM ADMINISTRATION BACKUP LOG (SA-3) |

| APPENDIX | TITLE |
|---|---|
| APPENDIX A | PERFORMANCE OF DATA MANAGEMENT AT A REMOTE LOCATION |
| FIGURE 10 | EXAMPLE OF RESOLUTION ANALYSIS TRACKING LOG (DM-8) |

## 1.0 OBJECTIVE

Eddy Current Data Management is the tracking, control, uploading, and reporting of eddy current data which has been acquired during an eddy current examination. The eddy current data is tracked from the initial receipt of the acquired data in the data management area to the delivery of the final results to Carolina Power and Light, Shearon Harris Nuclear Station. To prevent data management discrepancies, specific forms and procedures will be used to ensure the efficient routing and control of the acquisition media, optical disks, analysis results, and data management reports.

## 2.0 REFERENCES

2.1 Zetec Inspection Planning System & Inspection Management System User Guide, latest revision

2.2 Zetec EDDYNET Analysis System Users Guide.

2.3 Carolina Power and Light's Eddy Current Data Analysis Procedure, latest revision.

## 3.0 PERSONNEL REQUIREMENTS

Each person performing Data Management duties governed by this procedure shall be trained in the use and operation of the data management system in accordance with Reference 2.1 and the specific requirements of this procedure. In addition, each person performing EDDYNET system administration functions shall be trained in the use and operation of the EDDYNET Analysis System in accordance with Reference 2.2.

3.1 The Data Controller shall be responsible for all editing performed within the data management system. The Data Controller will assign specific editing actions to an analyst, trained in accordance with reference 2.3, when edits to the results files are required on the EDDYNET storage media.

3.2 Data Management shall be responsible for tracking all eddy current data from the time it is delivered to the data management/analysis center until final reports of analysis results are submitted to the client.

## 4.0 PRECAUTIONS AND PREREQUISITES

4.1 The eddy current data management equipment will be set up in an area designated by the site personnel and approved by the ABB Combustion Engineering Analysis and Data Management Team.

4.2 Data Management checkoff sheets will be used to document tracking of the eddy current data throughout the data management and analysis process.

4.3 Checkoff sheets may vary in form to meet specific site requirements or modifications.

4.4 The data management system will be pre-programmed with site specific information prior to the start of data input. This includes, but is not limited to, input of all analysis acronyms, and data checks.

4.5 The data management system setup will be verified by the Data Management Shift Coordinator prior to the start of data entry for the inspection. The verification shall be performed in accordance with Section 9.1 and documented on Form DM-6.

4.6 The data management system setup shall be re-verified under the following conditions and documented on Form DM-6:

4.6.1 Following the restoration of software executables from a backup disk.

4.6.2 Following any software updates.

## 5.0 SEQUENCE OF OPERATIONS

The following describes the sequence of operations to be followed in order to properly control the eddy current data, and to successfully load completed EDDYNET results files to the data management system.

5.1 (Acquisition) Deliver the eddy current data package to the data management area. At a minimum, the eddy current data package shall consist of:

5.1.1 Acquisition to DCR Tape

1. Original DCR tape
2. Original operator examination sheets
3. Calibration Sheet

5.1.2 Acquisition to Traveling Optical Disk

1. Traveling Optical Disk
2. Traveling Calibration Sheet
3. Operator examination sheets

5.1.3 Acquisition to Remote Optical

Notification of calibration group completion
Notification of data transfer and destination

5.2 **(Data Controller/System Administrator)** Log in receipt of tapes/calibrations on form DM-1.

5.3 **(System Administrator)** Document the transfer of raw eddy current data from acquisition media to analysis media and complete the appropriate logs in accordance with Section 10.1 of this procedure.

5.4 **(Data Controller)** For data acquired to DCR tape or traveling optical, prepare packages for primary and secondary analysis. As a minimum, the package should include:

5.4.1 Operator examination sheets. (original to primary and a copy to secondary)

5.4.2 T-list, if generated, from raw data transfer.

**NOTE: THE FOLLOWING STEPS APPLY TO PRIMARY, SECONDARY, AND FINAL ANALYSIS.**

5.5 **(Data Analysts)** Record initials on form DM-1 at the start of each tape or calibration group analyzed. If primary and secondary analysis is being performed remotely via T1 lines, a similar tracking form may be used, if required.

5.6 **(Data Analysts)** Build a report file when analysis is complete for each tape or calibration group. Return the examination sheets and the EDDYNET report printouts to the data management area. Record return of package on form DM-1. If primary and secondary analysis is being performed remotely via T1 lines, a similar tracking form may be used, if required.

CAUTION: If, after returning the completed data package to the data management area, the analyst determines that changes are necessary to the analysis results, the analyst will identify the changes to data management in order to ensure correct file retrieval from the Local Area Network. All edits to FINAL results will be done in accordance with Step 5.8.

**NOTE: THE FOLLOWING STEPS APPLY TO FINAL ANALYSIS.**

5.7 (Data Controller) Review the EDDYNET report printout for correct format and information.

5.8 (Data Analysts) If the information is in error, the EDDYNET file will be corrected by the analyst, and a new EDDYNET report printout will be generated. If the error requires tracking, the appropriate information will be recorded on form DM-3.

5.9 (Data Controller) When all information is verified, retrieve the EDDYNET data file from the Local Area Network.

5.10 (Data Controller) When primary and secondary analysis data has been completed for a given tape or calibration group, prepare the data package for resolution and notify the Lead Analyst. The package should contain both primary and secondary analysis folders.

5.11 (Data Controller) Load the EDDYNET file to the appropriate component database and record on form DM-2

5.11.1 If an error file is generated, the EDDYNET file will be edited as in Step 5.8 and the appropriate component database will be corrected.

## 6.0 VERIFICATION OF COMPLETION

When it has been indicated by Acquisition that the inspection plan in a given steam generator, or a generator subsection, has been completed, the Data Management Shift Coordinator, or a designee, will verify that the requirements of the examination scope have been met prior to approving equipment removal or relocation. The verification process will be tracked using a sheet similar to form DM-4. As a minimum, the following conditions will be verified using computer-generated reports, database queries, and graphic printouts:

6.1 Verify that all tubes in the inspection plan have been tested with the correct probe type.

6.2 Verify that all tubes in the inspection plan have been tested and analyzed to the required extent.

6.3 Verify that no reported retest is outstanding, and that all data necessary to complete each tube requiring a retest exam has been acquired and analyzed.

6.4 Verify that all analysis codes requiring further action, such as examination with another probe, or additional review, have been addressed appropriately.

**NOTE: ANALYSIS CODES REQUIRING FURTHER ACTION WILL BE DEFINED IN, AND USED IN ACCORDANCE WITH, REFERENCE 2.3, THE CAROLINA POWER AND LIGHT'S STEAM GENERATOR EDDY CURRENT ANALYSIS GUIDELINES.**

6.5 Verify that all technical specification requirements for additional testing have been satisfied.

**NOTE: ANY CONDITIONS NOT SATISFIED WILL BE REPORTED IMMEDIATELY TO THE SENIOR ANALYST AND/OR TASK MANAGER FOR CORRECTIVE ACTION.**

## 7.0 REPORTING CRITERIA

Reports of accumulated eddy current data shall be prepared by the Data Controller or a properly trained designee. Status reports and final reports will be generated in a timely fashion, and in accordance with client requirements. Whenever possible, report formats will be established before the start of work.

## 8.0 DATA MANAGEMENT SHIFT LOG

The Data Management Shift Coordinator shall maintain a log of the events occurring on each shift. Figure 5 displays a typical Data Management Log Sheet. The log book will function as the primary method of disseminating information between shifts. As a guideline, appropriate log book entries may include, but are not limited to, the following:

8.1 Problem and Trouble Shooting Documentation

8.1.1 Document all problems encountered with database hardware and software. Whenever possible, include the nature of the problem, problem duration, problem resolution, and action taken to prevent recurrence.

8.1.2 Document all problems encountered with reports, reporting formats, and report generation.

8.2 Requests for Information

Document any requests for information from outside of data management. Include any specific time commitments, formats, and the requesting party.

8.3 Changes to Reports or Screen formats

Document any additions or modifications to existing screens, menus, or reports. Include any specific instructions for using reports or input screens.

8.4 Changes Affecting Analysis Result Files

Document any changes to report formats, acronym usage, and report parameters that affect the reporting of results by analysis. This information is to be provided to the Lead Analyst for inclusion in shift turnover in accordance with Reference 2.3.

## 9.0 Database Setup Verification and Performance Demonstration

9.1 Input the correct data acceptance parameters into the data management system and document on Form DM-6.

9.1.1 Enter acceptable indication codes and identify all retest codes listed in Reference 2.3.

NOTE: EVENTS MAY REQUIRE A DEVIATION FROM THE ABOVE SETUP. PROPOSED CHANGES MUST BE APPROVED BY THE LEAD ANALYST PRIOR TO ADJUSTING THE DATA PARAMETERS. DOCUMENT UPDATES TO THE ABOVE SCREENS ON FORM DM-6.

9.2 Data Management System Performance Evaluation

9.2.1 Perform the following steps to demonstrate the data management system's ability to properly load analysis results and screen for data errors. Performance will be demonstrated for any extent type to be used during the exam.

Step 1 Open an outage called TEST.

Step 2 Schedule tubes in a dataset named TEST using the performance demo data disks.

Step 3 Load final data test files to the data management system from the performance demo data disks.

Step 4 Using the answer sheets from the performance demo, verify that all expected errors have been identified by the data management system.

Step 5 Document the results of the performance demo on form DM-7.

Step 6 Report any unsatisfactory results to the Lead Analyst.

Step 7 Document any corrective action on form DM-7, and perform the test again until satisfactory results are achieved, or the lead analyst determines that the results are acceptable.

9.2.2 The Lead Analyst shall review the results of the performance runs and indicate acceptance with a signature on form DM-7.

## 10.0 Eddynet System Administration Guidelines

### 10.1 Data Tracking and Control

Each Calibration Group initiated by data acquisition shall be tracked by the designated System Administrator (SA) on each shift using form SA-1. This information will also be posted on a white board in the site data room and remote location data rooms as follows:

cal001 P S R D
P=primary analysis
S=secondary analysis
R=resolution
D=data management

The appropriate letter will be circled by the analysts to indicate analysis is being performed, then lined through when analysis is complete. Priorities will be assigned with guidance from Data Management. The steam generator, test leg, server, and ROD will be identified in the space indicated on Form SA-1.

10.1.1 The SA shall enter in the control log the calibration group number, the first tube in the cal group, and the last tube in the calibration group as raw data is received from acquisition.

10.1.2 Primary, secondary, and final analysis results will be copied from the system hard drive to the original acquisition optical disk for each calibration group by the SA. The SA shall enter the date and time of task completion on form SA-1.

NOTE: If it is necessary to modify the results on the hard drive after the copy routine has been completed, the SA will update the results on the optical disk. The date and time of the update shall be documented on form SA-1.

10.1.3 After ensuring that all analysis is complete for a given calibration group, raw data can be removed from the hard drive by the SA. The completion of this task will be documented on form SA-1.

10.3 Eddynet Results Backup

The SA shall back up the Results file as necessary, but at a minimum of every six hours. Each time a backup is performed, the task shall be documented on form SA-3.

## FIGURE 1

## EXAMPLE ANALYSIS TRACKING LOG

ABB Combustion Engineering

Analysis Tracking Log

Plant: _____ Component: _____ Leg: _____

| CAL GROUP | Primary | | Secondary | | P/S | Resolution | | Data Input to ISIS |
|---|---|---|---|---|---|---|---|---|
| | Start | Finish | Start | Finish | Comp | Start | Finish | |
| | D/T Init. | D/T Init. | D/T Init. | D/T Init. | D/T Init. | D/T Init. | D/T Init. | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

FORM DM-1

## FIGURE 2

## EXAMPLE DATA MANAGEMENT/EDDYNET FILE TRACKING LOG

DATA MANAGEMENT TRACKING LOG S/G:_____ LEG:_____

| CAL GROUP | DATA SET | ZONE | FINAL RESOLUTION | | | | | | ERR | FIX | SUM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | File Retrieved | | | File Loaded | | | | | |
| | | | Date | Time | Init | Date | Time | Init | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

FORM DM-2

## FIGURE 3

## EXAMPLE DATA MANAGEMENT/EDDYNET EDIT TRACKING LOG

DATA MANAGEMENT/EDDYNET EDIT TRACKING FORM

| | |
|---|---|
| OPTICAL DISK:<br>CAL GROUP:<br>ROW/COL: | DATABASE EDIT [ ]<br>EDDYNET FILE [ ]<br>NEW PRINTOUT [ ] |
| DESCRIPTION OF EDIT: | INITIALS:<br>DATE/TIME: |
| | |
| | |
| | |
| | |
| | |

| | |
|---|---|
| OPTICAL DISK:<br>CAL GROUP:<br>ROW/COL: | DATABASE EDIT [ ]<br>EDDYNET FILE [ ]<br>NEW PRINTOUT [ ] |
| DESCRIPTION OF EDIT: | INITIALS:<br>DATE/TIME: |
| | |
| | |
| | |
| | |
| | |

FORM DM-3

FIGURE 4

EXAMPLE TEST PLAN VERIFICATION OF COMPLETION

SHEARON HARRIS
EDDY CURRENT CLOSEOUT CHECKLIST
SEPTEMBER, 1995

S/G _____ TEST PLAN: _____ GROUP:_____

_____1) PRINT ALL INDICATIONS REPORT

_____2) VERIFY ALL ANALYSIS CODES REQUIRING FURTHER ACTION HAVE BEEN DISPOSITIONED / CONFIRMED.

_____3) PRINT DAILY PROGRESS REPORT

_____4) RUN/PRINT RETEST REPORTS AND VERIFY THAT ALL RETESTS HAVE BEEN PROPERLY CLOSED OUT.

_____5) PRINT MASTER REPORT FOR EACH GROUP OR TEST PLAN AND CHECK DATA FOR ACCURACY.

_____6) PRINT MAP OF COMPLETED EXAMS.

_____7) PRINT REPAIR LIST WITH A MAP.

S/G CLOSED:_____
DATE TIME INITIALS

FORM DM-4

FIGURE 5

EXAMPLE DATA MANAGEMENT SHIFT LOG SHEET

| DATA MANAGEMENT SHIFT LOG | DATE: |
|---|---|
| | TIME: |
| PREPARED BY: | PAGE OF |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| DISTRIBUTION: ANAL ACQ N/A | |

FORM DM-5

FIGURE 6

EXAMPLE DATA PARAMETER SETUP VERIFICATION SHEET

Data Management Data Parameter Setup Verification

| Component | Software Version | Revision |
|---|---|---|

| Input Screens | Date | Time | Initials | Printout |
|---|---|---|---|---|
| Test Extents | | | | |
| Retest Codes | | | | |
| Analysis Codes | | | | |
| PID Setup | | | | |
| | | | | |

VERIFICATION REQUIRED FOR:

INITIAL SETUP [ ]
POST FILE RESTORATION [ ]
POST SOFTWARE UPGRADE [ ]
TEST/DATA CHANGE [ ]

PRINTOUTS ATTACHED [ ]

VERIFIED BY: _____ DATE: _____
TIME: _____

FORM DM-6

FIGURE 7

EXAMPLE DATA MANAGEMENT SYSTEM PERFORMANCE EVALUATION SHEET

| Data Management System Performance Evaluation | | | |
|---|---|---|---|
| Software Version: | Rev. No.: | Date: | Time: |
| Group 1 | | | |
| No. Expected Errors | | No. Errors Identified | |
| Satisfactory | | Corrective Action Required | |
| Group 2 | | | |
| No. Errors Expected | | No. Errors Identified | |
| Satisfactory | | Corrective Action Required | |
| Group 3 | | | |
| No. Errors Expected | | No. Errors Identified | |
| Satisfactory | | Corrective Action Required | |

Printouts Attached [ ]

Reviewed By: _____

Date: _____ Time: _____

FORM DM-7

FIGURE 8

EXAMPLE SYSTEM ADMINISTRATION CONTROL LOG

| STEAM GENERATOR: | | SERVER ID: | | | | |
|---|---|---|---|---|---|---|
| LEG: | | RAW DATA STORED ON ROD: | | | | |
| Calibration Group | Acquisition Optical Disc Number | Raw Data Transferred | | Results Transferred | | Raw Data Removed from Hard Drive |
| | | Original | Backup | Original Date/Time | Backup Date/Time | Date/Time |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

FORM SA-1

FIGURE 9

EXAMPLE SYSTEM ADMINISTRATION BACKUP LOG

System Backup Log

| Date | Time | Initials | Comments |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

FORM SA-3

# APPENDIX A

## PERFORMANCE OF DATA MANAGEMENT AT A REMOTE LOCATION

### 1.0 PURPOSE

To replace sections 5.0 and 10.0 of Procedure HNP-006.

### 2.0 APPLICABILITY

This appendix is in effect for an eddy current inspection for which Data Management is being performed at a remote location.

### 3.0 REFERENCES

3.1 Procedure for Control of Eddy Current Data for use with Multiforth or Eddynet Acquisition Systems, HNP-006.

### 4.0 DEFINITIONS

4.1 Remote. Location(s) where personnel have been assigned to perform Data Analysis and Management functions, which are physically distanced from the Site, and require special network connections, such as a T-1 line.

4.2 Local. Location(s) on or near the Site where personnel have been assigned to perform Acquisition, Analysis, or System Administration functions.

4.3 Network. Systems which share data, hardware, and software resources.

4.4 Server. A computer which provides file access, login access, files transfer, printing and other services across a network to a defined group of systems.

4.5 Spool. The process of data file transfer between servers on a network.

4.6 T-1 Line. Telephone communication line used to connect computer networks in different locations.

4.7 Results File. A file created on the EDDYNET system by a data analyst at the completion of a Calibration Group which summarizes the analysis results for the tubes in that Calibration Group.

## 5.0 SEQUENCE OF OPERATIONS

The following describes the sequence of operations required in order to successfully load final result files to the ISIS-TUBE data management system in a remote location.

5.1 (Acquisition) Spool raw data to the designated server in the Local Analysis area.

5.2 (System Administrator) Update Tracking board for incoming data in accordance with Section 10.1 of this Attachment.

5.3 (System Administrator) Spool raw data to remote locations for Primary and Secondary Analysis.

**NOTE: THE FOLLOWING STEPS APPLY TO PRIMARY, SECONDARY, AND RESOLUTION ANALYSIS.**

5.4 (Data Analyst) At the start and completion of each calibration group analyzed, update the tracking board in accordance with Section 10.1 of this Appendix. Resolution Analysts also record on Form DM-8.

5.5 (Data Analysts) When analysis is complete for each tape or calibration group, build a final report file of results.

5.6 (Data Analyst) Print out final results file at the specified analysis location.

**NOTE: THE FOLLOWING STEPS APPLY TO RESOLUTION ANALYSIS.**

5.7 (System Administrator) Collate Primary and Secondary reports for each Calibration Group, and provide to Resolution Analysts.

5.8 (Data Analysts) Transfer and print completed results file to the designated Server and for Data Management at the remote location, and record on Form DM-8.

**CAUTION: If, after file transfer has occurred, the analyst determines that changes are necessary to the results file, the analyst will contact data management to alert them to the required change. If the change requires tracking, the data manager will complete Form DM-3.**

5.9 (Data Manager) Retrieve final results files from the designated Server as they are transferred from Resolution, and complete the appropriate log entry on Form DM-2.

5.10 (Data Manager) Load the EDDYNET file to the appropriate ISIS-TUBE database and record on Form DM-2.

5.10.1 If errors occur, record the number of errors on Form DM-2.

5.10.2 Address each error, take corrective action if appropriate, and document any corrective action in writing, on the Error Log printout.

5.10.3 If corrective action requires an edit to the eddynet results file, complete Form DM-3, and notify the data analyst of the required action.

5.10.4 Corrected final results files will be transferred as in Step 5.8.

5.10.5 View the corrected file on the Server to insure that errors have been corrected, and document on Form DM-3.

5.10.6 After all errors have been satisfactorily resolved, initial the appropriate column on Form DM-2.

5.10.7 Error logs and edit forms shall be maintained for the duration of the inspection.

## 10.0 Eddynet System Administration Guidelines

### 10.1 Data Tracking and Control

Each Calibration Group initiated by data acquisition shall be tracked by the designated System Administrator (SA) on each shift using Form SA-1. This information will also be posted on a tracking board in the site data room and remote location data rooms as follows:

cal001 P S R D

P=primary analysis
S=secondary analysis
R=resolution
D=data management

The appropriate letter will be circled by the analysts to indicate analysis is being performed, then lined through when analysis is complete. Priorities will be assigned with guidance from Data Management. The steam generator, test leg, server, and ROD will be identified in the space indicated on Form SA-1.

10.1.1 The SA shall enter in the control log the calibration group number as raw data is received from acquisition.

10.1.2 Primary, secondary, and final analysis results will be copied from the system hard drive to the original acquisition optical disk for each calibration group by the SA. The SA shall enter the date and time of task completion on Form SA-1.

**NOTE: If it is necessary to modify the results on the hard drive after the copy routine has been completed, the SA will update the results on the optical disk. The date and time of the update shall be documented on Form SA-1.**

10.1.3 After ensuring that all analysis is complete for a given calibration group, and that raw data has been spooled to two different hard drives, raw data can be removed from the hard drive by the SA. The completion of this task will be documented on Form SA-1.

10.2 Eddynet Results Backup

The SA shall back up the Results file as necessary, with a recommended minimum of every six hours. Backup tasks performed shall be documented on Form SA-3.

FIGURE 10

EXAMPLE RESOLUTION ANALYSIS TRACKING LOG

## ABB Combustion Engineering
## Resolution Analysis Tracking Log

| SITE: | UNIT: | S/G: | LEG: |
|---|---|---|---|

| | START | | | FINISH | | | FILE SENT |
|---|---|---|---|---|---|---|---|
| CAL GROUP | DATE | TIME | INITIALS | DATE | TIME | INITIALS | REMOTE DM |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

FORM DM-8

# CERTIFICATION PROGRAM FOR NONDESTRUCTIVE EXAMINATION PERSONNEL

Major Revision

## 1.0 PURPOSE

1.1 To delineate the technical requirements for qualification and certification of Levels I, II and III nondestructive examination (NDE) personnel.

## 2.0 APPLICABILITY

2.1 This written practice is intended to meet or exceed the requirements of ASNT SNT-TC-1A, 1984 (Reference 5.4) and the ASME BPV Code (Reference 5.2), with the exception of Appendix VII and VIII requirements of Section XI.

2.2 Certifications to other Codes and standards, such as Section XI, Appendix VII, and ASNT CP-189 are addressed (or will be addressed, as needed) in Addenda which supplement this written practice and are shown on the certification document as additional endorsements.

2.3 Certifications issued to NDE personnel prior to adoption of this written practice and based on an approved ABB CE written practice shall be considered valid for the remainder of the individual's certification period. Future certifications and recertifications shall be in accordance with this written practice.

## 3.0 PREREQUISITES

3.1 None

## 4.0 PROCEDURE

### 4.1 LEVELS OF QUALIFICATION

4.1.1 Trainee - in the process of being qualified and certified to at least NDE Level I, an individual shall be considered a trainee. A trainee shall work with a certified individual and shall not independently conduct any test, interpret or evaluate any results of a test, or write a report of test results.

4.1.2 Level I - shall be qualified to properly perform specific calibrations, specific tests and specific evaluations for acceptance or rejection according to written instructions, and to record the results. The Level I shall receive the necessary guidance or supervision from a certified Level II or III in the same method. Those individuals performing work governed by ASME

Code Section XI shall not independently evaluate or accept the results of a nondestructive examination.

a. The Level I Trainee shall have completed the training and examination requirements for Level I, but need not have any experience.

4.1.3 Level I Limited - shall be qualified to perform only a specific activity or operation within a particular technique (e.g., application of penetrant materials, etc.).

4.1.4 Level II - shall be qualified to set up and calibrate equipment, and to interpret and evaluate test results with respect to applicable codes, standards and specifications. The Level II shall be able to prepare written instructions and to organize and report nondestructive testing investigations. The Level II shall also be familiar with the scope and limitations of the method and shall exercise assigned responsibility for on-the-job training and guidance of trainees and Level I personnel.

4.1.5 Level II A - (Eddy Current Data Analyst for heat exchanger tubing and nonferromagnetic steam generator tubing, except QDA, as defined below) - satisfies all the requirements for an Eddy Current Level II and in addition, is capable of interpreting and evaluating data taken from eddy current examinations of heat exchanger and nonferromagnetic steam generator tubing.

a. EPRI Qualified Data Analyst (QDA) - (Eddy Current Data Analyst for nonferromagnetic steam generator heat exchanger tubing) - satisfies all of the requirements for an Eddy Level II, is capable of interpreting and evaluating data taken from eddy current examinations of nuclear plant components, has successfully completed the EPRI Steam Generator Eddy Current Performance Demonstration using the Industry Database (IDB) Practical Examination and is qualified in accordance with Addendum B.

4.1.6 Level II Limited - shall be qualified to perform examinations to a specific technique, activity or operation within a method (e.g., solvent removable penetrant examination, contact ultrasonic examination, gamma radiography, film interpretation or evaluation of results of a technique or method, etc.).

4.1.7 Level III - shall be capable of and responsible for establishing techniques and procedures, interpreting codes, standards and specifications, and designating the particular test method and technique to be used. The individual shall be capable of evaluating results in terms of existing codes,

standards, specifications and shall have sufficient practical background in applicable materials, fabrication or product technology to establish techniques and acceptance criteria where none are otherwise available. The Level III may administer qualification examinations of NDE Level I, II and III candidates.

4.1.8 NDE Instructor - shall be responsible for developing course outlines and presenting classroom, laboratory and on-the-job training programs in accordance with written course outlines, approved by a Level III. The NDE Instructor shall be thoroughly familiar with the NDE method being taught and shall be able to effectively present the theoretical, technical and practical aspects of the method.

4.1.9 Principal Level III - shall be designated by management and is responsible for approval and administration of training programs, examinations and the written practice. The administration and grading of examinations may be performed by a Level III or, for written examinations only, by an individual delegated in writing, by the Principal Level III. The Principal Level III shall also be responsible for maintenance of personnel certification records.

## 4.2 EDUCATION, TRAINING AND EXPERIENCE

4.2.1 Level I and II personnel shall satisfy the education, training and experience requirements of Table 2.4-2, as modified below.

a. For a limited certification, work time experience and classroom training may be reduced for the technique, activity or operation being performed as shown in Table 2.4-3.

b. For Level IIA certification, an additional 24 hours specific training in eddy current data analysis is required to supplement the ET Level II training requirements as defined in Table 2.4-2. No additional experience is required.

c. Work time experience gained while performing administrative duties shall be considered NDE experience if the duties relate to those covered by certified individuals as defined in Paragraph 4.1.

d. Limitations for individuals certified in accordance with Paragraph 4.2.1 (a) shall be noted on their certification record.

4.2.2 Level III personnel shall satisfy one of the following education and experience options:

a. Graduate of a four (4) year accredited engineering or science college or university with a degree in engineering or science, plus one (1) year experience in an assignment comparable to that of an NDE Level II in the applicable method, or

b. Completion with a passing grade of at least two (2) years of engineering or science study at a university, college, or technical school, plus two (2) years experience in an assignment comparable to that of an NDE Level II in the applicable method, or

c. High school graduate, or equivalent, plus four (4) years experience in an assignment comparable to that of an NDE Level II in the applicable method.

4.2.3 Organized training shall be completed for all Level I and II individuals seeking certification. For Level III individuals, the training hours shall consist of at least the combined required hours for Levels I and II in the applicable method except when the candidate has been qualified or has held a position certified to that of a Level II, in which case, the requirement for training may be considered met.

4.2.4 NDE Instructors shall satisfy the Level III Basic and Method examination requirements of Paragraph 4.3.4 and shall also meet one of the following requirements:

a. The candidate shall maintain a current teacher or vocational instructor certificate issued by a state, municipal, provincial or federal authority, or

b. The candidate shall complete a minimum of forty (40) hours instruction in training and teaching techniques.

4.2.5 Training shall be conducted by an NDE Instructor, except that portions of the training may be conducted by individuals with specialized expertise and designated by the NDE Instructor or Principal Level III.

a. All training obtained prior to implementation of this written practice shall be considered valid. Only training necessary to meet additional training requirements of this written practice shall require an NDE Instructor.

b. Training obtained by an individual before employment by CENS but after implementation of this written practice shall be evaluated by the Principal Level III for acceptability and applicability to this written practice.

4.2.6 To assure that an individual has assimilated the training material presented, the individual shall satisfy the examination requirements of Paragraph 4.3, as applicable.

a. If the qualification examination for certification is not given at the conclusion of training, a final course examination shall be given. A grade of 70% is necessary to receive credit for the training hours.

b. When an individual fails a final course examination, additional training shall be required prior to reexamination. The additional training shall address the areas of weakness exhibited by the individual and shall be documented by the NDE Instructor.

4.2.7 Records used to substantiate education, training and experience shall be identified and maintained in accordance with Paragraph 7.0.

## 4.3 EXAMINATIONS

4.3.1 The following paragraphs describe the examinations for each qualification level. The written examinations shall be administered without access to reference material (closed book) except that necessary data such as graphs, tables, specifications, procedures and codes may be provided.

4.3.2 Qualification examinations for Levels I and II shall consist of a written General Examination, a written Specific Examination and a documented Practical Examination.

a. The General Examination shall cover the basic test principles relative to the applicable test method or technique. The minimum number of questions shall be as specified in Table 2.4-4.

b. The Specific Examination shall cover the equipment and operating procedures relative to the applicable test method or technique. The examination shall also cover specifications, codes and acceptance criteria used in the testing procedures. The minimum number of questions shall be as specified in Table 2.4-5.

c. The Practical Examination shall be administered by a Level III and shall demonstrate to the satisfaction of the Level III that the candidate is familiar with and can operate (except surveillance personnel, see Paragraph (d.3) below) the necessary test equipment and can interpret and record the resultant information from at least one (1) test specimen.

d. Additional requirements of the Practical Examination are as follows:

1) At least ten different check points requiring an understanding of the test variables and procedural requirements shall be included in the examination.

2) The description of the specimen(s), the test procedure including checkpoints, and the results of the examination shall be documented.

3) Surveillance personnel shall perform a Practical Examination that shall demonstrate to the satisfaction of the examiner that the candidate is familiar with the necessary equipment (except radiography) and can interpret and record the resultant information from at least one (1) test specimen. The requirements listed in Paragraphs 1) and 2) above shall also apply.

4.3.3 An Eddy Current Level IIA shall satisfy all of the examination requirements for an Eddy Current Level II and, in addition, shall demonstrate proficiency in evaluating data taken from actual eddy current inspections. The evaluation of data shall be done with regard to the applicable acceptance criteria. At least ten different check points requiring an understanding of the test variables and procedural requirements shall be included in the examination.

4.3.4 Qualification examinations for Level III certification shall consist of written Basic, Method and Specific Examinations. Candidates for initial Level III certification shall also complete a Practical Examination for Level II in accordance with Paragraph 4.3.2 (c) and (d).

a. The Basic Examination is required only once when examinations for more than one method are taken. The examination shall consist of:

1) At least twenty (20) questions relating to understanding the SNT-TC-1A document (Reference 5.4), and

2) At least fifteen (15) questions relating to applicable materials, fabrication and product technology, and

3) At least fifteen (15) questions which are selected from, or are similar to, Level II questions for other appropriate NDE methods.

b. The Method Examination shall be administered for each method for which certification is sought and shall consist of:

1) At least thirty (30) questions relating to fundamentals and principles which are selected from, or are similar to, the published ASNT Level III questions for each method, and

2) At least fifteen (15) questions relating to application and establishment of techniques and procedures which are selected from, or similar to, the published ASNT Level III questions for each method, and

3) At least twenty (20) questions relating to capability for interpreting codes, standards and specifications relating to the method.

c. The Specific Examination shall be administered for each method and shall consist of a written examination containing a minimum of twenty (20) questions relating to specifications, equipment, techniques and procedures applicable to products and methods similar to those utilized by the CENS NDE departments and administration of the NDE written practice.

4.3.5 The employer, the Principal Level III or his designee shall be responsible for conducting and grading the examinations.

4.3.6 A composite passing grade (average of all tests) of 80% or greater is required for examinations administered for qualification. In addition, each individual passing grade (General, Specific, etc.) shall be 70% or greater.

4.3.7 If the examinations are administered and graded by an outside agency which issues a pass/fail grade only, a grade value of 80% shall be assigned for each examination administered and successfully passed.

4.3.8 When an outside agency other than ASNT or EPRI is used for qualification services, those services rendered shall be in accordance with this written practice. Examinations prepared by an outside agency shall use procedures, techniques, etc., similar to those used by CENS. CENS shall retain responsibility for the adequacy of the program of the outside agency.

4.3.9 A valid endorsement on an ASNT NDE Level III certificate for a specific NDE method may be used to fulfill the Basic and Method examination criteria for Level III certification in the applicable NDE method.

4.3.10 Those failing to attain the required grades shall wait at least thirty (30) days or show evidence of having received additional training, as determined by the certifying individual, prior to re-examination.

4.3.11 All levels of NDE personnel shall successfully complete an eye examination to demonstrate natural or corrected near-distance acuity of 20/25 or greater Snellen fraction (Jaeger J-1), with at least one eye, by reading words or identifying characters on a near-distance test chart, such as a Jaeger chart, that meets the requirements of the following table:

Table 2.4-1, Near-Distance Acuity Test Distances and Character Heights

| Test Distance, inches | Maximum Lower Case Character Height, inches |
|---|---|
| 12 | 0.022 |
| 13 | 0.024 |
| 14 | 0.025 |
| 15 | 0.027 |
| 16 | 0.029 |

NOTE 1: The test distances (eye to chart) and corresponding character heights provide a visual angle of 6.25 minutes, which is equivalent to a Snellen fraction of 20/25.

NOTE 2: A measurement of one of the near-distance test chart characters shall be made once before initial use with an optical comparator (10X or greater) or other suitable instrument to verify that the height of a representative lower case character, without ascender or descender (e.g., a, c, e, o), for the selected type size, meets the requirements of the above table. This measurement shall be documented on the test chart.

a. When required by Code, contract, specification or standard, personnel shall have natural or corrected far-distance acuity equivalent to a Snellen fraction of 20/30 or greater with at least one eye.

b. NDE personnel shall also pass an Ishihara or equivalent color vision examination to show ability to distinguish and differentiate contrasts between colors used in the method for which qualified. When personnel are unable to pass this examination, they shall satisfactorily show ability to distinguish and differentiate contrast between colors as part of their NDE Practical Examination.

c. The eye examination shall be given to all NDE personnel on an annual basis.

d. Eye examinations shall be performed by a Level III, designate, or medical personnel.

e. The results of the examination shall be recorded on the Eye Examination Record (Exhibit 2.4-1) or equivalent.

## 4.4 CERTIFICATION

4.4.1 A Level III shall certify Level I and II personnel. Certification of Level III personnel shall be by CENS management. All certifications shall be documented on a Certification Record (Exhibit 2.4-2).

4.4.2 The certification period for Levels I and II personnel shall not exceed three (3) years. For Level III personnel, the certification period shall not exceed five (5) years.

4.4.3 Certification of all levels of NDE personnel shall be based on successful completion of the education, training and experience requirements of Paragraph 4.2 and the required examinations of Paragraph 4.3.

a. The maximum duration of interrupted service for each NDE method or technique shall be one (1) year. Where evidence of use of the method or technique can not be shown, the individual shall successfully complete the examination(s) deemed necessary by the responsible Level III or department head prior to reactivating the certification.

4.4.4 New employees having held valid NDE certifications with their former employer may be certified to their former NDE levels provided that:

a. The employee provides proof of prior certifications, or

b. The former employer provides documentation substantiating the training and experience qualification obtained by the employee. The qualifications shall meet the requirements of SNT-TC-1A (Reference 5.4) and this written practice.

NOTE: Every attempt shall be made to procure the documentation that substantiates the certification, however;

1) When the former employer will not verify training and experience time, an individual's personal history may be acceptable documentation;

2) The employee's former training and experience may be verified by telephone. A record of telephone conversation shall be acceptable documentation of an individual's prior training and/or experience when documentation is otherwise unavailable.

In addition:

c. The employee shall have been working in the test method within six months of termination and is certified within six months after termination.

1) When limits are in excess of those specified above, the employee shall receive additional training, as determined by the certifying individual, prior to certification.

d. The employee successfully completes the examination requirements, as applicable, of Paragraph 4.3.

4.4.5 Certification shall be revoked by the Level III or CENS management by evidence of unsatisfactory performance or termination of employment. Individuals who are separated shall not be considered terminated provided they return to work within one year.

## 4.5 RECERTIFICATION

4.5.1 Levels I and II personnel shall be recertified at least every three (3) years by either evidence of continued satisfactory performance or re-examination based on the governing Code and contract requirements.

4.5.2 Level III personnel shall be recertified at least every five (5) years by either continued satisfactory performance or re-examination based on the governing Code and contract requirements. When a Level III is recertified by continued satisfactory performance, the recertification shall be based on documented evidence performing Level III duties such as NDE training, procedure development, certification of Level I's and Level II's, test development, etc.

4.5.3 Level III personnel to be recertified by examination shall use the written Method and Specific Examinations (plus the Practical Examination, when required). Alternatively, Level III personnel may be recertified using only the written Method and Specific Examinations provided the following conditions are met:

a. The Level III candidate was previously certified or recertified using all the written examinations and the Practical Examination.

b. The Level III candidate is not being recertified due to interrupted service as defined in the employer's written practice.

## 5.0 REFERENCES

5.1 QAM-100 Quality Assurance Manual

5.2 ASME Code, Sections I, III, V, VIII, XI and ANSI B31.1

5.3 ASME/ANSI NQA-1, including Supplement 2S-2

5.4 SNT-TC-1A - 1984 Recommended Practice for Nondestructive Testing Personnel Qualification and Certification

5.5 QAP 17.1 Records Retention

## 6.0 DEFINITIONS

6.1 QAM-100 Terms and Definitions, NQA-1 Supplement S-1 and Appendix A of this manual contain definitions for many of the terms utilized herein.

6.2 Activity or Operation - Any part of a technique including but not limited to, film interpretation, ultrasonic thickness examination, application of penetrant materials, evaluation of examination results, etc.

6.3 Certification - Written testimony of qualification.

6.4 Certifying Agency - The employer of the individual being certified.

6.5 Employer - The corporate, private or public entity, which employs personnel for wages, salary, fees, or other considerations.

6.6 Method - The utilization of a physical principle in NDE in its entirety, i.e., radiography, ultrasonics, liquid penetrant, magnetic particle, eddy current, leak testing, acoustic emission, visual, etc.

6.7 Outside Agency - An independent company or functionally independent organization/individual that provides NDE Level III services and whose qualifications to provide those services have been reviewed by the employer that engages the company, organization or individual.

6.8 Qualification - The demonstrated skill, training, knowledge and experience required for personnel to properly perform the duties of a specific job.

6.9 Surveillance - The act of monitoring or observing to verify an item or activity conforms to specified requirements.

6.10 Technique - A specific way of utilizing a particular NDE method, i.e., gamma radiography, contact ultrasonics, solvent removable liquid penetrant examination, etc.

6.11 Training - The program developed to impart the knowledge and skills necessary for qualification.

## 7.0 RECORDS

7.1 The qualification records of the certified individual shall be maintained and shall include the following:

7.1.1 Name of the certified individual;

7.1.2 Level of certification and test method;

7.1.3 Educational background and experience of the certified individual;

7.1.4 Statement indicating satisfactory completion of training in accordance with this procedure;

7.1.5 Results of the physical examination prescribed in Paragraph 4.3.11;

7.1.6 Current examination copy(s) or evidence of successful completion of the examinations;

7.1.7 Other suitable evidence of satisfactory qualifications when such qualifications are used in lieu of examinations;

7.1.8 Composite grade(s) or suitable evidence of grades;

7.1.9 Date of certification and/or recertification and the date of assignment to NDE;

7.1.10 Signature of employer's designated representative.

7.2 Records shall be maintained by the responsible group or department and become quality records in accordance with QAP 17.1 when an individual has terminated or transferred from the department.

APPROVED: _____ 11/1/93
Principal NDE Level III Date

## TABLE 2.4-2, MINIMUM TRAINING and EXPERIENCE for LEVEL I and II

| Method | RT | | MT | | UT | | PT | | ET | | VT | | LT | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Level | I | II | I | II | I | II | I | II | I | II | I | II | I | | | | II | | | |
| Technique | | | | | | | | | | | | | BT | PCMT | HDLT | MSLT | BT | PCMT | HDLT | MSLT |
| Comp. of 2 yrs Eng. or Science Study in Univ or College or Tech School | TRAINING (HOURS) | | | | | | | | | | | | | | | | | | | |
| | 29 | 35 | 8 | 4 | 24 | 40 | 4 | 4 | 8 | 8 | 8 | 8 | 2 | 16 | 8 | 28 | 2 | 12 | 6 | 16 |
| High School or Equivalent | 39 | 40 | 12 | 8 | 40 | 40 | 4 | 8 | 12 | 8 | 16 | 24 | 2 | 24 | 12 | 40 | 4 | 16 | 8 | 24 |
| Grammar School * | 88 | 80 | 24 | 16 | 40 | 80 | 12 | 16 | 48 | 24 | 20 | 20 | 2 | 60 | 24 | 60 | 4 | 80 | 20 | 80 |
| All Education Levels as listed above | TOTAL WORK TIME EXPERIENCE (MONTHS PER LEVEL) | | | | | | | | | | | | | | | | | | | |
| | 3 | 9 | 1 | 3 | 3 | 9 | 1 | 2 | 1 | 9 | 1 | 3 | ** | 1.5 | 1.5 | 4 | 0.5 | 4 | 4 | 6 |

NOTES:

1. * - Grammar School graduation, or demonstration of proficiency, or additional training.

2. Training shall be as outlined in Reference 5.4. For Level II certification, the experience shall consist of time at Level I, or equivalent. If a person is being qualified directly to Level II with no time at Level I, the required experience shall consist of the sum of the times required for Level I and Level II and the hours of training required for Level I and Level II in total shall apply. Credit for experience may be gained simultaneously in two or more methods or techniques. The candidate must spend at least 25% of his work time in each method or technique for which experience is being claimed.

3. VT as identified above refers to VT-1 (which includes VT of weldments), VT-2, & VT-3 as defined in Section XI of the ASME BPV Code.

4. Work time experience accumulated in RT, MT, UT, PT, ET or other NDE related methods such as Dimensional, Mechanical, Optical, etc. shall be applied toward not more than 75% of the work time experience required for VT.

5. One (1) month equals 175 hours.

6. Personnel utilizing methods not covered in Table 2.4-2 above shall be trained and qualified in accordance with SNT-TC-1A and this written practice.

7. BT - Bubble Test, ** indicates 2 Hours; MSLT - Mass Spectrometer Leak Test;
PCMT - Pressure Change/Measurement Test; HDLT - Halogen Diode Leak Test.

## TABLE 2.4-3, TRAINING and EXPERIENCE for LIMITED CERTIFICATION

| TECHNIQUE / ACTIVITY | METHOD | TRAINING (HRS) | | EXPERIENCE (HRS) | |
|---|---|---|---|---|---|
| | | I | II | I | II |
| Isotope Radiography | RT | N/A | 40 | N/A | 720 |
| Film Interpretation | RT | N/A | 20 | N/A | 520 |
| Data Taking/Equip. Op. | RT | 39 | N/A | 0 | N/A |
| Surveillance | RT | N/A | 40 | 2 surveillance trips for LII | |
| | | | | | |
| Coil Technique | MT | 2 | 4 | 40 | 260 |
| Yoke Technique | MT | 3 | 4 | 40 | 260 |
| Prod Technique | MT | 3 | 4 | 40 | 260 |
| Evaluation | MT | N/A | 4 | N/A | 130 |
| Data Taking/Equip. Op. | MT | 12 | N/A | 0 | N/A |
| Surveillance | MT | N/A | 10 | 1 surveillance trip for LII | |
| | | | | | |
| Thickness Readings | UT | 10 | 10 | 240 | 240 |
| Contact Testing | UT | N/A | 20 | N/A | 720 |
| Evaluation | UT | N/A | 20 | N/A | 520 |
| Data Taking/Equip. Op. | UT | 40 | N/A | 0 | N/A |
| Surveillance | UT | N/A | 40 | 2 surveillance trips for LII | |
| | | | | | |
| Solvent Removable | PT | N/A | 4 | N/A | 130 |
| Evaluation | PT | N/A | 4 | N/A | 130 |
| Data Taking/Equip. Op. | PT | 4 | N/A | 0 | N/A |
| Surveillance | PT | N/A | 6 | 1 surveillance trip for LII | |
| | | | | | |
| Weldments | VT | 1 | 2 | 100 | 175 |
| Data Taking/Equip. Op. | VT | 2 | N/A | 0 | N/A |
| Surveillance | VT | N/A | 6 | 2 surveillance trips for LII | |
| | | | | | |
| Data Taking/Equip. Op. | ET | 12 | N/A | 0 | N/A |
| Surveillance | ET | N/A | 12 | 1 surveillance trip for LII | |
| Analysis of Fuel Rods | ET | N/A | 20 | N/A | 250, Note 6 |

Notes:

1. Work time experience accumulated in RT, MT, UT, PT, ET or other NDE related methods such as Dimensional, Mechanical, Optical, etc. shall be applied toward not more than 75% of the work time experience required for VT.

2. Personnel holding limited certification in Data Taking/Equipment Operation shall work with a certified (unlimited) individual and shall not independently conduct any test, interpret or evaluate any results of a test or write a report of the test results.

3. The above hours are based on a high school graduate or equivalent. For other education levels, the hours may be adjusted in a ratio based on the hours shown in Table 2.4-2.

4. It is not intended by this written practice that the sum of the hours listed for each method above is required for unlimited certification. See Table 2.4-2 for unlimited certification requirements.

5. For activities for which limited certification training and experience hours are not included in the table above, the Principal Level III shall establish and document the required training and experience hours prior to initiation of the qualification and certification activities.

6. Experience for ET Fuel Rod Analysis must be gained during a minimum of two field assignments. A knowledge of fuel rod manufacturing and/or design is also required.

TABLE 2.4-4, GENERAL EXAMINATION QUESTIONS

| METHOD | Level I | Level I Limited | Level II | Level II Limited |
|---|---|---|---|---|
| Radiography | 40 | 20 | 40 | 30 |
| Magnetic Particle | 30 | 15 | 30 | 20 |
| Ultrasonics | 40 | 20 | 40 | 30 |
| Liquid Penetrant | 30 | 15 | 30 | 20 |
| Eddy Current | 40 | 20 | 40 | 20 |
| Leak Testing | 20 | 10 | 20 | 10 |
| Visual | 40 | 20 | 40 | 20 |

TABLE 2.4-5, SPECIFIC EXAMINATION QUESTIONS

| METHOD | Level I | Level I Limited | Level II | Level II Limited |
|---|---|---|---|---|
| Radiography | 20 | 10 | 20 | 10 |
| Magnetic Particle | 20 | 10 | 15 | 10 |
| Ultrasonics | 20 | 10 | 20 | 10 |
| Liquid Penetrant | 20 | 10 | 15 | 10 |
| Eddy Current | 20 | 10 | 20 | 10 |
| Leak Testing | | | | |
| 1. Bubble Test | 15 | 10 | 15 | 10 |
| 2. Absolute Pressure Test (Pressure Change) | 15 | 10 | 15 | 10 |
| 3. Halogen Diode Leak Test | 15 | 10 | 15 | 10 |
| 4. Mass Spectrometer Leak Test | 20 | 10 | 40 | 20 |
| Visual | 25 | 15 | 25 | 15 |

ABB

## EYE EXAMINATION RECORD

NAME: Brian E. Albright DATE: 9/11/93

SSN: 044-45-0123

[X] JAEGER #1 [ ] JAEGER #2 [ ] ORTHORATER

[X] SNELLEN [ ] ISHIHARA [ ] OTHER: _____

**EXAMINATION RESULTS:**

| | | | | TO BE COMPLETED BY NDE DEPARTMENT | |
|---|---|---|---|---|---|
| | | | | ACCEPTABLE | UNACCEPTABLE |
| **NEAR VISION** | | | | | |
| NATURAL: | R J-1 | L J-1 | B J-1 | [X] | [ ] |
| CORRECTED: | R - | | B | [ ] | [ ] |
| **FAR VISION** | | | | | |
| NATURAL: | R 20 | L 20 | B 20 | [ ] | [X] |
| CORRECTED: | R 20/25 | L 20/30 | B 20/25 | [X] | [ ] |
| **COLOR VISION** | | | | [X] | [ ] |

[X] ISHIHARA [ ] A.O.I.

[ ] OTHER: _____

EXHIBIT

CORRECTIVE LENSES OR AIDS ARE REQUIRED WHILE CONDUCTING EXAMINATIONS:

| | | |
|---|---|---|
| NEAR VISION: | [ ] YES | [X] NO |
| FAR VISION: | [X] YES | [ ] NO |

ADMINISTERED BY: _____ TITLE: NDE Level III

ACCEPTED BY: _____ TITLE: NDE Level III

FM020102.160

EXHIBIT 2.4-1

ABB

## CERTIFICATION RECORD

**METHOD:** ULTRASONIC

**NAME:** Brian E. Albright
**LEVEL:** III

**SOC. SEC. NO.:** 044-45-0123
**CERTIFICATION DATE:** 9/12/93
**EXPIRATION DATE:** 9/12/98

**EDUCATION:**
Needham High School, Needham, MA - Grad 1968

**TRAINING:**
US Navy NDT of Metals School, San Diego, CA - August 1980 - Courses in UT Thickness & Silver Braze Inspection
ABB Combustion Engineering, Windsor,CT - August 1981 - 32 Hours UT LII
- May 1982 - 28 Hours UT LII
EPRI NDE Center, Charlotte, NC - December 1983 - 40 Hours IGSCC Sizing
- June 1985 - 40 Hours IGSCC Detection
Heller Assoc., Niantic, CT - 1992 - 24 Hours UT LIII

**EXPERIENCE:**
Certified and experienced at ABB CE as a Level I from December 1981 to July 1982, as a Level II from July 1982 to August 1988 and as a Level III from August 1988 to September 1993.

EXHIBIT

**EXAMINATION:**

General/Basic: 80.0
Specific/Method: 80.0
Practical/Specific: 89.9

ASNT Level III Basic and Method Exams - Passed 11/92

Practical Score : 92.0

Total: 341.9 / 4 = 85.4 COMPOSITE SCORE

The above named individual has completed the qualification/training requirements for certification in the above examination method in accordance with ABB Combustion Engineering Nuclear Services procedure QAP 2.4 revision 2 and only Addenda as anotated below.

CERTIFIED BY: G P Bloomquist
POSITION: Manager, Nuclear Quality

| ADDENDA | REV. | REFERENCE | CERTIFIED BY | POSITION | DATE |
|---|---|---|---|---|---|
| C | 0 | ASME Sect XI, App VII | G P Bloomquist | Mgr Nuc Qual | 9/26/93 |
| | | | | | |
| | | | | | |
| | | | | | |

FM020401169 6/15/92

EXHIBIT 2.4-2

# ADDENDUM B
# CERTIFICATION OF EPRI QUALIFIED DATA ANALYST (QDA) PERSONNEL

## 1.0 PURPOSE

1.1 This addendum modifies the requirements of QAP 2.4 for qualifications of EPRI Qualified Data Analyst (QDA), in accordance with PWR Steam Generator Examination Guidelines: Revision 3, EPRI NP-6201, Appendices G and H, November 1992.

## 2.0 APPLICABILITY

2.1 This Addendum applies only when required by Code, specification, contract or other governing document.

## 3.0 PREREQUISITES

3.1 Candidates for certification in accordance with this Addendum shall be certified to a minimum of Level IIA or shall be a Level II and have written permission of the Principal Level III.

## MODIFICATIONS/ADDITIONS/DELETIONS

## 4.0 PROCEDURE

4.2 EDUCATION, TRAINING AND EXPERIENCE [SAME EXCEPT AS NOTED]

change existing paragraph to:

4.2.1 b. For EPRI Qualified Data Analyst (QDA) an additional 40 hours specific training, including examination, in eddy current data analysis is required to supplement the ET Level II training requirements as defined in Table 2.4-2. No additional experience is required.

4.1 EXAMINATIONS [SAME EXCEPT AS NOTED]

change existing paragraph to:

4.3.3 The QDA shall satisfy all of the examination requirements for an Eddy Current Level II or III and, in addition, shall demonstrate proficiency by successful completion of the EPRI Steam Generator Eddy Current Performance Demonstration using the Industry Database (IDB) Practical Examination.

4.5 RECERTIFICATION [SAME EXCEPT AS NOTED]

add the paragraph:

4.5.4 Periodic requalification as a QDA is not required as long as an individual continues to assume actively the duties of a data analyst with no continuous lapse in these duties for a time span longer than fifteen (15) months, as specified in Reference 5.7. Yearly training requirements of a minimum of eight (8) hours as specified in Reference 5.7 must be satisfied as well.

5.0 REFERENCES [SAME EXCEPT AS NOTED]

add the following paragraphs:

5.7 PWR Steam Generator Examination Guidelines: Revision 3, EPRI NP-6201, Appendices G and H, November 1992.

5.8 Industry Database, EPRI Research Project S530, June 1993. (Consists of a written and practical examination and includes data from the three (3) NSSS vendors.)

7.0 RECORDS [SAME EXCEPT AS NOTED]

add the following paragraph:

7.3 Certification Records of Analysts who successfully complete the IDB Practical Examination shall have the designation "EPRI Qualified Data Analyst (QDA)" and the date of completion placed in the Examination Section.

APPROVED: _____ 11/1/93
Principal NDE Level III Date

ABB
ASEA BROWN BOVERI

September 9, 1995

Mr. Chip Bach
Shearon Harris Nuclear Plant
State Road 1134
New Hill, NC 27562

SUBJECT: PERSONNEL QUALIFICATIONS, ABB/CENO S/G CREW REVISION 1

Dear Chip:

The attached personnel matrix has been revised to reflect personnel qualification changes. Each revision has been denoted by an adjacent # symbol.

Sincerely,

Roy N. Brown
Harris R06
Steam Generator Manager

RNB:rps

Attachment



Combustion Engineering, Inc.
1201 Riverfront Parkway
Chattanooga, Tennessee 37402
Telephone (615) 752-2390
Toll Free 1-800-872-8836
Fax (615) 752-2449

ABB
ASEA BROWN BOVERI

MR. ROGER JOHNSON
CP&L

SUBJECT: LEAD RESOLUTION ANALYSTS

THE FOLLOWING ANALYSTS ARE ON SITE TO PERFORM RESOLUTION ANALYSIS.

TOM BIPES LEVEL III & QDA SENIOR LEAD

DONALD DANKE LEVEL III & QDA

DOUGLAS CALENDER LEVEL III & QDA

LYNN HOVER LEVEL III & QDA

9-19-95

ROY N. BROWN

ABB S/G PROJECT MANAGER

ABB Combustion Engineering Nuclear Services

Combustion Engineering, Inc. 1201 Riverfront Parkway Chattanooga, Tennessee 37402 Telephone (615) 752-2390 Toll Free 1-800-872-8836 Fax (615) 752-2449

REVISION___1___

# QUALIFICATION MATRIX

9/11/95

| NAME | Insp. Port Removal Replacement<br>CP & L Procedure | Sludge Lance Operator<br>ABB Procedure | FOSAR Operator<br>ABB Procedure | Sludge Lance Platform Worker<br>ABB Procedure | Eddy Current Analysis<br>ABB Procedure | Eddy Current Acquisition Level II<br>ABB Procedure | Eddy Current Acquisition Level I<br>ABB Procedure | Plugging CSO<br>ABB Procedure | Plugging and Eddy Current Platform Worker<br>ABB Procedure | Nozzle Dam Worker<br>CP&L Procedure | Manway Worker<br>CP&L Procedure | Helper or Trainee<br>CP&L or ABB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| BASSEN | | | | | | X | | | X | | | |
| BENEFIELD, C. * | | | | | X | | | | | | | |
| BIPES, T. | | | | | X | X | | | X | | | |
| BLAHNIK,S. | | | | | | | | | | X | | |
| BROWN, R. N. | | | | | | | | | X | O# | O# | X# |
| BROWN, W. | | | | | | X# | | | X | | | |
| CALENDAR, D. | | | | | X | | | | | | | |
| CAW, M. | | | | X | | | X | | X | | O | X |
| CHRISTIE, L. G. | | | | | | X | | | X | | X | |
| COOPER, J. | | | | | | | X | | X | | X | |
| DAHNKE, D. | | | | | X | | | | | | | |
| DEANE, L. | | | | | | | | | | X | | |
| HOGAN, C | | | | | | | | | O | O | O | X |
| DOSHE, M. * | | | | | X | | | | | | | |
| ELLIS | | | | | | X | | | X | | | |
| ESTES, G. | X | X | X | X | | | | | | | | |
| FOLSOM, D. | | | | | X | X | | X | X | | | |
| FORTENBERRY, G. | | | | | | X | | | X | | | |
| FRYE | | | | | SA-DM | | | | | | | |
| FUNG, P. * | | | | | X | | | | | | | |
| GALLANT, G. | | | | | | X | | X | X | | | |
| GIBSON, D. | | | | | | | X# | | X | | | |
| GREEN, J.C. | | | | | | X | | | X | | | |
| GREENE, D. * | | | | | X | | | | | | | |
| GANTT R. | | | | | | X# | | | X | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

# QUALIFICATION MATRIX



| NAME | Insp. Port Removal Replacement<br>CP & L Procedure | Sludge Lance Operator<br>ABB Procedure | FOSAR Operator<br>ABB Procedure | Sludge Lance Platform Worker<br>ABB Procedure | Eddy Current Analysis<br>ABB Procedure | Eddy Current Acquisition Level II<br>ABB Procedure | Eddy Current Acquisition Level I<br>ABB Procedure | Plugging CSO<br>ABB Procedure | Plugging and Eddy Current Platform Worker<br>ABB Procedure | Nozzle Dam Worker<br>CP&L Procedure | Manway Worker<br>CP&L Procedure | Helper or Trainee<br>CP&L or ABB Procedure |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HANSEN, L. | | | | | | | | | | X | | |
| HILL, D. M. | | | | | | X | | | X | | | |
| HOLCOMB, D. | | | | | | | | | | X | | |
| HOLMES, D. | | | | | | X | | X | X | | | |
| HOVER, L. | | | | | X | | | | | | | |
| HRABIK, J. | | | | | | | | | | X | | |
| INGENTHRON, G * | | | | | X | | | | | | | |
| IRWIN, W. | | | | | | X | | X | X | | | |
| JACOBS, J. | | | | | X | X | | X | X | | | |
| JOHNSTON, K. | | | | | | X | | | X | | X | |
| JONES, L. | | | | | | X | | X | X | | | |
| FREISNER, R * | | | | | X | | | | | | | |
| LANGLEY, T | | | | | | | | | O | O | O | X |
| MAUK, C | | | | | | | | | O | O | O | X |
| STEPHENSON, R | | | | | | | | | O | O | O | X |
| LEMIEUX, C. | | | | | | | | | | X | | |
| LEMIEUX, R. | | | | | | | | | | X | | |
| LENZ, P. | | | | | | X | | | X | | | |
| LONGLEY, A. | X | X | # | X | | | | | | | X | |
| MANLEY, D. L. | | | | | | | X | | X | | X | |
| NEYMAN, G. | X | X | X | X | | | | | | | X | |
| O'GRADY, P. * | | | | | X | | | | | | | |
| O'LAUGHLIN | | | | | SA-DM | | | | | | | |
| OVERCASH, L. | | | | | | X | | | X | | | |
| PADGENT, T. | | | | | | X | | | X | | | |
| PARKER, D. | | | | | | X | | | X | | | |
| PASCUCCI, A. | | | | | | X | | X | X | | | |
| PIEH, A. * | | | | | X | | | | | | | |
| KELSEY C. | | | | | | | | | O# | O# | 0# | X# |

| NAME | Insp. Port Removal Replacement<br>CP & L Procedure | Sludge Lance Operator<br>ABB Procedure | FOSAR Operator<br>ABB Procedure | Sludge Lance Platform Worker<br>ABB Procedure | Eddy Current Analysis<br>ABB Procedure | Eddy Current Acquisition Level II<br>ABB Procedure | Eddy Current Acquisition Level I<br>ABB Procedure | Plugging CSO<br>ABB Procedure | Plugging and Eddy Current Platform Worker<br>ABB Procedure | Nozzle Dam Worker<br>CP&L Procedure | Manway Worker<br>CP&L Procedure | Helper or Trainee<br>CP&L or ABB Procedure |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PLATH, R. | | | | | | X | | | X | | | |
| ROGERS, C. | | | | | | | | | | X | | |
| PYLE, S. | X | X | | X | X | X | | X | X | | X | |
| REICH, J. E. | | | | | | X | | X | X | | | |
| RHODES, D. | | | | | | | | | | X | | |
| ROBERTS | | | | | SA-DM | | | | | | | |
| SAPIA, M. * | | | | | X | | | | | | | |
| SHOCK, S. A. | | | | | | X | | X | X | | | |
| SILUS | | | | | SA-DM | | | | | | | |
| SMITH, D. | X | | | X | | X | | X# | X | | X | |
| SOUTHERLAND, T. | X | X | X | X | X | X | | X | X | X | X | |
| SPENCER, J. * | | | | | X | | | | | | | |
| STANDIFER, W. | X | | X | X | | | | | | | X | |
| STRICKLIN, R. | X | | X | X | | | | | X | | X | |
| TATE, T. * | | | | | X | | | | | | | |
| TAYLOR, M. | | | | | | | | | | X | | |
| TEAGUE, M. * | | | | | X | | | | | | | |
| TERNING, G. * | | | | | X# | | | | | | | |
| THOMAS, B. | | | | | | | | | | X | | |
| TOMAN, J. * | | | | | X | | | | | | | |
| TRAVIS, G. | X | | | X | | | | | X | X | X | |
| WALLIN, J. | X | X | X | X | | | | | | X | X | |
| WEATHFORD, J. | | | | | | X | | | X | | | |
| WILLS, L. | X | X | X# | X | | | | | | X | X | |
| ZIRKELBACH, J. | | | | X | | X | | X# | X | | X | |
| THOMPSON T. | | | | | | | | | | | X | |

# QUALIFICATION MATRIX



| NAME | Insp. Port Removal Replacement CP & L Procedure | Sludge Lance Operator ABB Procedure | FOSAR Operator ABB Procedure | Sludge Lance Platform Worker ABB Procedure | Eddy Current Analysis ABB Procedure | Eddy Current Acquisition Level II ABB Procedure | Eddy Current Acquisition Level I ABB Procedure | Plugging CSO ABB Procedure | Plugging and Eddy Current Platform Worker ABB Procedure | Nozzle Dam Worker CP&L Procedure | Manway Worker CP&L Procedure | Helper or Trainee CP&L or ABB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TURNER V. | | | | | | | | | | | X | |
| MORRISON D. | | | | | | | | | | | X | |
| ROSE W. | | | | | | | | | | X | X | |
| WILLIAMS C. | | | | | | | | | | X | X | |
| BRANNON W. | | | | | | | | | | X | | |
| ACKERMAN J. | | | | | | | | | | X | | |
| WHITE D. | | | | | | | | | | X | | |
| | | | | | | | | | | | | |
| * = CHATTANOOGA ANALYSIS | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| X= TRAINED/QUALIFIED /EXPERIENCED WORKERS | | | | | | | | | | | | |
| O= TRAINEE'S BY MOCK UP , NO FEILD EXPERIENCE | | | | | | | | | | | | |
| #= REVISON 1 CHANGES TO QUALIFICATION MATRIX | | | | | | | | | | | | |
| SA-DM= SYSTEM ADMINISTRATOR-DATA MANAGEMENT | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Prepared by R.P. Stricklin – Training | | | | | | | | | | | | |
| Reviewed by R.N. Brown - -Project Mgr. | | | | | | | | | | | | |
| Reviewed by R.Tate --Quality Contol Mgr. | | | | | | | | | | | | |
| Approved by CP&L REP. | | | | | | | | | | | | |

9-11-95

9-11-95

9/11/95

ZETEC
1370 NW Mall St. • PO Box 140
Issaquah, WA 98027-0140 USA
(800) 643-1771 • (206) 392-6316
FAX • (206) 392-2065

Z-QA 8A REV. 2

| CONDITION CODE: E |
|---|
| OWNER: ABB COMBUSTION ENGINEERING |

Zetec, Incorporated hereby certifies that the following instrument meets or exceeds all manufacturer's specifications.

| Instrument: MIZ-18A RDAU |
|---|
| Serial Number: 056 |

The calibration of this instrument is controlled by approved, documented procedures which meet or exceed ASME Section XI, Appendix IV and ASME Section V Article 8, Appendix I, through 1989 Edition December 1990 Addenda.

Calibration has been performed using standards whose accuracies are traceable to the National Institute of Standards and Technology.

STANDARDS USED: / 1524 / 098 / 091 / 086 /

CALIBRATION DATE: 24 Jan 1995

CALIBRATED BY: GRIFF NUTTALL

TECHNICIAN

CERTIFICATION DATE: 24 Jan 1995

EXPIRATION DATE: 24 Jan 1996

CERTIFIED BY: STEVE VON FUCHS

QUALITY ASSURANCE

COMMENTS: CALIBRATION PERFORMED USING PROCEDURE #CSP-RDAU-MIZ-18A REV. 3.

CERTIFICATE NUMBER A: 55179

ZETEC ADMIN Fax:206-392-2086 May 10 '95 10:21 P.02/02

ZETEC
1370 NW Mall St. • PO Box 140
Issaquah, WA 98027-0140 USA
(800) 643-1771 • (206) 392-5316
FAX • (206) 392-2086



CONDITION CODE: B

OWNER: ABB COMBUSTION ENGINEERING

Zetec, Incorporated hereby certifies that the following instrument meets or exceeds all manufacturer's specifications.

Instrument: MIZ-18A RDAU

Serial Number: 185

The calibration of this instrument is controlled by approved, documented procedures which meet or exceed ASME Section XI, Appendix IV and ASME Section V Article 8, Appendix I, through 1989 Edition December 1990 Addenda.

Calibration has been performed using standards whose accuracies are traceable to the National Institute of Standards and Technology.

STANDARDS USED: / 1817 / 1396 / 097 / 019 /

CALIBRATION DATE: 31 Jul 1995

CALIBRATED BY: GRIFF NUTTALL

TECHNICIAN

CERTIFICATION DATE: 31 Jul 1995

EXPIRATION DATE: 31 Jul 1996

CERTIFIED BY: WILL REYNOLDS

QUALITY ASSURANCE

COMMENTS: CALIBRATION PERFORMED USING PROCEDURE # CP-PDAU-MIZ-18A REV.3.
CUST. PO# 9506166

CERTIFICATE NUMBER A: 55690

ZETEC
1370 NW Mall St. • PO Box 140
Issaquah, WA 98027-0140 USA
(800) 643-1771 • (206) 392-5316
FAX • (206) 392-2086



| CONDITION CODE: 8 |
|---|
| OWNER: ABB COMBUSTION ENGINEERING |

Zetec, Incorporated hereby certifies that the following instrument meets or exceeds all manufacturer's specifications.

| Instrument: MIZ-18A RDAU |
|---|
| Serial Number: 111 |

The calibration of this instrument is controlled by approved, documented procedures which meet or exceed ASME Section XI, Appendix IV and ASME Section V Article 8, Appendix I. through 1989 Edition December 1990 Addenda.

Calibration has been performed using standards whose accuracies are traceable to the National Institute of Standards and Technology.

STANDARDS USED: / 1817 / 1396 / 097 / 019 /

CALIBRATION DATE: 31 Jul 1995

CALIBRATED BY: GRIFF NUTTALL

TECHNICIAN

CERTIFICATION DATE: 31 Jul 1995

EXPIRATION DATE: 31 Jul 1996

CERTIFIED BY: WILL REYNOLDS

QUALITY ASSURANCE

COMMENTS: CALIBRATION PERFORMED USING PROCEDURE # CSP-RDAU-MIZ-18A REV.3.
U.I. PO# 950...

CERTIFICATE NUMBER A: 55689

ZETEC
70 NW Mall St. • PO Box 140
Issaquah, WA 98027-0140 USA
(800) 643-1771 • (206) 392-5316
FAX • (206) 392-2666

Z-QA 8A REV. 2

| CONDITION CODE: B |
|---|
| OWNER: ABB COMBUSTION ENGINEERING |

Zetec, Incorporated hereby certifies that the following instrument meets or exceeds all manufacturer's specifications.

| Instrument: MIZ-18A RDAU |
|---|
| Serial Number: 069 |

The calibration of this instrument is controlled by approved, documented procedures which meet or exceed ASME Section XI, Appendix IV and ASME Section V Article 8, Appendix I, through 1989 Edition December 1990 Addenda.

Calibration has been performed using standards whose accuracies are traceable to the National Institute of Standards and Technology.

STANDARDS USED: / 1136 / 019 / 054 / 003 /

CALIBRATION DATE: 19 Jan 1995

CALIBRATED BY: BRETT E. PYREN

Brett E. Pyren
TECHNICIAN

CERTIFICATION DATE: 19 Jan 1995

EXPIRATION DATE. 19 Jan 1996

CERTIFIED BY: WILL REYNOLDS

W. Reynolds
QUALITY ASSURANCE

COMMENTS: CALIBRATION PERFORMED USING PROCEDURE #OSP-RDAU-MIZ-18A REV. 3.

CERTIFICATE NUMBER A: 55159

ZETEC
1370 NW Mall St. • PO Box 140
Issaquah, WA 98027-0140 USA
(800) 643-1771 • (206) 392-5316
FAX • (206) 392-2086

Z-QA 8A REV. 2

| CONDITION CODE: B |
|---|
| OWNER: ABB COMBUSTION ENGINEERING |

Zetec, Incorporated hereby certifies that the following instrument meets or exceeds all manufacturer's specifications.

| Instrument: MIZ-18A RDAU |
|---|
| Serial Number: 072 |

The calibration of this instrument is controlled by approved, documented procedures which meet or exceed ASME Section XI, Appendix IV and ASME Section V Article 8, Appendix I, through 1989 Edition December 1990 Addenda.

Calibration has been performed using standards whose accuracies are traceable to the National Institute of Standards and Technology.

STANDARDS USED: / 1817 / 1396 / 097 / 019 /

CALIBRATION DATE: 31 Jul 1995

CALIBRATED BY: GRIFF NUTTALL

G. Nuttall
TECHNICIAN

CERTIFICATION DATE: 31 Jul 1995

EXPIRATION DATE: 31 Jul 1996

CERTIFIED BY: WILL REYNOLDS

W Reynolds
QUALITY ASSURANCE

COMMENTS: CALIBRATION PERFORMED USING PROCEDURE # CSP-RDAU-MIZ-18A REV.3.
USI. PO# 950166

CERTIFICATE NUMBER A: 55694

ZETEC
370 NW Mall St. • PO Box 140
[illegible], WA 98027-0140 USA
[illegible] 3-1771 • (206) 392-5316
[illegible] (206) 392-2086



CONDITION CODE: 8

OWNER: ABB COMBUSTION ENGINEERING

Zetec, Incorporated hereby certifies that the following instrument meets or exceeds all manufacturer's specifications.

Instrument: MIZ-30

Serial Number: 031

The calibration of this instrument is controlled by approved, documented procedures which meet or exceed ASME Section XI, Appendix IV and ASME Section V Article 8, Appendix I, through 1989 Edition December 1990 Addenda.

Calibration has been performed using standards whose accuracies are traceable to the National Institute of Standards and Technology.

STANDARDS USED: / 2652 / 098 / 097 / 091

CALIBRATION DATE: 5 May 1995

CALIBRATED BY: GRIFF NUTTALL

TECHNICIAN

CERTIFICATION DATE: 8 May 1995

EXPIRATION DATE: 8 May 1996

CERTIFIED BY: BRETT E. PYREN

QUALITY ASSURANCE

COMMENTS: 4 ANALOG BOARDS

CERTIFICATE NUMBER A: 55454

ZETEC
1370 NW Mall St • PO Box 140
Issaquah, WA 98027-0140 USA
(800) 553-1771 • (206) 392-5316
FAX • (206) 392-2065

Z-QA 8A REV. 2

| CONDITION CODE: NEW |
|---|
| OWNER: ABB COMBUSTION ENGINEERING |

Zetec, Incorporated hereby certifies that the following instrument meets or exceeds all manufacturer's specifications.

| Instrument: MIZ-30-8 |
|---|
| Serial Number: 089 |

The calibration of this instrument is controlled by approved, documented procedures which meet or exceed ASME Section XI, Appendix IV and ASME Section V Article 8, Appendix I, through 1989 Edition December 1990 Addenda.

Calibration has been performed using standards whose accuracies are traceable to the National Institute of Standards and Technology.

STANDARDS USED: 057 / 2501 / 098

CALIBRATION DATE: 28 Jul 1995

CALIBRATED BY: JASON KING

FOR
TECHNICIAN

CERTIFICATION DATE: 14 Aug 1995

EXPIRATION DATE: 14 Aug 1996

CERTIFIED BY: BRETT E. PYREN

QUALITY ASSURANCE

COMMENTS: PROCEDURE NUMBER: ESP-COP MIZ-30-8 REV. 4

CERTIFICATE NUMBER A: 55681

ZETEC
1370 NW Mall St. • PO Box 140
Issaquah, WA 98027-0140 USA
(800) 643-1771 • (206) 392-5316
FAX • (206) 392-2066



| |
|---|
| CONDITION CODE: NEW |
| OWNER: ABB COMBUSTION ENGINEERING |

Zetec, Incorporated hereby certifies that the following instrument meets or exceeds all manufacturer's specifications.

| |
|---|
| Instrument: MIZ-30-8 |
| Serial Number: 090 |

The calibration of this instrument is controlled by approved, documented procedures which meet or exceed ASME Section XI, Appendix IV and ASME Section V Article 8, Appendix I, through 1989 Edition December 1990 Addenda.

Calibration has been performed using standards whose accuracies are traceable to the National Institute of Standards and Technology.

STANDARDS USED: 056 / 1810 / 1816 / 2655

CALIBRATION DATE: 28 Jul 1995

CALIBRATED BY: ARTIE LEACH

TECHNICIAN

CERTIFICATION DATE: 14 Aug 1995

EXPIRATION DATE: 14 Aug 1996

CERTIFIED BY: BRETT E. PYREN

QUALITY ASSURANCE

COMMENTS: PROCEDURE NUMBER: ESP-COP MIZ-30-8 REV. 4

CERTIFICATE NUMBER A: 55683

ZETEC
1370 NW Mall St. • PO Box 140
Issaquah, WA 98027-0140 USA
(800) 543-1771 • (206) 392-5316
FAX • (206) 392-2065



CONDITION CODE: NEW

OWNER: ABB COMBUSTION ENGINEERING

Zetec, Incorporated hereby certifies that the following instrument meets or exceeds all manufacturer's specifications.

Instrument: MIZ-30-8

Serial Number: 092

The calibration of this instrument is controlled by approved, documented procedures which meet or exceed ASME Section XI, Appendix IV and ASME Section V Article 8, Appendix I, through 1989 Edition December 1990 Addenda.

Calibration has been performed using standards whose accuracies are traceable to the National Institute of Standards and Technology.

STANDARDS USED: 057 / 2501 / 098

CALIBRATION DATE: 28 Jul 1995

CALIBRATED BY: JASON KING

TECHNICIAN

CERTIFICATION DATE: 14 Aug 1995

EXPIRATION DATE: 14 Aug 1996

CERTIFIED BY: BRETT E. PYREN

QUALITY ASSURANCE

COMMENTS: PROCEDURE NUMBER: ESP-COP MIZ-30-8 REV. 4

CERTIFICATE NUMBER A: 55686

ZETEC
NW Mail St. • PO Box 140
Issah, WA 98027-0140 USA
) 643-1771 • (206) 392-5316
FAX • (206) 392-2065

Z-QA 8A REV. 2

CONDITION CODE: NEW

OWNER: ABB COMBUSTION ENGINEERING

Zetec, Incorporated hereby certifies that the following instrument meets or exceeds all manufacturer's specifications.

Instrument: MIZ-30-8

Serial Number: 094

The calibration of this instrument is controlled by approved documented procedures which meet or exceed ASME Section XI, Appendix IV and ASME Section V Article 8, Appendix I, through 1989 Edition December 1990 Addenda.

Calibration has been performed using standards whose accuracies are traceable to the National Institute of Standards and Technology.

STANDARDS USED: /0055 /0098 /0092 /1898

CALIBRATION DATE: 17 Aug 1995

CALIBRATED BY: JASON KING

TECHNICIAN

CERTIFICATION DATE: 17 Aug 1995

EXPIRATION DATE: 17 Aug 1996

CERTIFIED BY: BRETT E. PYREN

QUALITY ASSURANCE

COMMENTS: PROCEDURE NUMBER: ESP-COP MIZ-30-8 REV.4

CERTIFICATE NUMBER A: 55740

ZETEC
1370 NW Mall St. • PO Box 140
...h, WA 98027-0140 USA
...)-1771 • (206) 392-5316
FA...06) 392-2066



CONDITION CODE: NEW

OWNER: ABB COMBUSTION ENGINEERING

Zetec, Incorporated hereby certifies that the following instrument meets or exceeds all manufacturer's specifications.

Instrument: MIZ-30-8

Serial Number: 096

The calibration of this instrument is controlled by approved, documented procedures which meet or exceed ASME Section XI, Appendix IV and ASME Section V Article 8, Appendix I, through 1989 Edition December 1990 Addenda.

Calibration has been performed using standards whose accuracies are traceable to the National Institute of Standards and Technology.

STANDARDS USED: /0055 /0098 /0092 /1898

CALIBRATION DATE: 17 Aug 1995

CALIBRATED BY: JASON KING

TECHNICIAN

CERTIFICATION DATE: 17 Aug 1995

EXPIRATION DATE: 17 Aug 1996

CERTIFIED BY: BRETT E. PYREN

QUALITY ASSURANCE

COMMENTS: PROCEDURE NUMBER: ESP-COP MIZ-30-8 REV.4

CERTIFICATE NUMBER A: 55742

ZETEC
'370 NW Mall St. • PO Box 140
saquah, WA 98027-0140 USA
)0) 643-1771 • (206) 392-5316
AX • (206) 392-2086

Z-QA 8A REV. 2

| CONDITION CODE: NEW |
|---|
| OWNER: ABB COMBUSTION ENGINEERING |

Zetec, Incorporated hereby certifies that the following instrument meets or exceeds all manufacturer's specifications.

| Instrument: MIZ-30-8 |
|---|
| Serial Number: 097 |

The calibration of this instrument is controlled by approved, documented procedures which meet or exceed ASME Section XI, Appendix IV and ASME Section V Article 8, Appendix I, through 1989 Edition December 1990 Addenda.

Calibration has been performed using standards whose accuracies are traceable to the National Institute of Standards and Technology.

STANDARDS USED: /0055 /0098 /0092 /1898

CALIBRATION DATE: 17 Aug 1995

CALIBRATED BY: JASON KING

TECHNICIAN

CERTIFICATION DATE: 17 Aug 1995

EXPIRATION DATE: 17 Aug 1996

CERTIFIED BY: BRETT E. PYREN

QUALITY ASSURANCE

COMMENTS: PROCEDURE NUMBER: ESP-COP MIZ-30-8 REV.4

CERTIFICATE NUMBER A- 55741

ZETEC
770 NW Mall St. • PO Box 140
Issaquah, WA 98027-0140 USA
(800) 553-1771 • (206) 392-5316
FAX (206) 392-2086

Z-QA 8A REV. 2

CONDITION CODE: NEW

OWNER: ABB COMBUSTION ENGINEERING

Zetec, Incorporated hereby certifies that the following instrument meets or exceeds all manufacturer's specifications.

Instrument: MIZ-30-8

Serial Number: 104

The calibration of this instrument is controlled by approved documented procedures which meet or exceed ASME Section XI, Appendix IV and ASME Section V Article 8, Appendix I, through 1989 Edition December 1990 Addenda.

Calibration has been performed using standards whose accuracies are traceable to the National Institute of Standards and Technology.

STANDARDS USED: /0055 /0098 /0092 /1898

CALIBRATION DATE: 17 Aug 1995

CALIBRATED BY: JASON KING

TECHNICIAN

CERTIFICATION DATE: 17 Aug 1995

EXPIRATION DATE: 17 Aug 1996

CERTIFIED BY: BRETT E. PYREN

QUALITY ASSURANCE

COMMENTS: PROCEDURE NUMBER: ESP-COP MIZ-30-8 REV.4

CERTIFICATE NUMBER A: 55739

1370 N.W. Mall, P.O. Box 140, Issaquah, WA 98027-0140 (206) 392-5316 Telex 15 2592 Telecopy (206) 392-2086

# CERTIFICATE OF COMPLIANCE

This certifies that, to the best of our knowledge, the material delivered under this purchase agreement is in accordance with the terms of the contract.

Customer: ABB COMBUSTION ENGINEERING

Contract/Purchase Order Number: 9507505

By _____, on SEPT. 12, 1995
Quality Assurance Representative Date

☐ See Attachments: _____

COMMENTS: STANDARD SERIAL NUMBERS:

Z-14089 THROUGH Z-14094

C P&L CONTRACT W/ABB XM10370000
WORK AUTHORIZATION XS10370016
ABB QA MGR, RANDY TATE
9/15/95

10CFR REQUIREMENTS ARE NOT EXTENDED BEYOND ZETEC FOR COMMERCIAL ITEMS OR MATERIAL SUPPLIED TO ZETEC.

# ZETEC

## TEST CERTIFICATE

**DATE:** SEPTEMBER 9, 1993

**MATERIAL:** SEAMLESS ANNEALED INCONEL 600 SB-163

| Heat No. | Description |
|---|---|
| NX8502 | 3/4" DIA. X .043 NOM. WALL THICKNESS |

**CHEMICAL ANALYSIS**

| C | Si | Mn | P | S | Ni | Cr | Mo | Al | Zn |
|---|---|---|---|---|---|---|---|---|---|
| .034 | .26 | .240 | | <.001 | 75.47 | 15.4 | | | |
| **Pb** | **B** | **Ca** | **Cd** | **Co** | **Cu** | **Fe** | **Nb** | **Ti** | **Other** |
| | | | | | .14 | 8.20 | | | |

**TENSILE PROPERTIES**

| Yield Strength | Ultimate Strength PSI | % Elongation | Rb Hardness |
|---|---|---|---|
| 37,600 | 93,600 | 55% | HRB60 |

| Expansion | Flattening | Hydrostatic | Surface | Flaring | SPEC |
|---|---|---|---|---|---|
| | | OK | | OK | ASME SB-163 |

We certify that the above data is as furnished by the producing mill or supplier.

Zetec, Inc.

Date: 10/1/93

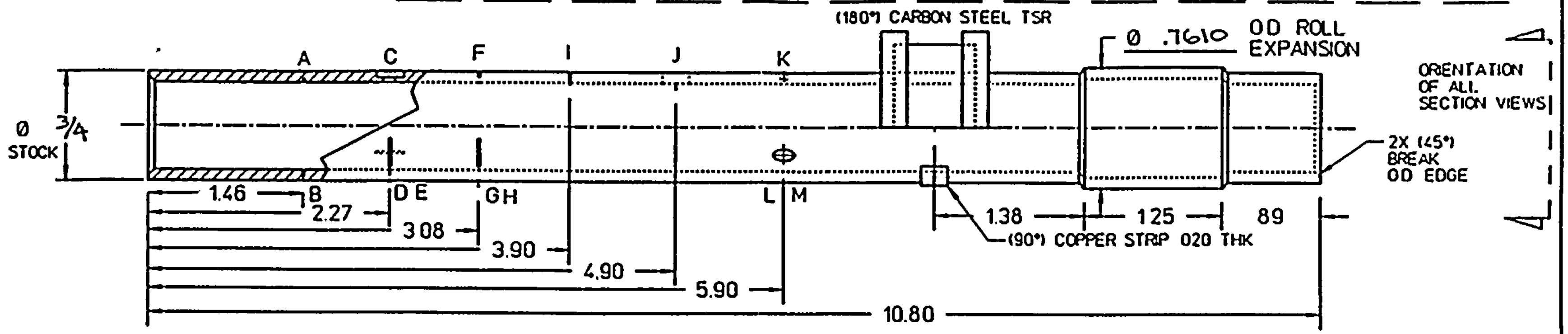
ZETEC, INC.
1370 NW Mall Street
PO Box 140
Issaquah WA 98027-0140
USA
Telephone (206) 392-5316
Telefax (206) 392-2086
Telex 15 2592

| | | | | C | REVISIONS | REV STATUS OF SHEETS |
|---|---|---|---|---|---|---|
| | | | | 2 | SHEET | |

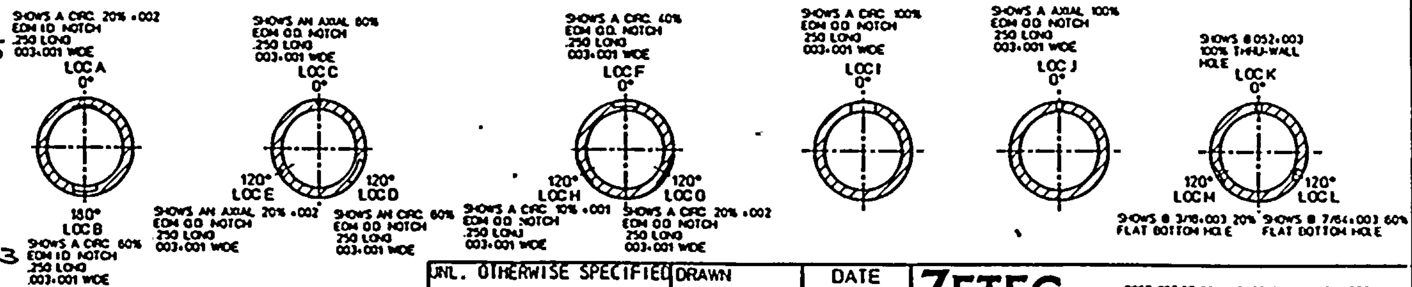
REVISIONS

| LTR | DATE | DESCRIPTION | APVD | CK | DR |
|---|---|---|---|---|---|
| C | 8/29/95 | REDRAWN W/CHANGES.REV SHT #2 | [illegible] | [illegible] | KZ |

| LOCATION | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYSICALLY MEAS DEPTH | .0095 | .0275 | .0275 | .0250 | .0090 | .0160 | .0085 | .0040 | THRU | THRU | THRU | .0245 | .0090 |
| DEPTH IN % OF WALL | 22% | 65% | 65% | 59% | 21% | 38% | 20% | 9% | 100% | 100% | 100% | 58% | 21% |
| E T PHASE ANGLE MEAS | NA | | | | | | | | | | | | |




MATERIAL INCONEL 600
AVERAGE MEAS. WALL THK. .0425
NOMINAL WALL THK. .043
HEAT LOT NO. NX8502
TEST FREQ. USED NA
SERIAL NO. Z-14089
P.O. NO 9507505
REL. NO. REQ # 9419-95-083
QUALITY REL. NO NA
DATE MFG. 9-12-95
Q.A. INSP. [signature]
CUSTOMER ABB CE
RECORDED NA
PROBE USED NA
REVIEWED BY [signature]




NOTE:

UNL. OTHERWISE SPECIFIED
DIM ARE IN INCHES
TOLERANCES
DECIMAL FRACT. ± 1/16
XXXX ± .003
XXX ±.015
XX ±.050
X ±.003
ANGULAR ±3°
FINISH

| | | DATE |
|---|---|---|
| DRAWN | K ZEGKE | 08/18/95 |
| CHECK | C B | 8/22/95 |
| DESIGN | | |
| APVD QA | G A. | 8/22/95 |

ZETEC INC
POST OFFICE BOX 140 ISSAQUAH WASHINGTON 98027-0140 U.S.A TELEPHONE (206) 392-5316

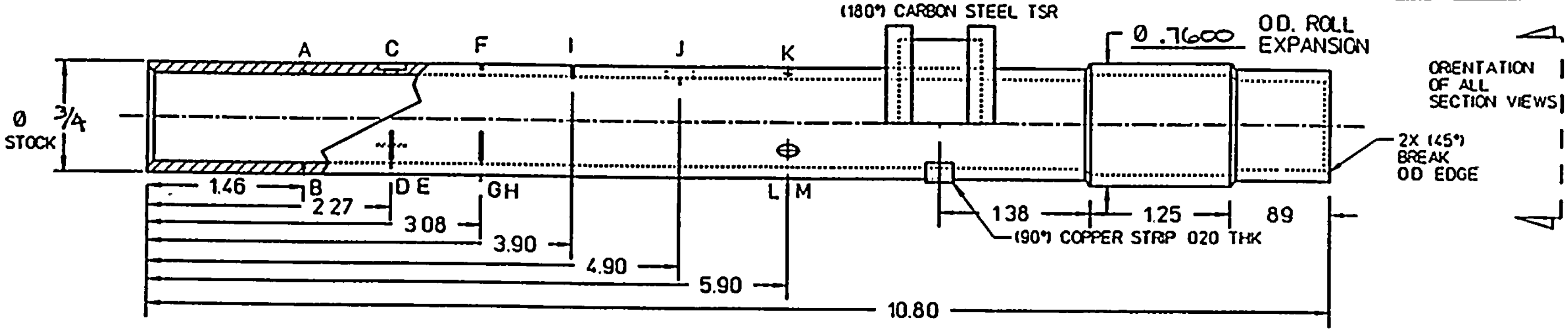
TITLE
MISC. DEFECT STANDARD
D#3538-1-A P#2956

SIMILAR | DWG NO 2-421-1007
SCALE NTS | USED ON | SHT 1 OF 2

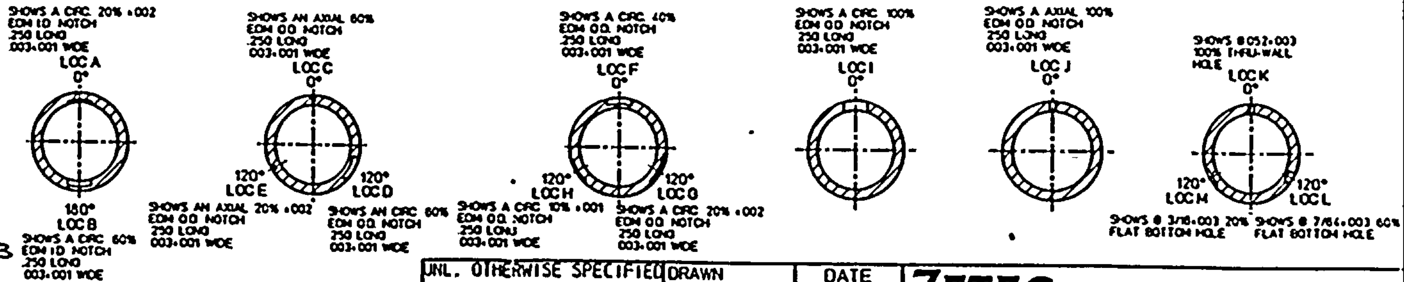
| | | | | C | REVISIONS | REV STATUS OF SHEETS |
|---|---|---|---|---|---|---|
| | | | | 2 | SHEET | |

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| LTR | DATE | DESCRIPTION | APVD | CK | DR |
| C | 8/29/95 | REDRAWN W/CHANGES.REV SHT #2 | [illegible] | [illegible] | KZ |

| LOCATION | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYSICALLY MEAS DEPTH | .0090 | .0260 | .0265 | .0250 | .0095 | .0175 | .0090 | .0040 | THRU | THRU | THRU | .0240 | .0085 |
| DEPTH IN % OF WALL | 21% | 61% | 62% | 59% | 22% | 41% | 21% | 9% | 100% | 100% | 100% | 56% | 20% |
| E T PHASE ANGLE MEAS | NA | | | | | | | | | | | | |




MATERIAL INCONEL 600
AVERAGE MEAS. WALL THK. .0425
NOMINAL WALL THK. .043
HEAT LOT NO. NX8502
TEST FREQ. USED NA
SERIAL NO. Z-14090
P.O. NO. 9507505
REL. NO. REQ #9419-95-083
QUALITY REL. NO. NA
DATE MFG. 9-12-95
Q.A. INSP. [signature]
CUSTOMER ABB CE
RECORDED NA
PROBE USED NA
REVIEWED BY [signature]




NOTE:

UNL. OTHERWISE SPECIFIED
DIM ARE IN INCHES
TOLERANCES
DECIMAL FRACT. ± 1/16
.XXXX ± .003
.XXX ± .015
.XX ± .050
% ± .003
ANGULAR ± 3°
FINISH

| | | |
|---|---|---|
| DRAWN | K ZEGKE | DATE 08/18/95 |
| CHECK | C B | 8/22/95 |
| DESIGN | | |
| APVD QA | G A. | 8/22/95 |

ZETEC INC
POST OFFICE BOX 140 ISSAQUAH WASHINGTON 98027-0140 U.S.A. TELEPHONE (206) 392-5316

TITLE
MISC. DEFECT STANDARD
D#3538-1-A P#2956

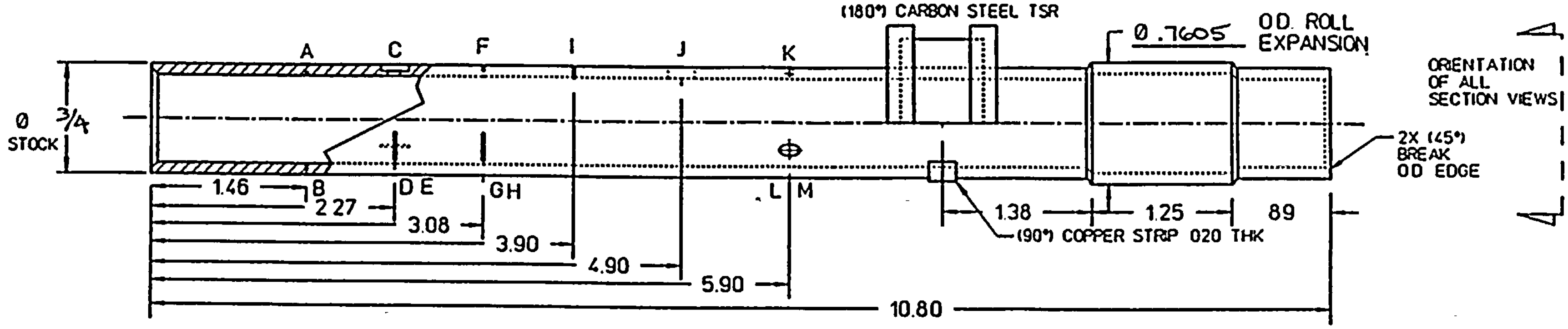
SIMILAR | DWG NO 2-421-1007

SCALE NTS | USED ON | SHT 1 OF 2

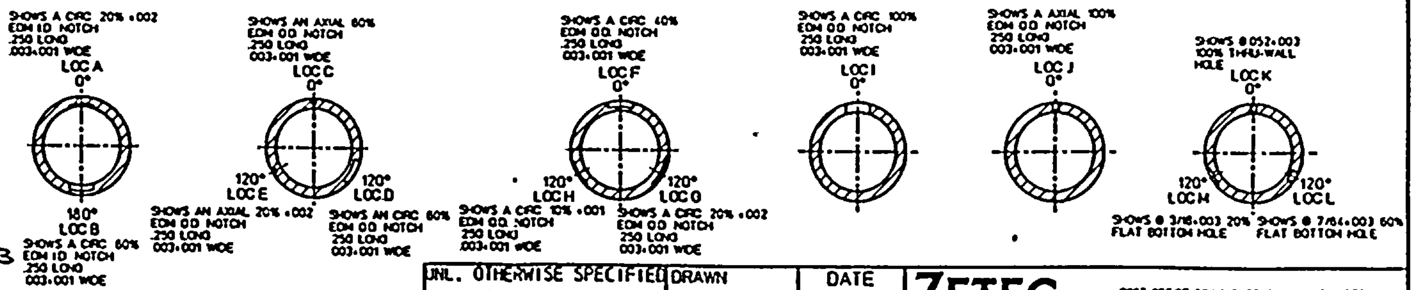
| | | | | C | REVISIONS | REV STATUS OF SHEETS |
|---|---|---|---|---|---|---|
| | | | | 2 | SHEET | |

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| LTR | DATE | DESCRIPTION | APVD | CK | DR |
| C | 8/29/95 | REDRAWN W/CHANGES. REV SHT #2 | | | KZ |

| LOCATION | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYSICALLY MEAS DEPTH | .0085 | .0260 | .0255 | .0260 | .0090 | .0170 | .0085 | .0045 | THRU | THRU | THRU | .0245 | .0080 |
| DEPTH IN % OF WALL | 20% | 61% | 60% | 61% | 21% | 40% | 20% | 11% | 100% | 100% | 100% | 58% | 19% |
| E.T PHASE ANGLE MEAS | NA | | | | | | | | | | | | |




MATERIAL INCONEL 600
AVERAGE MEAS. WALL THK. .0425
NOMINAL WALL THK. .043
HEAT LOT NO. NX8502
TEST FREQ. USED NA
SERIAL NO. Z-14091
P.O. NO 9507505
REL. NO. REQ # 9419-95-083
QUALITY REL. NO. NA
DATE MFG. 9-12-95
Q.A. INSP.
CUSTOMER ABB CE
RECORDED NA
PROBE USED NA
REVIEWED BY




NOTE:

UNL. OTHERWISE SPECIFIED
DIM ARE IN INCHES
TOLERANCES
DECIMAL FRACT. ± 1/16
.XXXX ± .003
.XXX ±.015
.XX ±.050
% ±.003
ANGULAR ±3°
FINISH

| | | DATE |
|---|---|---|
| DRAWN | K. ZEGKE | 08/18/95 |
| CHECK | CB | 8/22/95 |
| DESIGN | | |
| APVD QA | G.A. | 8/22/95 |

**ZETEC** INC
POST OFFICE BOX 140 ISSAQUAH WASHINGTON 98027-0140 USA TELEPHONE (206) 392-5316

TITLE
# MISC. DEFECT STANDARD
D#3538-1-A P#2956

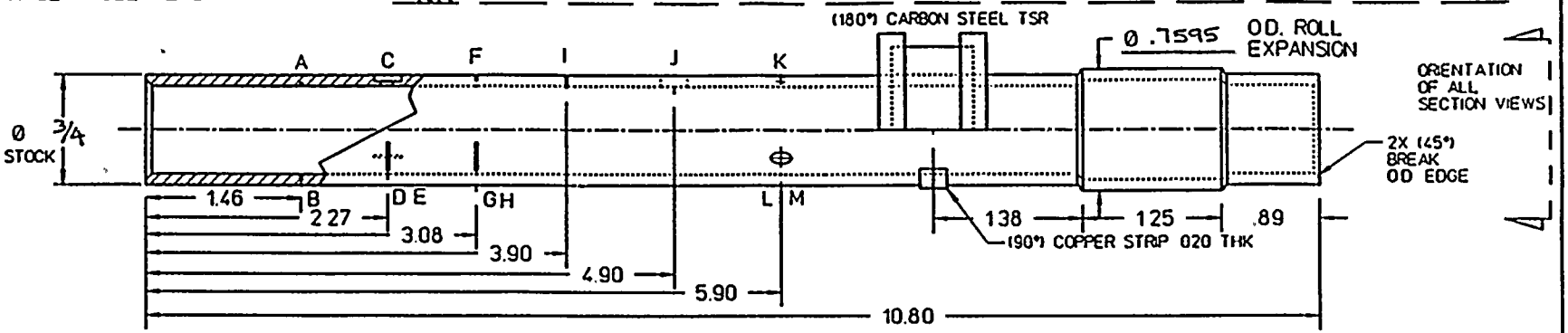
SIMILAR
DWG NO 2-421-1007
SCALE NTS
USED ON
SHT 1 OF 2

| C | REVISIONS |
|---|---|
| 2 | SHEET |

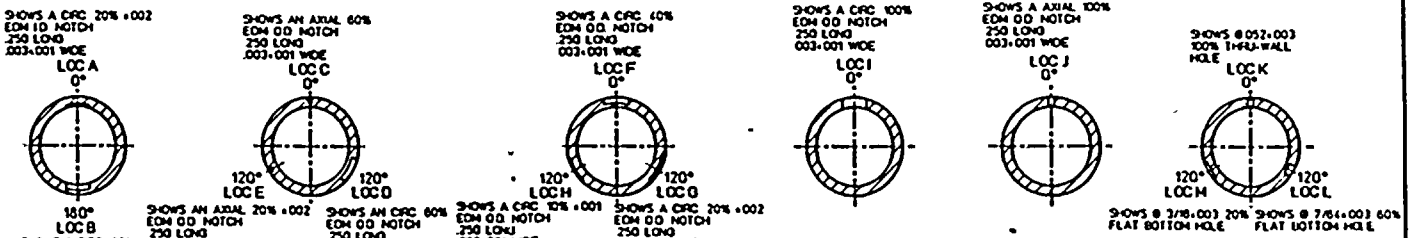
REV STATUS OF SHEETS

| REVISIONS | | | | |
|---|---|---|---|---|
| LTR | DATE | DESCRIPTION | APVD | CK | DR |
| C | 8/29/95 | REDRAWN W/CHANGES.REV SHT #2 | | | KZ |

| LOCATION | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYSICALLY MEAS DEPTH | .0080 | .0260 | .0250 | .0245 | .0085 | .0180 | .0085 | .0045 | THRU | THRU | THRU | .0245 | .0090 |
| DEPTH IN % OF WALL | 19% | 61% | 59% | 58% | 20% | 42% | 20% | 11% | 100% | 100% | 100% | 58% | 21% |
| E T PHASE ANGLE MEAS | NA | | | | | | | | | | | | |




MATERIAL INCONEL 600
AVERAGE MEAS. WALL THK. .0425
NOMINAL WALL THK. .043
HEAT LOT NO. NY8502
TEST FREQ. USED NA
SERIAL NO. Z-14092
P.O. NO 9507505
REL. NO. REQ #9419-95:083
QUALITY REL. NO. NA
DATE MFG. 9-12-95
Q A. INSP.
CUSTOMER ABB CE
RECORDED NA
PROBE USED
REVIEWED BY:




NOTE:

UNL. OTHERWISE SPECIFIED
DIM ARE IN INCHES
TOLERANCES
DECIMAL FRACT. ± 1/16
XXXX ± 003
XXX ±.015
XX ±.050
X ±.003
ANGULAR ±3°
FINISH

| | | |
|---|---|---|
| DRAWN | K. ZEGKE | 08/18/95 |
| CHECK | C B | 8/22/95 |
| DESIGN | | |
| APVD QA | G A. | 8/22/95 |

ZETEC INC
POST OFFICE BOX 140 ISSAQUAH WASHINGTON 98027-0140 U.S.A. TELEPHONE (206) 392-5316

TITLE
MISC. DEFECT STANDARD
D#3538-1-A P#2956

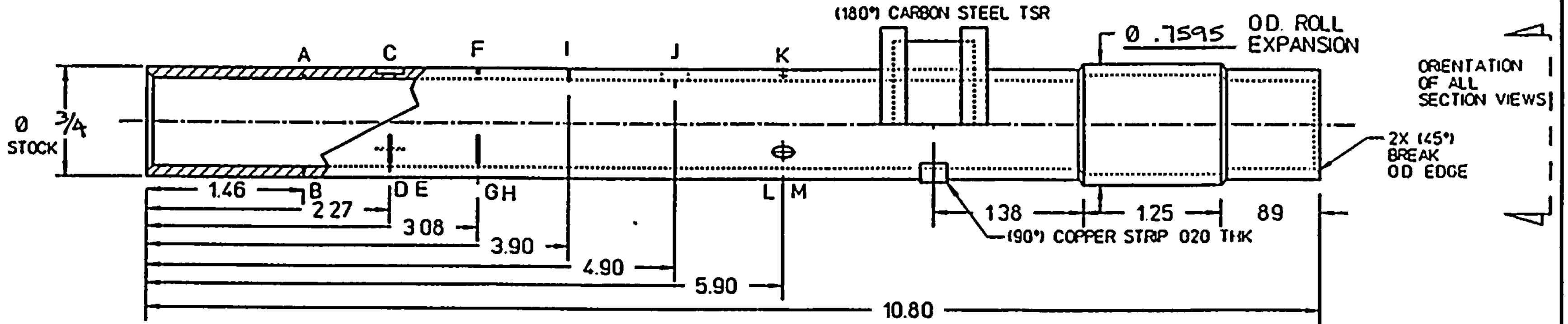
SIMILAR
DWG NO 2-421-1007
SCALE NTS
USED ON
SHT 1 OF 2

| | | | | C | REVISONS | REV STATUS OF SHEETS |
|---|---|---|---|---|---|---|
| | | | | 2 | SHEET | |

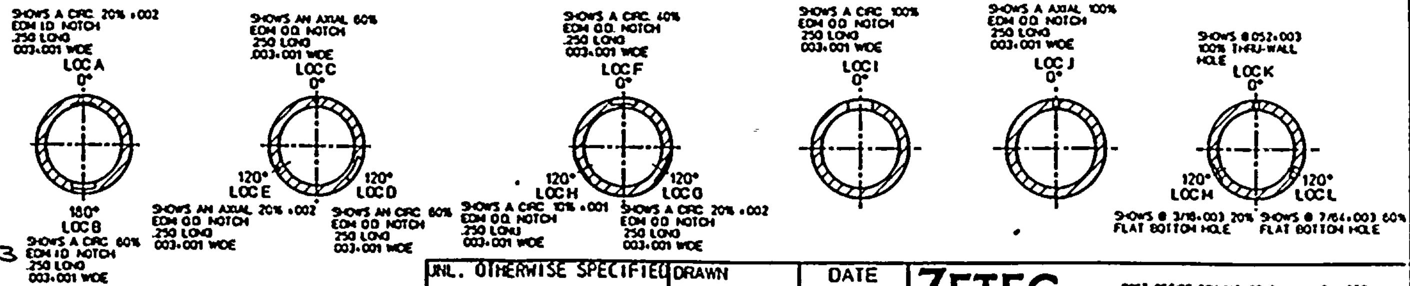
REVISIONS

| LTR | DATE | DESCRIPTION | APVD | CK | DR |
|---|---|---|---|---|---|
| C | 8/29/95 | REDRAWN W/CHANGES. REV SHT #2 | [illegible] | [illegible] | KZ |

| LOCATION | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYSICALLY MEAS DEPTH | .0080 | .0260 | .0250 | .0260 | .0090 | .0175 | .0085 | .0045 | THRU | THRU | THRU | .0240 | .0085 |
| DEPTH IN % OF WALL | 19% | 61% | 59% | 61% | 21% | 41% | 20% | 11% | 100% | 100% | 100% | 56% | 20% |
| E T PHASE ANGLE MEAS | NA | | | | | | | | | | | | |




MATERIAL INCONEL 600
AVERAGE MEAS. WALL THK. .0425
NOMINAL WALL THK. .043
HEAT LOT NO. NX8502
TEST FREQ. USED NA
SERIAL NO. Z-14093
P.O. NO 9507505
REL. NO. REQ #9419-95-083
QUALITY REL. NO. NA
DATE MFG. 9-12-95
Q A. INSP. [illegible]
CUSTOMER ABB CE
RECORDED NA
PROBE USED NA
REVIEWED BY. [illegible]




NOTE:

UNL. OTHERWISE SPECIFIED
DIM ARE IN INCHES
TOLERANCES
DECIMAL FRACT. ± 1/16
.XXXX ±.003
.XXX ±.015
.XX ±.050
% ±.003
ANGULAR ±3°
FINISH

| | | DATE |
|---|---|---|
| DRAWN | K ZEGKE | 08/18/95 |
| CHECK | C B. | 8/22/95 |
| DESIGN | | |
| APVD QA | G A. | 8/22/95 |

ZETEC INC
POST OFFICE BOX 140 ISSAQUAH WASHINGTON 98027-0140 USA TELEPHONE (206) 392-5316

TITLE
MISC. DEFECT STANDARD
D#3538-1-A P#2956

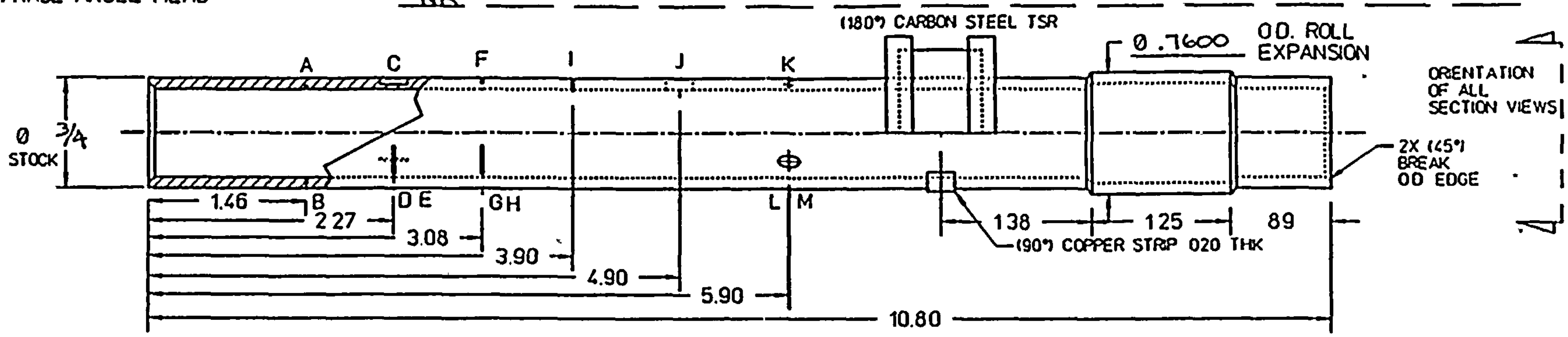
SIMILAR
DWG NO 2-421-1007
SCALE NTS
USED ON
SHT 1 OF 2

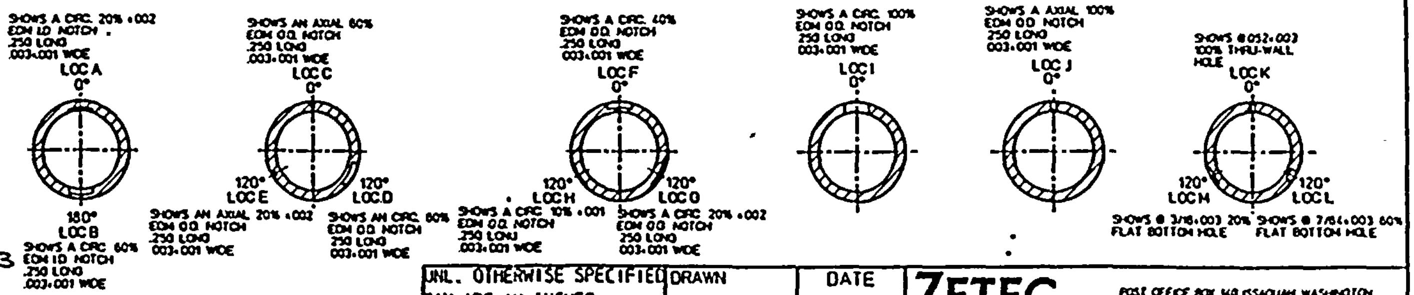
| | | | | | C | REVISIONS | REV STATUS OF SHEETS |
|---|---|---|---|---|---|---|---|
| | | | | | 2 | SHEET | |

REVISIONS

| LTR | DATE | DESCRIPTION | APVD | CK | DR |
|---|---|---|---|---|---|
| C | 8/29/95 | REDRAWN W/CHANGES, REV SHT #2 | [illegible] | [illegible] | KZ |

| LOCATION | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYSICALLY MEAS DEPTH | .0085 | .0255 | .0250 | .0260 | .0085 | .0170 | .0085 | .0045 | THRU | THRU | THRU | .0245 | .0085 |
| DEPTH IN % OF WALL | 20% | 60% | 59% | 61% | 20% | 40% | 20% | 11% | 100% | 100% | 100% | 58% | 20% |
| E T PHASE ANGLE MEAS | NA | | | | | | | | | | | | |




MATERIAL INCONEL 600
AVERAGE MEAS. WALL THK. .0425
NOMINAL WALL THK. .043
HEAT LOT NO. NX8502
TEST FREQ. USED NA
SERIAL NO. Z-14094
P.O. NO. 9507505
REL. NO. REQ # 9419-95-083
QUALITY REL. NO. NA
DATE MFG. 9-12-95
Q.A. INSP. [signature]
CUSTOMER ABB CE
RECORDED NA
PROBE USED NA
REVIEWED BY [signature]

NOTE:

UNL. OTHERWISE SPECIFIED DIM ARE IN INCHES
TOLERANCES
DECIMAL FRACT. ± 1/16
.XXXX ±.003
.XXX ±.015
.XX ±.050
% ±.003
ANGULAR ±3°
FINISH

| | | |
|---|---|---|
| DRAWN | K. ZEGKE | DATE 08/18/95 |
| CHECK | CB | 8/22/95 |
| DESIGN | | |
| APVD QA | G.A. | 8/22/95 |

**ZETEC** INC
POST OFFICE BOX 140 ISSAQUAH WASHINGTON 98027-0140 USA TELEPHONE (206) 392-5316

TITLE
MISC. DEFECT STANDARD
D#3538-1-A P#2956

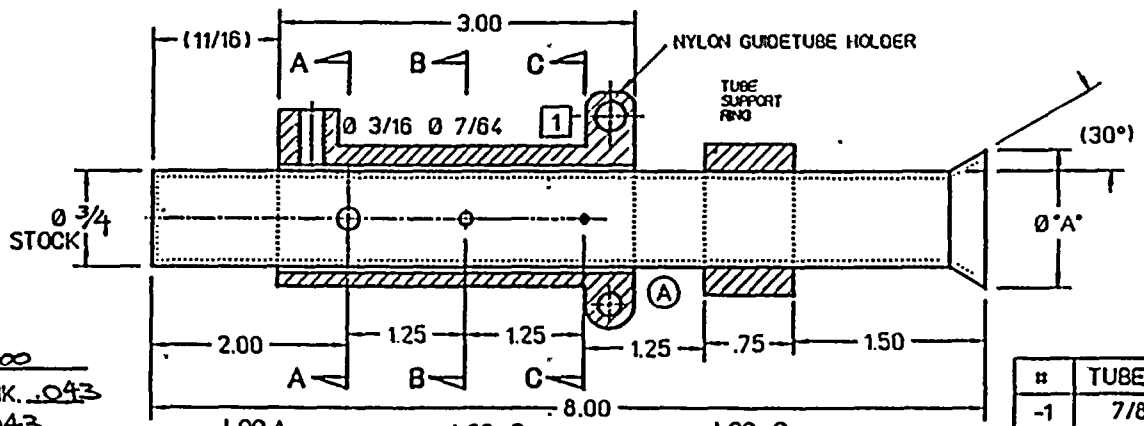
SIMILAR | DWG NO 2-421-1007
SCALE NTS | USED ON | SHT 1 OF 2

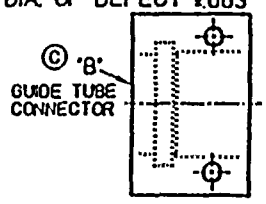
| REVISIONS | | | | | |
|---|---|---|---|---|---|
| LTR | DATE | DESCRIPTION | APVD | CK | DR |
| © | 10/2/90 | ALL FLAW LOC. DIM. CHANGED, TOTAL LENGTH WAS 7.00 ADDED "B" REMOVED KNURL | KJW | | KZ |

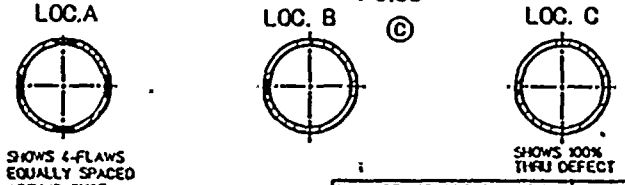
| LOCATION | A | B | C |
|---|---|---|---|
| PHYSICALLY MEAS. DEPTH | .0090 | .0260 | THRU |
| % OF WALL LOSS | 21% | 60% | 100% |
| PHASE ANGLE MEAS. | 153° | 107° | 40° |

SEE DWG#5-001191 FOR TOTAL ASSY.

[1] 0.052 IN STD. ≤ 0.75
0.067 IN STD. > 0.75




| © | TUBE Ø | "A" | "B" |
|---|---|---|---|
| -1 | 7/8 | 1.10 | 1-000090 |
| (-2) | 3/4 | .950 | 1-000098 |
| -3 | 11/16 | .930 | 1-000097 |

MATERIAL INCONEL 600
AVERAGE MEAS. WALL THK. .043
NOMINAL WALL THK. .043
HEAT LOT NO. 86234
TEST FREQ. USED 550 KHZ
SERIAL NO. Z-8711
P.O. NO. 000544
REL. NO. NA
QUALITY REL. NO. NA
DATE MFG. 11.12.90
Q.A. INSPECTION
CUSTOMER CONAM NUCLEAR
RECORDED 32
PROBE USED AG501C/HF #69848
REVIEWED BY M. DeMartino

NOTE:

| UNL. OTHERWISE SPECIFIED DIM. ARE IN INCHES TOLERANCES | DRAWN | DATE |
|---|---|---|
| DECIMAL FRACT. +/- 1/16<br>XXXX ±.003<br>XXX ±.015<br>XX ±.050<br>% ±.003<br>ANGULAR +/- 3° | K.ZEGKE | 8/16/90 |
| | CHECK B.J. | 8/16/90 |
| | DESIGN | |
| FINISH | APVD. QA K.WARLICK | 8/21/90 |

ZETEC INC. P.O. BOX 140 ISSAQUAH, WASHINGTON 98027 U.S.A. TELEPHONE 206 392-5316

TITLE SM-10 GUIDE TUBE STD. W/20%,60%,100% FLAWS & TSR
A#1189 D#1463-1-A

DWG NO 2-4463

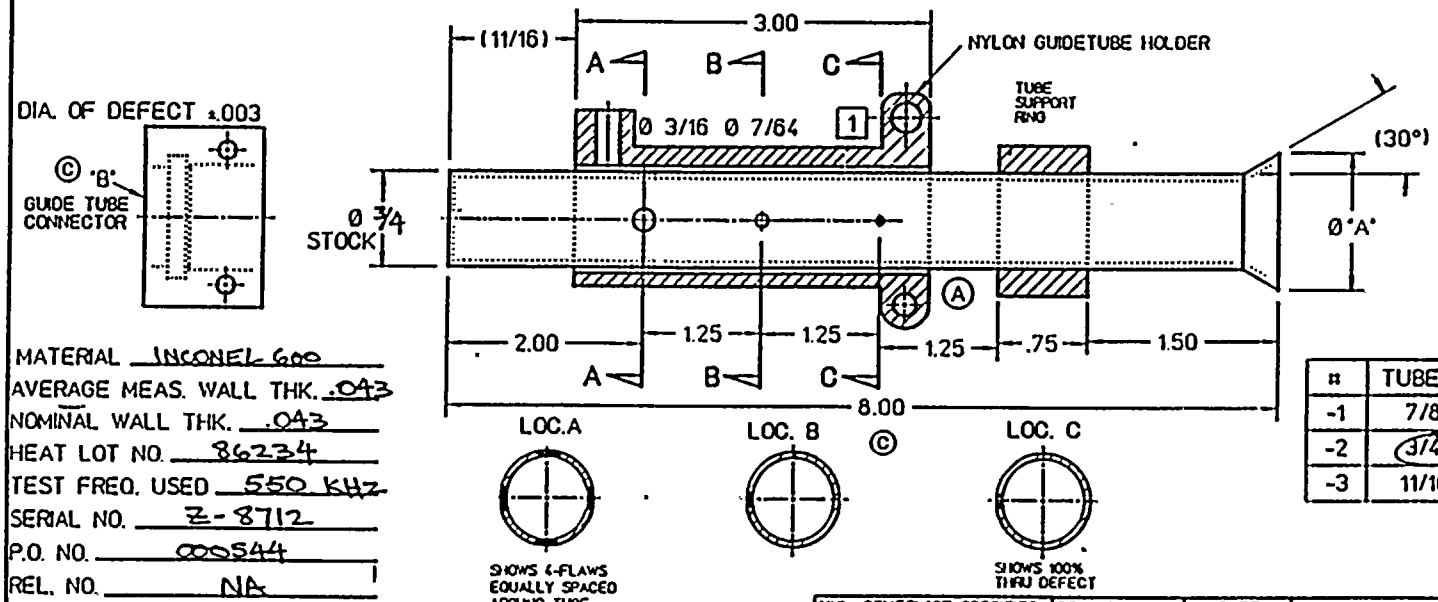
SCALE NONE RELDATE 8/21/90 SHT 1 OF 1

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| LTR | DATE | DESCRIPTION | APVD | CK | DR |
| © | 10/2/90 | ALL FLAW LOC. DIM. CHANGED. TOTAL LENGTH WAS 7.00 ADDED "B" REMOVED KNURL | MW | JS | KZ |

| LOCATION | A | B | C |
|---|---|---|---|
| PHYSICALLY MEAS. DEPTH | .0095 | .0250 | THRU |
| % OF WALL LOSS | 22% | 58% | 100% |
| PHASE ANGLE MEAS. | 150° | 110° | 40° |

SEE DWG#5-001191 FOR TOTAL ASSY.

[1] 0.052 IN STD. ≤ 0.75
0.067 IN STD. > 0.75




| © | TUBE Ø | "A" | "B" |
|---|---|---|---|
| -1 | 7/8 | 1.10 | 1-000090 |
| -2 | 3/4 | .950 | 1-000098 |
| -3 | 11/16 | .930 | 1-000097 |

MATERIAL INCONEL 600
AVERAGE MEAS. WALL THK. .043
NOMINAL WALL THK. .043
HEAT LOT NO. 86234
TEST FREQ. USED 550 KHz
SERIAL NO. Z-8712
P.O. NO. 000544
REL. NO. NA
QUALITY REL. NO. NA
DATE MFG. 11.12.90
Q.A. INSPECTION [signature]
CUSTOMER CONAM NUCLEAR
RECORDED 32
PROBE USED A650LC/HF #69848
REVIEWED BY M. DeMartino

NOTE:

UNL. OTHERWISE SPECIFIED DIM. ARE IN INCHES
TOLERANCES
DECIMAL FRACT. +/- 1/16
XXXX ±.003
XXX ±.015
XX ±.050
% ±.003
ANGULAR +/- 3°
FINISH

| | | |
|---|---|---|
| DRAWN | K.ZEGKE | 8/16/90 |
| CHECK | B.J. | 8/16/90 |
| DESIGN | | |
| APVD. QA | K.WARLICK | 8/21/90 |

ZETEC INC
P.O. BOX 148 ISSAQUAH, WASHINGTON 98027 U.S.A.
TELEPHONE 206 392-6310

TITLE SM-10 GUIDE TUBE STD.
W/20%,60%,100% FLAWS & TSR
A#1189 D#1463-1-A

DWG NO 2-4463

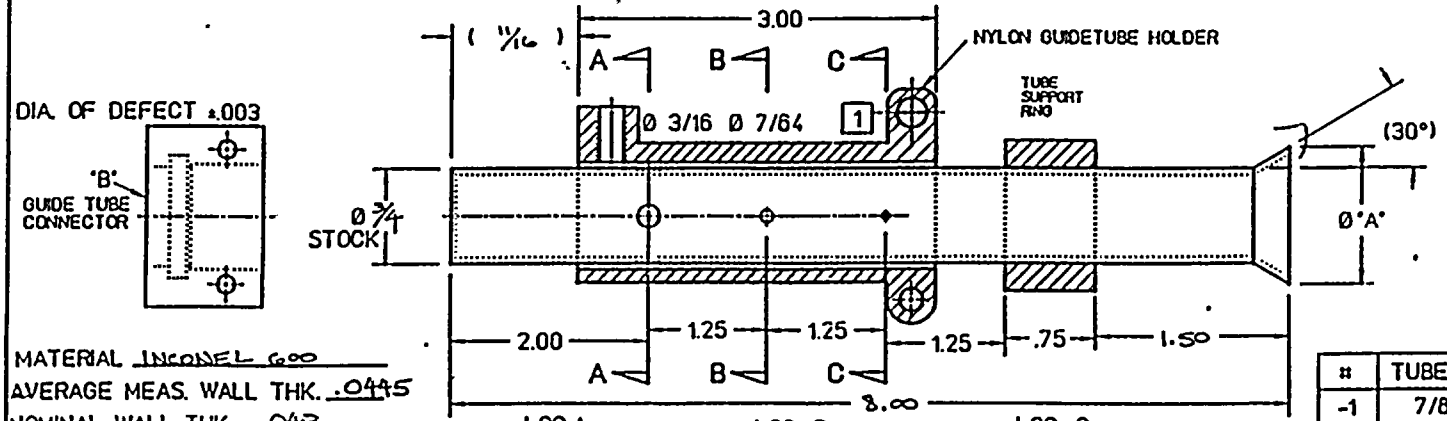
SCALE NONE | REL DATE 8/21/90 | SHT 1 OF 1

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| LTR | DATE | DESCRIPTION | APVD | CK | DR |
| Ⓓ | 2/26/92 | REMOVED TOTAL LENGTH & END DIM. | 9.7. | KZ | KZ |

| LOCATION | A | B | C |
|---|---|---|---|
| PHYSICALLY MEAS. DEPTH | .0090 | .0270 | THRU |
| % OF WALL LOSS | 20% | 61% | 100% |
| PHASE ANGLE MEAS. * 550 KHz: | 162° | 120° | 38° |
| PHASE ANGLE MEAS. * 500 KHz: | 156° | 114° | 40° |

SEE DWG#5-001191 FOR TOTAL. ASSY.

[1] 0.052 IN STD. ≤ 0.75
0.067 IN STD. > 0.75




| # | TUBE Ø | "A" | "B" |
|---|---|---|---|
| -1 | 7/8 | 1.10 | 1-000090 |
| -2 | 3/4 | .950 | 1-000098 |
| -3 | 11/16 | .930 | 1-000097 |

MATERIAL INCONEL 600
AVERAGE MEAS. WALL THK. .0445
NOMINAL WALL THK. .043
HEAT LOT NO. 72045
TEST FREQ. USED 500 & 550 KHz *
SERIAL NO. Z-10951
P.O. NO. MR2195 1
REL. NO. NA
QUALITY REL. NO. NA
DATE MFG. 10.13.92
Q.A.INSPECTION
CUSTOMER CONAM NUCLEAR
RECORDED 35
PROBE USED A650I/HF #69848
REVIEWED BY

NOTE:

* THE 550KHz TEST FREQUENCY IS BASED ON THE NOM. WALL THICKNESS OF .043 AND DOES NOT MEET THE ZETEC EQA-4.1 CURVE WITH THE 100% FLAW AT 40° & 2° AND THE 20% FLAW AT 155° & 5°. THE 500 KHz TEST FREQUENCY IS BASED ON THE ACTUAL WALL THICKNESS OF .0445 AND MEETS THE ZETEC EQA-4.1 CURVE.

| UNL. OTHERWISE SPECIFIED DIM. ARE IN INCHES : TOLERANCES | | | |
|---|---|---|---|
| DECIMAL | FRACT. +/- 1/16 | DRAWN K.ZEGKE | DATE 8/16/90 |
| XXXX ±.003 | | CHECK B.J. | 8/16/90 |
| XXX ±.015 | | DESIGN | |
| XX ±.050 | | APVD. QA K.WARLICK | 8/21/90 |
| % ±.003 | | | |
| ANGULAR +/- 3° | | | |
| FINISH | | | |

ZETEC INC. P.O. BOX 140 ISSAQUAH, WASHINGTON 98027 U.S.A. TELEPHONE 206 392-6310

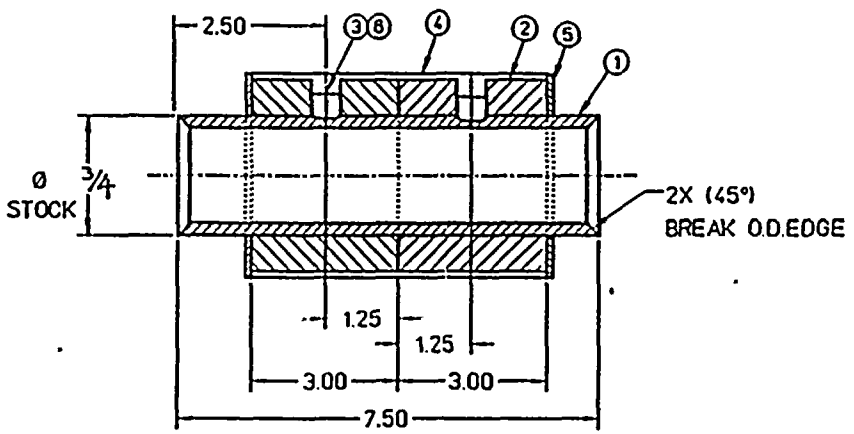
TITLE SM-10 GUIDE TUBE STD. W/20%,60%,100% FLAWS & TSR
A#1189 D#1463-1-A

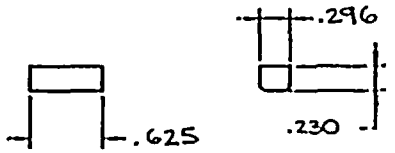
DWG NO 2-4463

SCALE NONE | RELDATE 8/21/90 | SHT 1 OF 1

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| LTR | DATE | DESCRIPTION | APVD | CK | DR |
| (A) | 10/8/90 | CHANGED TOL.BLOCK; ADDED #6 | KHJ | SJ | KZ |

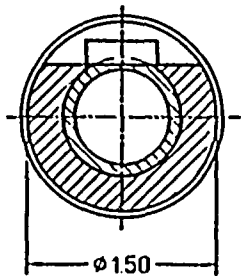
| LOCATION | A | B |
|---|---|---|
| PHYSICALLY MEAS. DEPTH | .0130 | .0215 |
| % OF WALL LOSS | 30% | 50% |




A.V.B.MATERIAL CHROME PLATED INCONEL
TUBE MATERIAL INCONEL 600
AVERAGE MEAS. WALL THK. .043
NOMINAL WALL THK. .043
HEAT LOT NO. 86234
TEST FREQ. USED NA
SERIAL NO. Z-8715
P.O. NO. 000544
REL. NO. NA
QUALITY REL. NO. NA
DATE MFG. 11.13.90
Q.A. INSPECTION [signature]
CUSTOMER CONAM NUCLEAR
RECORDED NA
PROBE USED NA
REVIEWED BY M. DeMartino

LOC A & B




NOTE:

| ITEM NO | DESCRIPTION |
|---|---|
| (A) 6 | BAR-.625 L X .316 W X .230 H INCONEL |
| 5 | DELRIN SPACER FOR LEXAN |
| 4 | LEXAN TUBE - 1 3/4 ID. X 2.0 OD. |
| 3 | BAR - .625 X .395 X .750 405 S.S. |
| 2 | DELRIN SPACER 1.50 OD. X 3.00 LG. |
| 1 | TUBE-INCONEL |

| UNL. OTHERWISE SPECIFIED DIM. ARE IN INCHES TOLERANCES | DRAWN | DATE |
|---|---|---|
| DECIMAL FRACT. +/- 1/16<br>XXXX ±.003<br>XXX ±.015<br>XX ±.050<br>% ±.003<br>ANGULAR +/- 3° | K.ZEGKE | 12/22/89 |
| | CHECK B.J. | 12/22/89 |
| | DESIGN | |
| FINISH | APVD. QA K.WARLICK | 12/28/89 |


ZETEC INC
P.O. BOX 140 ISSAQUAH WASHINGTON 98027 U.S.A.
TELEPHONE 206 392-5316

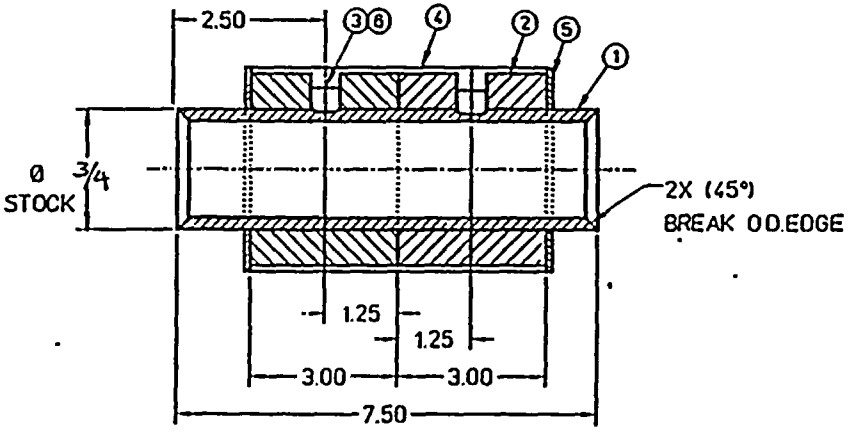

TITLE 2-FLAW A.V.B. NOTCH STD. W/LEXAN COVER
A#0995 D#1258-1-A

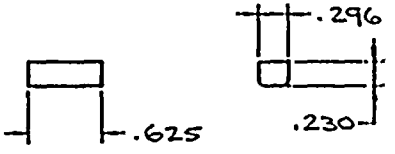
DWG NO 2-4418

SCALE NONE | RELDATE 12/28/89 | SHT 1 OF 1

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| LTR | DATE | DESCRIPTION | APVD | CK | DR |
| (A) | 10/8/90 | CHANGED TOL.BLOCK, ADDED #6 | KJ | SJ | KZ |

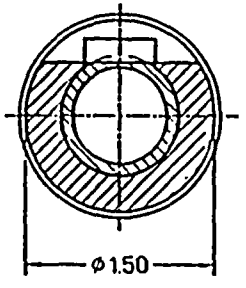
| LOCATION | A | B |
|---|---|---|
| PHYSICALLY MEAS. DEPTH | .0125 | .0205 |
| % OF WALL LOSS | 29% | 48% |




A.V.B. MATERIAL CHROME PLATED INCONEL
TUBE MATERIAL INCONEL-600
AVERAGE MEAS. WALL THK. .043
NOMINAL WALL THK. .043
HEAT LOT NO. 86234
TEST FREQ. USED NA
SERIAL NO. Z-8716
P.O. NO. 000544
REL. NO. NA
QUALITY REL. NO. NA
DATE MFG. 11.12.90
Q.A. INSPECTION [signature]
CUSTOMER CONAM NUCLEAR
RECORDED NA
PROBE USED NA
REVIEWED BY M. DeMartino

LOC A & B




NOTE:

| (A) | ITEM NO | DESCRIPTION |
|---|---|---|
| | 6 | BAR-.625 L X .318 W X .230 H INCONEL |
| | 5 | DELRIN SPACER FOR LEXAN |
| | 4 | LEXAN TUBE - 1 3/4 ID. X 2.0 OD. |
| | 3 | BAR - .625 X .395 X .750 405 S.S. |
| | 2 | DELRIN SPACER 150 OD. X 3.00 LG. |
| | 1 | TUBE-INCONEL |

(A) UNL. OTHERWISE SPECIFIED DIM. ARE IN INCHES
TOLERANCES
DECIMAL FRACT. +/- 1/16
XXXX ±.003
XXX ±.015
XX ±.050
% ±.003
ANGULAR +/- 3°
FINISH

| | | |
|---|---|---|
| DRAWN | K.ZEGKE | 12/22/89 |
| CHECK | B.J. | 12/22/89 |
| DESIGN | | |
| APVD. QA | K.WARLICK | 12/28/89 |

ZETEC INC
P.O. BOX 148 ISSAQUAH, WASHINGTON 98027 U.S.A.
TELEPHONE 206 392-5316

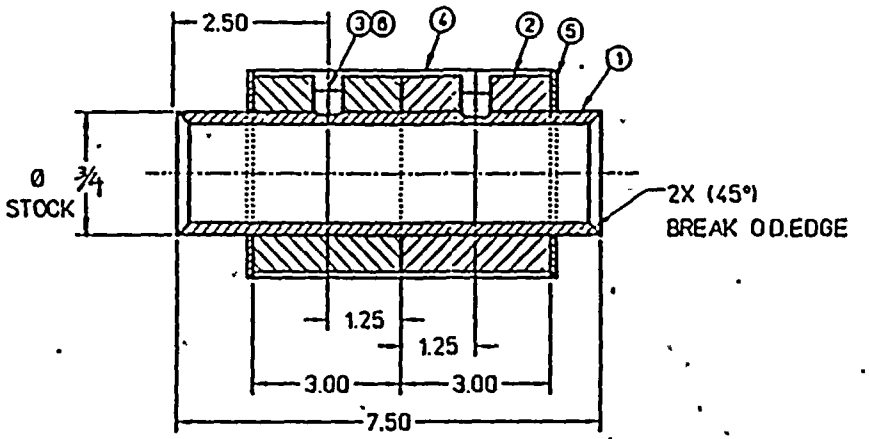
TITLE 2-FLAW A.V.B. NOTCH STD. W/LEXAN COVER
A#0995 D#1258-1-A

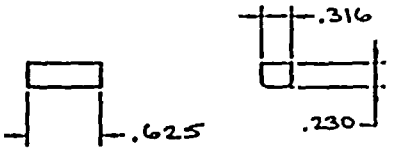
DWG NO 2-4418

SCALE NONE | RELEASE DATE 12/28/89 | SHT 1 OF 1

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| LTR | DATE | DESCRIPTION | APVD | CK | DR |
| (A) | 10/18/90 | CHANGED TOL.BLOCK;ADDED #6 | KWL | BJ | KZ |

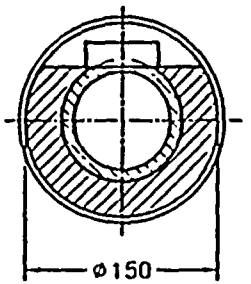
| LOCATION | A | B |
|---|---|---|
| PHYSICALLY MEAS. DEPTH | .0120 | .0210 |
| % OF WALL LOSS | 23% | 49% |




A.V.B. MATERIAL INCONEL 600
TUBE MATERIAL INCONEL 600
AVERAGE MEAS. WALL THK. .043
NOMINAL WALL THK. .043
HEAT LOT NO. 86234
TEST FREQ. USED NA
SERIAL NO. Z-9052
P.O. NO. 1129
REL. NO. JOB # EL-0655
QUALITY REL. NO. NA
DATE MFG. 3.5.91
O.A. INSPECTION
CUSTOMER CONAM NUCLEAR
RECORDED NA
PROBE USED NA
REVIEWED BY

LOC A & B




NOTE:

| (A) | ITEM NO | DESCRIPTION |
|---|---|---|
| | 6 | BAR-.625 L X .316 W X .230 H INCONEL |
| | 5 | DELRIN SPACER FOR LEXAN |
| | 4 | LEXAN TUBE - 1 3/4 ID. X 2.0 OD. |
| | 3 | BAR - .625 X .395 X .750 405 S.S. |
| | 2 | DELRIN SPACER 150 OD. X 300 LG. |
| | 1 | TUBE-INCONEL |

UNL. OTHERWISE SPECIFIED DIM. ARE IN INCHES
TOLERANCES
DECIMAL FRACT. +/- 1/16
XXXX .003
XXX .015
XX .050
% .003
ANGULAR +/- 3°
FINISH

| | | |
|---|---|---|
| DRAWN | K.ZEGKE | 12/22/89 |
| CHECK | B.J. | 12/22/89 |
| DESIGN | | |
| APVD. QA | K.WARLICK | 12/28/89 |

ZETEC INC.
P.O. BOX 113 ISSAQUAH WASHINGTON 98027 U.S.A.
TELEPHONE 206 392-5316

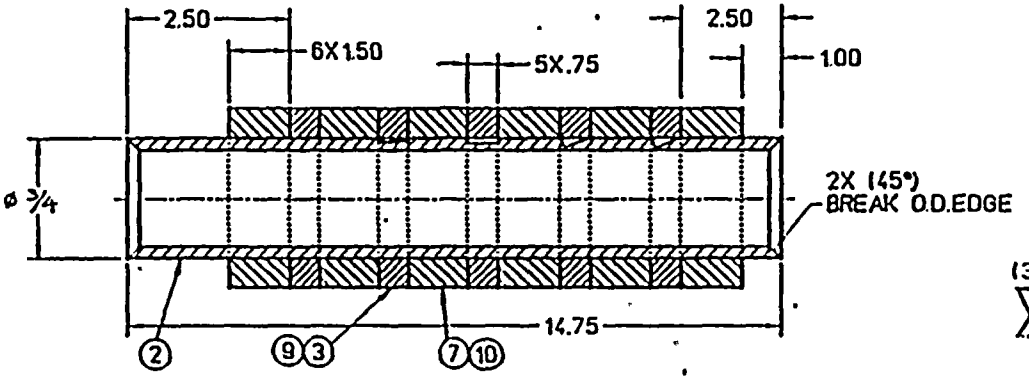
TITLE 2-FLAW A.V.B. NOTCH STD. W/LEXAN COVER
A#0995 D#1258-1-A

DWG NO 2-4418

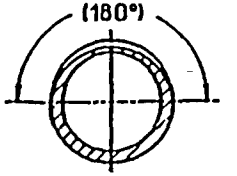
SCALE NONE | RELDATE 12/28/89 | SHT 1 OF 1

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| LTR | DATE | DESCRIPTION | APVD | CK | DR |
| | | | | | |

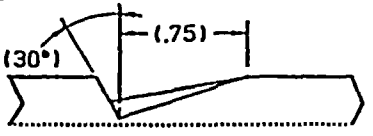
| LOCATION | A | B | C | D |
|---|---|---|---|---|
| PHYSICALLY MEAS. DEPTH | .0130 | .0215 | .0125 | .0210 |
| % THRU WALL | 30% | 49% | 29% | 48% |




LOC C & D



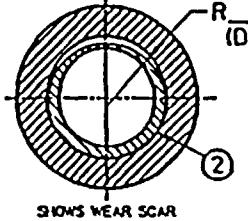

SHOWS RADIAL WEAR SCAR




LOC C & D

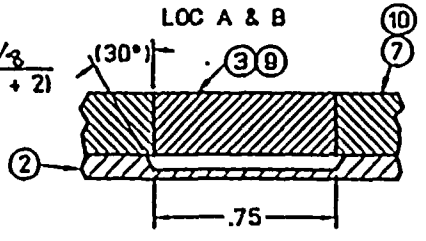
MATERIAL INCONEL 600
ACTUAL MEAS. WALL THK. .0425
NOM/MIN WALL THK. .043
HEAT LOT NO. 86234
TEST FREQ. USED NA
SERIAL NO. Z-9130
P.O. NO. MR001697
REL. NO. JOB # EC-0655
QUALITY REL. NO. NA
DATE MFG. 3.20.91
O.A. INSPECTION [illegible]
CUSTOMER CONAM NUCLEAR
RECORDED NA
PROBE USED NA
REVIEWED BY [illegible]

LOC A & B




SHOWS WEAR SCAR

LOC A & B




NOTE:

| | | QTY | | PART NO | DESCRIPTION |
|---|---|---|---|---|---|
| • | | 6 | | -10 | DELRN SPACER 125 O.D.X.891 I.D.X 150 LG. |
| • | | 5 | | -9 | TUBE SUPPORT, RNG 2-4000-5 |
| • | | | | -8 | 4 FLAW WEAR SCAR STD. ASSY.(7/8 O.D.) |
| | • | 6 | | -7 | DELRN SPACER 125 O.D.X.761 I.D.X 150 LG. |
| | • | 5 | | -3 | TUBE SUPPORT RNG 2-4000-4 |
| • | • | 1 | | -2 | STANDARD TUBE |
| | • | | | -1 | 4 FLAW WEAR SCAR STD. ASSY.(3/4 O.D.) |

UNL. OTHERWISE SPECIFIED DIM. ARE IN INCHES
TOLERANCES
DECIMAL FRACT. +/- 1/16
XXXX ±.003
XXX ±.015
XX ±.050
% ±.003
ANGULAR +/- 3°
FINISH

| | | DATE |
|---|---|---|
| DRAWN | K.ZEGKE | 3/15/91 |
| CHECK | [illegible] | 3/18/91 |
| DESIGN | | |
| APVD. QA | [illegible] | 3/18/91 |

ZETEC INC
P.O. BOX 140 ISSAQUAH, WASHINGTON 98027 U.S.A.
TELEPHONE 206 391-6216

TITLE
CUSTOM WEAR SCAR STD.
P#1406 D#1681-1-A

DWG NO 2-4513

SCALE NONE | RELEASE 3/18/91 | SHT 1 OF 1

ABB
ASEA BROWN BOVERI

September 23, 1995

Mr. Chip Bach
Carolina Power & Light Company
Shearon Harris Steam Electric Plant
State Road 1134
New Hill, NC 27562

**SUBJECT: STEAM GENERATOR EDDY CURRENT TESTING PRELIMINARY REPORT AND DATA CARTRIDGES**

Dear Mr Bach:

ABB/Combustion Engineering is transmitting the following items to you.

- Preliminary Report
- Data Cartridges H95A01-H95A12, H95B01-H95B11, H95C01-H95C12

Please acknowledge receipt of these items by signing a copy of this letter and forwarding it to me.

ROGER L. JOHNSON
Receipt Acknowledged

9-24-95
Date

Sincerely,

**ABB/COMBUSTION ENGINEERING**

Thomas U. Bipes
Eddy Current Level III

cc: R. Brown
H. Mahdavy
D. Meleg (CP&L)



Combustion Engineering, Inc.
1201 Riverfront Parkway
Chattanooga, Tennessee 37402
Telephone (615) 752-2390
Toll Free 1-800-872-8836
Fax (615) 752-2449