FRAMATOME TECHNOLOGIES

ENGINEERING INFORMATION RECORD

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Title INTERIM ENGINEERING EVALUATION: ONS UNIT 2 1996 CRDM NOZZLE INSPECTION

PREPARED BY:		REVIEWED BY:	
Name	S. Fyfitch	**Name**	C. A. Campbell
Signature	S Fyfitch	**Signature**	CA Campbell
Date	4/23/96	**Date**	4/23/96

Technical Manager Statement: Initials KEW
Reviewer is Independent.

Remarks:

This document contains an interim engineering evaluation of the NDE results obtained during the CRDM nozzle inspection performed at Oconee Unit 2 in April 1996. It has been determined that the indications detected are acceptable based on the NRC-approved acceptance criteria developed for CRDM nozzle flaws.

******NON-PROPRIETARY******

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1.0 Purpose

The purpose of this document is to evaluate the indications detected during the Oconee Nuclear Station (ONS) Unit 2 control rod drive mechanism (CRDM) nozzle reinspection in April 1996 with respect to the NRC-approved acceptance criteria.

2.0 Background

An inspection of the CRDM nozzles at ONS Unit 2 was completed during the End-Of-Cycle 14 (EOC-14) refueling outage in October 1994. The inspection was performed beneath the reactor vessel head by Framatome Technologies, Inc. (FTI) [formerly known as B&W Nuclear Technologies] and consisted of blade probe eddy current (BPEC) inspection of all sixty-nine nozzles, motorized rotating pancake coil (MRPC) inspection of three nozzles, and dye penetrant (PT) and ultrasonic (UT) inspection of two nozzles.

The BPEC inspection found nozzle 23 to contain numerous small, shallow axial indications near the top of the weld at the 180° orientation occurring along the circumference at approximately the same elevation. The MRPC inspection confirmed the blade probe results.

The BPEC inspection found nozzle 28 to contain a small, shallow indication below the weld at the 15° orientation. The MRPC inspection did not confirm the blade probe results. The indication that was detected with MRPC exhibited non-flaw-like characteristics, including improper phase rotation, and was dispositioned as No Detectable Degradation (NDD).

The BPEC inspection found nozzles 60, 62, 63, and 65 to contain small, shallow axial indications throughout the weld signature area, at locations above and below the weld. These indications occur near the qualified phase threshold of the indication criteria of FTI. Nozzle 63 was identified to contain the most severe indications. An MRPC inspection of nozzle 63 confirmed the blade probe results. Although these nozzles were dispositioned as NDD, further non-destructive examination (NDE) analysis was recommended.

The BPEC inspection found nozzles 16, 45, 46, 50, 52, 56, and 57 to contain indications similar to, but less severe than, those detected in nozzles 60, 62, 63, and 65, and were dispositioned as NDD. All remaining nozzles were also dispositioned as NDD during the BPEC inspection.

For nozzle 23, the PT results showed 20 individual indications ranging in length from 0.08" to 0.37" between the 135 and 259° angular positions in the nozzle circumference (with 0° defined at the downhill side of the weld). All indications were axial in relation to the nozzle except for two indications; one indication turned in the circumferential direction at the upper end and the second indication was 0.10" in length in the circumferential direction.

For nozzle 63, no indications were detected during the PT examination.

An ultrasonic test was performed on nozzle 23 to quantify the indications detected with eddy current examination and to verify the non-detectable results for nozzle 63. The UT method used is qualified to size axially-oriented CRDM nozzle flaws having depths of 0.079" (2 mm) and greater.

For nozzles 23 and 63, the scanning bounded the indication area identified with the eddy current examination. Review of the UT data showed that there was no evidence of indications of measurable size within the limits of the UT qualification. Therefore, it was determined that there were no axial flaws in the region of the eddy current indications with depths greater than 0.079" (2 mm).

Therefore, linear indications were detected during the 1994 inspection in nozzle 23; these indications were evaluated relative to the acceptance criteria approved by the United States Nuclear Regulatory Commission (U.S. NRC) and found acceptable in Reference 1.

A reinspection of CRDM nozzle numbers 23 and 63 at ONS Unit 2 was completed by FTI during the EOC-15 refueling outage in April 1996. This reinspection consisted of an MRPC and PT inspection of these two nozzles from the CRDM nozzle flange above the reactor vessel head.

2.1 Acceptance Criteria

Prior to inspections within the U.S., the nuclear industry developed acceptance criteria to be implemented during an inspection to identify which cracks are acceptable (i.e., not requiring immediate repair) based on size and location. Initially, the Nuclear Management and Resources Council (NUMARC), now the Nuclear Energy Institute (NEI), submitted the following acceptance criteria, for cracks above the J-groove weld, to the U.S. NRC for review:

ACCEPTANCE CRITERIA SUBMITTED BY NUMARC/NEI IN 1993

Crack Orientation	Allowable Length	Allowable Depth
Axial	any length	75% through-wall
Circumferential	50% around circumference	75% through-wall

Axial cracks below the J-groove weld would be acceptable for any length, at a depth of up to 100% through-wall.

The acceptance criterion for axial cracks identified above was accepted by the NRC as identified above; however, the acceptance criterion for circumferentially-oriented cracks was rejected. Based on a discussion with the NRC, DPCo identified acceptance criteria for circumferential cracks which was implemented at ONS Unit 2 during the 1994 inspection; this information had been submitted to the NRC[1] prior to the inspection. The acceptance criterion implemented by DPCo for circumferential cracks is as follows:

ACCEPTANCE CRITERIA SUBMITTED BY DUKE POWER COMPANY

Crack Orientation	Allowable Length	Allowable Depth
Circumferential	2" on outside surface (~16% around circ.)	75% through-wall

Cracks exceeding the acceptance criteria would require engineering analyses and/or repair.

The same acceptance criteria were used by DPCo for the 1996 reinspection of nozzles 23 and 63.

2.2 Indications Detected at ONS Unit 2

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The following subsections describe the non-destructive examination (NDE) inspections performed at ONS Unit 2 during the April 1996 refueling outage and the results obtained from the inspections.

2.2.1 Eddy Current Results

The MRPC Eddy Current Technique (ET) inspection was performed in accordance with FTI Procedure ISI 491-3 (Multifrequency Eddy Current Examination of CRDM Nozzles Using a Motorized Rotating Pancake Coil [MRPC]). A 100% inspection (360° of circumference from bottom of nozzle to 2" minimum above weld) of nozzles 23 and 63 was completed during the MRPC inspection.

The MRPC inspection found nozzle 23 to contain numerous small, shallow axial indications near the top of the weld at the 180° orientation (with 0° defined at the downhill side of the weld) occurring along the circumference at approximately the same elevation. A comparison between the 1994 MRPC data and the 1996 MRPC data resulted in no significant change in amplitude or phase response for the indications found.

Nozzle 23 was then honed for two minutes and reinspected with eddy current. No significant change in signal response was noted after honing.

The MRPC inspection found nozzle 63 to contain many small axial indications throughout the weld signature area, at locations above and below the weld. A comparison between the 1994 MRPC data and the 1996 MRPC data resulted in no significant change in amplitude or phase response for the indications found.

Nozzle 63 was then honed for two minutes and reinspected with eddy current. Again, no significant change in signal response was noted after honing.

2.2.2 Liquid Penetrant Results

Following the MRPC inspection, a solvent-removable penetrant test (PT) was performed on nozzles 23 and 63.

For nozzle 23, the PT results showed numerous axial linear indications, illustrated in Figure 1. A group of indications, ranging in length from 0.06" to 0.34", exists between approximately the 160° and 250° angular positions in the nozzle circumference (with 0° defined at the downhill side of the weld). In addition, two indications (0.06" and 0.09" in length) were identified at approximately the 320° angular position and one indication (0.06" in length) was identified at approximately the 65° angular position.

For nozzle 63, the PT results showed numerous axial linear indications scattered throughout the nozzle circumference as illustrated in Figure 2. The indications range from 0.03" to 0.44" in length.

Comparison of the PT examination results of 1996 versus the results obtained during the 1994 inspection revealed the following:

- The 1994 PT examination utilized the water-washable visible dye method using a wet developer.
- The 1996 PT examination utilized the solvent-removable method with a non-aqueous developer.

- The cleaning method used in the 1996 inspection was superior to the 1994 cleaning method thereby providing improved examination results. This was especially noted on nozzle 63 in which the 1994 examination results indicated no recordable indications.

2.2.3 Summary of NDE Inspection Results

In preparation for the 1996 reinspection, an improved cleaning procedure was funded by DPCo and recommended by FTI for use at ONS Unit 2. This cleaning procedure includes the use of honing to remove deposits from the inside surface of the CRDM nozzle for NDE inspection. Also, the decision was made to use the more sensitive solvent-removable PT in lieu of the water-washable PT that was used in 1994.

The 1996 reinspection of nozzles 23 and 63 again identified indications present in both nozzles with the use of the MRPC technique. No significant change in amplitude or phase response for the indications was observed between the 1994 and the 1996 results. However, the PT inspection confirmed indications in both nozzles 23 and 63 in 1996, whereas indications were only confirmed in nozzle 23 in 1994. This is attributed to the improved cleaning technique and the more sensitive dye penetrant materials utilized during the 1996 inspection.

In summary, indications were identified in CRDM nozzles 23 and 63. As illustrated in Figure 1, there were numerous axial linear indications identified in nozzle 23 by ET and PT showed the lengths of the indications to be 0.06 to 0.34". Figure 2 illustrates the numerous axial linear indications identified by ET and further evaluated by PT in nozzle 63. The lengths of the indications range from 0.03" to 0.44."

NOTE: Figures 1 and 2 represent preliminary results of the 1996 CRDM inspection at ONS Unit 2. The data points are referenced to the PT indications (both axially and circumferentially). A reconciliation of the 1996 ET and PT results is anticipated to be comparable to the final results of the 1994 inspection in Reference 1.

Since a comparison of the MRPC results between 1994 and 1996 resulted in no observable changes, the UT examination from 1994 remains valid. As discussed in Section 2.0 and in Reference 1, the UT method used is qualified to size axially-oriented CRDM nozzle flaws having depths of 0.079" (2 mm) and greater. The UT data showed that there was no evidence of indications of measurable size within the limits of the UT qualification. In addition, a flaw depth study conducted by DPCo, FTI, and the EPRI NDE Center in February 1996 concluded that the deepest flaws detected in CRDM nozzles 23 and 63 did not exceed 0.079"(2 mm) in depth.[2] Therefore, the indications in nozzles 23 and 63 are not greater than 0.079" deep.

The following section describes the evaluations completed by FTI to reconcile the results obtained from the inspection to the acceptance criteria identified above.

3.0 Evaluation of Individual Flaws ACK 4/23/96

3.1 Previous Evaluation of Individual Flaws

Each of the 20 indications, identified in nozzle 23 during the 1994 inspection, was evaluated previously [1] relative to the acceptance criteria and acceptable flaw sizes allowed. The allowable flaw sizes calculated previously are included in Table 1 and illustrated in Figures 3 and 4. It was determined that the 20 flaws, 18 axially-oriented and 2 circumferentially-oriented, are within the allowable flaw sizes for at least one operating cycle (18 months) based on the acceptance criteria.

It should be noted that the allowable flaw sizes identified above were initially calculated for flaws at 0 to 2 inches above the nozzle weld; the stress profiles generated from the finite element analysis for the CRDM nozzles indicated that cracks (if any) should be located in that region. However, the indications detected during the NDE inspection are located at the level of the weld. The stresses at the weld location were evaluated and it has been determined that the allowable flaw sizes for flaws above the weld are conservative (i.e., bounding) for flaws located at the weld.

The longest flaw detected during the 1996 inspection has a length of 0.44" (11.2 mm) and an assumed depth of 0.079" (2 mm). As stated above, the 2 mm depth is based on the minimum (qualified) detectable depth of UT, whereas no indications were detected during the 1994 UT inspection. Based on the stresses at this location, it was calculated that the longest flaw (0.37" from 1994) may grow to 75% through-wall (and exceed the ASME Code required fracture toughness margin[3]) in 2.89 years of steady-state operation. [Note: Steady-state operation implies time at temperature for normal operating conditions.]

This calculation is made based on stresses taken from the finite element model developed for B&W-design CRDM nozzles. However, the stresses obtained from the finite element model are based on a material yield strength of 64.4 ksi and a peripheral nozzle location. Nozzle 23 has a yield strength of 55.2 ksi and nozzle 63 has a yield strength of 31.1 ksi (from the Certified Material Test Report [CMTR]) and is not located on the periphery of the RV head. Thus, there are additional conservatisms in this calculation; these conservatisms are addressed in the following discussion.

3.2 Conservatisms in Analysis

As mentioned above, the allowable flaw sizes calculated previously for nozzle 23 are conservative based on the inputs used in the analysis. For example, the nozzle stresses obtained from the finite element model are based on a heat of material with a

yield strength of 64.4 ksi, whereas nozzles 23 and 63 were manufactured from heats of material with yield strengths of 55.2 and 31.1 ksi per the CMTRs, respectively. Also, the finite element model from which the stresses were obtained was based on a peripheral nozzle. While nozzle 63 is on the periphery, nozzle 23 is not at a peripheral location. Another conservatism is the crack growth rate utilized in the analysis. Crack growth rates determined for in-service cracks (1.7 mm/year average to 3.3 mm/year maximum)[4] are below the values used in the analysis of allowable flaw sizes for ONS Unit 2 nozzles 23 and 63 (1.5 to 6 mm/year, over three years), which is based on the P. Scott model.[5]

The 2.89 years of allowable operation was calculated based on time at operating temperature, which is related to effective full power duration by the capacity factor for the unit (which is 95.5% for ONS Unit 2). Shutdown periods are not included in the allowable operating time calculated. The following information should also be noted for ONS Unit 2:

Cycle No.	Estimated Effective Full Power Days (EFPD)[a]
16	480
17	480

For Cycles 16 and 17,

$$\text{Estimated time at temperature} = \frac{(480 \text{ days} + 480 \text{ days})}{365 \text{ days/year}} \times \frac{1}{95.5\%} = 2.75 \text{ years}$$

which is less than the 2.89 years calculated previously. Therefore, the flaws detected in nozzles 23 and 63 during the EOC-15 outage will not exceed the acceptance criteria until after Cycle 17, at minimum, based on normal operating conditions.

Finally, it should be noted that the appearance of flaws in nozzles 23 and 63 at ONS Unit 2 closely resemble flaws that have been detected at Ringhals Unit 2.[6] At Ringhals, it was determined during subsequent inspections that although more flaws were detected, the previous flaws appeared only to grow in length, not depth.[7] Also, all flaws detected at ONS Unit 2 were assumed to be 2 mm (0.079") deep, the detectable limit of flaws by UT; the flaws may actually be shallower.

4.0 Conclusions

It is concluded, based on the evaluations and results described above, that the indications detected at ONS Unit 2 during the April 1996 CRDM nozzle inspection are acceptable for a minimum of 2.89 years of steady-state operation (time at temperature for normal operation) based on the acceptance criteria for detected flaws. Based on

[a] Per Duke Power Company.

the conservatisms in the analysis and calculated time at temperature (2.75 years) for Cycles 16 and 17, the flaws detected in nozzles 23 and 63 during EOC-15 will not exceed the acceptance criteria during two consecutive operating cycles (16 and 17). Thus, no additional inspections of nozzles 23 and 63 are necessary until after Cycle 17.

It should be noted that any deviations from normal operation that occur prior to EOC-17 should be evaluated on a case-by-case basis to determine effects (if any) of such deviations on the above conclusions.

5.0 Recommendations

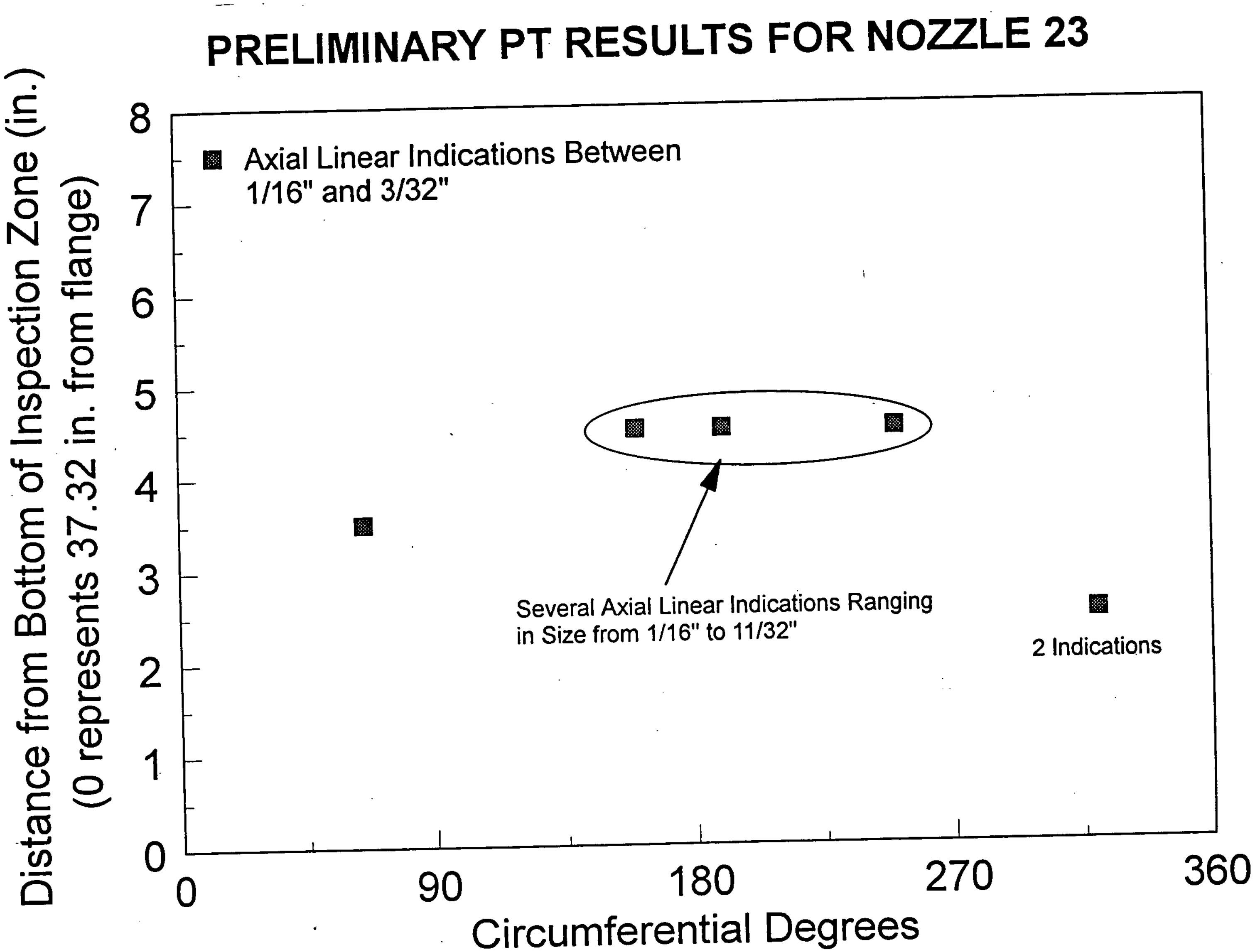
It is recommended, as a minimum, that NDE inspection of nozzles 23 and 63 be performed during refueling outage EOC-17. Based on the results of that inspection, future actions will be determined.

TABLE 1
ALLOWABLE CRACK LENGTHS FOR CRDM NOZZLES FOR ONE FUEL CYCLE

Length /Depth Ratio	Crack Length (Inches)		
	Hillside Nozzle Downhill Side (0°)	Hillside Nozzle Uphill Side (180°)	Center Nozzle
Axial Flaw			
1	0.3285	0.2896	0.3674
2	0.5400	0.4790	0.6460
3	0.6873	0.6220	0.8820
4	0.8028	0.6669	1.0843
5	0.8672	0.6947	1.2500
6	0.9110	0.7110	1.4080
7	0.9466	0.7175	1.4913
8	0.9732	0.7212	1.5610
9	0.9892	0.7169	1.6395
10	0.9942	0.7101	1.6796
Circumferential Flaw			
1	0.4625	0.4607	0.4625
2	0.9090	0.9016	0.9250
3	1.3449	1.3171	1.3829
4	1.3829	1.3829	1.3829
5	1.3829	1.3829	1.3829
6	1.3829	1.3829	1.3829
7	1.3829	1.3829	1.3829
8	1.3829	1.3829	1.3829
9	1.3829	1.3829	1.3829
10	1.3829	1.3829	1.3829

FIGURE

INTERIM RESULTS: LOCATION OF 1996 INDICATIONS AT ONS UNIT 2 NOZZLE 23



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INTERIM RESULTS: LOCATION OF 1996 INDICATIONS AT ONS UNIT 2 NOZZLE 63

PRELIMINARY PT RESULTS FOR NOZZLE 63

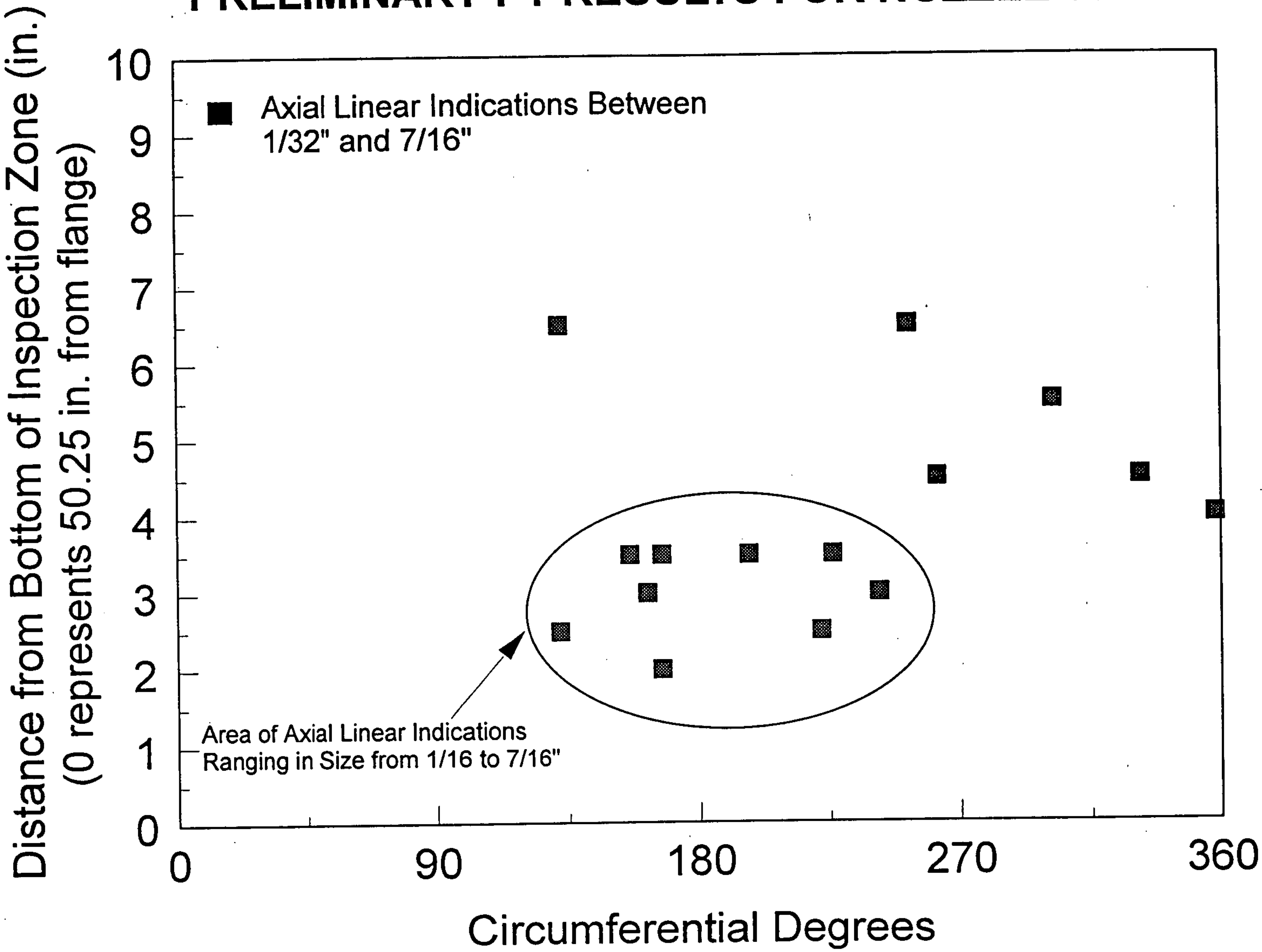

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FIGURE 3

ALLOWABLE FLAW SIZE FOR AN INTERNAL SEMI-ELLIPTICAL AXIAL FLAW

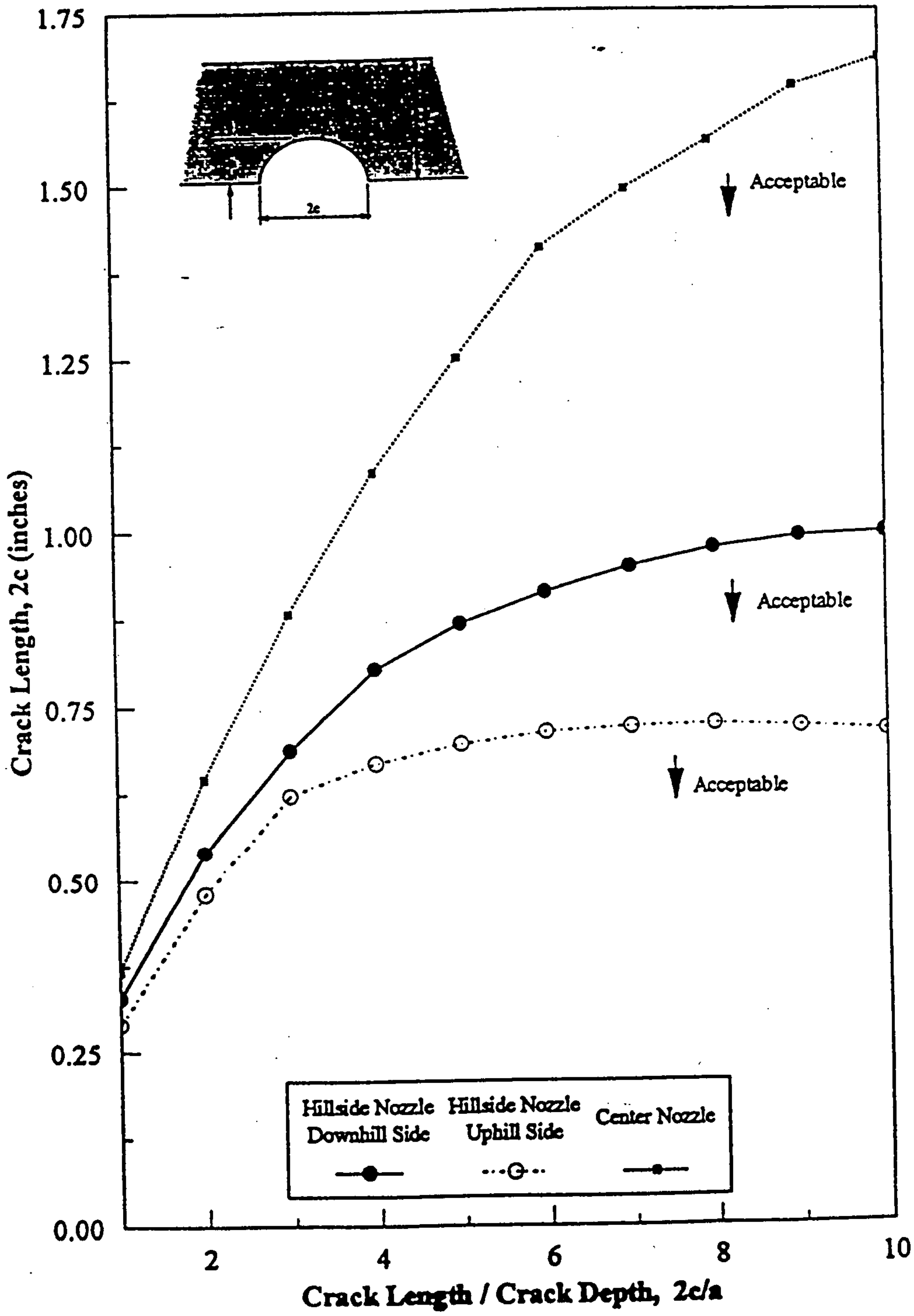
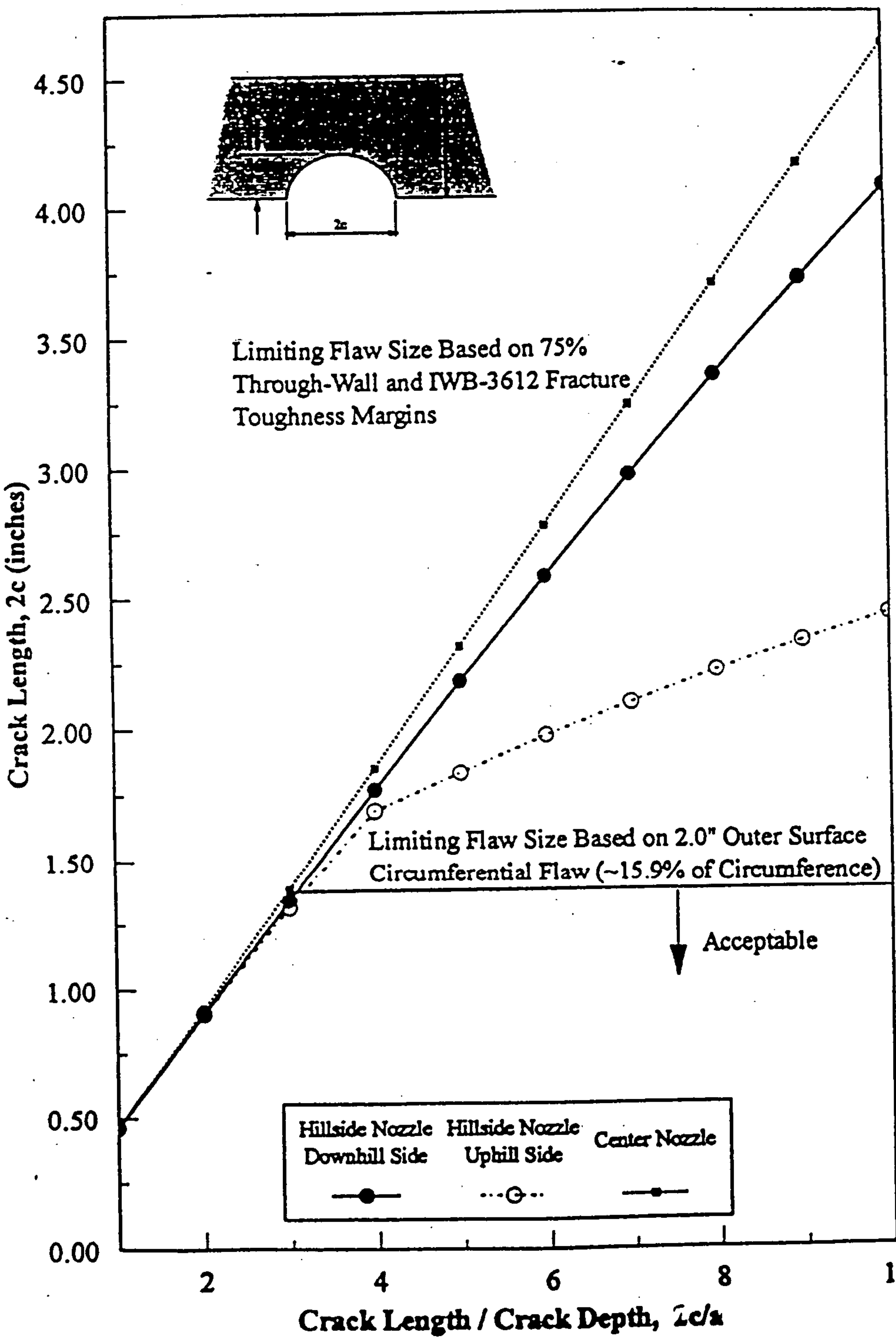


FIGURE 4

ALLOWABLE FLAW SIZE FOR AN INTERNAL, SEMI-ELLIPTICAL CIRCUMFERENTIAL FLAW



6.0 References

1. Letter and attachments to letter from J. Peele for J.W. Hampton, Site Vice President (ONS), to U.S. Nuclear Regulatory Commission, Subject: Acceptance Criteria for Control Rode Drive Mechanism Penetration Inspection, Docket Nos. 50-269, 50-270, 50-287, dated September 22, 1994.

2. Letter from L. Cagle, Jr. (EPRI NDE Center) to D. Whitaker (DPCo), Subject: Trip Report, Duke Power Company, Oconee Unit 2, dated April 14, 1996.

3. ASME Boiler and Pressure Vessel Code, Section XI, 1986 (without Addenda).

4. Salin, J., "Overview of CRDM Nozzle Inservice Inspections in France (1991-1994) -- In Plant Evaluation of Crack Propagation Kinetics," Paper E2, Proceedings: 1994 EPRI Workshop on PWSCC of Alloy 600 in PWRs, EPRI TR-105406, Tampa, Florida, November 15-17, 1994.

5. Scott, P.M., "An Analysis of Primary Water Stress Corrosion Cracking in PWR Steam Generators," Proceedings of the Specialists Meeting on Operating Experience with Steam Generators, Paper No. 5-6, Brussels, Belgium, September 16-20, 1991.

6. Wilson, B., "Inspection and Repair Strategy for Reactor Vessel Head Penetrations in Ringhals," Paper B3, Proceedings: 1992 EPRI Workshop on PWSCC of Alloy 600 in PWRs, EPRI TR-103345, Orlando, Florida, December 1-3, 1992.

7. Sjostrand, H., "Ringhals Unit #2, #3 and #4, RVHP Examination Results from NDE and Boat Sample Analysis," Paper A3, Proceedings: 1994 EPRI Workshop on PWSCC of Alloy 600 in PWRs, EPRI TR-105406, Tampa, Florida, November 15-17, 1994.

ATTACHMENT 2

Supporting Information Package for Interim Engineering Evaluation

EPRI NDE CENTER

Electric Power Research Institute
Nondestructive Evaluation Center —— *Leadership in Technology Transfer*

April 14, 1996

Dave Whitaker
Duke Power Company
P. O. Box 1006 (EC2-090)
Charlotte, NC 28201-1006

SUBJECT: Trip Report, Duke Power Company., Oconee Unit 2

Dear Dave:

In August of 1994 Babcock & Wilcox Nuclear Technologies (BWNT) demonstrated their eddy current (ET) capabilities for inspecting Control Rod Drive Mechanism (CRDM) head penetrations on the EPRI NDE Center CRDM mockups. One of the eddy current demonstrations performed utilized a motorized rotating pancake coil (MRPC) probe inspection technique. BWNT demonstrated this technique for flaw detection and flaw characterization capabilities. Flaw characterization included providing the circumferential location, axial location, and length sizing for each indication. Results of the eddy current demonstration were recorded along with the essential variables for both inspection techniques.

On April 8, 1996 I traveled to Duke Powers' Oconee Nuclear Plant to review ET essential variables and to oversee the MRPC probe inspection of two CRDM penetrations performed by BWNT now known as Framatome, Inc. Upon arrival at the Oconee Unit 2, Duke personal had removed the lead screw assemblies from CRDM penetrations #23 and #63 and Framatome personnel had cleaned the ID surface of both penetrations with a scotch bright pad to prepare for the ET inspection. Prior to the ET inspection I reviewed the MRPC probe essential variables, inquired about data acquisition, and discussed analysis procedures with Framatomes' eddy current level 2 on site. After ensuring that the CRDM penetration inspection was being performed with the same essential variables used during the EPRI mockup demonstration, the ET inspection began.

Two ET inspection were performed on both CRDM penetrations. The first followed the scotch bright pad cleaning process used to remove ID deposits such as boron. The second ET inspection followed a two minute honing process used to prepare the ID surface of the CRDM penetrations for the up-coming liquid dye-penetrant inspection. Following the completion of both ET inspections, I reviewed the ET data from penetrations #23 and #63 an compared the ET results from before and after honing. No reportable changes in ET data were evident due to the honing process.

1300 Harris Boulevard • Charlotte, North Carolina 28262 • Telephone: (704) 547-6100
(P.O. Box 217097, Charlotte, North Carolina 28221) • FAX: (704) 547-6168

During ET data review of penetrations #23 and #63, I noted several clusters of indications similar to the indications detected during the 1994 CRDM inspection. A comparison of the latest ET data to the data acquired in 1994 from penetrations # 23 and #63 indicated that signal amplitudes and phase angles from both sets of ET data were virtually identical. As a result, the ET comparison provided substantial evidence that the indications detected in CRDM penetrations #23 and #63 had not significantly grown in length or depth from 1994 to present.

Following the MRPC ET inspection, Framatome personnel performed a red dye-penetrant examination on the ID surface of penetrations #23 and #63. The dye-penetrant exam detected axial flaw indications in both CRDM penetrations that correlated with the indications detected during the ET inspections.

Based on a CRDM flaw depth study conducted by Duke Power, Framatome, and the EPRI NDE Center in February of 1996, indications from both CRDM penetration indicated that the deepest flaws detected in CRDM penetrations #23 and #63 did not exceed 2mm in depth. The flaw depth study provided considerable information on how ET signal responses are effected by various flaw depths, flaw orientations, and cluster flaw configurations. The study provided a non-qualified ET depth sizing procedure that was used as a "for information only depth sizing technique".

Sincerely,

Larry Cagle, Jr.
EPRI NDE Center

LC:inb
DUKE1.DOC

cc: F. Ammirato
K. Krzywosz
K. Kietzman
Mel Arey
Donna Keck, Duke Power
R. Pathania, EPRI
Utility File

DUKE POWER COMPANY - OCONEE UNIT 2
CRDM NOZZLE EDDY CURRENT INSPECTION RESULTS
APRIL 11, 1996

Two CRDM nozzles, #23 and #63, were inspected from above the reactor vessel head with a rotating eddy current probe. The inspection was performed in accordance with Framatome Technologies Inc. Procedure ISI-491 Rev. 3, Technical Procedure for the Multifrequency Eddy Current Examination of Reactor Vessel Head Penetrations Using a Motorized Rotating Pancake Coil (MRPC) Probe. The area of interest included the weld area and two inches above and below the weld.

Nozzle #23 contained many small axial indications near the top of the weld (180 degrees) occurring along a circumferential line. A comparison between the 1994 MRPC data and the 1996 MRPC data resulted in no significant change in amplitude or phase response for the indications found.

Nozzle #23 was honed for two minutes and reinspected with eddy current. No significant change in signal response was noted after honing.

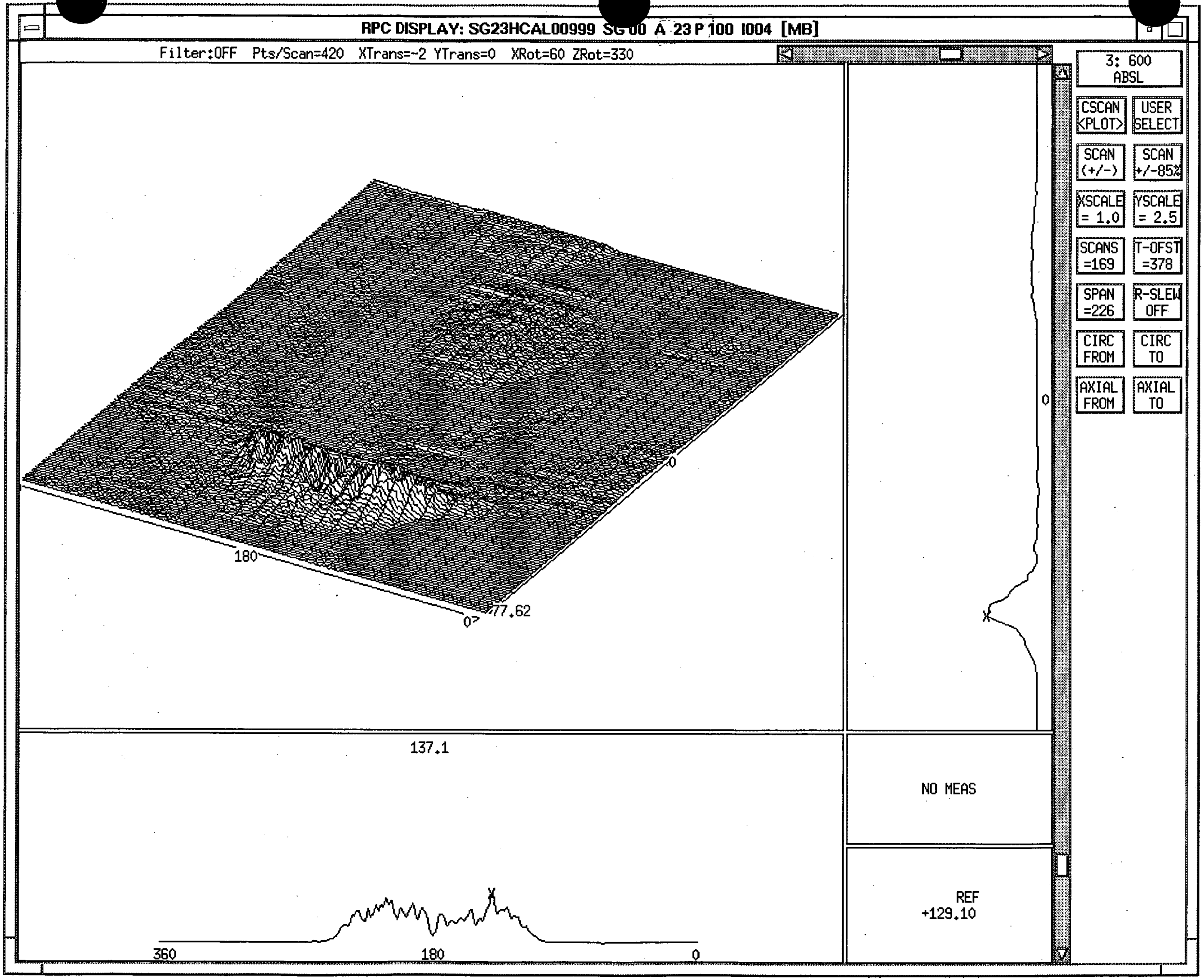
Nozzle #63 contained many small axial indications throughout the weld signature area. A comparison between the 1994 MRPC data and the 1996 MRPC data resulted in no significant change in amplitude or phase response for the indications found.

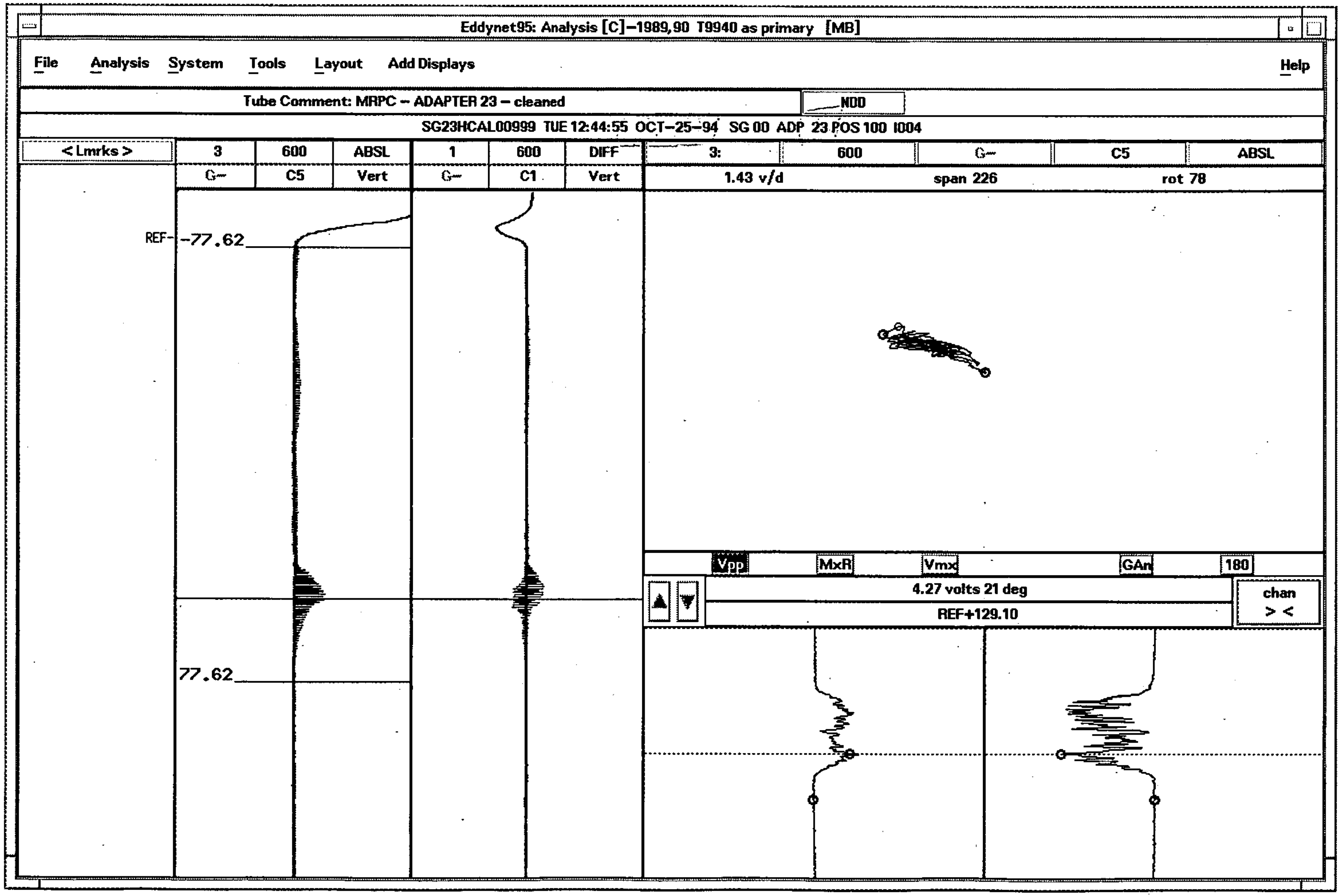
Nozzle #63 was honed for two minutes and reinspected with eddy current. No significant change in signal response was noted after honing.

P.A. Triska 4/11/96
P.A. Triska - NDE Services
Framatome Technologies Inc.

Penetration #23

1994 Data

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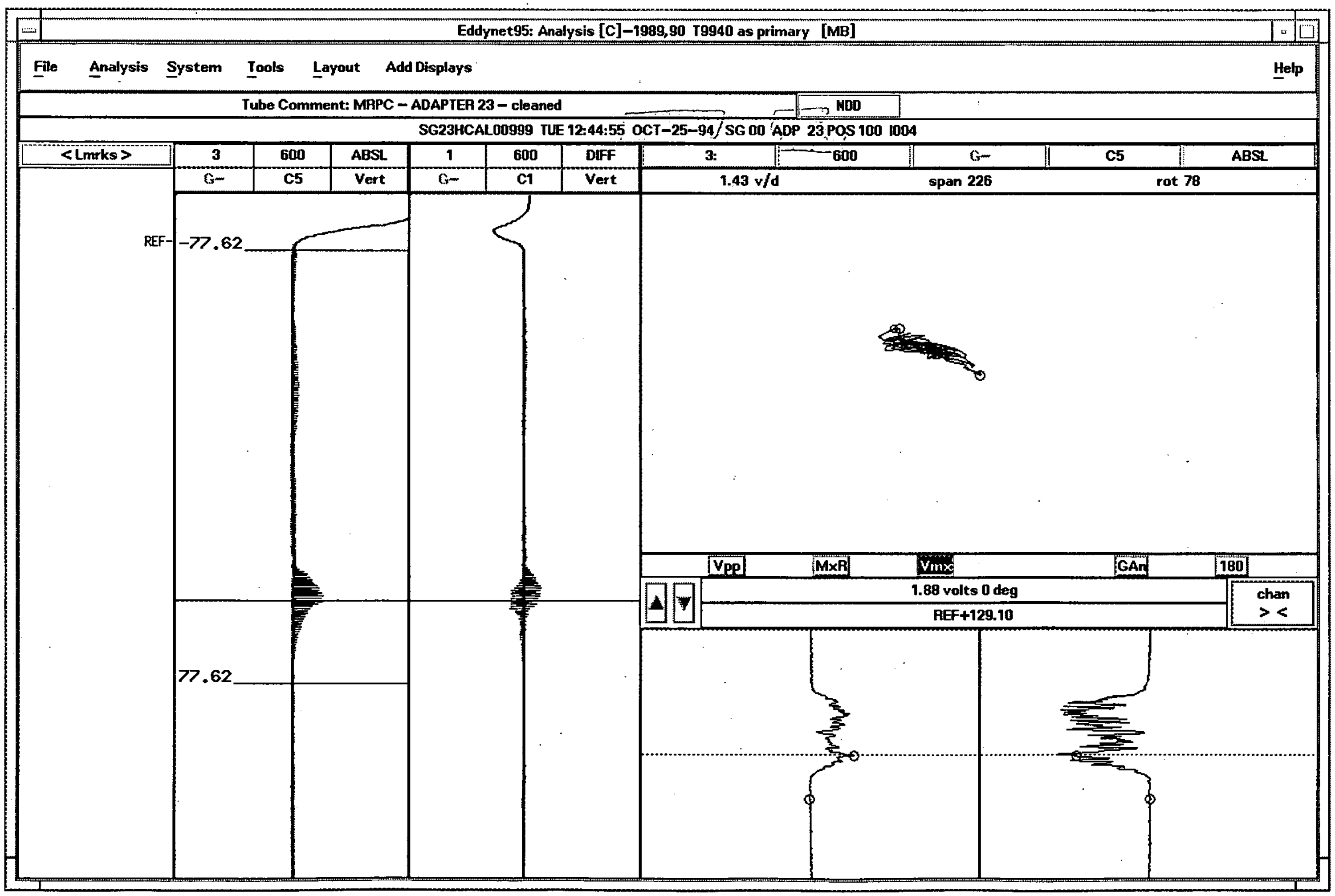
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Penetration #23

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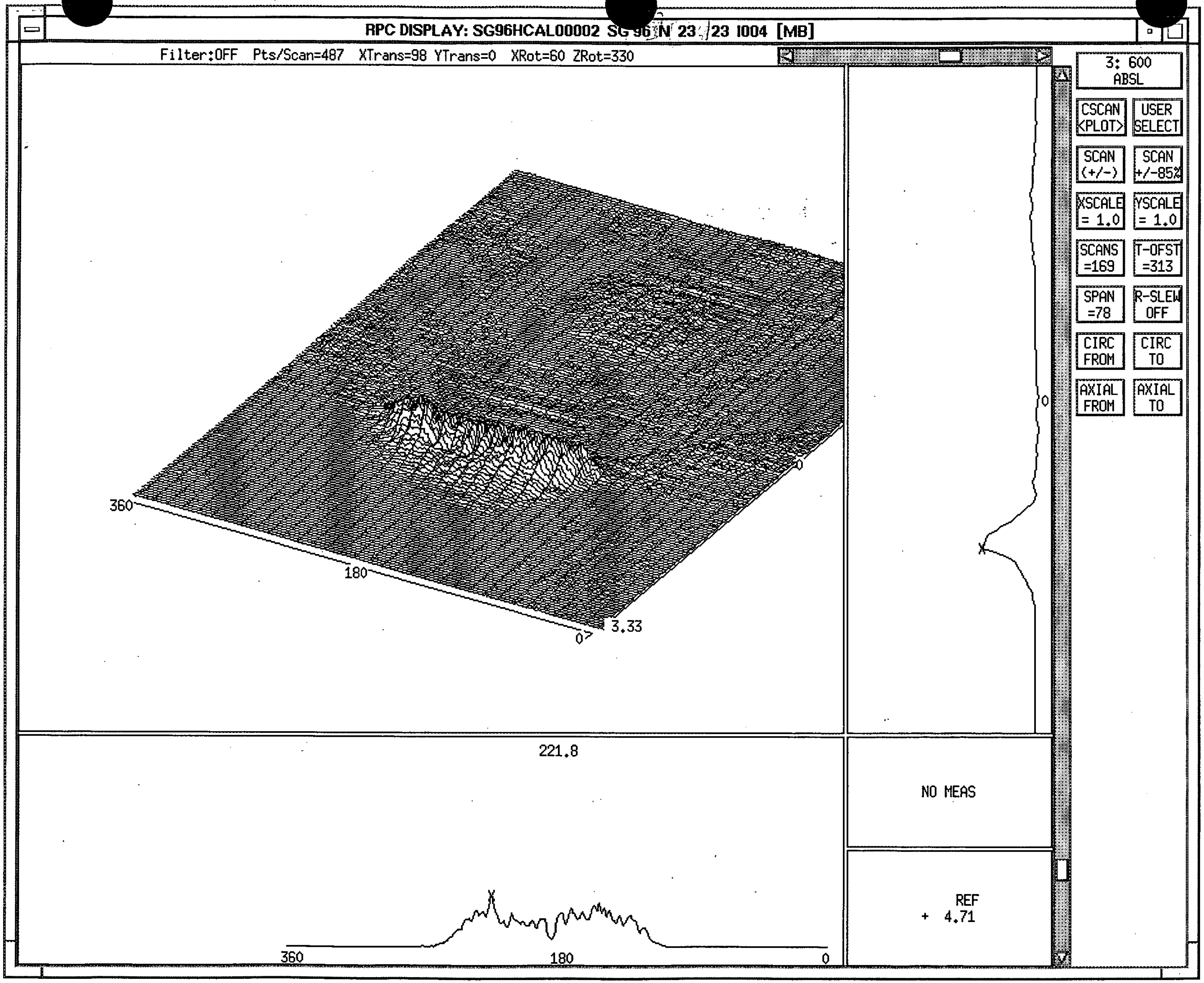

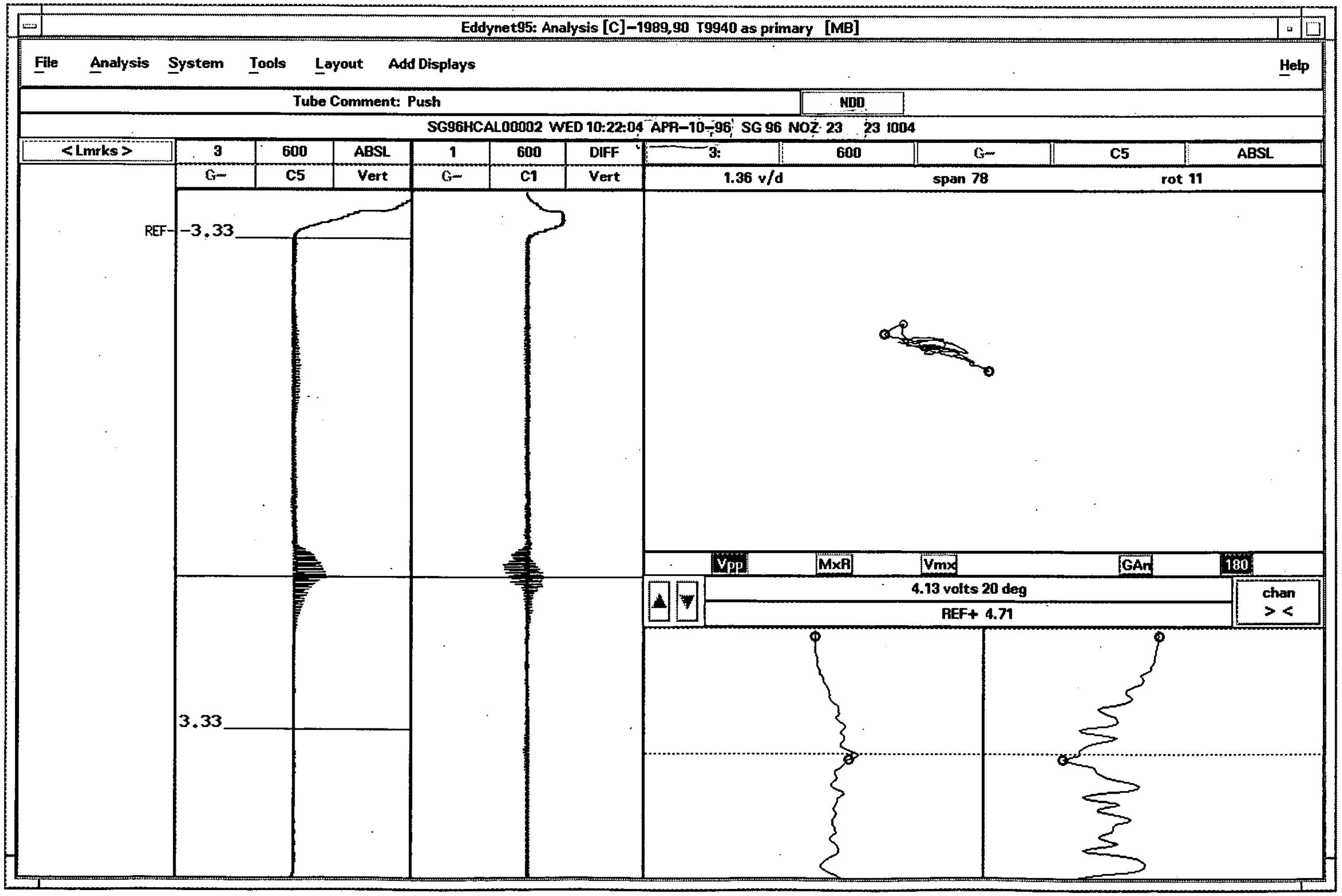
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Vpp
MxR
Vmx
GAn
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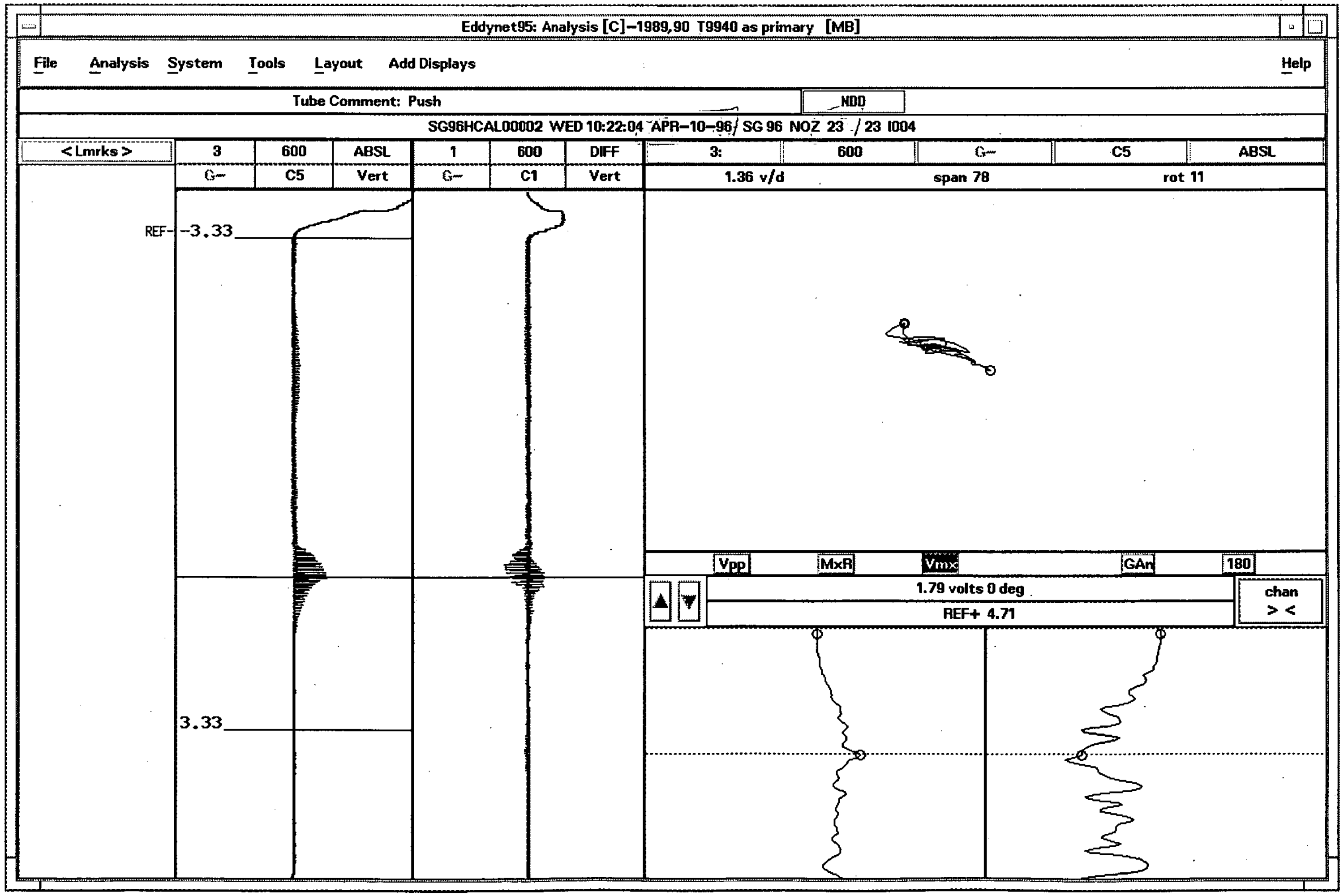
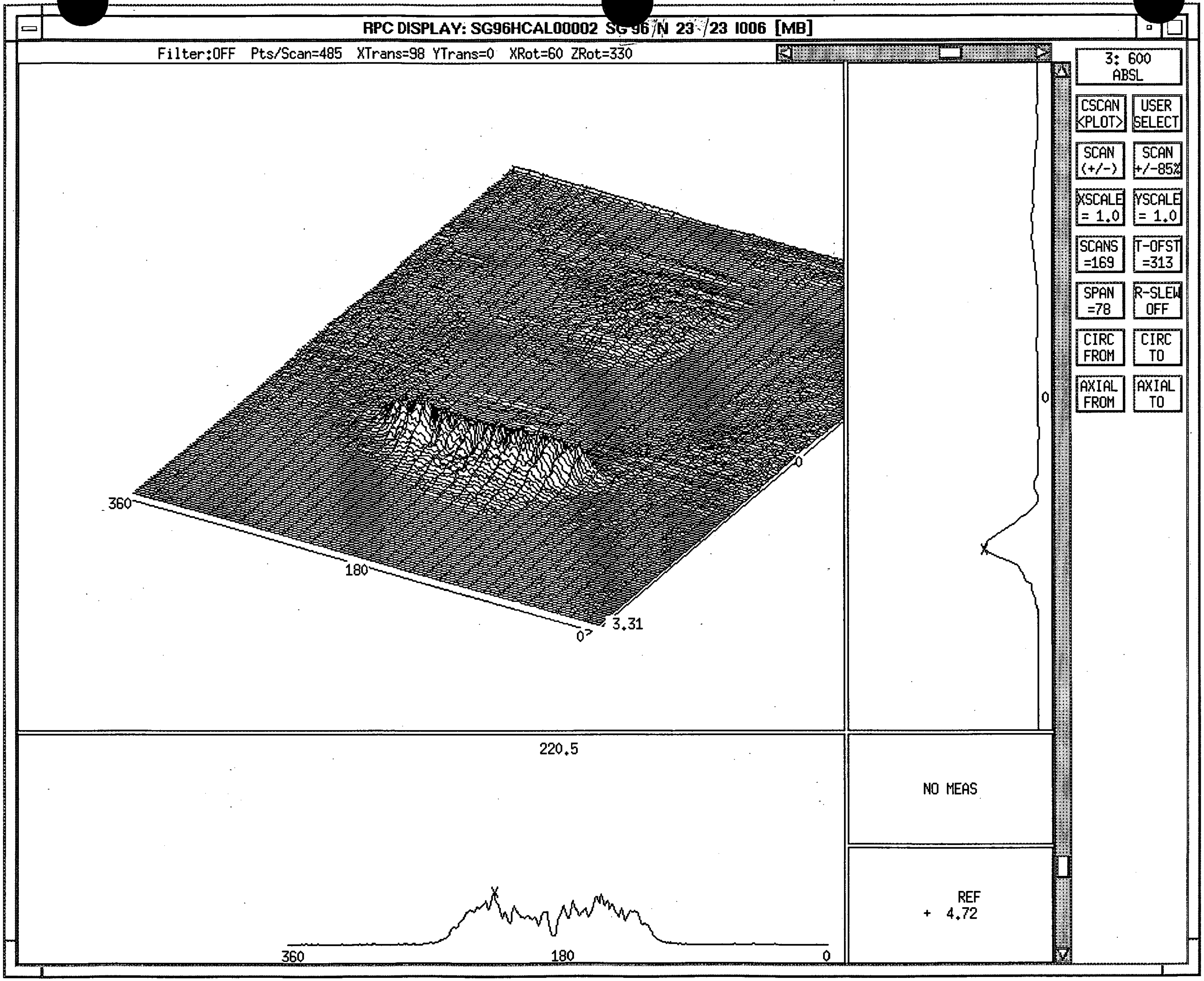
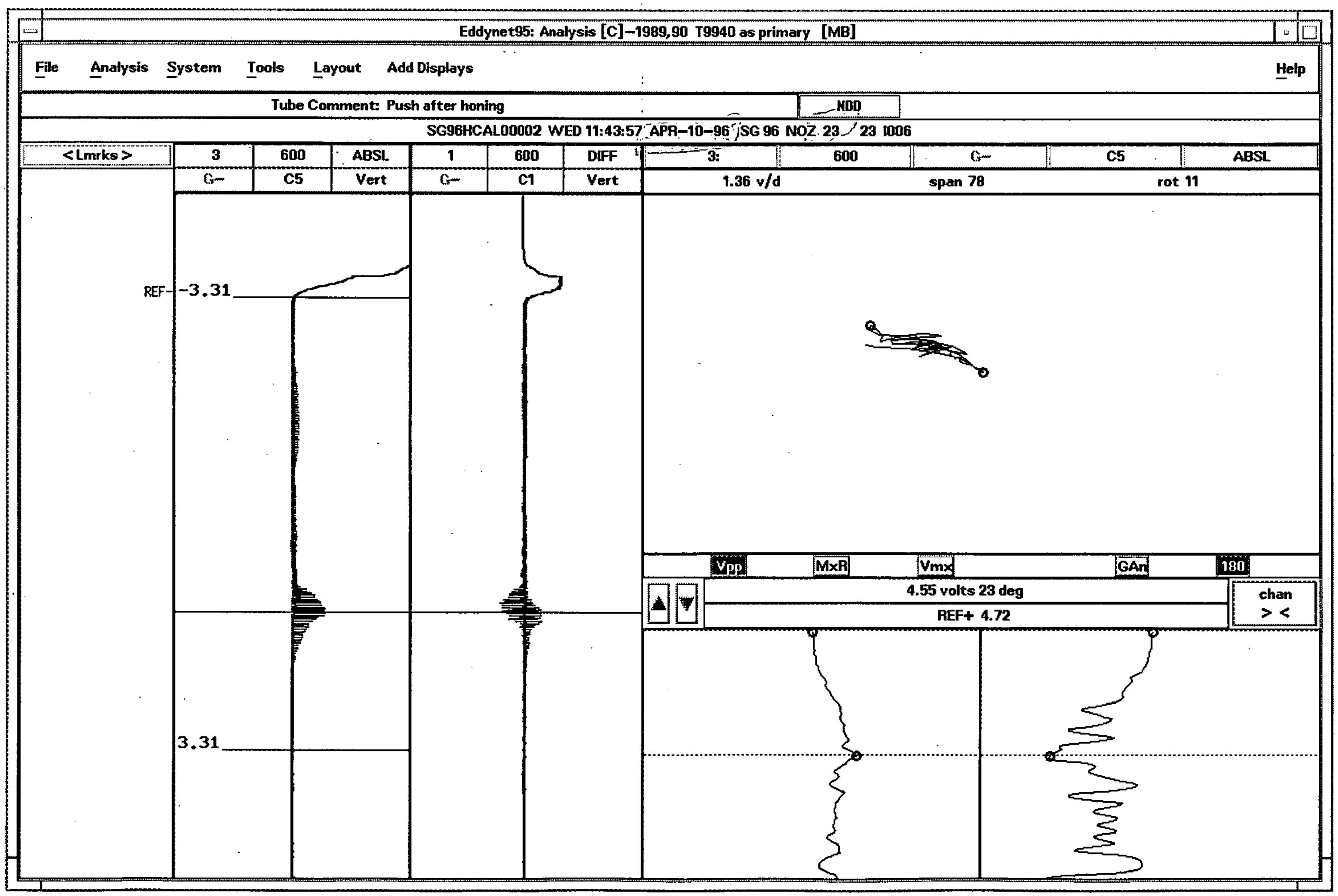
REF+ 4.71
chan
> <


Eddynet95: Analysis [C]-1989,90 T9940 as primary [MB]
File
Analysis
System
Tools
Layout
Add Displays
Help
Tube Comment: Push
NDD
SG96HCAL00002 WED 10:22:04 APR-10-96 SG 96 NOZ 23 / 23 I004
<Lmrks>
3
600
ABSL
G-
C5
Vert
1
600
DIFF
G-
C1
Vert
3:
600
G-
C5
ABSL
1.36 v/d
span 78
rot 11
REF-
-3.33
3.33
Vpp
MxR
Vmx
GAn
180
1.79 volts 0 deg
REF+ 4.71
chan
> <

Penetration #23

1996 Data: After Honing

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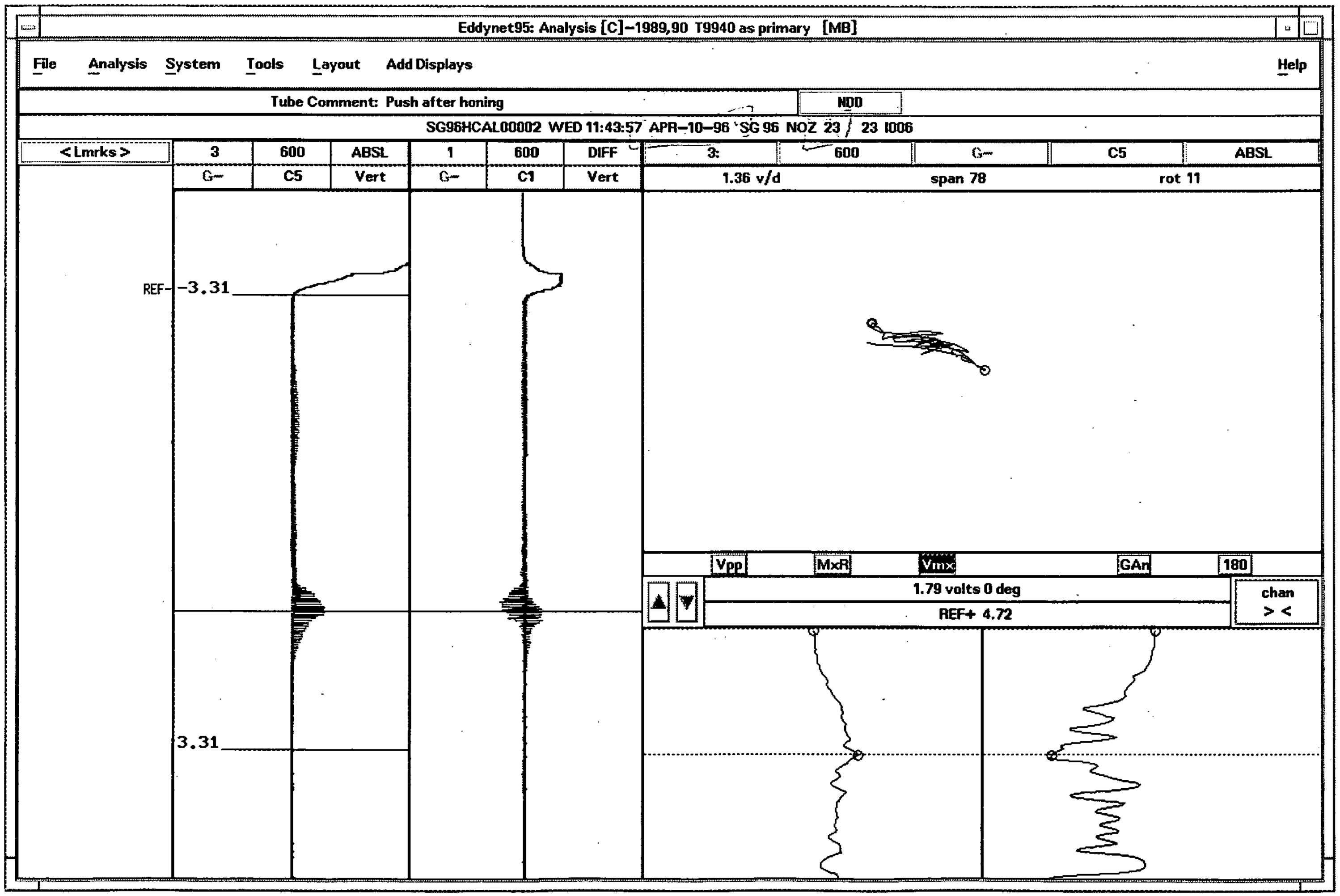
File
Analysis
System
Tools
Layout
Add Displays
Help
Tube Comment: Push after honing
NDD
SG96HCAL00002 WED 11:43:57 APR–10–96 SG 96 NOZ 23 23 1006
<Lmrks>
3
600
ABSL
G–
C5
Vert
1
600
DIFF
G–
C1
Vert
3:
600
G–
C5
ABSL
1.36 v/d
span 78
rot 11
REF– -3.31
3.31
Vpp
MxR
Vmx
GAn
180
4.55 volts 23 deg
REF+ 4.72
chan
> <

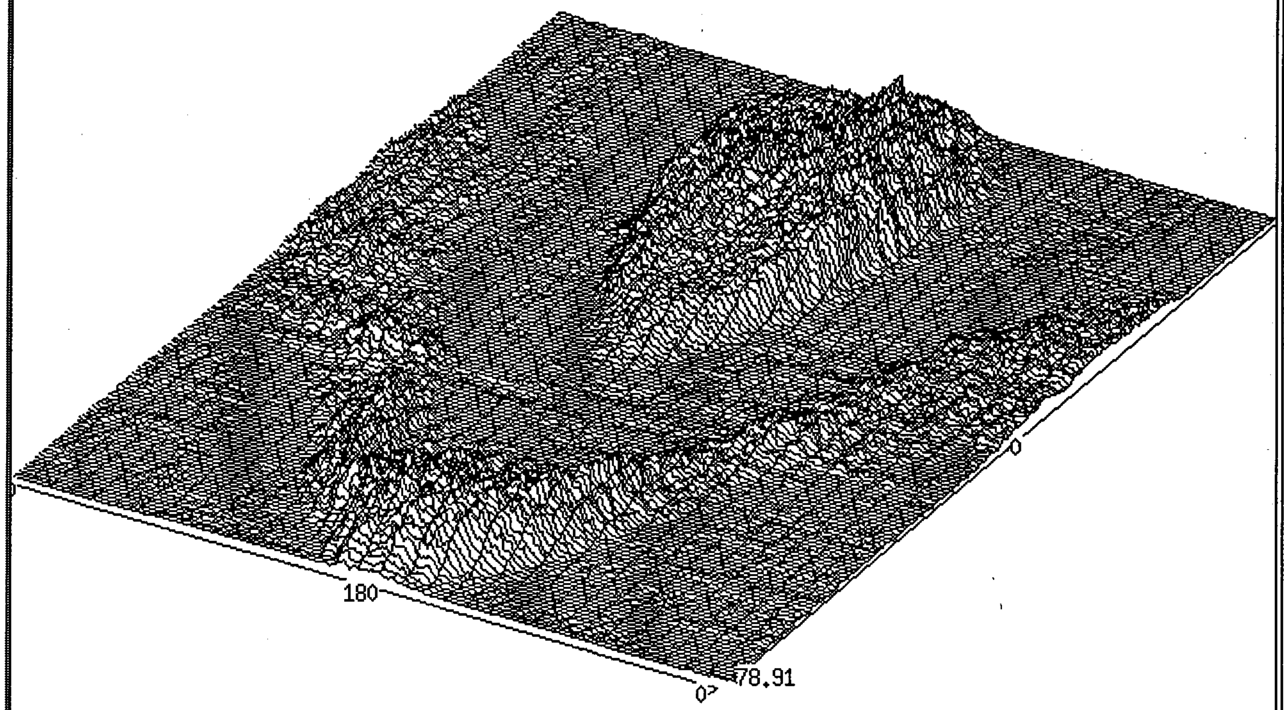

Eddynet95: Analysis [C]–1989,90 T9940 as primary [MB]
File
Analysis
System
Tools
Layout
Add Displays
Help
Tube Comment: Push after honing
NDD
SG96HCAL00002 WED 11:43:57 APR–10–96 SG 96 NOZ 23 / 23 I006
<Lmrks>
3
600
ABSL
1
600
DIFF
3:
600
G–
C5
ABSL
G–
C5
Vert
G–
C1
Vert
1.36 v/d
span 78
rot 11
REF–
-3.31
3.31
Vpp
MxR
Vmx
GAn
180
1.79 volts 0 deg
REF+ 4.72
chan
> <

Penetration # 63

1994 Data

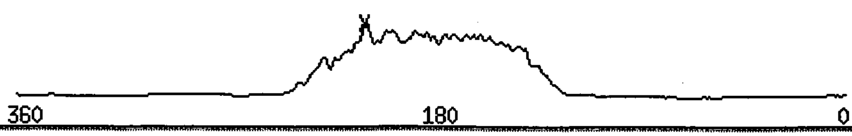
RPC DISPLAY: SG63HCAL01999 SG 00 A 63 P 100 I003 [MB]

Filter:OFF Pts/Scan=427 XTrans=0 YTrans=0 XRot=60 ZRot=330



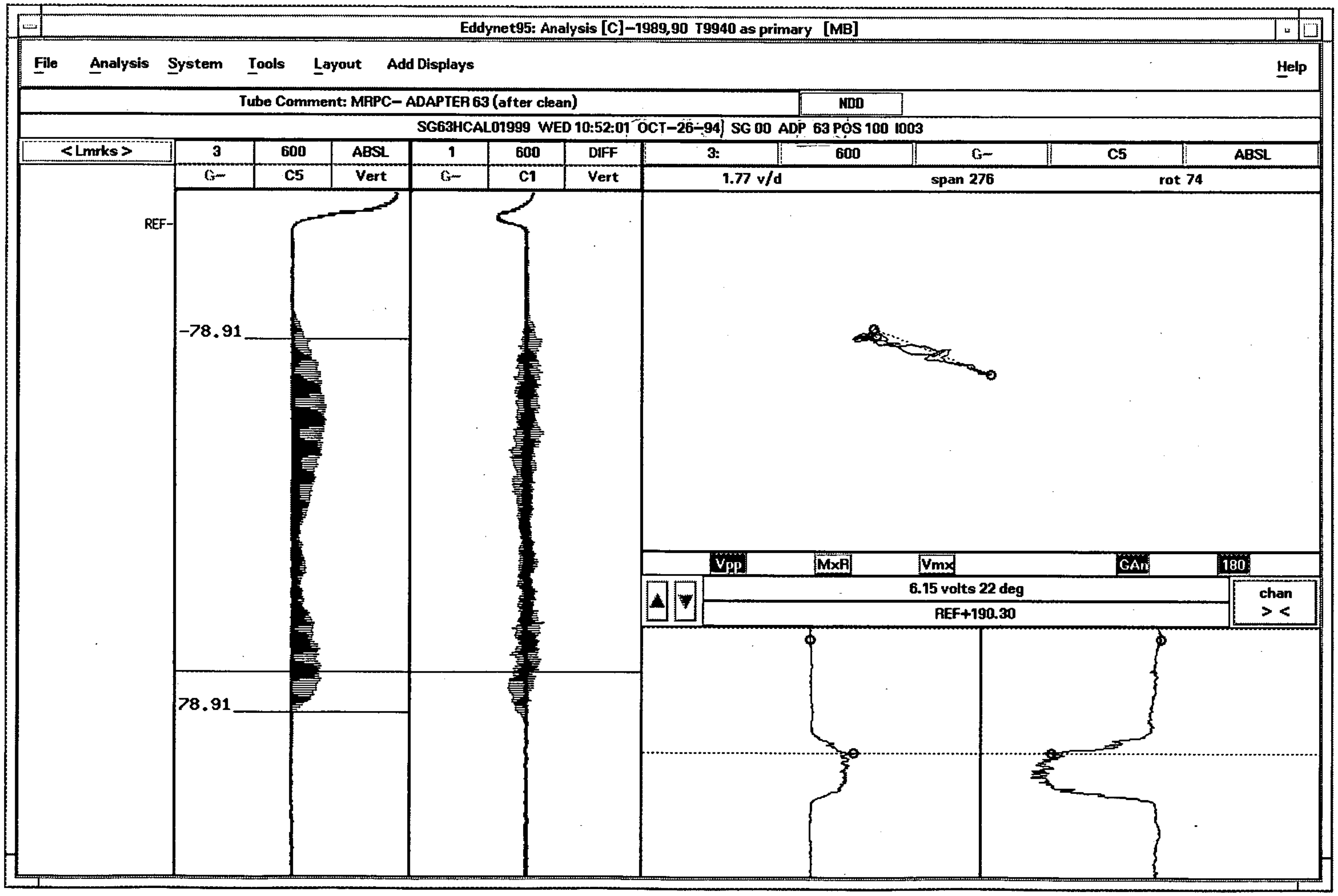
3: 600 ABSL	
CSCAN <PLOT>	USER SELECT
SCAN (+/-)	SCAN +/-85%
XSCALE = 1.0	YSCALE = 2.5
SCANS =169	T-OFST =378
SPAN =276	R-SLEW OFF
CIRC FROM	CIRC TO
AXIAL FROM	AXIAL TO

208.2

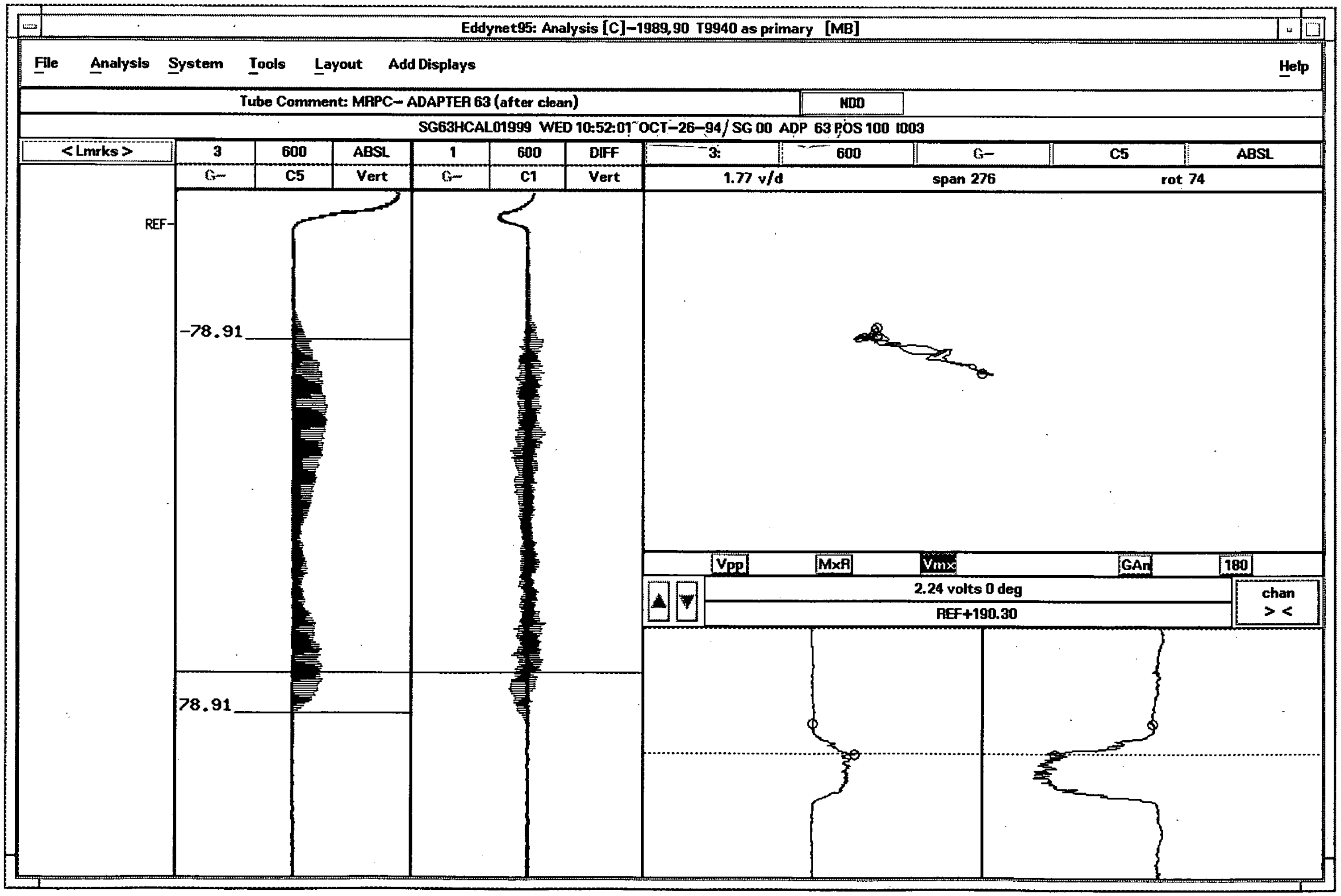


NO MEAS

REF
+190.30

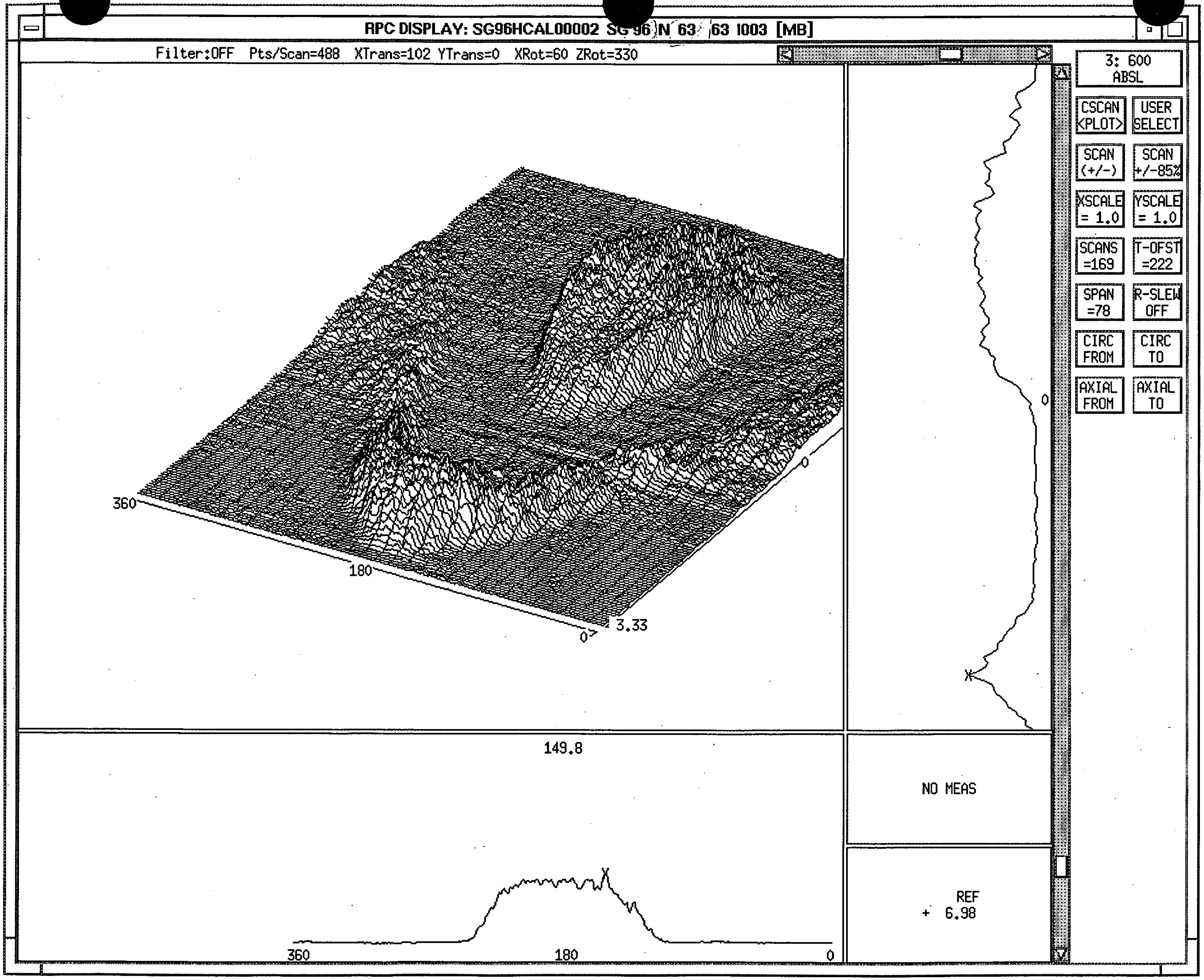


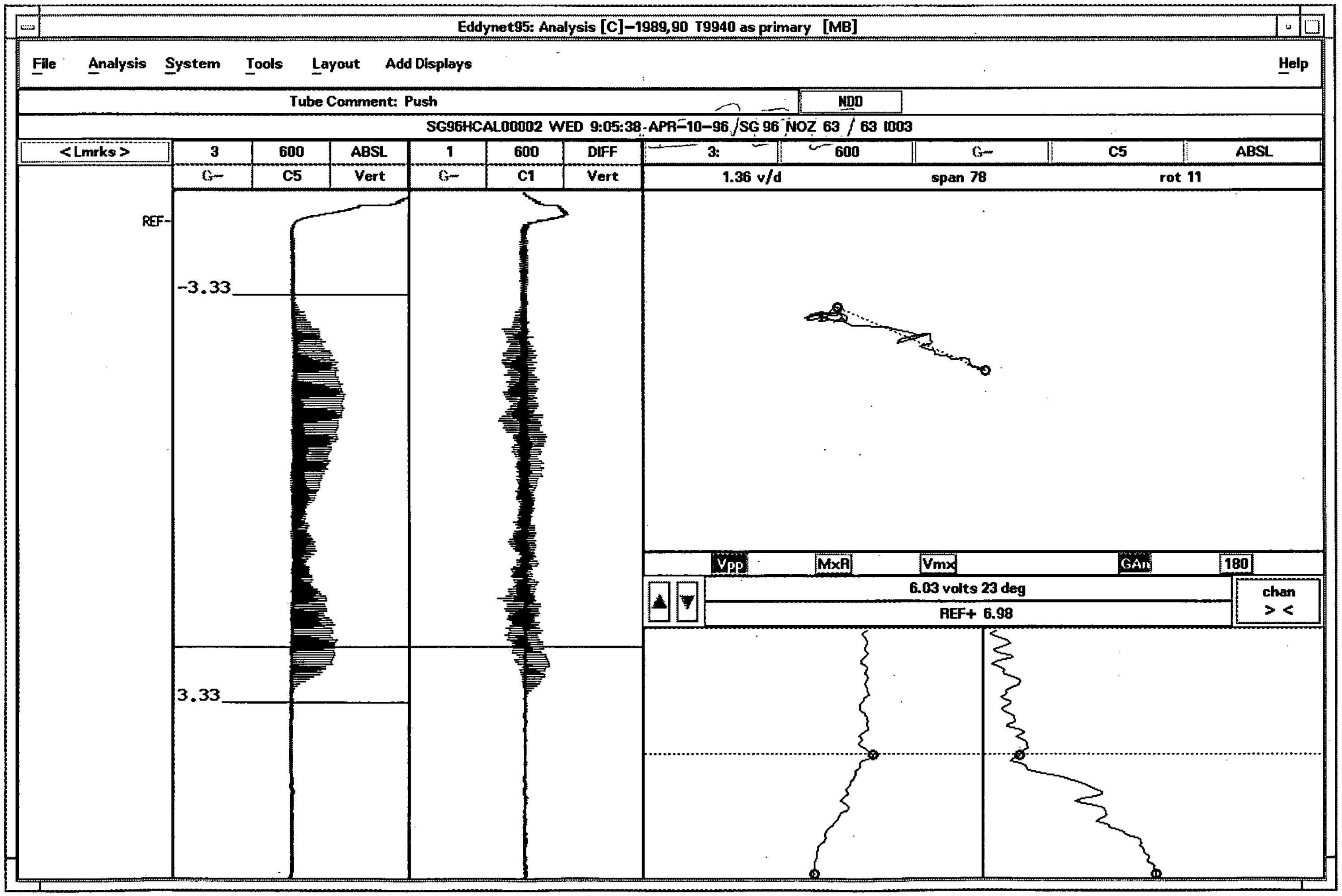
Eddynet95: Analysis [C]–1989,90 T9940 as primary [MB]
File
Analysis
System
Tools
Layout
Add Displays
Help
Tube Comment: MRPC– ADAPTER 63 (after clean)
NDD
SG63HCAL01999 WED 10:52:01 OCT–26–94 SG 00 ADP 63 POS 100 I003
< Lmrks >
3
600
ABSL
G–
C5
Vert
1
600
DIFF
G–
C1
Vert
3:
600
G–
C5
ABSL
1.77 v/d
span 276
rot 74
REF–
–78.91
78.91
Vpp
MxR
Vmx
GAn
180
6.15 volts 22 deg
REF+190.30
chan
> <

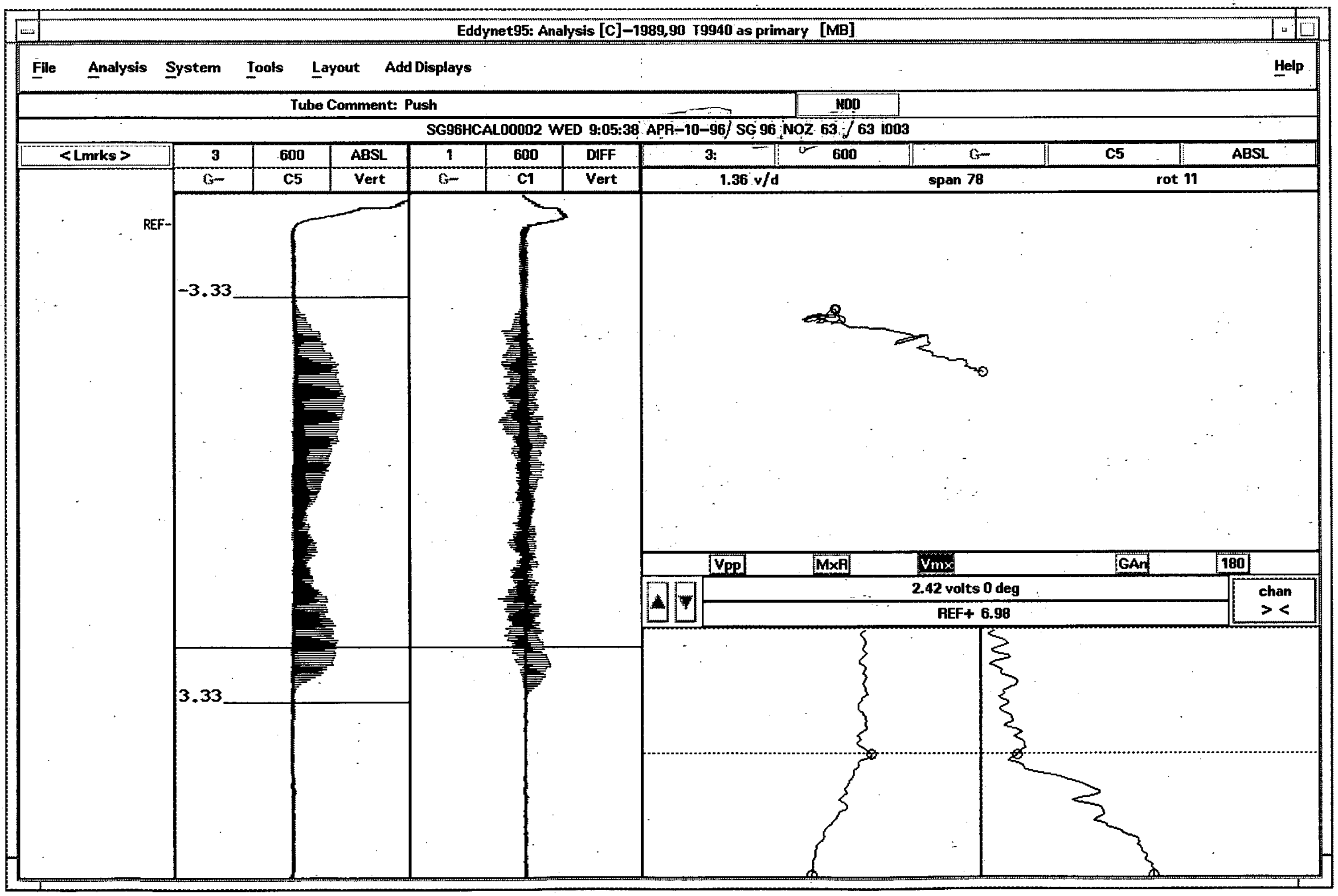

Eddynet95: Analysis [C]–1989,90 T9940 as primary [MB]
File Analysis System Tools Layout Add Displays Help
Tube Comment: MRPC– ADAPTER 63 (after clean)
NDD
SG63HCAL01999 WED 10:52:01 OCT–26–94/ SG 00 ADP 63 POS 100 I003
< Lmrks >
3 600 ABSL
G– C5 Vert
1 600 DIFF
G– C1 Vert
3 600 G– C5 ABSL
1.77 v/d span 276 rot 74
REF–
–78.91
78.91
Vpp MxR Vmx GAn 180
2.24 volts 0 deg
REF+190.30
chan
> <

Penetration #63

1996 Data - Before Honing

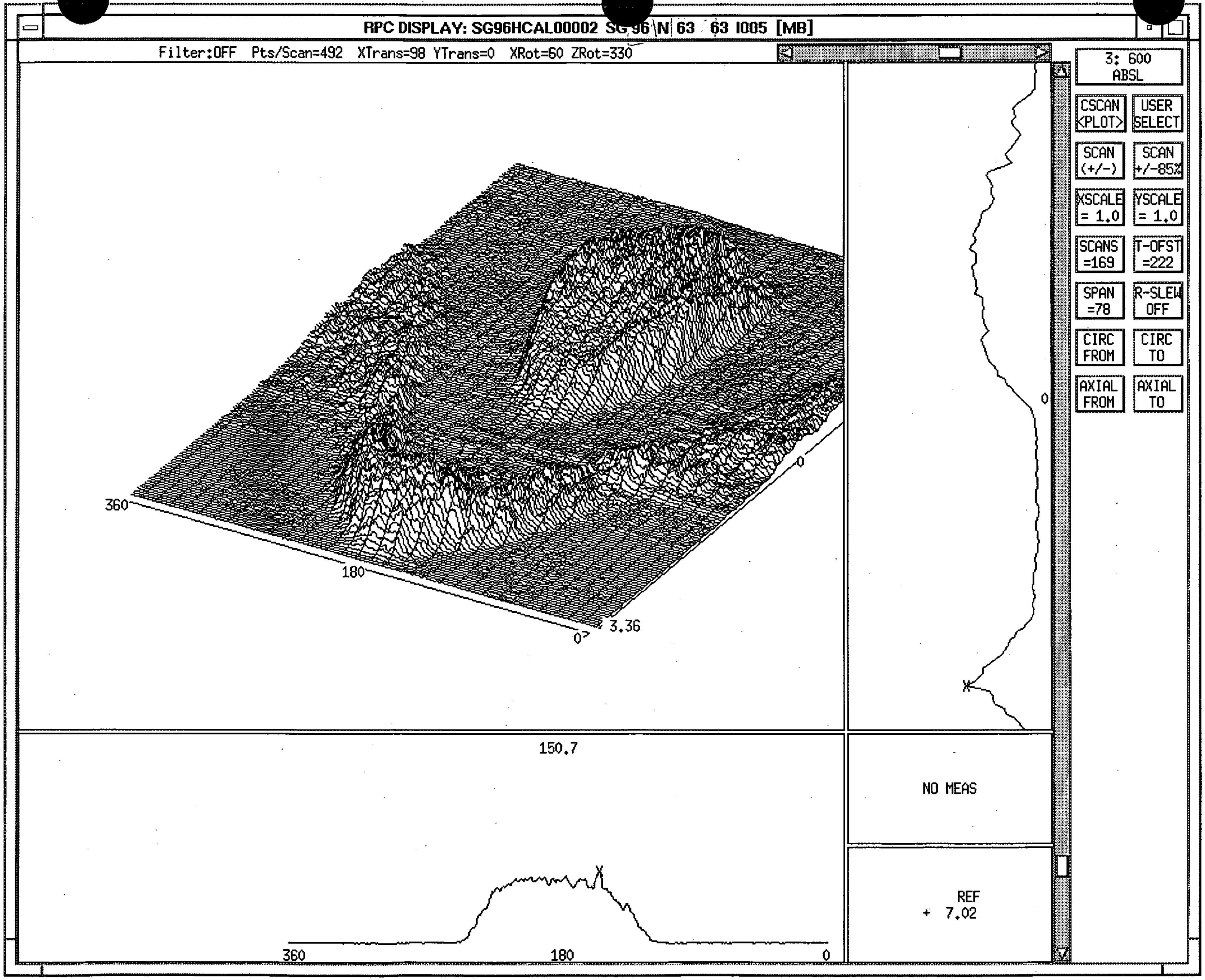


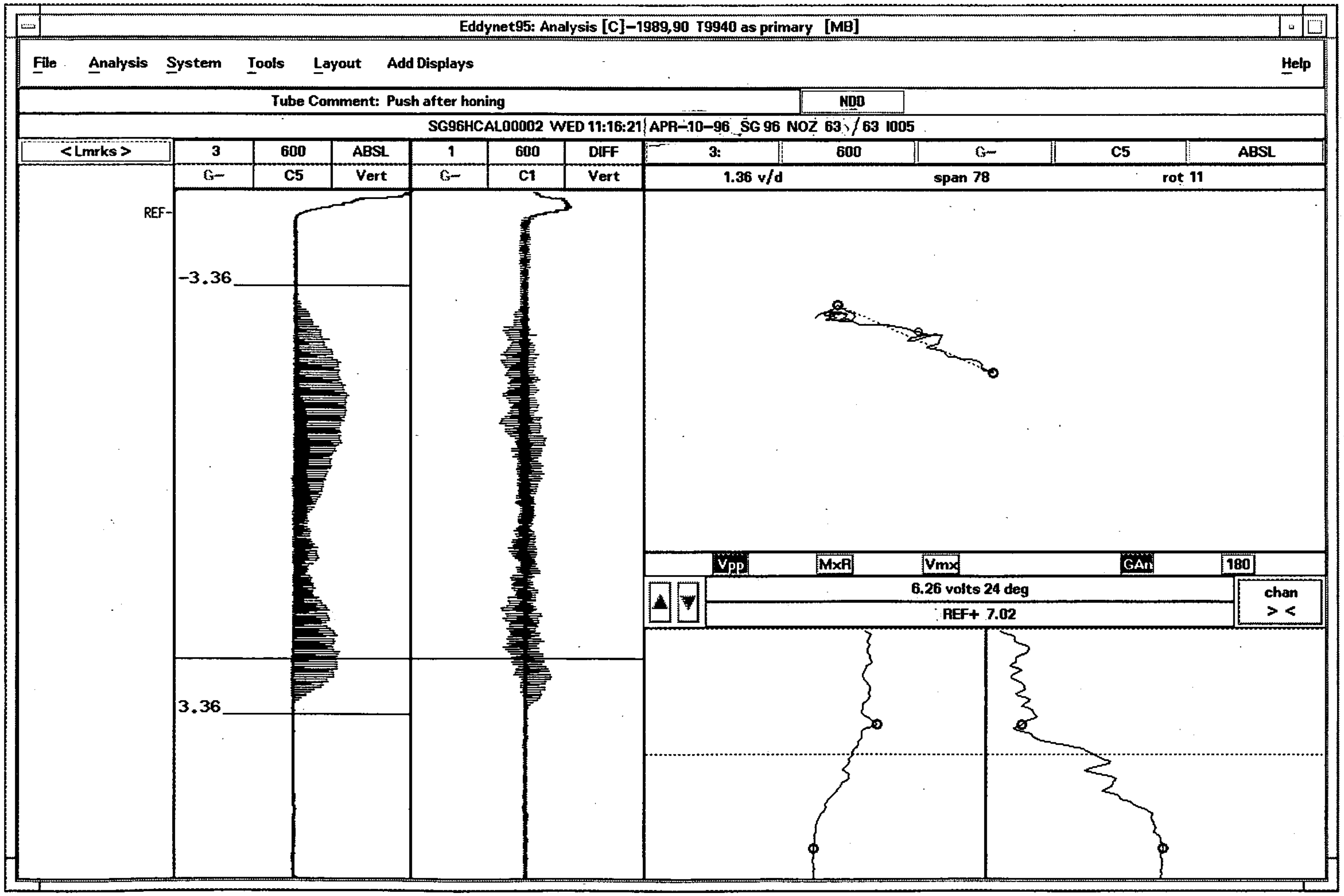

Eddynet95: Analysis [C]–1989,90 T9940 as primary [MB]
File
Analysis
System
Tools
Layout
Add Displays
Help
Tube Comment: Push
NDD
SG96HCAL00002 WED 9:05:38-APR-10-96 /SG 96 NOZ 63 / 63 I003
<Lmrks>
3
600
ABSL
G~
C5
Vert
1
600
DIFF
G~
C1
Vert
3:
600
G~
C5
ABSL
1.36 v/d
span 78
rot 11
REF-
-3.33
3.33
Vpp
MxR
Vmx
GAn
180
6.03 volts 23 deg
REF+ 6.98
chan
> <

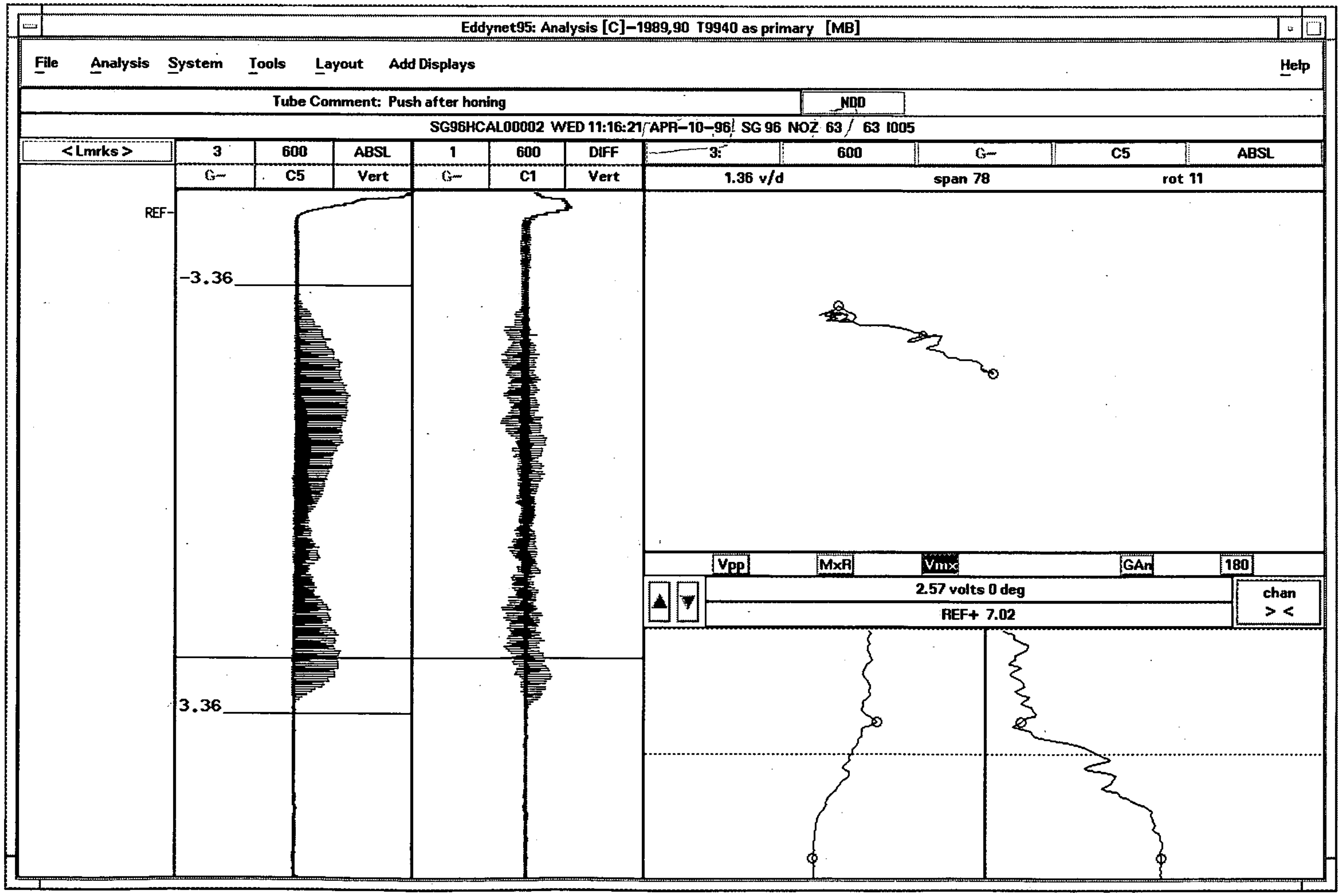

Eddynet95: Analysis [C]–1989,90 T9940 as primary [MB]
File
Analysis
System
Tools
Layout
Add Displays
Help
Tube Comment: Push
NDD
SG96HCAL00002 WED 9:05:38 APR–10–96 SG 96 NOZ 63 / 63 I003
< Lmrks >
3
600
ABSL
G–
C5
Vert
1
600
DIFF
G–
C1
Vert
3:
600
G–
C5
ABSL
1.36 v/d
span 78
rot 11
REF–
-3.33
3.33
Vpp
MxR
Vmx
GAn
180
2.42 volts 0 deg
REF+ 6.98
chan
> <

Penetration #63

1996 Data - After Honing.




Eddynet95: Analysis [C]–1989,90 T9940 as primary [MB]
File Analysis System Tools Layout Add Displays Help
Tube Comment: Push after honing
NDD
SG96HCAL00002 WED 11:16:21 APR–10–96 SG 96 NOZ 63 / 63 I005
<Lmrks>
3 600 ABSL
G– C5 Vert
1 600 DIFF
G– C1 Vert
3: 600 G– C5 ABSL
1.36 v/d span 78 rot 11
REF–
–3.36
3.36
Vpp MxR Vmx GAn 180
6.26 volts 24 deg
REF+ 7.02
chan
> <


Eddynet95: Analysis [C]–1989,90 T9940 as primary [MB]
File
Analysis
System
Tools
Layout
Add Displays
Help
Tube Comment: Push after honing
NDD
SG96HCAL00002 WED 11:16:21 APR–10–96 SG 96 NOZ 63 / 63 I005
<Lmrks>
3
600
ABSL
G–
C5
Vert
1
600
DIFF
G–
C1
Vert
3
600
G–
C5
ABSL
1.36 v/d
span 78
rot 11
REF
-3.36
3.36
Vpp
MxR
Vmx
GAn
180
2.57 volts 0 deg
REF+ 7.02
chan
> <

4/17/96

Duke Power Company - Oconee Site Unit 2
CRDM Liquid Penetrant Examination Results

Two CRDM nozzles, 23 and 63 were inspected by the liquid penetrant solvent removable visible dye method from above the reactor vessel head using a remote inspection tool designed for the inspection.

Both nozzles 23 and 63 were honed for two minutes prior to the eddy current Inspection. After the eddy current inspection the areas of interest for nozzles 23 and 63 were visually examined using the video camera mounted on the ET tool. Results of the pretest cleaning and honing of the examination areas of interest for both nozzles (23 and 63) were satisfactory, and were recorded on tape. Pretest cleaning with the approved solvent/cleaner, and the evaporation time of five minutes were done. It is to be noted, these nozzles were cleaned concurrently.

After the required cleaner/remover evaporation time had elapsed the penetrant was applied to the surface to be examined on nozzle 23 and allowed to dwell for a time of 15 minutes.

When the penetrant dwell time had expired, the excess penetrant was removed and the surface was final cleaned using clean wipes dampened with the approved cleaner/remover. The surface was then allowed to dry for three (3) minutes.

The developer tool was then inserted into the nozzle and the surface was then sprayed with the penetrant developer. After the developer was applied to the area being examined it was allowed to dry for a period of 10 minutes.

The video camera was then mounted to the CRDM nozzle flange, and driven to the examination area by the computer controller and the surface was examined for indications, and recorded on tape.

When CRDM nozzle 23 was completed and recorded on tape, CRDM nozzle 63 was then examined in the same manner as describe above, and recorded on tape.

Comparison of the examination results versus the results obtained during the 1994 inspection revealed the following:

- 1994 Examination: PT method utilized was the water-washable visible dye method, using a wet developer.

- 1996 Examination: PT method using the solvent-removable method with a non-aqueous developer.

- The cleaning method used in the 1996 inspection was far superior to the 1994 pretest cleaning method thereby enabling the developed surface to be far superior in the examination results. This was especially noted on nozzle 63, in which the 1994 examination results indicated no recordable indications.

George R. Stromer

George R. Stromer, Level III PT

Customer: Duke Power Company

Location: Oconee Nuclear Station, Unit 2

Component: R.V. Closure Head, CRDM Housing No. 23 & 63

Examination: Liquid Penetrant Examination in Support of ET Examination

1. After preparation of the I.D. surfaces of CRDM 23 and CRDM 63 areas of interest, a video examination was performed to ensure the I.D. area of interest was satisfactory for the penetrant examination of the areas of interest. Counter number 0:03:04 thru 0:27:58.

2. Penetration 23 (CRDM) - Penetrant applied to the penetration for a 15-minute dwell time. Excess penetrant was removed and the evaporation time for the cleaner was 5 minutes. After which time the developer was applied to the examination surface. The developer was allowed to dry for 10 minutes.

3. Counter Number 0:28:18 - Commenced evaluation and sizing of indications as listed below:

	Coordinate Position	
(1)	A = 2.4 to 19.4 Z = 29.82	Slight indication of no consequence. No significant length.
(2)	A = 279.79 Z = 30.82	Rounded indication within acceptable criteria.
(3)	A = 159.81 Z = 32.82	Several axial linear indications ranging in sizes from 1/16" to 9/32".
(4)	A = 109.82 Z = 32.82	Several axial linear indications ranging in sizes from 3/32" to 11/32".
(5)	A = 69.82 Z = 32.82	Several axial linear indications ranging in sizes from 5/32" to 11/32".
(6)	A = 334.81 Z = 33.82	Axial linear 1/16".
(7)	A = 229.82 Z = 34.82	Two axial linear 1/16" and 3/32".

Counter 0:39:20 end of exam.

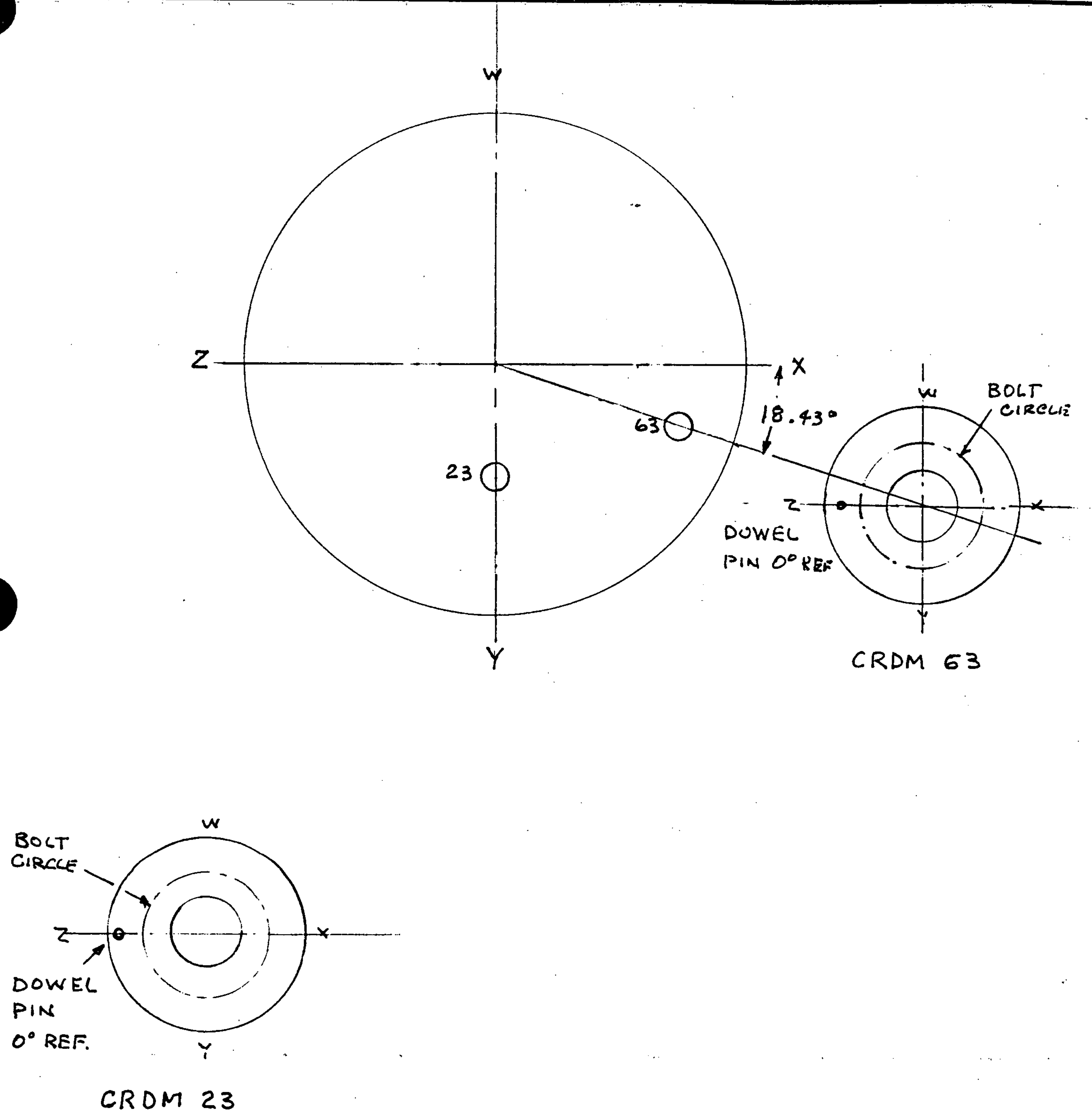
Penetration 63 (CRDM)
Counter 0:46:39

1	A = 329.81 Z = 43.75	Several axial linear indications ranging in sizes from 1/32" to 9/32".
2	A = 89.83 Z = 43.75	Axial linear 5/32".
3	A = 139.83 Z = 44.75	Intermittent linear axial 5/32".
4	A = 169.82 Z = 45.75	Axial linear ~5/64".
5	A = 99.79 Z = 45.75	Axial linear 3/32".
6	A = 195.19 Z = 46.25	Axial linear indications ranging in sizes from ~3/64" to 1/8".
7	A = 354.78 Z = 46.75	Axial linear indications ranging in sizes from 1/16" to 1/8".
8	A = 64.84 to 34.83 Z = 46.75	Several axial linear indications ranging from 1/32" to 7/32".
9	A = 4.82 to 80.19 Z = 46.75 to 47.25	Grouped axial linear indications ranging from 1/32" to 7/16".
10	A = 360.02 to 329.77 Z = 47.25 to 47.75	Same group as above.
11	A = 59.80 to 4.82 Z = 47.75 to 48.25	Same group as above.

Counter 0:59:34 end of exam.

FRAMATOME TECHNOLOGIES

CALCULATION GRAPH PAPER



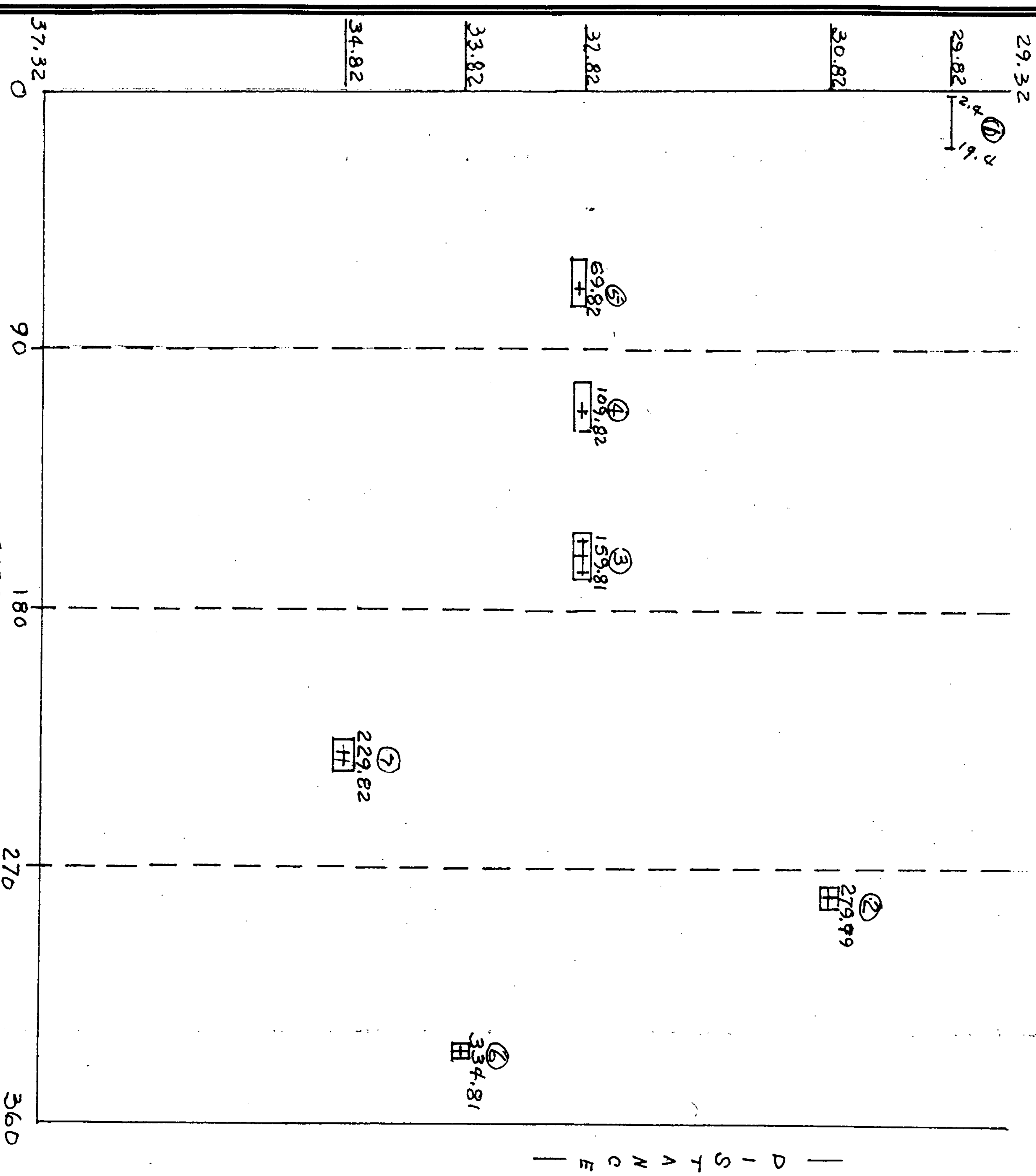
0° REFERENCE POINTS.

REF.: DWG. #152005E6

TITLE				DOC. NO.
PREPARED BY	DATE	REVIEWED BY	DATE	PAGE NO.

FRAMATOME TECHNOLOGIES

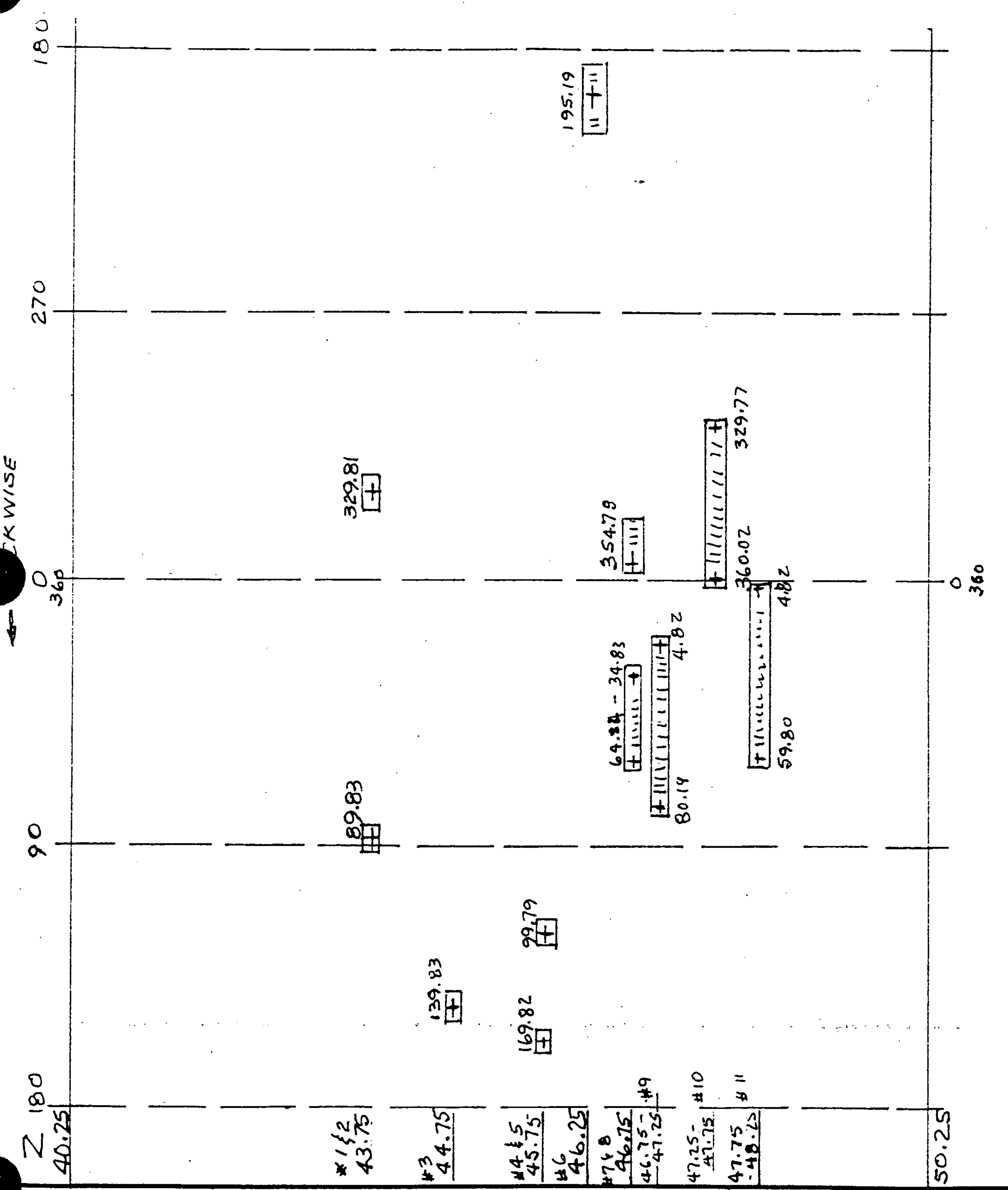
CALCULATION GRAPH PAPER



TITLE CRDM #23 PT INDICATION MAP OCONEE UNIT 2	DOC. NO.
PREPARED BY G.R. STROMIER DATE 4-19-96 / REVIEWED BY DATE	PAGE NO.

FRAMATOME TECHNOLOGIES

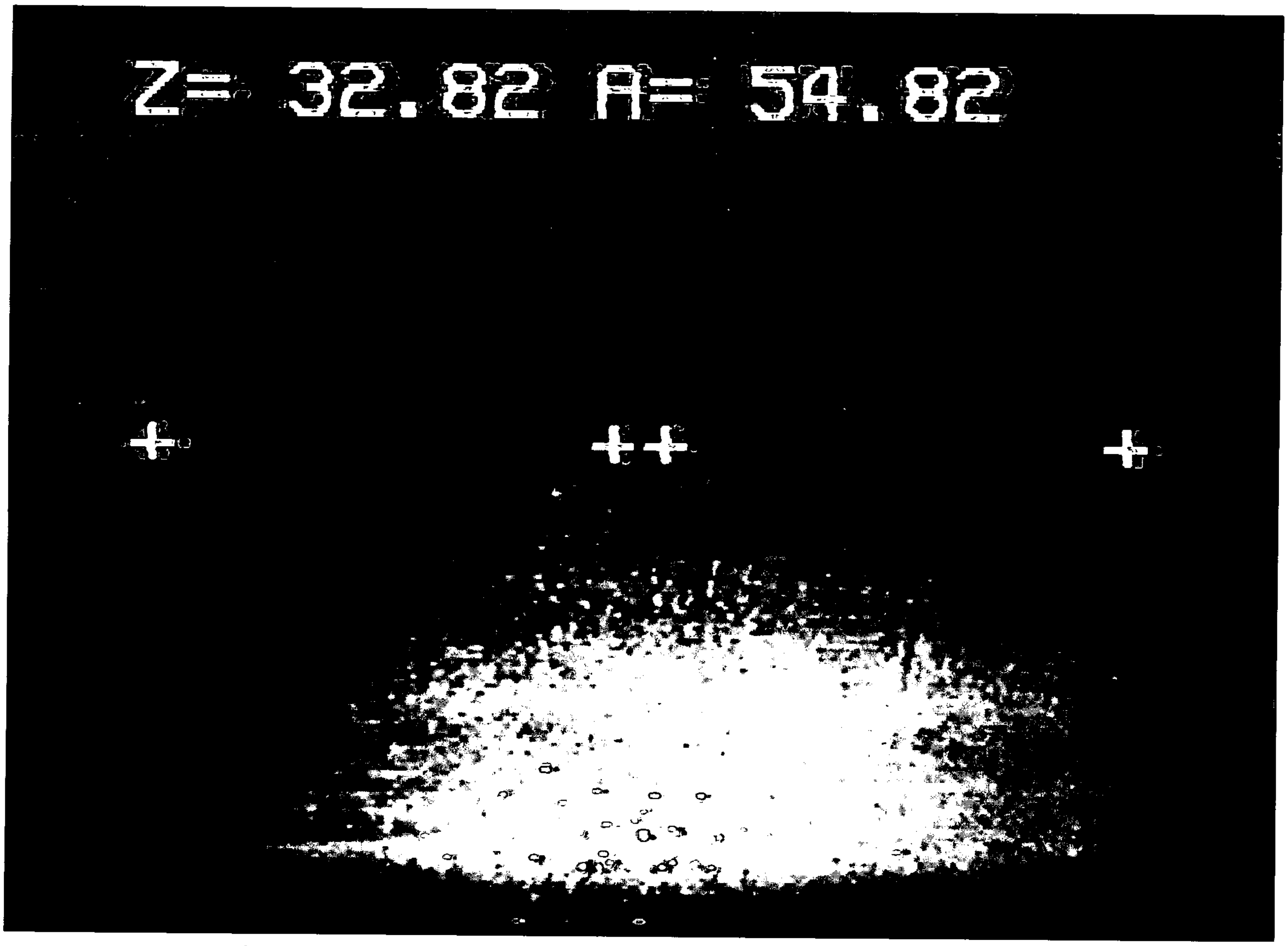
CALCULATION GRAPH PAPER



CRDM #63 PT INDICATION MAP
OCONEE UNIT 2

PREPARED BY	DATE	REVIEWED BY	DATE	DOC. NO.
G. R. STROMER	4-13-98			PAGE NO.

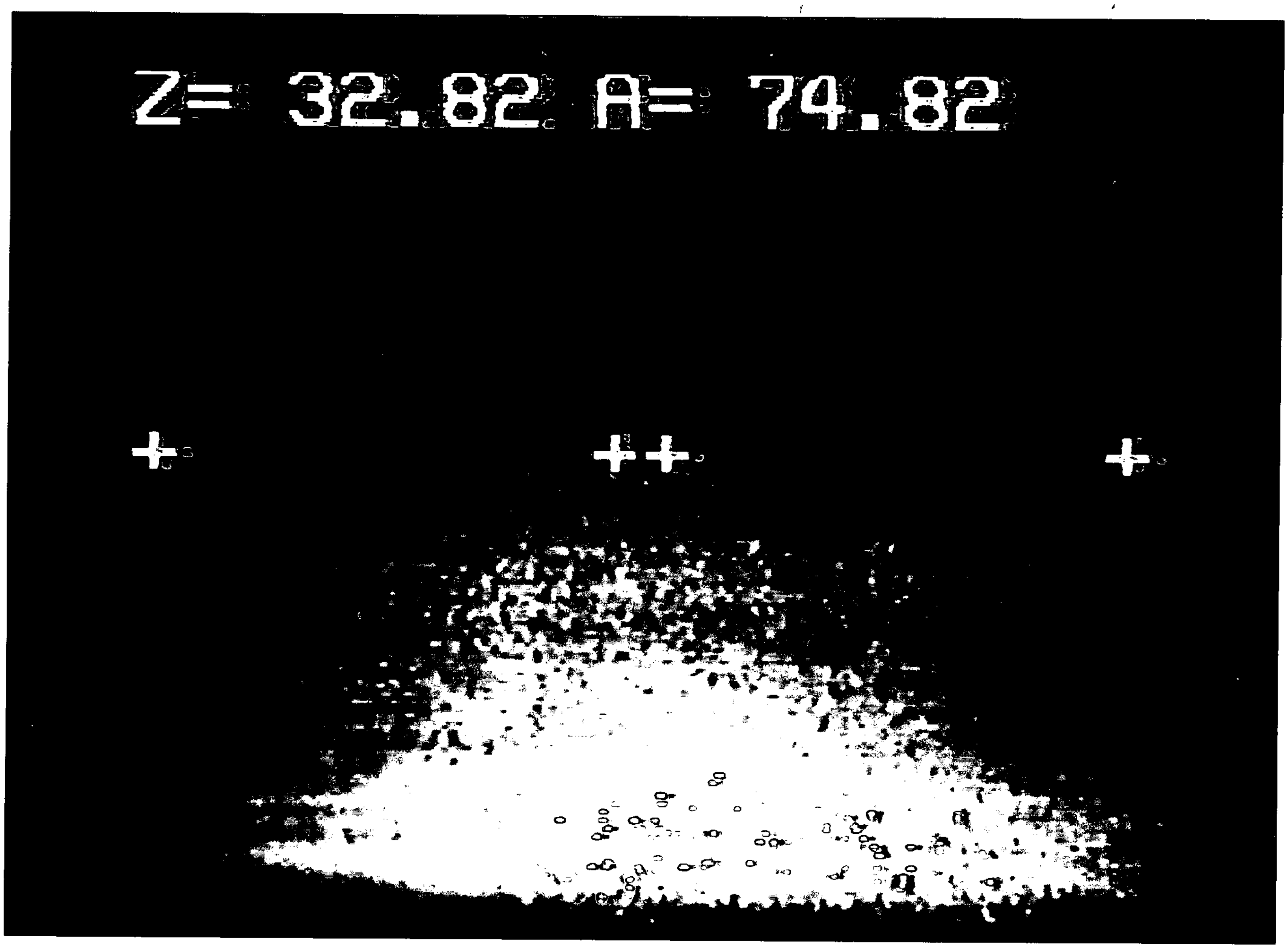
ONS-2 CRDM Nozzle 23



FRAMATOME
TECHNOLOGIES

96C45G

ONS-2 CRDM Nozzle 23

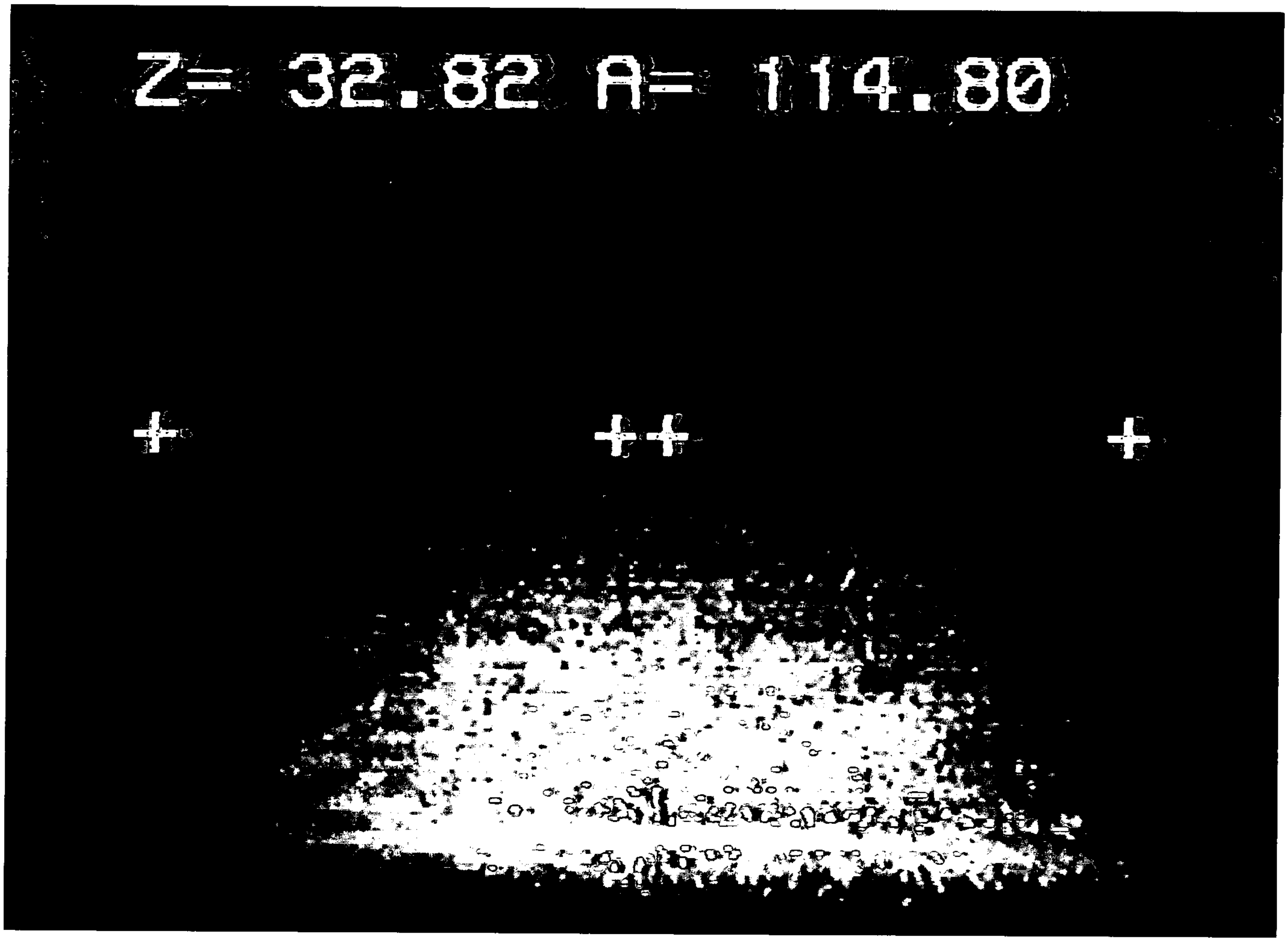


1 Inches 2

FRAMATOME
TECHNOLOGIES

96C45G

ONS-2 CRDM Nozzle 23

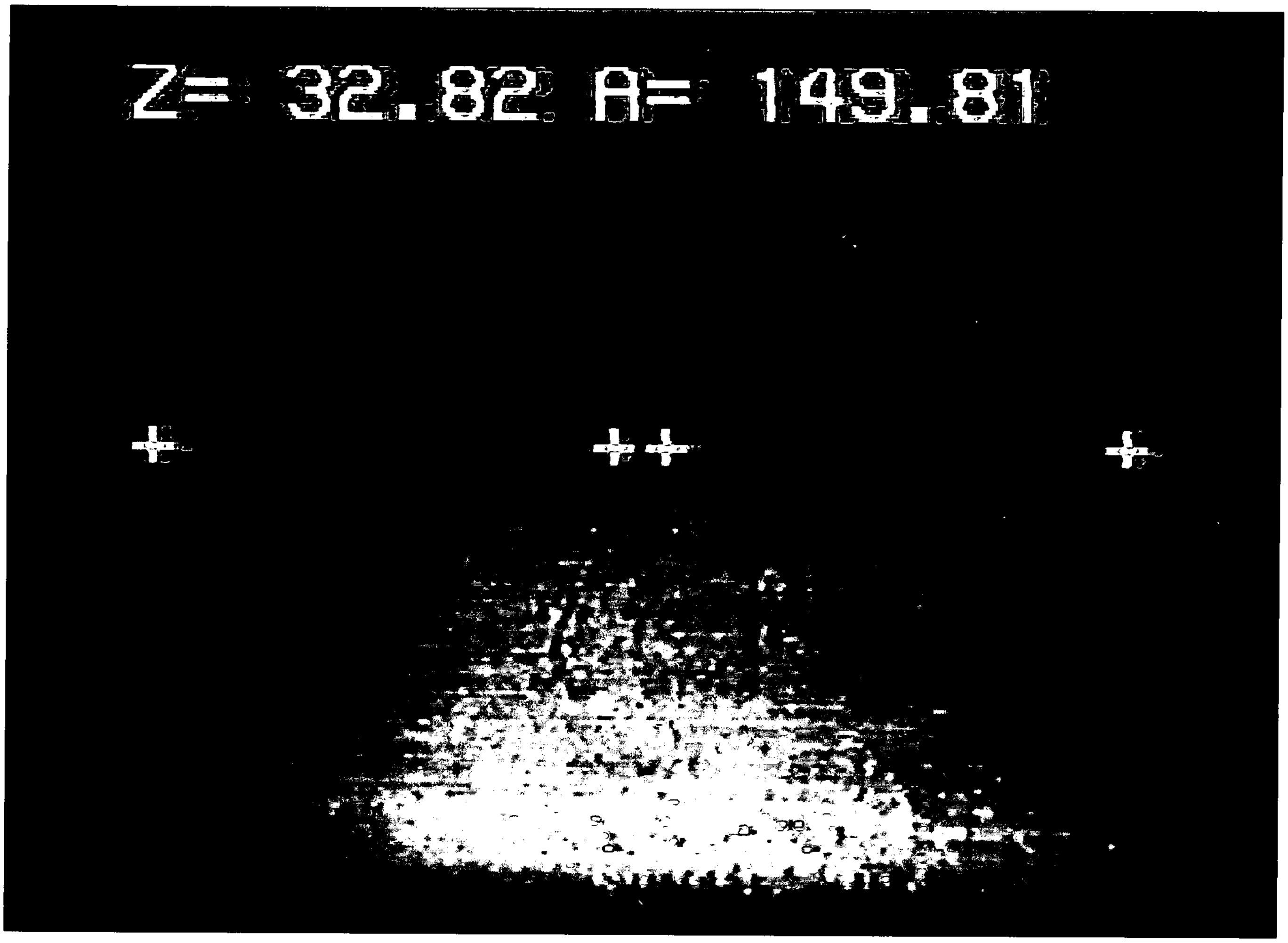


1 Inches 2

96C45G

FRAMATOME TECHNOLOGIES

ONS-2 CRDM Nozzle 23

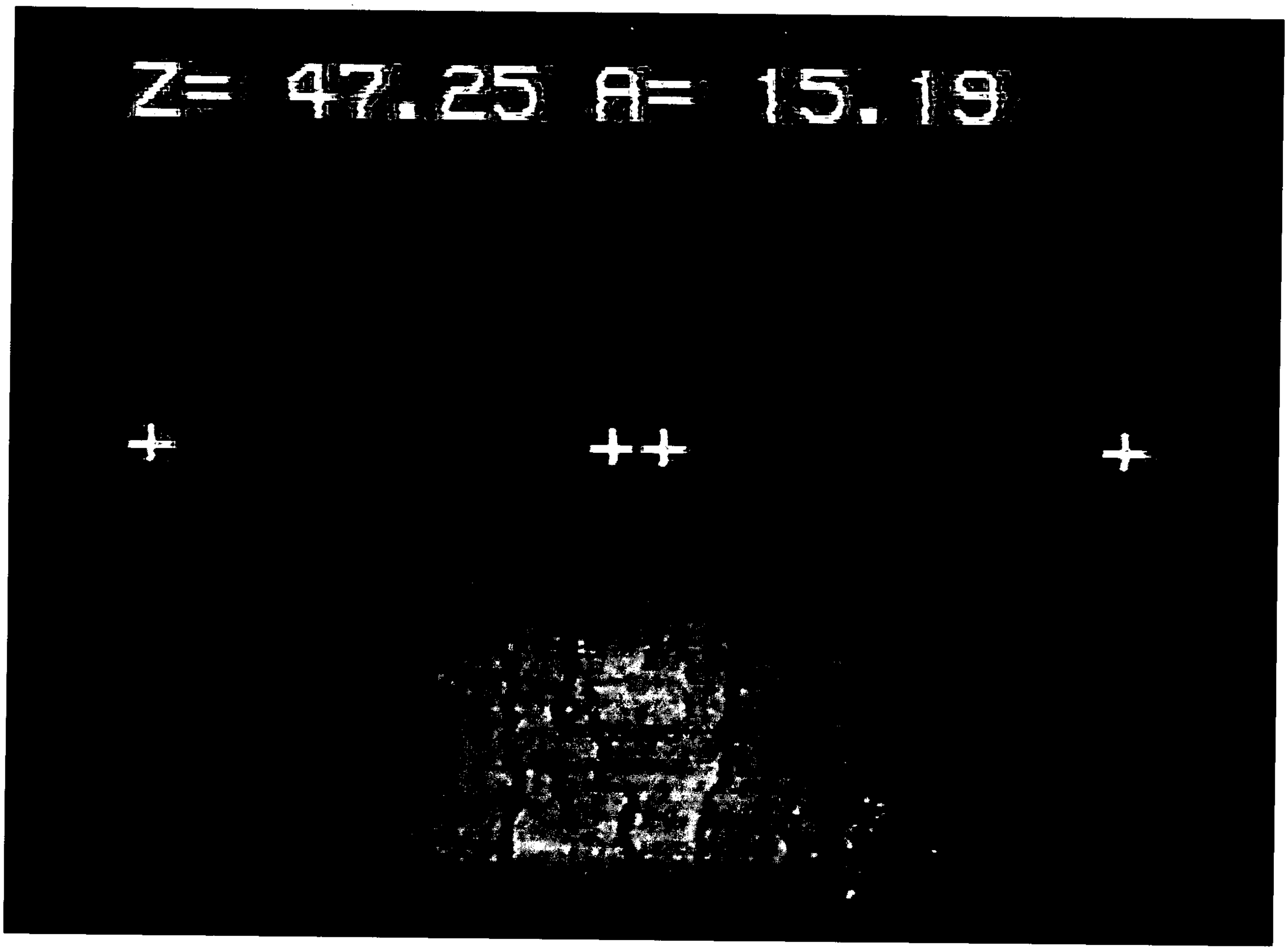


1 Inches 2

96C45G

FRAMATOME TECHNOLOGIES

ONS-2 CRDM Nozzle 63

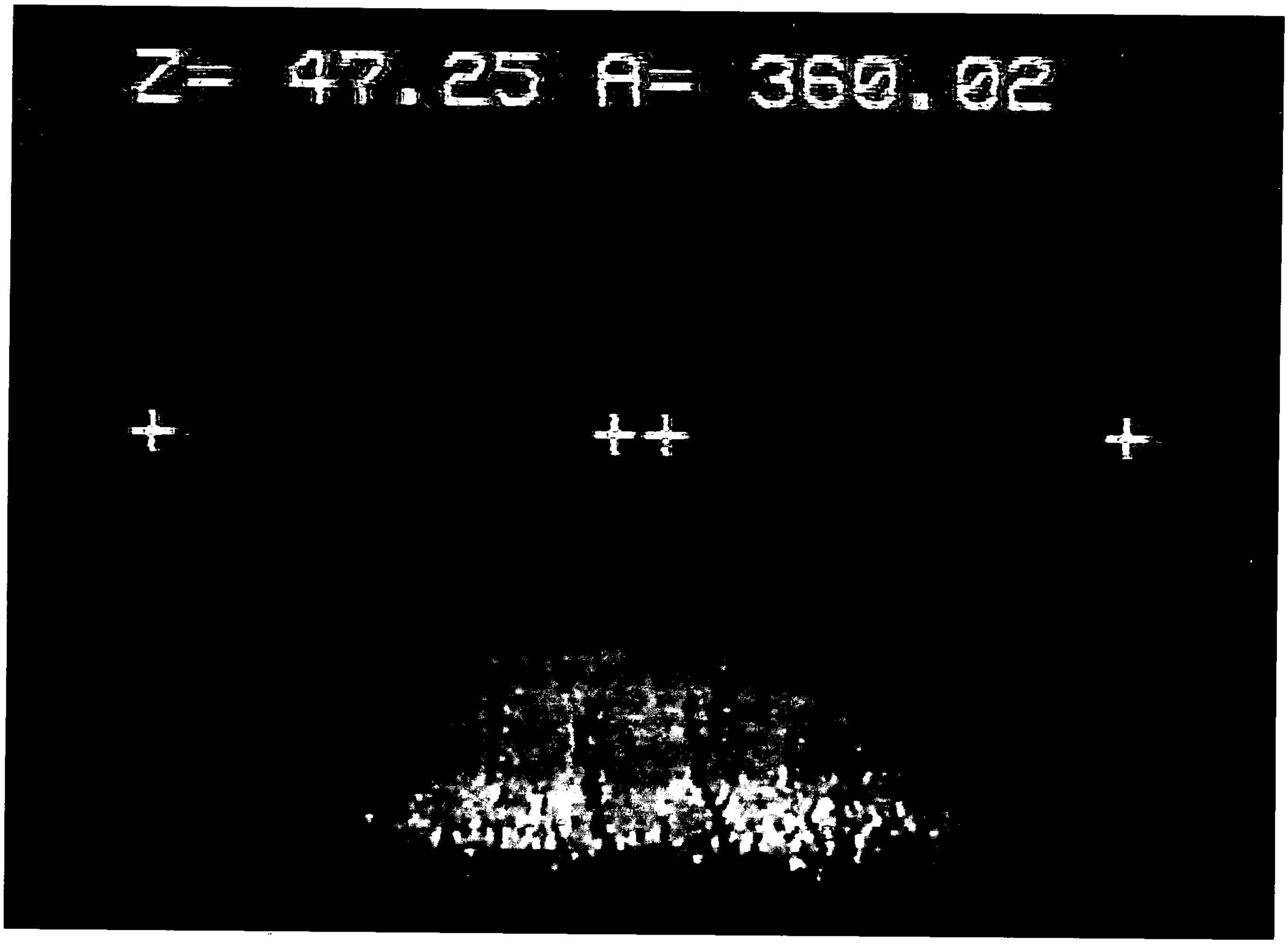


1 Inches 2

96C45G

FRAMATOME TECHNOLOGIES

ONS-2 CRDM Nozzle 63

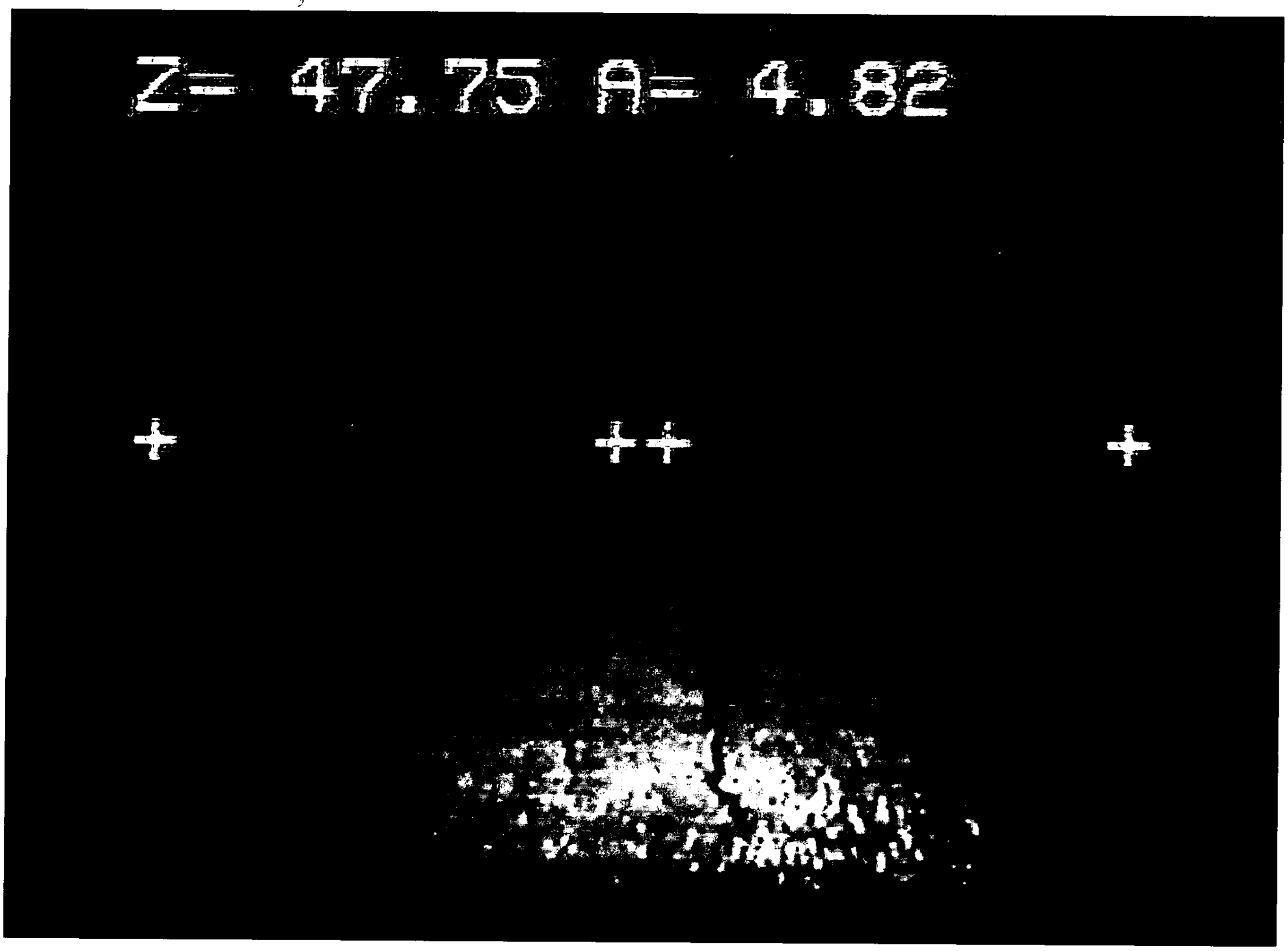


1 Inches 2

96C45G

FRAMATOME
TECHNOLOGIES

ONS-2 CRDM Nozzle 63



1 Inches 2

96C45G

FRAMATOME TECHNOLOGIES