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Nondestructive Evaluation: Ultrasonic Equivalency Testing of Weld Inlaid Components

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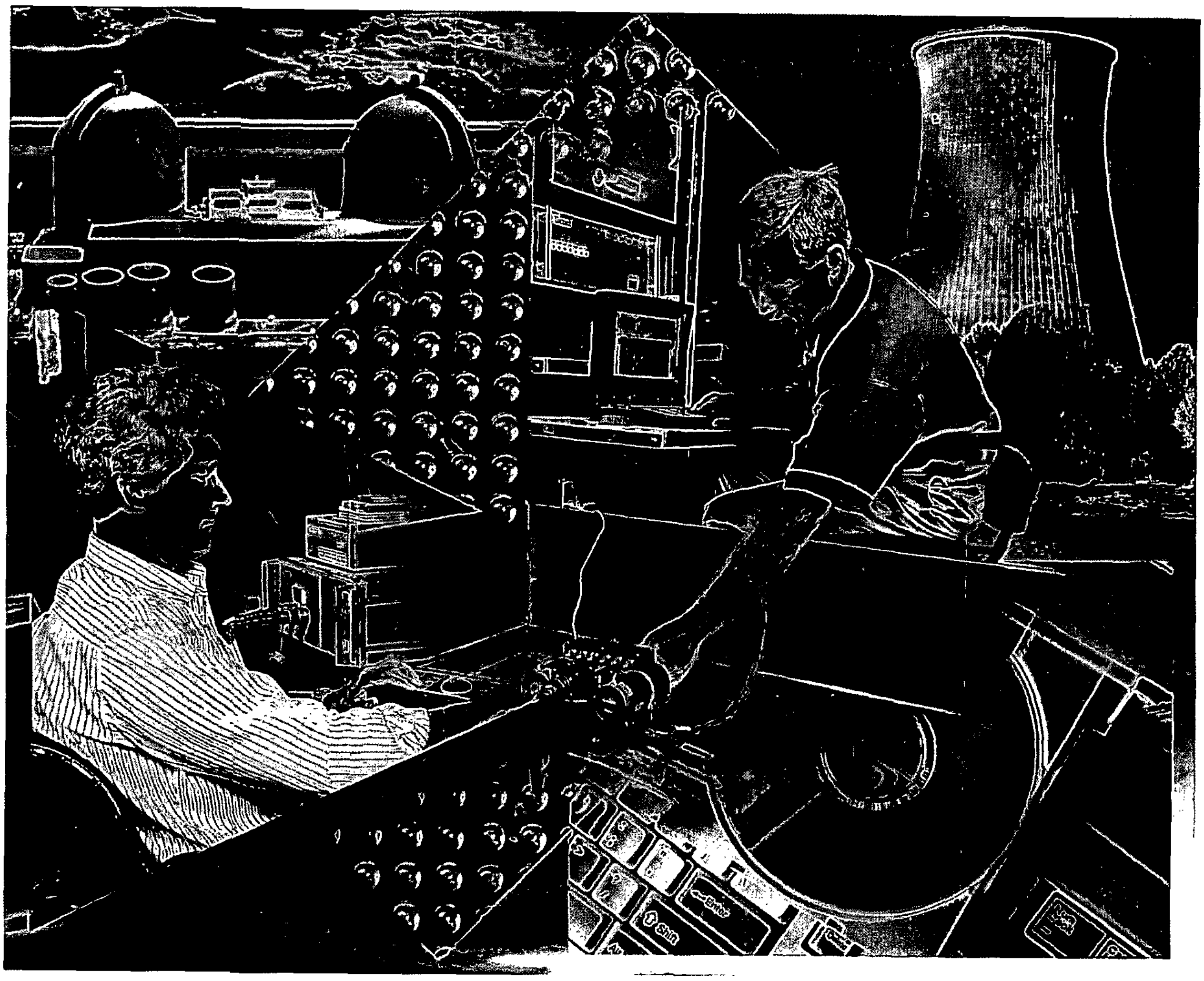

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Technical Update, April 2008

EPRI Project Manager

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Electric Power Research Institute (EPRI)

AREVA NP, Inc.

WesDyne International, LLC

This is an EPRI Technical Update report. A Technical Update report is intended as an informal report of continuing research, a meeting, or a topical study. It is not a final EPRI technical report.

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CITATIONS

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This document describes research sponsored by EPRI.

The publication is a corporate document that should be cited in the literature in the following manner:

Nondestructive Evaluation: Ultrasonic Equivalency Testing of Weld Inlaid Components. EPRI, Palo Alto, CA: 2008. 1016543.

PRODUCT DESCRIPTION

This report describes an investigation in which ultrasonic data were acquired by following the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, Appendix VIII, qualified procedures from both a Performance Demonstration Initiative (PDI) 601 series hot leg to reactor vessel mockup and a Pressurized Water Reactor Owners Group inlay test mockup containing similar crack-like flaws. The objective of this investigation was to determine the equivalency of using qualified techniques for the inspection of inlaid nozzle dissimilar metal welds from the inner surface of the nozzle.

Results and Findings

Experiments performed by AREVA NP and WesDyne International demonstrated that qualified techniques for inspecting inlaid nozzle dissimilar metal welds from the inner surface of the nozzle can be used to detect, characterize, and size the length and depth of axial and circumferential flaws. No procedural changes were required by either vendor during these demonstrations, and the qualified techniques worked as expected. The data, which are presented in this report, demonstrate that inlaid components can be examined reliably using the current Appendix VIII qualified inside surface procedures with no further demonstrations required for procedures, personnel, or equipment.

Challenges and Objective

The hot and cold leg primary nozzles in PWRs contain dissimilar metal weld configurations using Alloy 600 materials joining the ferritic reactor pressure vessel to the austenitic coolant piping. Because these welds are exposed to primary coolant water, they are susceptible to primary water stress corrosion cracking (PWSCC). As a result, the Electric Power Research Institute (EPRI) report 1010087, *Materials Reliability Program: Primary System Piping Butt Weld Inspection and Evaluation Guideline* (MRP-139), requires an increased inspection frequency on these components unless actions are taken to minimize the risk for PWSCC. In response to MRP-139, the weld inlay was designed to isolate the PWSCC-susceptible material from the primary environment.

The objective of this investigation was to determine the equivalency of using qualified techniques for the inspection of inlaid nozzle dissimilar metal welds from the inner surface of the nozzle. A demonstration of equivalency would allow the use of these techniques and associated procedures on inlay weld designs without the need for additional qualification activities.

Application, Value, and Use

Currently, 31 plants in the United States have the potential for PWSCC in their hot and cold leg primary nozzles and could benefit from inlay mitigation.

EPRI Perspective

ASME Section XI, Appendix VIII, currently identifies requirements for examination of structural weld inlay (corrosion-resistant clad) austenitic piping welds as "In Course of Preparation." Therefore, implementation of Appendix VIII qualified examination techniques might require utilities to submit one or more relief requests. EPRI, in conjunction with affected utilities, will develop guidelines for these relief requests as required. These guidelines, along with applicable safety evaluation reports, will be available at www.epriq.com.

Approach

An inlay test mockup was created that was identical to an existing PDI 601 series weld configuration. This mockup is a full-scale representation of a PWR hot leg to reactor pressure vessel DMW, including the safe-end and the safe-end-to-pipe connecting weld. Both the 601 and the inlay mockup were fabricated from actual dropouts taken from a cancelled PWR in order to ensure that materials and welding processes are typical of those found in an operating plant. The inlay material was applied using welding techniques and hardware developed by AREVA NP. In order to identify welding imperfections that might exist in the DMW, the inlay mockup was ultrasonically inspected by AREVA NP using a qualified Appendix VIII procedure before inlay material was applied.

AREVA NP and WesDyne International inspected the inlay mockup and used previously collected data on similar flaws in the 601 mockup for comparison. Data were collected following each vendor's applicable Appendix VIII qualified automated ultrasonic procedure. Both vendors had prior knowledge of the crack-like flaw locations and sizes for the inlay mockup. The ultrasonic scanning was conducted under the observation and guidance of EPRI PDI personnel to ensure procedural compliance. All scanning was performed from the inner diameter surface, with scanning in both axial and circumferential directions using qualified equipment.

Keywords

Inlay
Dissimilar metal weld
Mitigation
Pressurized water reactor (PWR)
Nozzles
Ultrasonic examination

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1 INTRODUCTION

Objective

This report documents the results of equivalency testing between Performance Demonstration Initiative (PDI) qualified ultrasonic inspection techniques applied to the Pressurized Water Reactor Owners Group inlay test mockup. This project was designed to evaluate the effectiveness of current automated ultrasonic procedures developed for inner surface inspection on inlaid welds without modification of essential variables. A demonstration of equivalency would allow the use of these techniques and associated procedures on inlay weld designs without the need for additional qualification activities.

Background

Primary water stress corrosion cracking (PWSCC) was first identified as a failure mechanism for Alloy 600 materials in reactor pressure vessels in the United States following the leakage event of a pressurizer heater sleeve at Calvert Cliffs Unit 2 in 1989. Since then, considerable research has been conducted on the environmental influences of this cracking phenomenon. PWSCC occurs in Alloy 600 materials that are directly exposed to the primary coolant water. The susceptibility and onset of cracking for a particular component is influenced by temperature, pressure, material residual stresses, water chemistry, and service life, with incidences in both BWRs and PWRs. The focus of this report is PWSCC and related inlay mitigation in PWRs, specifically the hot and cold leg primary nozzle dissimilar metal welds (DMWs). Currently, 31 plants in the United States have the potential for PWSCC in their hot and cold leg primary nozzles and could benefit from inlay mitigation.

The hot and cold leg primary nozzles in PWRs contain DMW configurations using Alloy 600 materials joining the ferritic reactor pressure vessel to the austenitic coolant piping. Because these welds are exposed to primary coolant water, susceptibility to PWSCC exists. As a result, the Electric Power Research Institute (EPRI) report 1010087, *Materials Reliability Program: Primary System Piping Butt Weld Inspection and Evaluation Guideline* (MRP-139), requires an increased inspection frequency on these components unless actions are taken to minimize the risk for PWSCC. In response to MRP-139, the weld inlay was designed to isolate the PWSCC-susceptible material from the primary environment.

Weld inlay is a process in which weld material is deposited onto the inner surface of the nozzle using remote, automated welding techniques. Although the inlay can provide additional structural support for the weldment, its primary function is to isolate the Alloy 600 material from the primary coolant water. Isolating the susceptible material allows the component's classification to change to Category A, as defined by MRP-139. As a result, the inspection frequency decreases to a 10-year in-service inspection cycle. In contrast, plants using a full structural overlay mitigation strategy still require increased inspection frequency under current guidelines because isolation of the susceptible material was not achieved.

Although an inlay mitigation process can decrease the frequency of inspection as required by MRP-139, it does not eliminate inspection requirements. Presently, ASME Section XI, Appendix VIII, Supplement 10, specifically excludes components with corrosion-resistant cladding from the scope of the qualification for procedures, personnel, and equipment. Therefore, no PDI-qualified technique currently exists that can be used to inspect inlaid DMWs. However, qualified examination procedures do exist that are applicable for hot and cold leg DMWs from the inside surface, but they apply only to unclad austenitic surfaces.

Before this investigation, the effect of inlay material on the ability to ultrasonically inspect a DMW using a qualified procedure was unknown. The primary focus of this project is to evaluate the capabilities of Appendix VIII, Supplement 10, qualified procedures used for examination of DMWs from the inside surface on an inlaid component. The data collected should clearly show the effect of inlay material on the ability to ultrasonically detect and size flaws that might develop later in the service life of an inlaid component. If equivalency is demonstrated, the need for additional qualification activities would be eliminated because currently available inspection procedures could be used.

2
EQUIVALENCY TESTING APPROACH

Mockup

An inlay test mockup was created that was identical to an existing PDI 601 series weld configuration. This mockup is a full-scale representation of a PWR hot leg to reactor pressure vessel DMW, including the safe-end and the safe-end-to-pipe connecting weld. Both the 601 and the inlay mockup were fabricated from actual dropouts taken from a cancelled PWR to ensure that materials and welding processes are typical of those found in an operating plant. The inlay material was applied using welding techniques and hardware developed by AREVA NP. In order to identify welding imperfections that might exist in the DMW, the inlay mockup was ultrasonically inspected by AREVA NP using a qualified Appendix VIII procedure before inlay material was applied.

The inlay test mockup has four 90° quadrants with varying inlay thicknesses that were blended smooth on the inner diameter surface. The first quadrant of the mockup was used for a baseline for noise comparison and had no weld inlay or flaws. The second and third quadrants have 0.20-in. and 0.07-in. (0.508-cm and 0.178-cm) thick inlays, respectively. In addition to the inlay, the three quadrants have the same set of four flaws identified as Flaws 1, 2, 3, and 12, which are identical to flaws found in the 601 practice mockup. In the fourth quadrant, an embedded flaw represents the partial removal and subsequent 1-in. (2.54-cm) deep inlay repair of a deep flaw. The flaws were implanted in the mockup using the same techniques used for the fabrication of the PDI 601 mockup. The flaws were generated using an electrodischarged machining technique, with the topography of the notch designed to simulate that of a crack. Figures 2-1 through 2-4 are drawings of the inlay mockup.

Data Collection

Two vendors were contracted to inspect the inlay mockup. Previously collected data on similar flaws in the 601 mockup were used as a comparative reference. All data were collected following each vendor's applicable Appendix VIII qualified automated ultrasonic procedure. The procedures used by the vendors were AREVA NP's 54-ISI-821-000, "ID Automated Ultrasonic Examination of Austenitic and Dissimilar Metal Piping Welds for Detection and Length Sizing," and 54-ISI-822-000, "ID Automated Ultrasonic Examination of Austenitic and Dissimilar Metal Piping Welds for Depth Sizing," and WesDyne's PDI-ISI-254-SE, "Field Inspection Procedure," Revision 2. Both vendors had prior knowledge of the crack-like flaw locations and sizes for the inlay mockup. The ultrasonic scanning was conducted under the observation and guidance of EPRI PDI personnel to ensure procedural compliance. All scanning was performed from the inner diameter surface, with scanning in both axial and circumferential directions using qualified equipment.

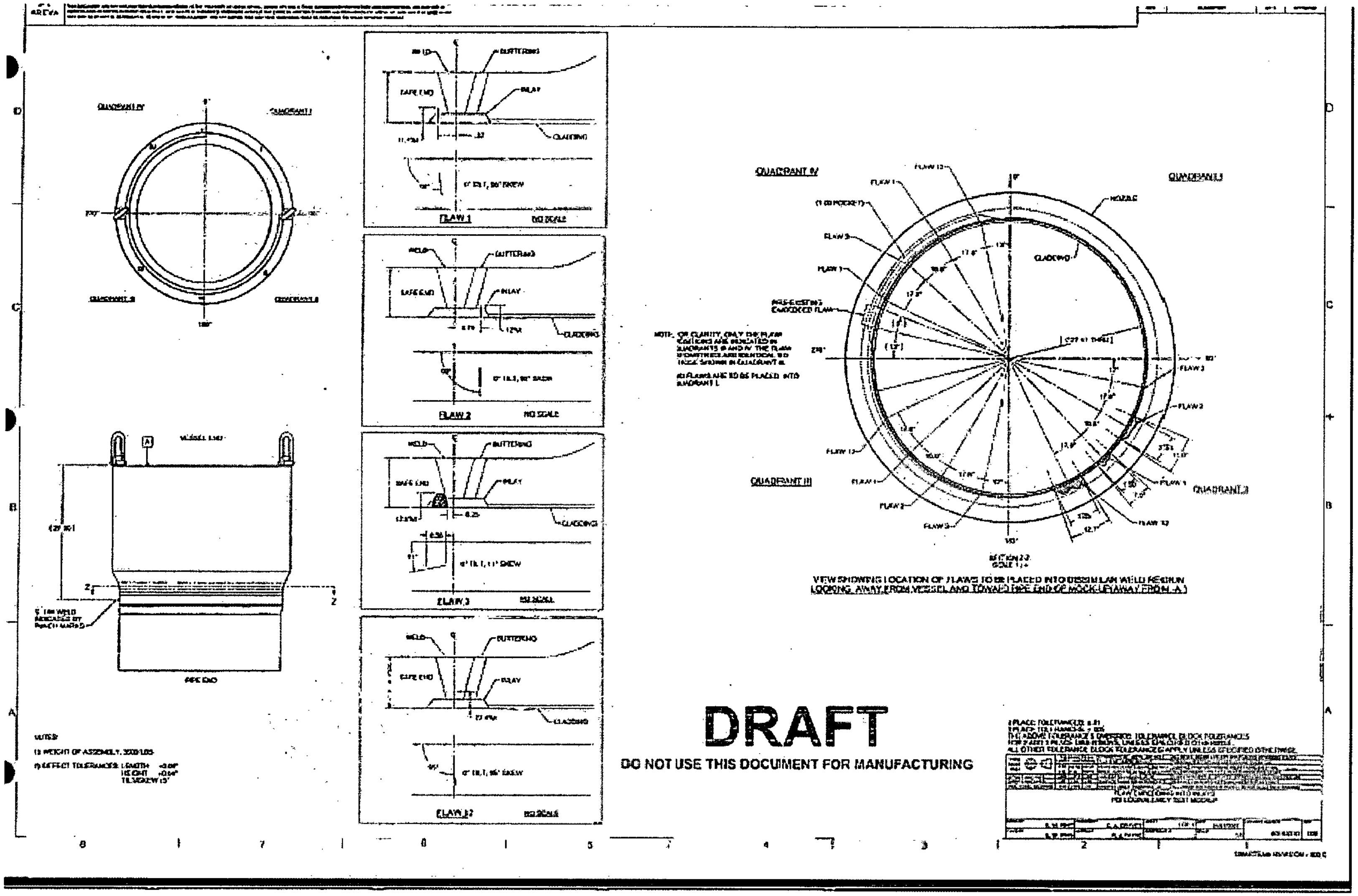

Figure 2-1
Inlay mockup drawing: location of flaws

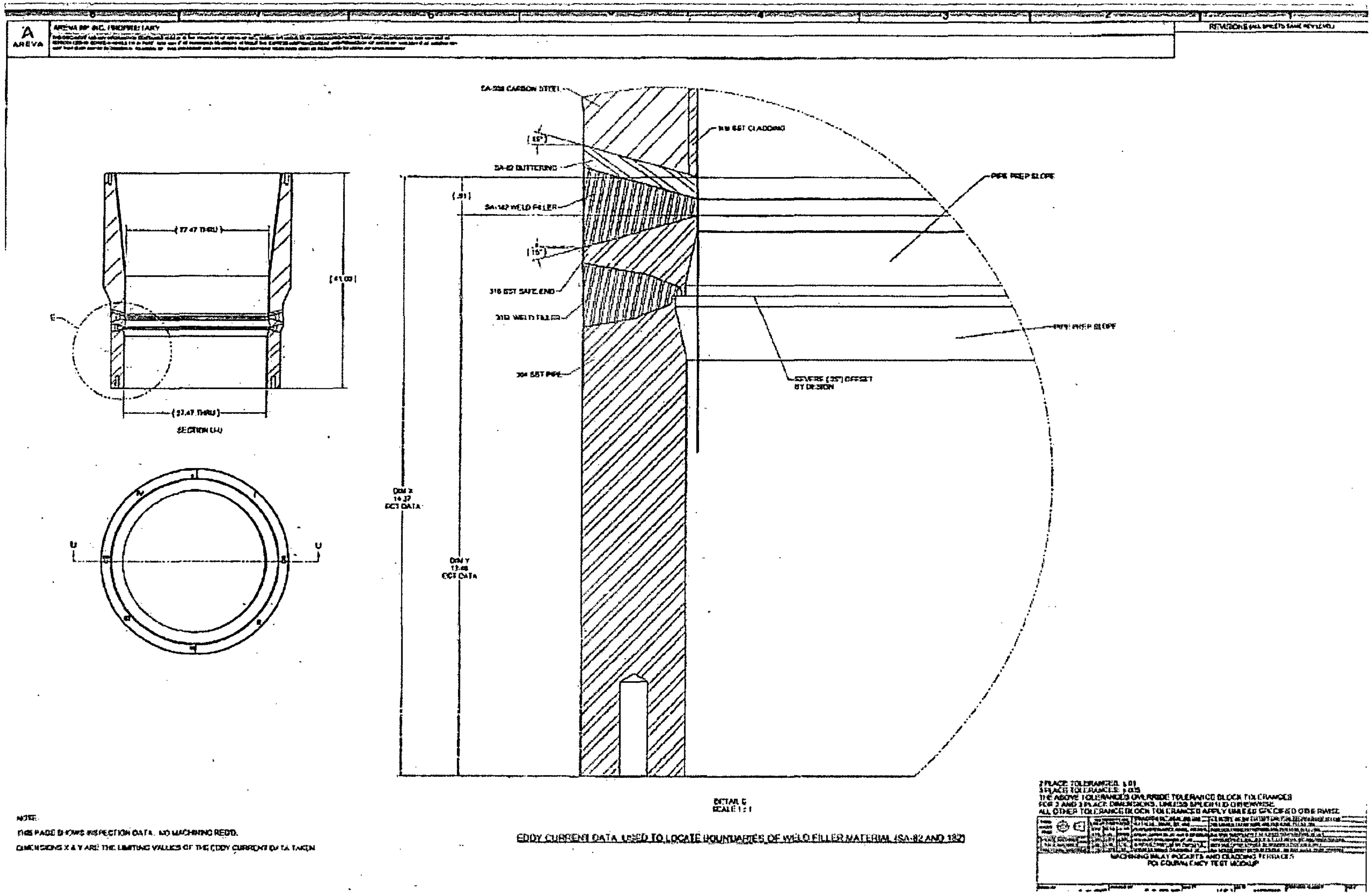

Figure 2-2
Inlay mockup drawing: inspection data

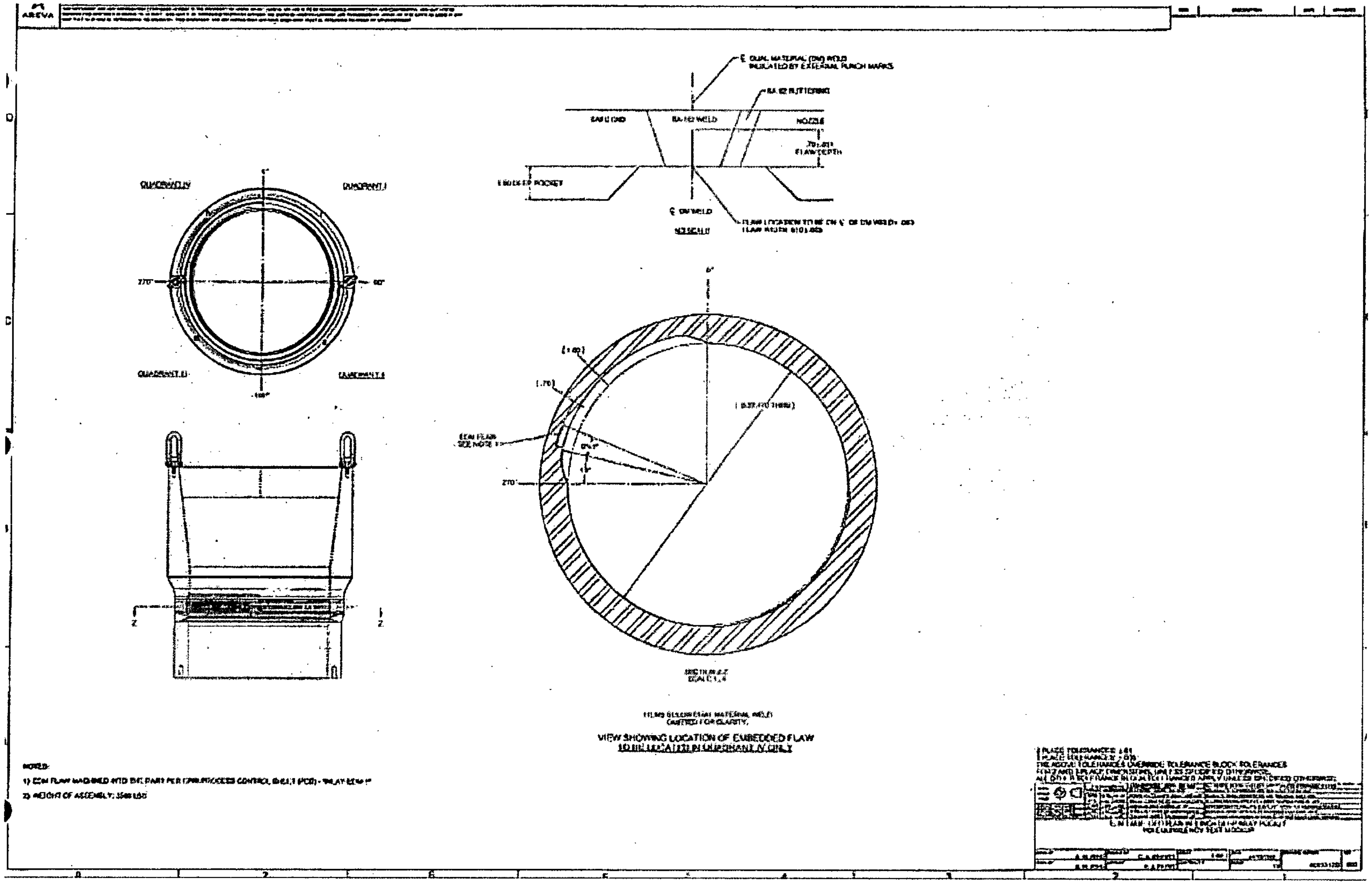

Figure 2-3
Inlay mockup drawing: location of embedded flaws

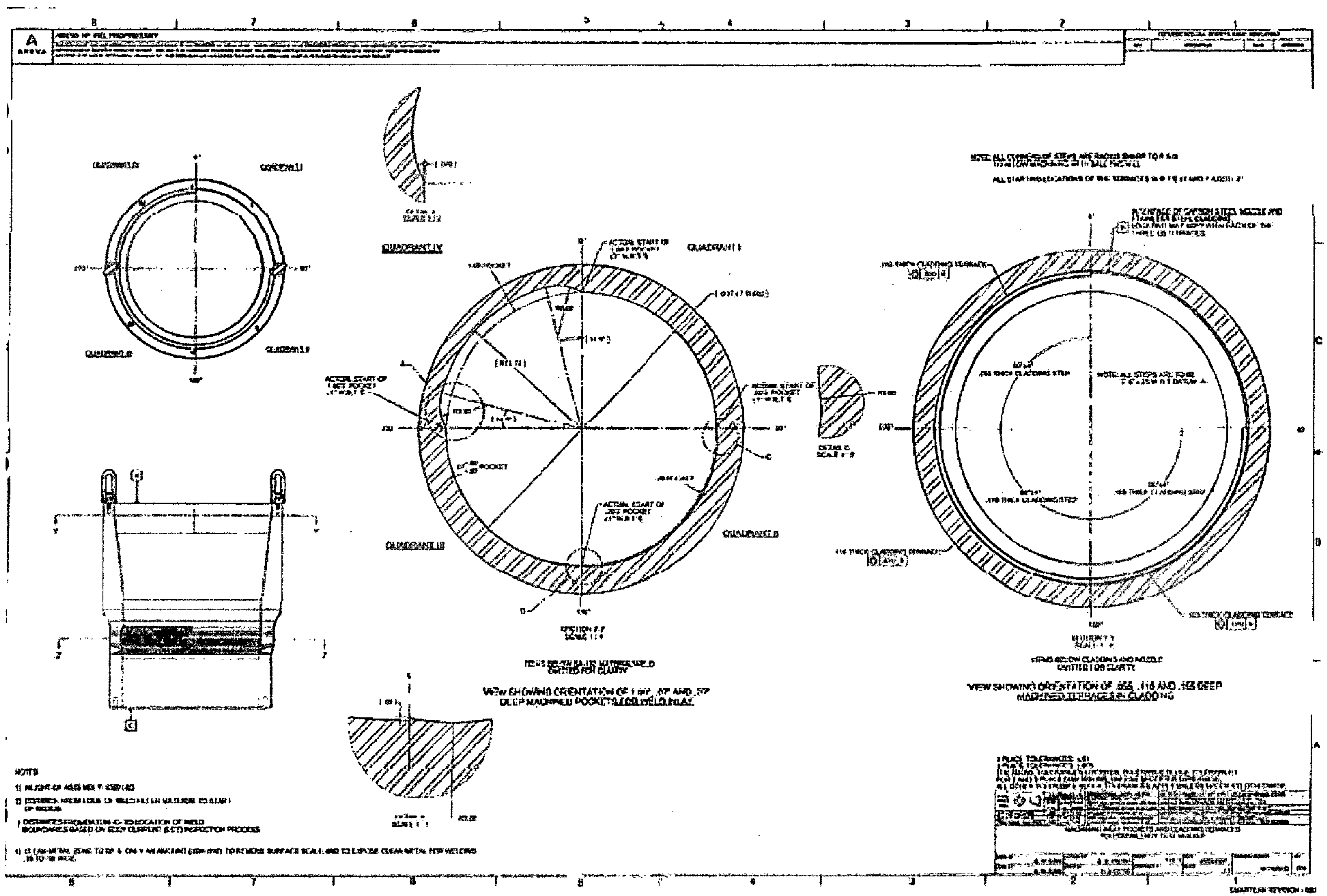

Figure 2-4
Inlay mockup drawing: orientation of machined pockets and terraces

3
RESULTS

Both vendors prepared inspection reports summarizing the flaw detection capabilities and sizing results for the four flaws using data collected from mockup 601 for comparison. Figures 3-1 and 3-2 show typical flaw images obtained from mockup 601. The inspection reports contain objective evidence in the form of data images and quantitative measurements to support the findings and conclusions. These reports are provided in Appendix A, WesDyne Report WDI-DFD-2009-QDP-001, and Appendix B, AREVA NP Report 51-9068587-000.

AREVA

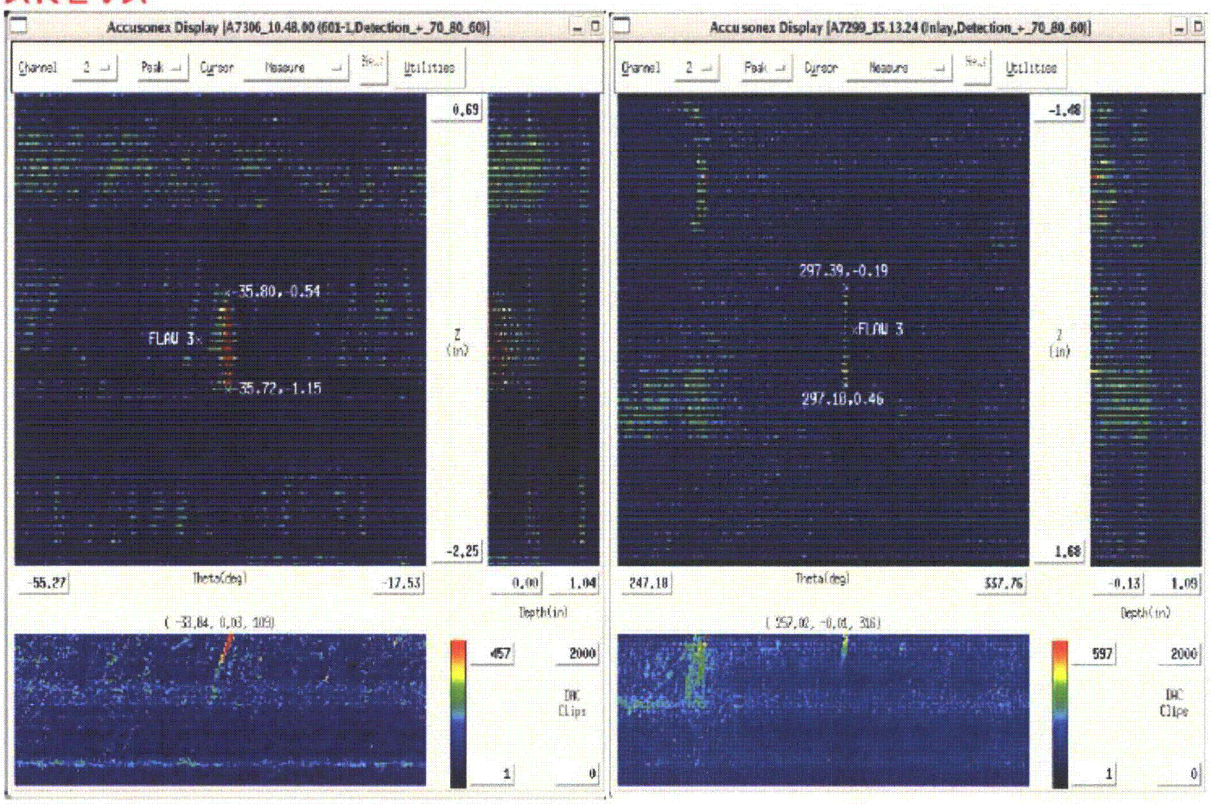

Figure C-29
601-1 Flaw 3: 80°L from Positive Direction
Reference Flaw

Figure C-30
Inlay Mockup Flaw 3-4: 80°L from Positive Direction
Quadrant 4 – 1" Inlay

Figure 3-1
Typical axial flaw image (AREVA) from 601 and 1 in. (2.54 cm) inlay mockup

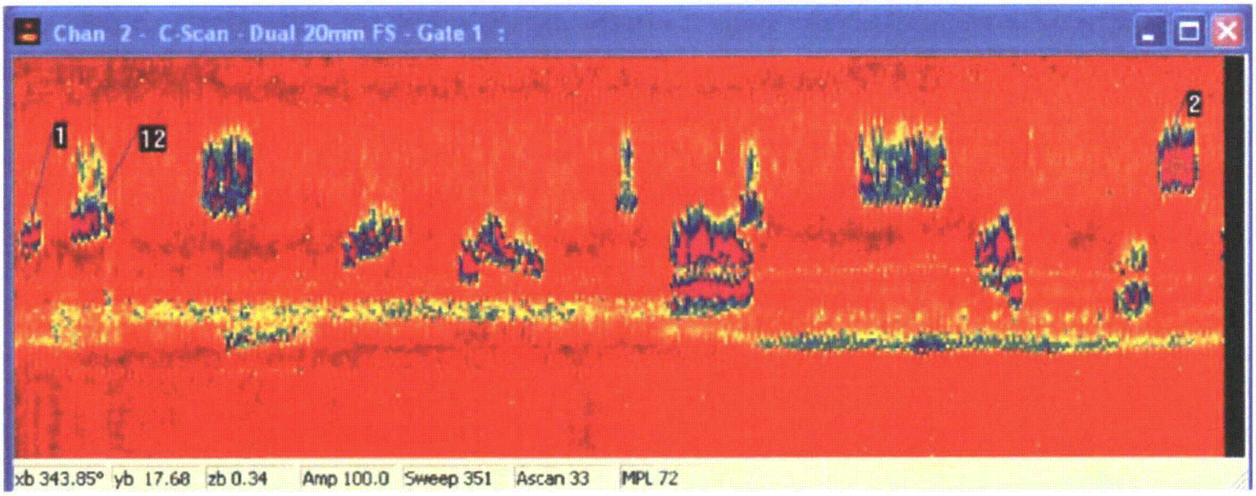

Figure 3-2
Typical ultrasonic image (WesDyne) from 601 block of circumferentially oriented flaws

Both vendors reported similar findings with respect to flaw detection, sizing, and relative noise levels within the areas of the inlay. Both vendors were able to detect, characterize, length size, and depth size all the implanted axial and circumferential flaws within the tolerances imposed by EPRI's PDI-qualified inspection procedures. Tables 3-1, 3-2, and 3-3 summarize the measurements obtained by each vendor on each flaw.

Table 3-1
WesDyne detection and sizing results

WesDyne

PLANT: PDI Supplement 2 10 Demonstration
PROCEDURE: PDI -ISI-254-SE Rev. 2
COMPONENT: Actual Flaw size to UT results of 601 block and Inlay Block
ANALYST:

Indication	Actuals		601 Sizing		Inlay Sizing			
No.	Length	T/W	Length	T/W	Ind. No.	Length	T/W	COMMENTS
1	1.80"	0.339"	1.875"	0.37"	1-Q2	1.75"	0.37"	
2	2.63"	0.350"	2.75"	0.39"	2-Q2	2.75"	0.34"	
3	* 0.60" ** 0.50"	0.374"	0.40"	0.44"	3-Q2	0.64"	0.40"	
12	3.05"	0.815"	3.25"	0.79"	12-Q2	3.00"	0.81"	
embed	2.23"	0.70"						
					1-Q3	1.75"	0.42"	
					2-Q3	2.375"	0.33"	
					3-Q3	0.64"	0.37"	
					12-Q3	2.875"	0.81"	
					1-Q4	1.625"	0.36"	
					2-Q4	2.625"	0.37"	
					3-Q4	0.72"	0.27"	
					12-Q4	3.125"	0.77"	
					embed	2.25"	0.71"	

* 601 Block
** Inlay Block

1 in. = 2.54 cm

Table 3-2
AREVA detection and length sizing results
Flaw detection and length sizing results for inlay mockup and mockup 601-1 comparisons

Circumferential Flaws									Measurements from the Nozzle Side					Measurements from the Safe-end Side				
Mockup	Quadrant Start (deg.)	Flaw #	Reference Location (deg.)	Actual Flaw Length (in.)	Actual Flaw Length (deg.)	Actual Center Position (deg.)	Actual Flaw Start Position (deg.)	Actual Flaw End Position (deg.)	**Measured Flaw Start Position (deg.)**	**Measured Flaw End Position (deg.)**	**Measured Flaw Length (in.)**	**Measured Flaw Length (deg.)**	**Length Variance (in.)**	**Measured Flaw Start Position (deg.)**	**Measured Flaw End Position (deg.)**	**Measured Flaw Length (in.)**	**Measured Flaw Length (deg.)**	**Length Variance (in.)**
601-1	N/A	2	343.40	2.63	10.40	343.40	338.20	348.60	-22.14	-10.20	**3.02**	11.94	0.39	-22.02	-11.12	**2.76**	10.90	0.13
		1	0.00	1.80	7.10	0.00	-3.55	3.55	-2.77	4.03	**1.72**	6.80	-0.08	-3.34	4.18	**1.90**	7.52	0.10
		12	17.80	3.05	12.10	17.80	11.75	23.85	12.26	24.79	**3.17**	12.53	0.12	11.82	24.15	**3.12**	12.33	0.07
Inlay	90	2-2	29.80	2.63	11.00	119.80	114.30	125.30	116.82	128.22	**2.74**	11.40	0.11	117.18	127.81	**2.55**	10.63	-0.08
		1-2	46.40	1.80	7.50	136.40	132.65	140.15	135.38	142.42	**1.69**	7.04	-0.11	136.42	142.67	**1.50**	6.25	-0.30
		12-2	64.20	3.05	12.70	154.20	147.85	160.55	150.90	163.50	**3.02**	12.60	-0.03	149.97	163.27	**3.19**	13.30	0.14
	180	2-3	29.80	2.63	11.00	209.80	204.30	215.30	207.44	218.07	**2.55**	10.63	-0.08	207.01	218.46	**2.75**	11.45	0.12
		1-3	46.40	1.80	7.50	226.40	222.65	230.15	225.36	232.82	**1.79**	7.46	-0.01	225.73	233.01	**1.75**	7.28	-0.05
		12-3	64.20	3.05	12.70	244.20	237.85	250.55	240.27	253.72	**3.23**	13.45	0.18	239.99	253.40	**3.22**	13.41	0.17
	270	2-4	42.60	2.63	11.00	312.60	307.10	318.10	310.00	320.97	**2.63**	10.97	0.00	309.66	321.10	**2.75**	11.44	0.12
		1-4	59.20	1.80	7.50	329.20	325.45	332.95	328.49	335.09	**1.58**	6.60	-0.22	328.48	334.61	**1.47**	6.13	-0.33
		12-4	77.00	3.05	12.70	347.00	340.65	353.35	342.86	355.37	**3.00**	12.51	-0.05	343.32	356.04	**3.05**	12.72	0.00
		embedded	17.00	2.15	9.00	287.90	283.40	292.40	283.83	293.72	**2.37**	9.89	0.22	286.95	295.20	**1.98**	8.25	-0.17

Axial Flaws									Negative Beam Direction Measurements					Positive Beam Direction Measurements				
Mockup	Quadrant Start (deg.)	Flaw #	Reference Location (deg.)	Actual Flaw Length (in.)	Beam Angle (deg.)	Actual Center Position (deg.)	Actual Flaw Start Position (deg.)	Actual Flaw End Position (deg.)	**Measured Flaw Start Position (in.)**	**Measured Flaw End Position (in.)**	**Measured Flaw Length (in.)**	**Measured Flaw Length (deg.)**	**Length Variance (in.)**	**Measured Flaw Start Position (in.)**	**Measured Flaw End Position (in.)**	**Measured Flaw Length (in.)**	**Measured Flaw Length (deg.)**	**Length Variance (in.)**
601-1	N/A	3	325.60	0.60	60L	325.60	325.60	325.60	-0.42	-0.94	**0.52**	0.00	-0.08	-0.64	-0.99	**0.35**	0.00	-0.25
Inlay	90	3-2	12.00	0.60	60L	102.00	102.00	102.00	ND	ND				0.01	0.41	**0.40**	0.00	-0.20
	180	3-3	12.00	0.60	60L	192.00	192.00	192.00	-0.32	0.18	**0.50**	0.00	-0.10	-0.28	0.22	**0.50**	0.00	-0.10
	270	3-4	24.80	0.60	60L	294.80	294.80	294.80	ND	ND				0.01	0.56	**0.55**	0.00	-0.05
601-1		3	325.60	0.60	80L	325.60	325.60	325.60	-0.59	-1.14	**0.55**	0.00	-0.05	-0.54	-1.15	**0.61**	0.00	0.01
Inlay	90	3-2	12.00	0.60	80L	102.00	102.00	102.00	-0.42	0.07	**0.49**	0.00	-0.11	-0.43	0.11	**0.54**	0.00	-0.06
	180	3-3	12.00	0.60	80L	192.00	192.00	192.00	-0.48	0.09	**0.57**	0.00	-0.03	-0.43	0.06	**0.49**	0.00	-0.11
	270	3-4	24.80	0.60	80L	294.80	294.80	294.80	ND	ND				-0.19	0.46	**0.65**	0.00	0.05

Note: ND means the flaw was not detected.

Table 3-3
AREVA depth sizing results

Flaw Depth Sizing Results for Inlay Mockup and Mockup 601-1 Comparisons

Circumferential Flaws											UT Measurement	
Mockup	Quadrant Start (deg.)	Flaw #	Reference Location (deg.)	Actual Flaw Length (in.)	Actual Flaw Length (deg.)	Actual Center Position (deg.)	Actual Flaw Start Position (deg.)	Actual Flaw End Position (deg.)	Actual Flaw Depth (in.)		Measured Flaw Depth (in.)	Depth Variance (in.)
601-1	N/A	2	343.40	2.63	10.40	343.40	338.20	348.60	0.350		0.290	-0.060
		1	0.00	1.80	7.10	0.00	-3.55	3.55	0.339		0.390	0.051
		12	17.80	3.05	12.10	17.80	11.75	23.85	0.815		0.823	0.008
Inlay	90	2-2	29.80	2.63	11.00	119.80	114.30	125.30	0.350		0.355	0.005
		1-2	46.40	1.80	7.50	136.40	132.65	140.15	0.339		0.405	0.066
		12-2	64.20	3.05	12.70	154.20	147.85	160.55	0.815		0.850	0.035
	180	2-3	29.80	2.63	11.00	209.80	204.30	215.30	0.350		0.349	-0.001
		1-3	46.40	1.80	7.50	226.40	222.65	230.15	0.339		0.306	-0.033
		12-3	64.20	3.05	12.70	244.20	237.85	250.55	0.815		0.844	0.029
	270	2-4	42.60	2.63	11.00	312.60	307.10	318.10	0.350		0.343	-0.007
		1-4	59.20	1.80	7.50	329.20	325.45	332.95	0.339		0.319	-0.020
		12-4	77.00	3.05	12.70	347.00	340.65	353.35	0.815		0.876	0.061
		Embedded	17.00	2.15	9.00	287.00	283.40	292.40	0.701		0.728	0.027

Axial Flaws										UT Measurement	
Mockup	Quadrant Start (deg.)	Flaw #	Reference Location (deg.)	Actual Flaw Length (in.)	Beam Angle (deg.)	Actual Center Position (deg.)	Actual Flaw Start Position (deg.)	Actual Flaw End Position (deg.)	Actual Flaw Depth (in.)	Measured Flaw Depth (in.)	Depth Variance (in.)
601-1	N/A	3	325.6	0.6	60L	325.6	325.6	325.6	0.374	0.460	0.086
Inlay	90	3-2	12	0.6	60L	102	102	102	0.374	0.332	-0.042
	180	3-3	12	0.6	60L	192	192	192	0.374	0.322	-0.052
	270	3-4	24.8	0.6	60L	294.8	294.8	294.8	0.374	0.472	0.098

1 in. = 2.54 cm

Figures 3-1 and 3-3 show typical flaw images obtained from the inlay mockup. Although the procedures are not qualified for the detection and sizing of embedded flaws, the embedded flaw in quadrant four was also successfully detected and sized using procedurally acceptable search units and techniques. No procedural changes were required by either vendor during these demonstrations, and the qualified techniques worked as expected.

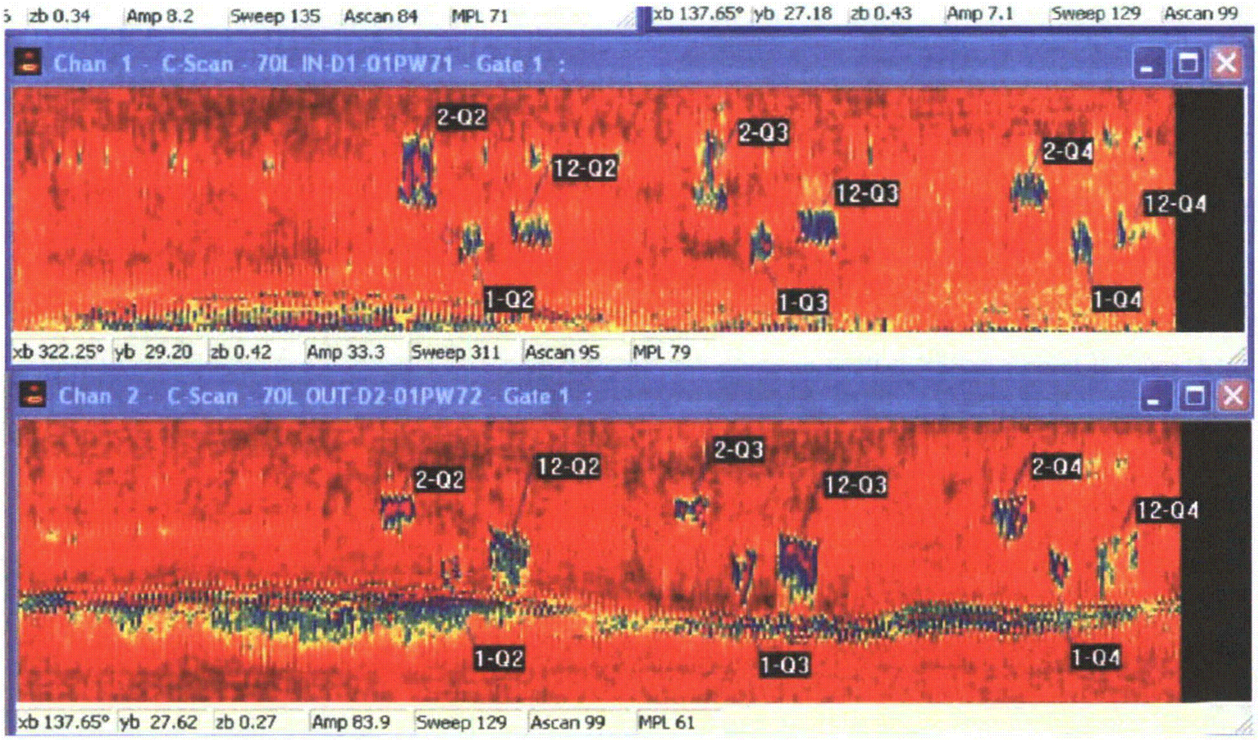

Figure 3-3
Typical ultrasonic image (WesDyne) from inlay mockup of circumferentially oriented flaws (opposite directions)

The procedures used for this investigation use high beam angles and are not designed to detect an inlay disbond condition. This report demonstrates technique equivalency of crack detection techniques; it does not address the detection of flaws contained in inlay material or at the inlay-to-parent material bond.

Both vendors observed an apparent increase in the noise level in the areas where the inlays were applied. This reference noise level increased as the thickness of the inlay material increased, with the largest reference noise level appearing in the fourth quadrant, where the 1 in. (2.54 cm) inlay material was located. Figure 3-4 is an ultrasonic image that shows the relative noise level of each quadrant.

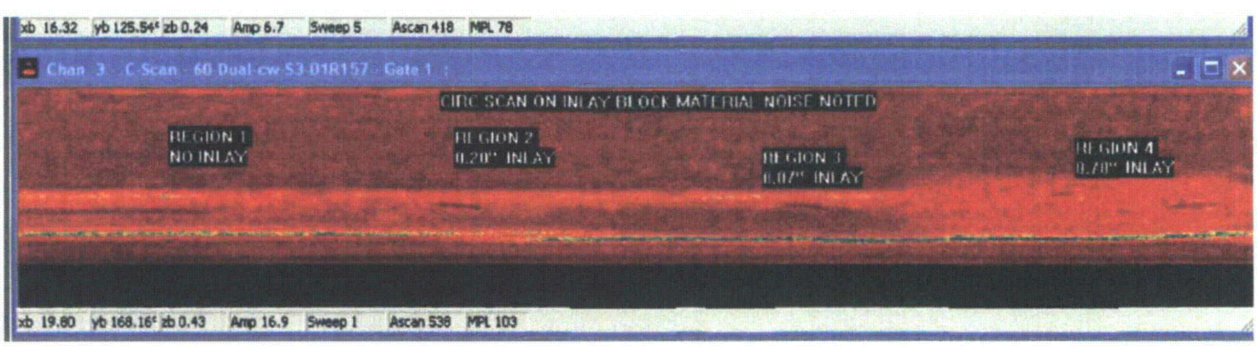

Figure 3-4
Circumferential scan data (WesDyne) showing background noise increase with inlay thickness

Figure 3-4 clearly illustrates an increase in background noise level associated with the 1 in. (2.54 cm) inlay material when compared to the rest of the block. In the axially oriented flaws, the signal-to-noise ratio was more noticeably affected, but it was not at a level that would impact the results of the examination. This increase in noise generally made flaw depth sizing more difficult, but it had a lesser effect on detection capabilities. Although the precise cause of this noise is not known, it is assumed to be associated with the microstructure of the inlay material. Possible causes could be related to small discontinuities in the material or a preferred orientation of crystallographic grain structure and size that tends to scatter the sound energy as it passes through. Both vendors recommended further investigations to determine the origin of the noise and to determine whether the welding process could be modified to reduce or eliminate the noise.

4
SUMMARY

The objective of this project was to demonstrate the equivalency of existing ASME Section XI, Appendix VIII, Supplement 10 or 14, automated ultrasonic procedures on inlay weld configurations. This was demonstrated through a series of tests by two vendors in which a mockup representing inlays of various thicknesses was inspected using qualified procedures and probes. Both vendors were able to successfully detect, characterize, and length and depth size all the flaws in the inlay mockup without deviating from the procedurally qualified techniques. These experiments demonstrate that components inlaid in a process similar to that used to fabricate the inlay mockup can be examined reliably using the current Appendix VIII qualified inside surface procedures with no further demonstrations required, assuming the inlay material is properly bonded and free of flaws.

Although an increased noise level was noted in the areas where the inlay was applied, it did not affect the procedures' capabilities to detect, characterize, and size the flaws, and it had no effect on the examination. However, it is recommended that additional work be performed to determine whether the welding process can be modified to reduce or eliminate the source of this noise, which would enhance the effectiveness of the examination.

ASME Section XI, Appendix VIII, currently identifies requirements for examination of structural weld inlay (corrosion-resistant clad) austenitic piping welds as "In Course of Preparation." Therefore, implementation of Appendix VIII qualified examination techniques might require utilities to submit one or more relief requests. EPRI, in conjunction with affected utilities, will develop guidelines for these relief requests as required. These guidelines, along with applicable safety evaluation reports, will be available at www.epriq.com.

A
WESDYNE REPORT

WesDyne report number WDI-DFD-2009-QDP-001, "Report Summary for Supplements 2 and 10 Flaw Comparisons between EPRI Block 601 and the Inlay Test Block," Revision 0, December 2007.

WDI-DFD-2009-QDP-001

DEMONSTRATION OF TECHNIQUE:

Report Summary for Supplements 2 and 10 Flaw Comparisons between EPRI Block 601 and the Inlay Test Block

Revision 0

December 2007

WesDyne International LLC
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I-70 EXIT 25A – Gate D
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WESDYNE INTERNATIONAL

WDI-DFD-2009-QDP-001

DEMONSTRATION OF TECHNIQUE:

Report Summary for Supplements 2 and 10 Flaw Comparisons between EPRI Block 601 and the Inlay Test Block

December 2007

Prepared by: [signature] for AM Date: 1-3-08
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DEMONSTRATION OF TECHNIQUE:

Report Summary for Supplements 2 and 10 Flaw Comparisons between EPRI Block 601 and the Inlay Test Block

Table of Contents

EXECUTIVE SUMMARY

1.0 INTRODUCTION

WesDyne International performed an open procedure demonstration by scanning an inlay test block using qualified procedure PDI-ISI-254-SE, Revision 2. The Inlay Test Block, (reference attachment 9) is a 360 degree welded replica of a primary loop piping DM and safe-end weld divided into four 90 degree segments. Three segments have protective stainless steel inlay applied in layers of varying thickness blended smooth to conform to the ID surface. The fourth segment represents a standard dissimilar metal safe end configuration without inlay. The Inlay Block segments contain a number of crack-like flaws oriented axially and circumferentially. The locations and sizes of the cracks were known to the exam team. Results from the inlay Test Block were compared to baseline data taken previously on PDI practice specimen 601, a standard DM safe end practice specimen containing crack indications. The purpose of the demonstration was to insure that procedures qualified for detection of flaws in primary piping DM welds (Section XI, Appendix VIII, Supplements 2 and 10), were capable of detecting and measuring flaws on primary piping DM welds mitigated by inlay without changing the essential variables of the qualified procedure.

All equipment, setup, scanning and data interpretation was performed between November 26 and Dec. 7, 2007 at the Westinghouse Waltz Mill Service Center. Processed data was also reviewed at EPRI after the initial assessment by WesDyne.

This demonstration was conducted as a controlled exercise under written instructions from a Program Plan developed by WesDyne using information supplied from EPRI and AREVA. Although not present for scanning, the Performance Demonstration Administrator (PDA) was fully informed about the progress of the project and the PDA provided guidance on the preparation of test results. In order to compare similar flaw data from non-inlay and inlay specimens, WesDyne used prior data taken on demonstration block 601 as a basis for comparison with data from the Inlay demonstration block. There are some crack sizes common to both specimens serving as a good basis for comparison.

All scanning was performed with the inlay mock-up immersed in a tank designed specifically for UT demonstrations with SUPREEM scanners. The test system was assembled in the essential configuration depicted in procedure PDI-ISI-254-SE, Revision 2. Examiners qualified to the procedure performed all relevant NDE tasks.
The demonstration results were reviewed with Carl Latiolais of EPRI on December 7, at the EPRI NDE Center in Charlotte, NC.

2.0 EQUIPMENT DESCRIPTION

The ultrasonic test system used for this demonstration consisted of the following components:

- WesDyne PARAGON (Software Version Acq. 3.50 Proto. 2, Analysis, 6.3.0)
- SUPREEM ROSA 5 Scanner and associated hardware
- RD TECH Pulser/ Receiver
- Approved Transducers as defined in PDI-ISI-254-SE

The inlay test block was supplied by EPRI as part of this demonstration and is identified as 8019331D and is shown in Attachment 9.

2.0 EXAMINATION PROCESS

The following parts of the WesDyne Field Inspection Procedure, PDI-ISI-254-SE Rev. 2 were used in this demonstration:

- Calibration – The UT system was calibrated in accordance with Sections 6.0 and 8.0 of PDI-ISI-254-SE Rev. 2. Examination sensitivity was established per table 6.4.1 and verified by using the histogram method set forth in Paragraph 9.2.

- Evaluation of Data – The evaluation of data was performed in accordance with Section 9.0 of PDI-ISI-254-SE Rev. 2.

- Scanning was performed in both axial and circumferential directions. All scanning was performed at speeds less than 3 inches per second.

The scan boundaries, sled arrangement and test configuration are defined in the examinations were performed in accordance with the written Open Demonstration Test Plan found in Attachment 8.

3.0 SUMMARY OF RESULTS

- The demonstration was performed using procedure PDI-254-SE Rev. 2 to compare the flaws 1, 2, 3, & 12 of the EPRI practice block 601 to the EPRI replica inlay block which has three sets of virtually identical flaws. The three sets of flaws were positioned in three separate quadrants (2, 3 and 4) and are propagating through the inlay. Quadrant 1 is free from flaws and inlay and quadrant 4 has an additional embedded flaw. Varying thickness' of inlay material was place in each quadrant. Quadrant 2 has a 0.20"thick inlay, Quadrant 3 has a 0.07" thick inlay, and Quadrant 4 has a 1.0" thick inlay.
-

- Although all flaws were detected, through wall and length sized within tolerances of the qualification and procedure PDI-254-SE Rev 2, it should be noted that additional material noise was seen in the inlay areas that made it more difficult to discern sizing features (For a given flaw the signal to noise ratio was less in the EPRI block 601 when comparing the corresponding flaws in the inlayed areas). Flaws that were most affected by this elevated noise were circumferentially oriented flaw12 in quadrant 4, and axially orientated flaw 3 in all 3 quadrants. Each of the axially orientated flaws was sized using the 60° instead of the 45° which is not the optimum angle for through wall sizing but is allowed by procedure. It should also be noted that even though there was more material noise observed in the processed data, the flaws were seen and measured with the procedure and no changes in the essential variables or procedure instructions were necessary to accomplish the overall objective.

- The results including printouts of all flaws and noise issues are in the following attachments according to the table of contents.

4.0 REFERENCES

4.1 Open Demonstration Plan (PDI Inlay Test Mockup) Rev. 0 Dated 11-8-07

4.2 WesDyne Inspection Procedure, PDI-ISI-254-SE Rev. 2: *Remote Inservice Examination of Reactor Vessel Nozzle To Safe End, Nozzle to Pipe and Safe End to Pipe Welds.*

ATTACHMENT 1:

UT Probe Calibrations

WESDYNE INTERNATIONAL

SENSITIVITY CALIBRATION DATA SHEET # SE-DET

Utility:	Wesdyne	Plant:		Unit:		Outage:	
Procedure No:	PSI-ISI-254-SE			Procedure Rev. No.:	2		
Applicable Weld Numbers:							
Applicable PARAGON UT Session(s):	Inlay SE-DET-Ax / Circ						

PARAGON Operator Signature:	Dal Nelson	Date:	11-30-07
UT Examiner Signature:	Dal Nelson	Date:	11-30-07

EQUIPMENT INFORMATION

PARAGON SAP #:	104591	RPR SAP #:	104592
PARAGON Acq. Software Release No:	3.5.0 Proto 2	PARAGON Anal. Software Release No:	6.3.0

Calibration/Inspection Cable Types	Cable Length (ft.)				No of Intermediate Connectors
	Calibration		Inspection		
	Cable #1	Cable #2	Cable #3	Cable #4	
UT Probes to Underwater Connector	150'		150'	150'	
Underwater Connector to RPR	48"		48"	48"	
RPR to Remote CPU	40"		40"	40"	
UT Profile Probe Extension	N/A	N/A	6"		
Color	Blk		White	Black	

UT PROBE INFORMATION

Make	Serial Number	Mode	Measured Sound Beam Exit Point (in.)	Measured Angle (deg)	Center Freq (MHz)	Bandwidth (%)	No of Elements	Element Shape	Element Size (mm)	Focal Sound Path (mm)	Contour (mm)
KB	01PW71	L	0	70	1.46	66	2	REC	7.6x14.2 (2)mm	20	N/A
KB	01PW72	L	0	70	1.40	60	2	REC	7.6x14.2 (2)mm	20	N/A
KB	01PW73	L	0	70	1.40	60	2	REC	7.6x14.2 (2)mm	20	N/A
KB	01PW74	L	0	70	1.46	66	2	REC	7.6x14.2 (2mm)	20	N/A
KB	01PHLH	L	0	0	4.88	50	1	ROUND	.25"	.625	N/A

WESDYNE INTERNATIONAL

SENSITIVITY CALIBRATION DATA SHEET # SE-DET

UT SENSITIVITY/TIMEBASE CALIBRATION

Calibration Block:	Navship	**Calibration Block S/N:**	103155	**Block Temp:**	70° F
Thermometer S/N:	105509	**Couplant:**	Demin	**Essential Variable Settings per Appendix A, Figures A1-3 through A1-14:**	

Wire #	Wire Color	RPR Channel (P/R #)	Probe S/N	Probe Angle (deg)	Buffer Bias	Hole I.D.	Hole Amp %FSH	Gain (dB)	Exam. Gain (dB)	Measured Depth (in)
1	Blk	1	01PW71	70	35	A	80	24	30	.247
2	Blk					B	53	---	---	.417
1	Blk	2	01PW72	70	33	A	80	25	31	.247
2	Blk					B	54	---	---	.427
1	Blk	3	01PHLH	0	182	ID	100	6	6	0
2	Blk							---	---	
1	Blk	4	01PW73	70	70	A	80	25	31	,247
2	Blk					B	50	---	---	.249
1	Blk	5	01PW74	70	70	A	80	24.5	30.5	.242
2	Blk					B	50	---	---	.452
								---	---	
								---	---	
			CLAD EXAM					---	---	
1	Blk	1	01NVC9	0	41	A	50	19.5	31.5	.222
2	Blk		PDI-Cal			C	29	---	---	.804

WESDYNE INTERNATIONAL

SENSITIVITY CALIBRATION DATA SHEET # SE-DET

CALIBRATION VERIFICATION					
Reference Block:	B1	**Reference Block S/N:**	103939	**Block Temp:**	70° F
Thermometer S/N:	105509	**Couplant:**	Ultragel		
Essential Variable Settings per Appendix A, Figures A1-3 through A1-14, Sensitivity/Timebase Calibration and Para. 6.5.2:					
UT Sessions:	InlaySE-DET-Ax-Calver / InlaySE-DET-Circ-Calver				

Calibration Verification – Baseline

Wire #s	Wire Color	RPR Channel (P/R #)	Probe S/N	Reflector ID	Amp. (%FSH)	Gain (dB)	Noise (dB or dB + %FSH)	Depth Position (in)
1-2	Blk	1	01PW71	1" Radius	80	6.5	58	.664
1-2	Blk	2	01PW72	1" Radius	80	7.0	56.5	.673
1-2	Blk	4	01PW73	1" Radius	80	6.5	57	.779
1-2	Blk	5	01PW74	1" Radius	80	6.5	53	.779

Calibration Verification – Transfer

Wire #s	Wire Color	RPR Channel (P/R #)	Probe S/N	Reflector ID	Amp. (%FSH)	Gain (dB)	Noise (dB or dB + %FSH)	Depth Position (in)	EPP Sled Position
1-2	W	1	01PW71	1" Radius	81	7.0	56	.664	D1
3-4	W	2	01PW72	1" Radius	78	7.0	57	.664	D2
5-6	W	4	01PW73	1" Radius	79	6.0	58	.782	D3
7-8	W	5	01PW74	1" Radius	82	6.5	51	.774	D4

Acceptance of Calibration Verification (Y or N):	

WESDYNE INTERNATIONAL

SENSITIVITY CALIBRATION DATA SHEET # SE-Size-Circ

Utility:	Wesdyne	**Plant:**		**Unit:**		**Outage:**	
Procedure No:	PSI-ISI-254-SE			**Procedure Rev. No.:**	2		
Applicable Weld Numbers:							
Applicable PARAGON UT Session(s):	Inlay SE-Size-Circ						

PARAGON Operator Signature:	Dal Nelson	**Date:**	11-30-07
UT Examiner Signature:	Dal Nelson	**Date:**	11-30-07

EQUIPMENT INFORMATION			
PARAGON SAP #:	104591	**RPR SAP #:**	104592
PARAGON Acq. Software Release No:	3.5.0 Proto 2	**PARAGON Anal. Software Release No:**	6.3.0

Calibration/Inspection Cable Types	**Cable Length (ft.)**				**No of Intermediate Connectors**
	Calibration		**Inspection**		
	Cable #1	**Cable #2**	**Cable #3**	**Cable #4**	
UT Probes to Underwater Connector	150'		150'	150'	
Underwater Connector to RPR	48"		48"	48"	
RPR to Remote CPU	40"		40"	40"	
UT Profile Probe Extension	N/A	N/A			
Color	Blk		White	Black	

UT PROBE INFORMATION

Make	Serial Number	Mode	Measured Sound Beam Exit Point (in.)	Measured Angle (deg)	Center Freq (MHz)	Bandwidth (%)	No of Elements	Element Shape	Element Size (mm)	Focal Sound Path (mm)	Contour (mm)
KB	01PWPV	L	0	45	1.89	58	2	REC	8.6x15.2 (2)mm	30	N/A
KB	01PWPT	L	0	45	1.89	58	2	REC	8.6x15.2 (2)mm	30	N/A
KB	01R157	L	0	60	1.95	62	2	REC	7.6x14.2 (2)mm	20	N/A
KB	01R158	L	0	60	1.95	62	2	REC	7.6x14.2 (2)mm	20	N/A
KB	01PW9D	L	0	37	1.07	37	2	REC	16x29.2 (2)mm	80	736.6
KB	01PW9F	L	0	37	1.07	37	2	REC	16x29.2 (2)mm	80	736.6

WESDYNE INTERNATIONAL

SENSITIVITY CALIBRATION DATA SHEET # SE-Size-Circ

UT SENSITIVITY/TIMEBASE CALIBRATION					
Calibration Block:	Navship	**Calibration Block S/N:**	103155	**Block Temp:**	70° F
Thermometer S/N:	105509	**Couplant:**	Demin	**Essential Variable Settings per Appendix A, Figures A1-3 through A1-14:**	

Wire #	Wire Color	RPR Channel (P/R #)	Probe S/N	Probe Angle (deg)	Buffer Bias	Hole I.D.	Hole Amp %FSH	Gain (dB)	Exam. Gain (dB)	Measured Depth (in)
1	Blk	1	01PWPV	45	57	D	80	21.5	31.5	0.98
2	Blk					B	80+3.5			0.49
1	Blk	2	01PWPT	45	57	D	80	21.5	31.5	0.98
2	Blk					B	80+4.5			0.50
1	Blk	3	01R157	60	58	B	80	27.5	37.5	0.49
2	Blk					D	30			1.0
1	Blk	4	01R158	60	58	B	80	26	36	0.40
2	Blk					D	27			1.0
1	Blk	5	01PW9D	37	66	B	80	24	32	2.49
2	Blk					F	94			1.45
1	Blk	6	01PW95	37	66	B	80	24	32	2.49
2	Blk					F	80	---	---	1.48

WESDYNE INTERNATIONAL

SENSITIVITY CALIBRATION DATA SHEET # SE-Size-Circ

CALIBRATION VERIFICATION					
Reference Block:	B1	Reference Block S/N:	103939	Block Temp:	70° F
Thermometer S/N:	105509	Couplant:	Ultragel		
Essential Variable Settings per Appendix A, Figures A1-3 through A1-14, Sensitivity/Timebase Calibration and Para. 6.5.2:					
UT Sessions:	InlaySE-Size-Circ-Calver				

Calibration Verification – Baseline

Wire #s	Wire Color	RPR Channel (P/R #)	Probe S/N	Reflector ID	Amp. (%FSH)	Gain (dB)	Noise (dB or dB + %FSH)	Depth Position (in)
1-2	Blk	1	01PWPV	1" Radius	80	4.0	62	0.709
1-2	Blk	2	01PWPT	1" Radius	80	6.0	64	0.709
1-2	Blk	3	01R157	1" Radius	80	9.0	70	0.515
1-2	Blk	4	01R158	1" Radius	80	10.0	70	0.515
1-2	Blk	5	01PW9D	2" Radius	82	4.5	40	1.62
1-2	Blk	6	01PW9F	2" Radius	80	5.5	39	1.62

Calibration Verification – Transfer

Wire #s	Wire Color	RPR Channel (P/R #)	Probe S/N	Reflector ID	Amp. (%FSH)	Gain (dB)	Noise (dB or dB + %FSH)	Depth Position (in)	EPP Sled Position
1-2	Blk	1	01PWPV	1" Radius	81	4.5	64	0.709	S1
1-2	W	2	01PWPT	1" Radius	78	6.0	63	0.711	S2
3-4	Blk	3	01R157	1" Radius	80	8.5	68	0.519	S3
3-4	W	4	01R158	1" Radius	81	10.5	71	0.515	S4
5-6	Blk	5	01PW9D	2" Radius	84	5.0	42	1.64	S5
5-6	W	6	01PW9F	2" Radius	81	5.0	40	1.62	S6

Acceptance of Calibration Verification (Y or N):	

WESDYNE INTERNATIONAL

SENSITIVITY CALIBRATION DATA SHEET # InlaySE-Size-Ax

	Wesdyne	Plant:		Unit:		Outage:
Procedure No:	PDI-ISI-254-SE			Procedure Rev. No.:	2	
Applicable Weld Numbers:						
Applicable PARAGON UT Session(s):	InlaySE-Size-Ax					

PARAGON Operator Signature:	Dal Nelson	Date:	12-1-07
UT Examiner Signature:	Dal Nelson	Date:	12-1-07

EQUIPMENT INFORMATION

PARAGON SAP #:	104591	RPR SAP #:	104592
PARAGON Acq. Software Release No:	3.5.0 Proto 2	PARAGON Anal. Software Release No:	6.3.0

Calibration/Inspection Cable Types	Cable Length (ft.)					No of Intermediate Connectors
	Calibration		Inspection/ cal Cable			
	Cable #1	Cable #2	Cable #3	Cable #4	Cable #5	
UT Probes to Underwater Connector	150'	N/A	150'	150'	150'	0
Underwater Connector to RPR	48"	N/A	48"	48"	48"	0
RPR to Remote CPU	40"	N/A	40"	40"	40"	0
UT Profile Probe Extension	N/A	N/A	N/A	N/A	6"	0
Color	BLK	N/A	RED	WHITE	BLUE	

UT PROBE INFORMATION

Make	Serial Number	Mode	Measured Sound Beam Exit Point (in.)	Measured Angle (deg)	Center Freq (MHz)	Bandwidth (%)	No of Elements	Element Shape	Element Size (mm)	Focal Sound Path (mm)	Contour (mm)
KB	01PWPR	L	0.0	45	1.89	58	2	Rect.	8.6 X 15.2	30mm	N/A
KB	01PWPW	L	0.0	45	1.89	58	2	Rect.	8.6 X 15.2	30mm	N/A
KB	01R154	L	0.0	60	1.95	62	2	Rect.	7.6 X 14.2	20mm	N/A
KB	01R155	L	0.0	60	1.95	62	2	Rect.	7.6 X 14.2	20mm	N/A
KB	01PYD0	L	0.0	45	1.46	66	2	Rect.	16 X 28.5	80mm	736mm
KB	01PYD1	L	0.0	45	1.46	66	2	Rect.	16 X 28.5	80mm	736mm
KB	01PW9H	L	0.0	37	1.04	58	2	Rect.	16 X 29.2	80mm	737.6mm
KB	10PW9J	L	0.0	37	1.04	58	2	Rect.	16 X 29.2	80mm	737.6mm
KB	01PHLH	L	0.0	0	4.88	50	2	Rnd	.25"	.625"	Profile

WesDyne International

SENSITIVITY CALIBRATION DATA SHEET # InlaySE-Size-Ax

UT SENSITIVITY/TIMEBASE CALIBRATION										
Calibration Block:		NAVSHIP		Calibration Block S/N:			103933	Block Temp:		70° F
Thermometer S/N:		105509	Couplant:	DEMIN	Essential Variable Settings per Appendix A, Figures A1-3 through A1-14:					YES
Wire #	Wire Color	RPR Channel (P/R #)	Probe S/N	Probe Angle (deg)	Buffer Bias	Hole I.D.	Hole Amp %FSH	Gain (dB)	Exam. Gain (dB)	Measured Depth (in)
1	BLK	1	01PWPR	45	55	D	80	22	32	0.98
2	BLK					B	80 +4			0.49
1	BLK	2	01PWPW	45	56	D	80	22	32	0.98
2	BLK					B	80 +2.5			0.49
1	BLK	3	01R154	60	57	A	80	26	36	1.0
2	BLK					B	36			0.51
1	BLK	4	01R155	60	54	A	80	24.5	34.5	1.0
2	BLK					B	33			0.51
1	BLK	5	01PYD0	45	60	B	80	27	27	2.29
2	BLK					F	93			1.49
1	BLK	6	01PYD1	45	60	B	80	27.5	27.5	2.40
2	BLK					F	98			1.50
1	BLK	7	01PW9H	37	63	B	80	25	33	2.48
2	BLK					F	99			1.50
1	BLK	8	01PW9J	37	61	B	80	24.5	32.5	2.48
2	BLK					F	99			1.49
1	BLK	9	01PHLH	0	179	ID	100	6	6	0
2	BLK									

WESDYNE INTERNATIONAL

SENSITIVITY CALIBRATION DATA SHEET # InlaySE-Size-Ax

CALIBRATION VERIFICATION					
Reference Block:	ROMPAS	**Reference Block S/N:**	103939	**Block Temp:**	70°F
Thermometer S/N:	105509	**Couplant:**	Ultragel		
Essential Variable Settings per Appendix A, Figures A1-3 through A1-14, Sensitivity/Timebase Calibration and Para. 6.5.2:					N/A
UT Sessions:	InlaySE-Size-Ax-Calver				

Calibration Verification – Baseline

Wire #s	Wire Color	RPR Channel (P/R #)	Probe S/N	Reflector ID	Amp. (%FSH)	Gain (dB)	Noise (dB or dB + %FSH)	Depth Position (in)
1+2	BLK	1	01PWPR	1"Radius	80	4.5	64	0.706
1+2	BLK	2	01PWPW	1"Radius	80	5.0	63	0.719
1+2	BLK	3	01R154	1"Radius	80	7.0	70	0.508
1+2	BLK	4	01R155	1"Radius	80	6.5	68	0.517
1+2	BLK	5	01PYD0	2"Radius	80	9.0	56	1.41
1+2	BLK	6	01PYD1	2"Radius	78	8.0	62	1.41
1+2	BLK	7	01PW9H	2"Radius	78	4.5	49	1.64
1+2	BLK	8	01PW9J	2"Radius	82	3.5	39	1.64

Calibration Verification – Transfer

Wire #s	Wire Color	RPR Channel (P/R #)	Probe S/N	Reflector ID	Amp. (%FSH)	Gain (dB)	Noise (dB or dB + %FSH)	Depth Position (in)	EPP Sled Position
1-2	W	1	01PWPR	1"Radius	81	5.0	62	0.712	A1
3-4	W	2	01PWPW	1"Radius	79	5.0	64	0.720	A2
1-2	Blk	3	01R154	1"Radius	80	6.5	70	0.510	A3
3-4	Blk	4	01R155	1"Radius	81	7.0	66	0.520	A4
5-6	W	5	01PYD0	2"Radius	80	8.5	58	1.42	A5
7-8	W	6	01PYD1	2"Radius	80	8.0	61	1.42	A6
5-6	Blk	7	01PW9H	2"Radius	79	5.0	50	1.66	A7
7-8	Blk	8	01PW9J	2"Radius	81	4.0	40	1.64	A8

Acceptance of Calibration Verification (Y or N):	Y

WESDYNE INTERNATIONAL

SENSITIVITY CALIBRATION DATA SHEET # InlaySE-Size-Ax

SYSTEM CHARACTERIZATION					
Block Type:	SECONDARY STD.	**Block S/N:**	N/A	**Block Temp:**	87°F
Couplant:	DEMIN WATER	**Essential Variable Settings per Appendix A, Figures A1-3 through A1-14, Sensitivity/Timebase Calibration and Para. 6.5.2:**			YES
UT Session:	AxSysChar				

System Characterization – Initial 05/20/07 1120

Wire #s	Wire Color	RPR Channel (P/R #)	Probe S/N	Reflector ID	Amp.(% FSH)	Gain (dB)	Depth Position (In)
1-2	White	1	014PMD	SLOT	79	25.5	1.124
5-6	Red	2	014PMF	SLOT	78	28.5	1.124
3-4	White	3	01DJ1D	SLOT	82	5.5	0.834
3-4	Red	4	01DJJK	SLOT	78	12.5	0.853
5-6	White	5	012KWF	SLOT	82	18.5	1.04
7-8	Red	6	012KWC	SLOT	80	17.0	1.04
5-6	Blue	7	00WXDH	SLOT	80	16.0	0.91
1-2	Blue	8	00WXDF	SLOT	78	14.5	0.93
1-2	Red	9	00W97X	SLOT	82	24.5	1.16
3-4	Blue	10	00W97W	SLOT	81	14.0	1.16

System Characterization – Interim*

Wire #s	Wire Color	RPR Channel (P/R #)	Probe S/N	Reflector ID	Amp.(% FSH)	Gain (dB)	Depth Position (In)

System Characterization – Final 05/21/07 1831

Wire #s	Wire Color	RPR Channel (P/R #)	Probe S/N	Reflector ID	Amp.(% FSH)	Gain (dB)	Depth Position (In)
1-2	White	1	014PMD	SLOT	79	25.5	1.124
5-6	Red	2	014PMF	SLOT	78	28.5	1.124
3-4	White	3	01DJ1D	SLOT	82	5.5	0.834
3-4	Red	4	01DJJK	SLOT	78	12.5	0.853
5-6	White	5	012KWF	SLOT	82	18.5	1.04
7-8	Red	6	012KWC	SLOT	80	17.0	1.04
5-6	Blue	7	00WXDH	SLOT	80	16.0	0.91
1-2	Blue	8	00WXDF	SLOT	78	14.5	0.93
1-2	Red	9	00W97X	SLOT	82	24.5	1.16

WESDYNE INTERNATIONAL

SENSITIVITY CALIBRATION DATA SHEET # InlaySE-Size-Ax

3-4	Blue	10	00W97W	SLOT	61	14.0	1.16

- - adding additional 'Interim' checks to this form is permissible.

ATTACHMENT 2:

Block 601 UT 70º Detection Results

WESDYNE INTERNATIONAL

INDICATION ASSESSMENT

PLANT PDI Supplement 2 10 Demonstration

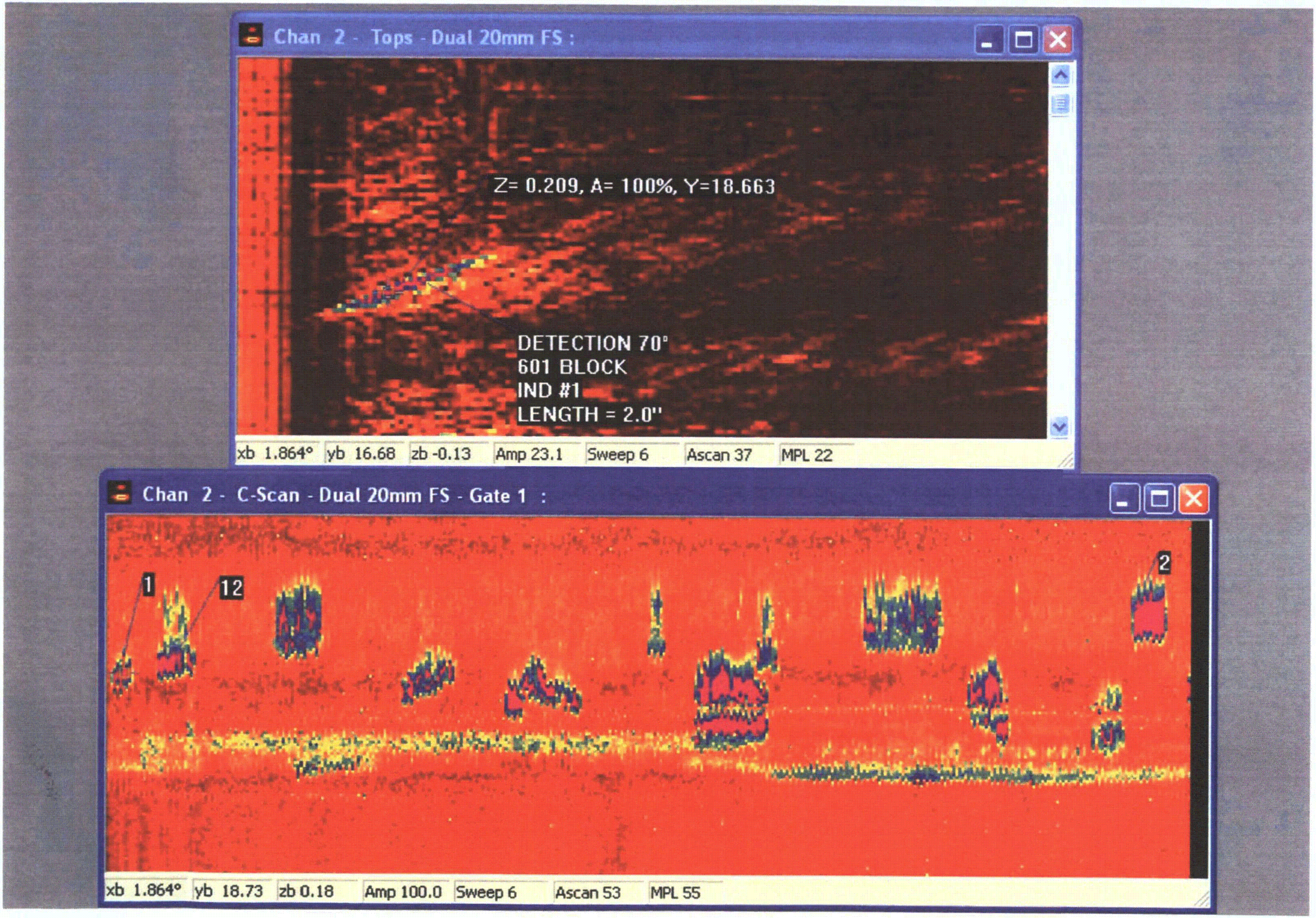
PROCEDURE PDI -ISI-254-SE Rev. 2

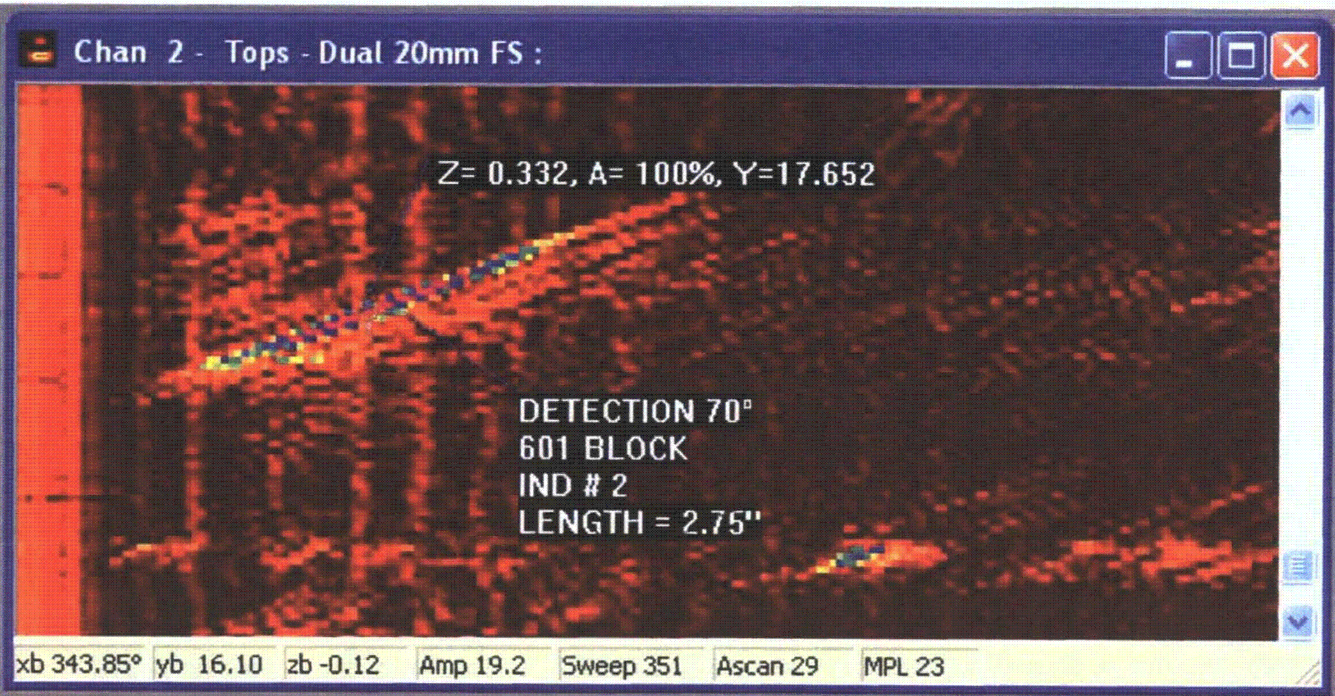
COMPONENT 601 Detection

ANALYST [signature] 12-5-07

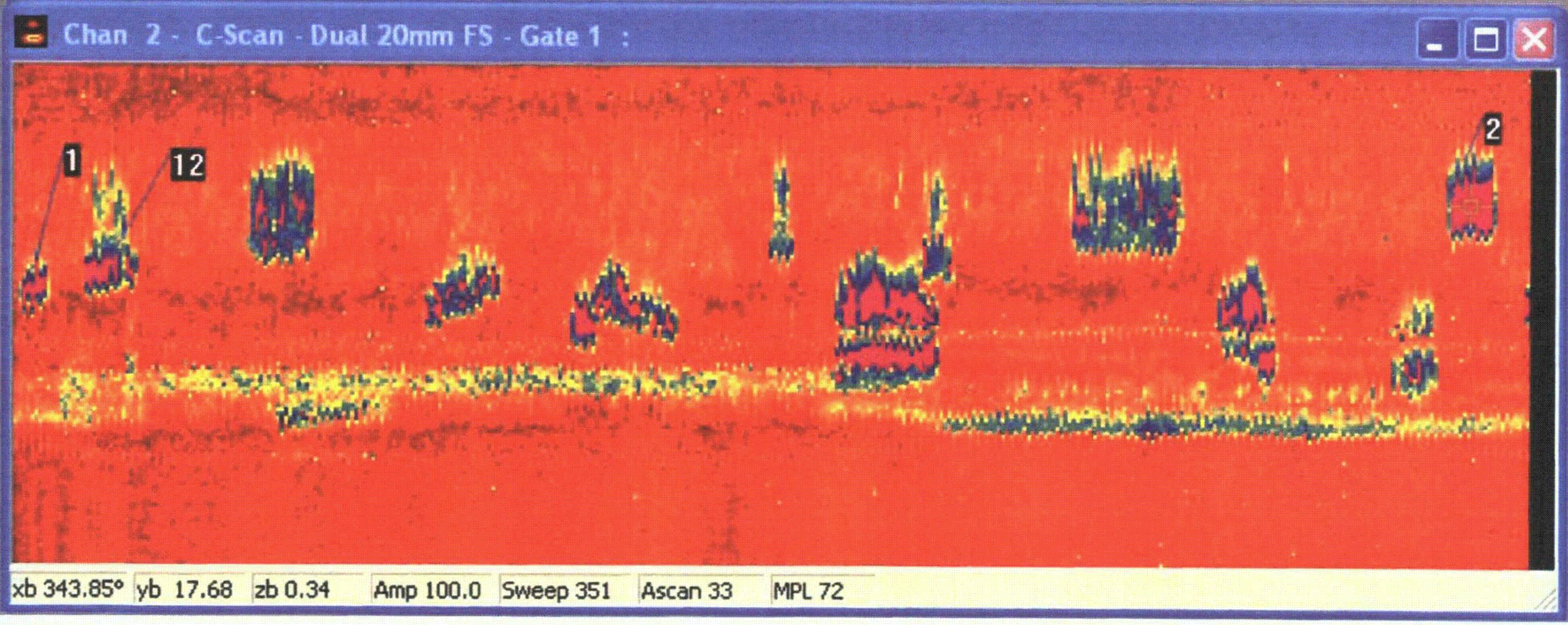
FILE NAME	INDICATION NO.	BEAM ANGLE	BEAM/ DIRECTION in, out, cw, ccw	MIN SWP#	MAX SWP #	TOTAL# SWPS	XB MIN	XB MAX	CENTER LINE= XB MIN + XB MAX / 2	AVERAGE YB (average of two consecutive sweeps) for in out scan = distance from cl of vessel for cw ccw scan = theta	LENGTH PER PROCEDURE(L) (inches) (number of sweeps X increment value)	TOTAL THROUGH WALL BOTTOM TIP ZB (corrected from profilometry view)
AxDet-601-2	1	70	IN/OUT	2	9	8	357.90°	4.84°	1.37°	18.80"	2.00"	detection only
AxDet-601-2	2	70	IN/OUT	346	357	12	338.90°	349.80°	344.35°	17.55"	3.00"	detection only
CIRCDET601	3	70	CW/CCW	53	61	9	18.41"	19.05°	18.73"	322.00°	0.72"	detection only
AxDet-601-2	12	70	IN/OUT	18	30	13	13.76°	25.65°	19.71°	18.50"	3.25"	detection only

NOTES

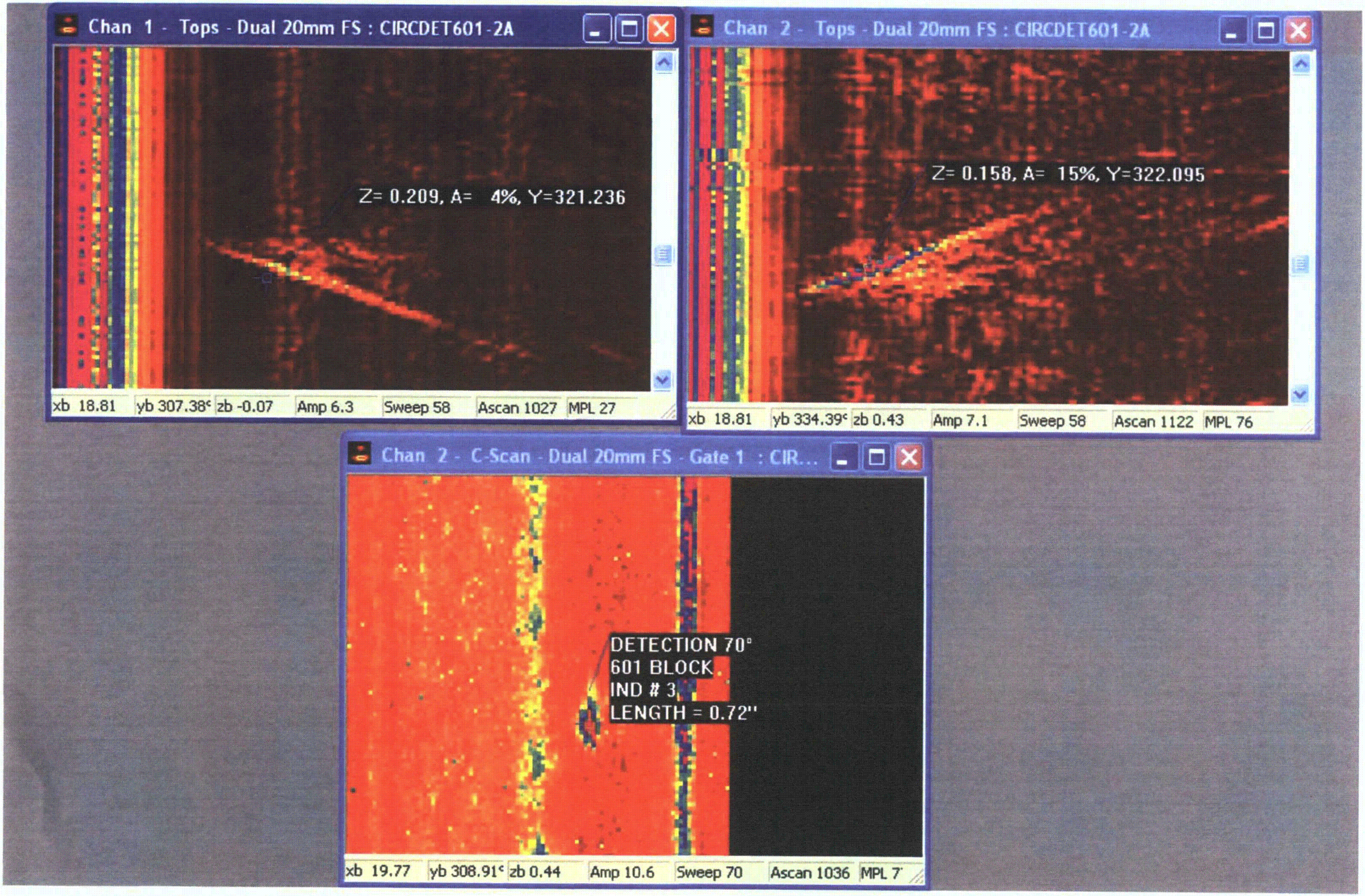

Chan 2 - Tops - Dual 20mm FS :
Z= 0.209, A= 100%, Y=18.663
DETECTION 70°
601 BLOCK
IND #1
LENGTH = 2.0"
xb 1.864° yb 16.68 zb -0.13 Amp 23.1 Sweep 6 Ascan 37 MPL 22
Chan 2 - C-Scan - Dual 20mm FS - Gate 1 :
1
12
2
xb 1.864° yb 18.73 zb 0.18 Amp 100.0 Sweep 6 Ascan 53 MPL 55



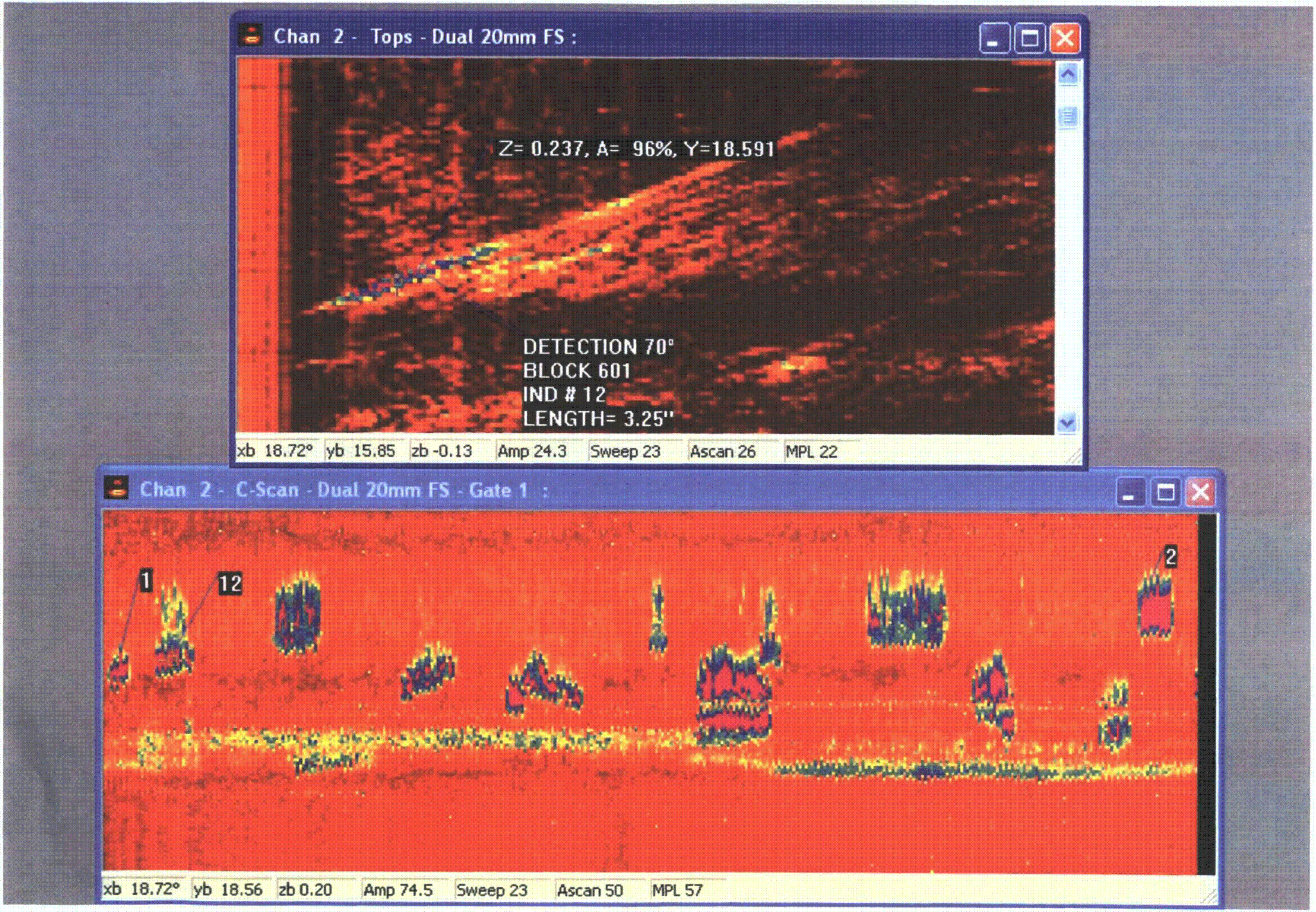
Chan 2 - Tops - Dual 20mm FS :
Z= 0.332, A= 100%, Y=17.652
DETECTION 70°
601 BLOCK
IND # 2
LENGTH = 2.75"
xb 343.85° yb 16.10 zb -0.12 Amp 19.2 Sweep 351 Ascan 29 MPL 23



Chan 2 - C-Scan - Dual 20mm FS - Gate 1 :
1
12
2
xb 343.85° yb 17.68 zb 0.34 Amp 100.0 Sweep 351 Ascan 33 MPL 72



Chan 1 - Tops - Dual 20mm FS : CIRCDET601-2A
Z= 0.209, A= 4%, Y=321.236
xb 18.81 yb 307.38° zb -0.07 Amp 6.3 Sweep 58 Ascan 1027 MPL 27
Chan 2 - Tops - Dual 20mm FS : CIRCDET601-2A
Z= 0.158, A= 15%, Y=322.095
xb 18.81 yb 334.39° zb 0.43 Amp 7.1 Sweep 58 Ascan 1122 MPL 76
Chan 2 - C-Scan - Dual 20mm FS - Gate 1 : CIR...
DETECTION 70°
601 BLOCK
IND # 3
LENGTH = 0.72"
xb 19.77 yb 308.91° zb 0.44 Amp 10.6 Sweep 70 Ascan 1036 MPL 7


Chan 2 - Tops - Dual 20mm FS :
Z= 0.237, A= 96%, Y=18.591
DETECTION 70°
BLOCK 601
IND # 12
LENGTH= 3.25"
xb 18.72° yb 15.85 zb -0.13 Amp 24.3 Sweep 23 Ascan 26 MPL 22
Chan 2 - C-Scan - Dual 20mm FS - Gate 1 :
1
12
2
xb 18.72° yb 18.56 zb 0.20 Amp 74.5 Sweep 23 Ascan 50 MPL 57

ATTACHMENT 3:

Block 601 UT Sizing Results

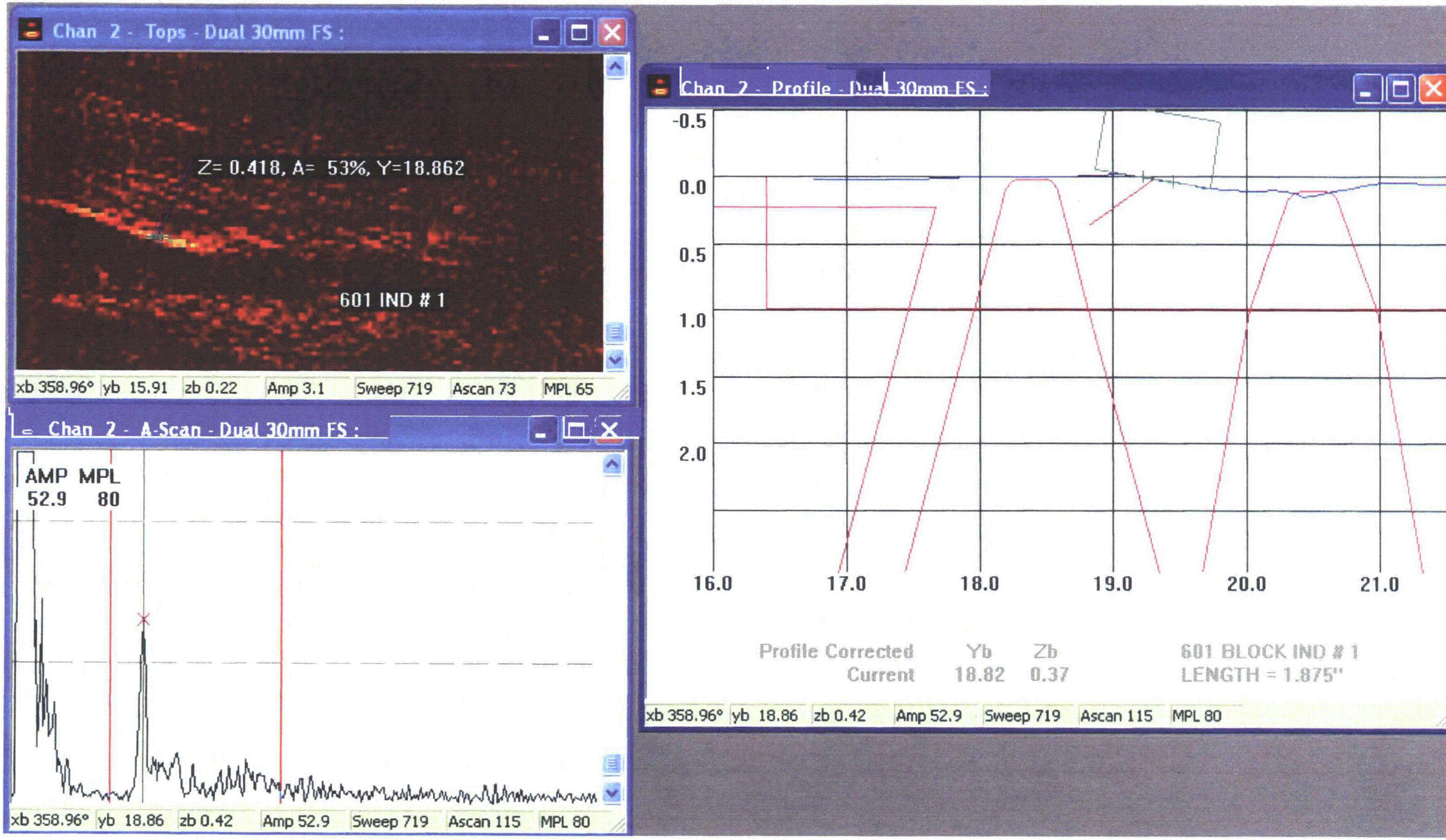
WESDYNE INTERNATIONAL

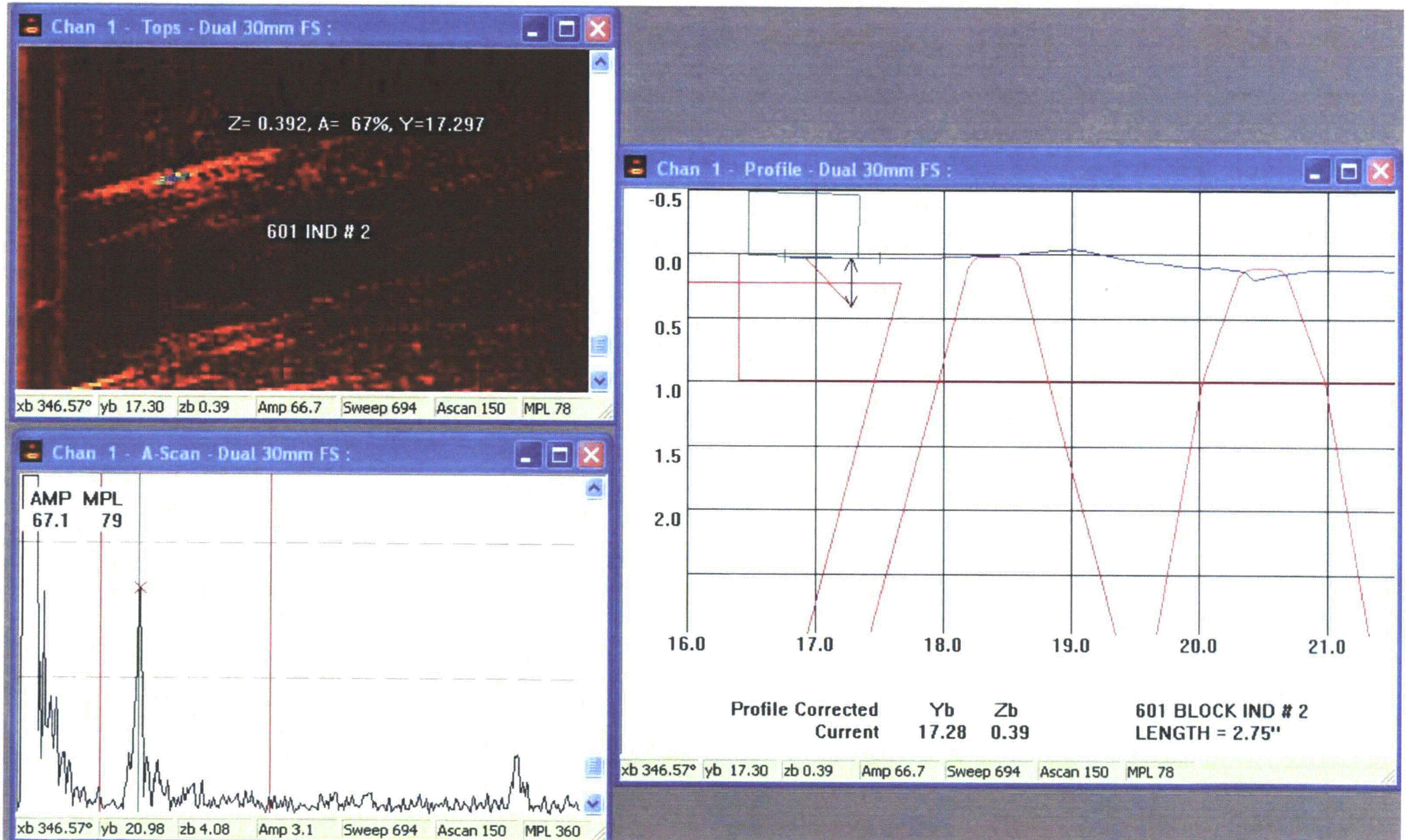
INDICATION ASSESSMENT

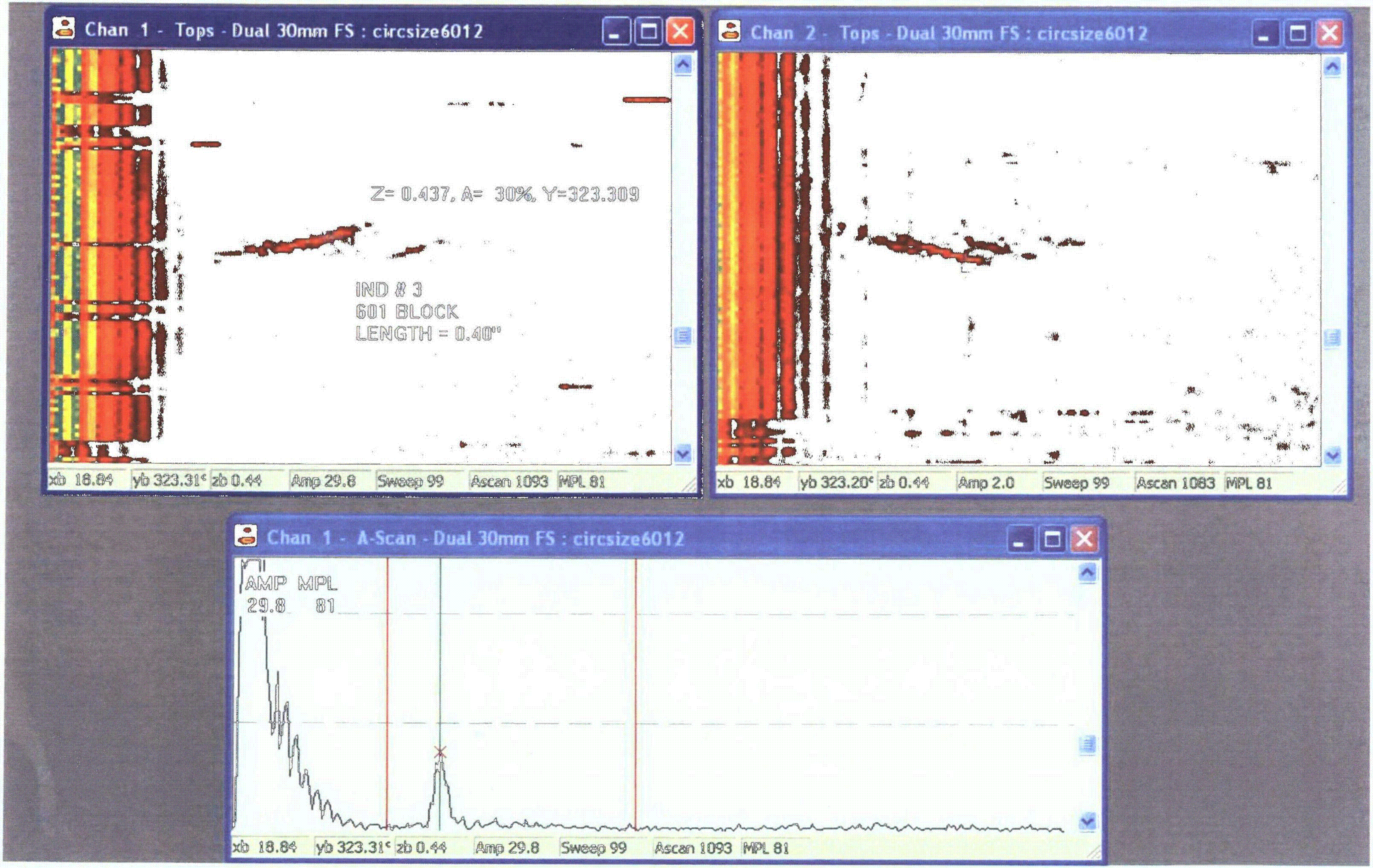
PLANT PDI Supplement 2 10 Demonstration
PROCEDURE PDI -ISI-254-SE Rev. 2
COMPONENT 601 Sizing
ANALYST [signature] 12-5-07

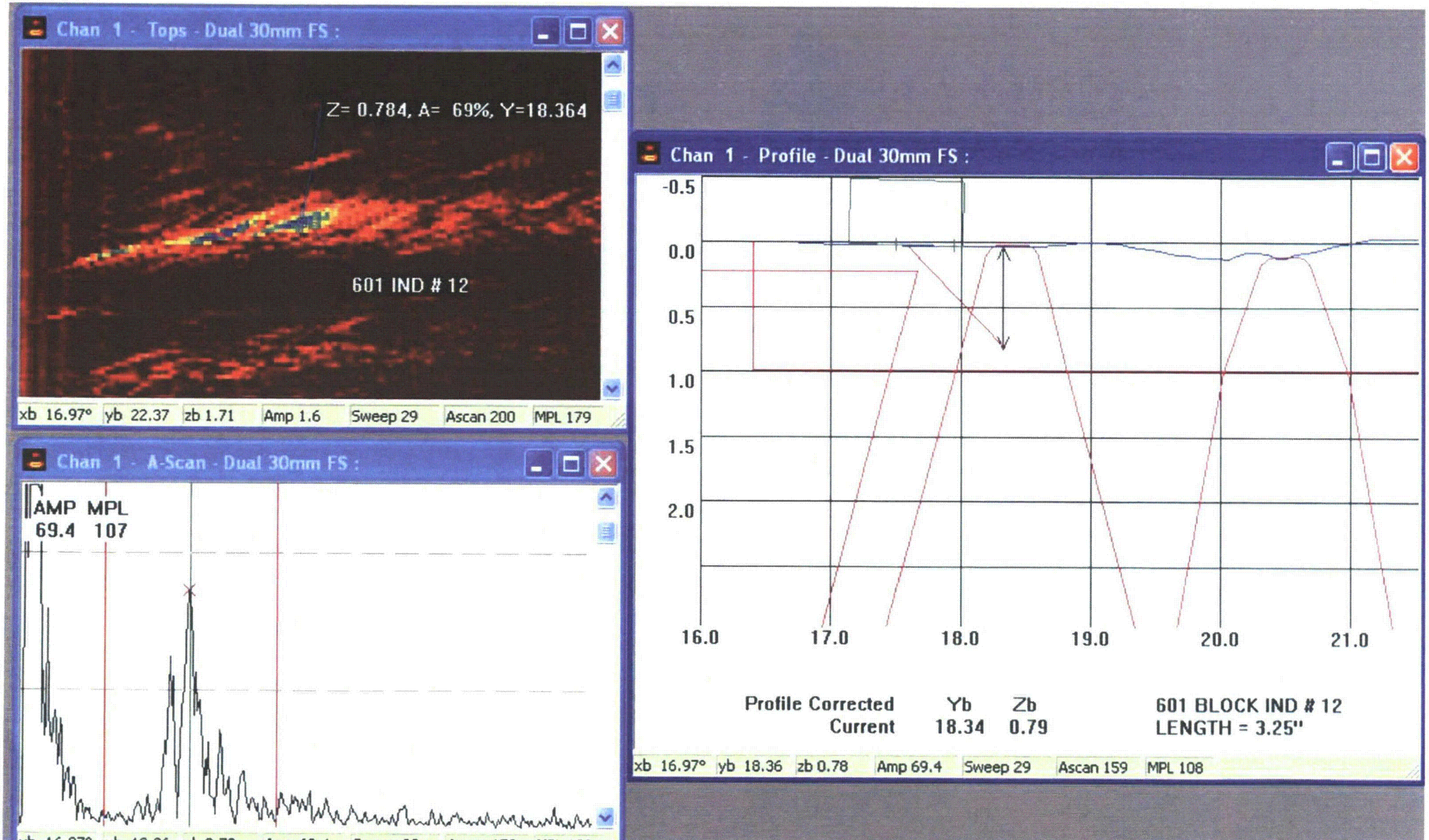
FILE NAME	INDICATION NO.	BEAM ANGLE	BEAM/ DIRECTION in, out, cw, ccw	MIN SWP#	MAX SWP #	TOTAL# SWPS	XB MIN	XB MAX	CENTER LINE= XB MIN + XB MAX / 2	AVERAGE YB (average of two consecutive sweeps) for in out scan = distance from cl of vessel for cw ccw scan = theta	LENGTH PER PROCEDURE(L) (inches) (number of sweeps X increment value)	TOTAL THROUGH WALL BOTTOM TIP ZB (corrected from profilometry view)
axsize601-pro	1	45	IN/OUT	715	3	15	356.98°	4.08°	0.53°	18.70"	1.875"	0.37"
axsize601-pro	2	45	IN/OUT	676	697	22	337.65°	348.06°	342.86°	17.35"	2.75"	0.39"
circsize6012	3	45	CW/CCW	96	100	5	18.60"	18.92"	18.76"	322.70°	0.40"	0.44"
axsize601-pro	12	45	IN/OUT	18	43	26	11.52°	23.91°	17.71°	18.20"	3.25"	0.79"

NOTES


Chan 2 - Tops - Dual 30mm FS :
Z= 0.418, A= 53%, Y=18.862
601 IND # 1
xb 358.96° yb 15.91 zb 0.22 Amp 3.1 Sweep 719 Ascan 73 MPL 65
Chan 2 - A-Scan - Dual 30mm FS :
AMP MPL
52.9 80
xb 358.96° yb 18.86 zb 0.42 Amp 52.9 Sweep 719 Ascan 115 MPL 80
Chan 2 - Profile - Dual 30mm FS :
-0.5
0.0
0.5
1.0
1.5
2.0
16.0
17.0
18.0
19.0
20.0
21.0
Profile Corrected Yb Zb
Current 18.82 0.37
601 BLOCK IND # 1
LENGTH = 1.875"
xb 358.96° yb 18.86 zb 0.42 Amp 52.9 Sweep 719 Ascan 115 MPL 80


Chan 1 - Tops - Dual 30mm FS :
Z= 0.392, A= 67%, Y=17.297
601 IND # 2
xb 346.57° yb 17.30 zb 0.39 Amp 66.7 Sweep 694 Ascan 150 MPL 78
Chan 1 - A-Scan - Dual 30mm FS :
AMP MPL
67.1 79
xb 346.57° yb 20.98 zb 4.08 Amp 3.1 Sweep 694 Ascan 150 MPL 360
Chan 1 - Profile - Dual 30mm FS :
-0.5
0.0
0.5
1.0
1.5
2.0
16.0
17.0
18.0
19.0
20.0
21.0
Profile Corrected Yb Zb
Current 17.28 0.39
601 BLOCK IND # 2
LENGTH = 2.75"
xb 346.57° yb 17.30 zb 0.39 Amp 66.7 Sweep 694 Ascan 150 MPL 78


Chan 1 - Tops - Dual 30mm FS : circsize6012
Z= 0.437, A= 30%, Y=323.309
IND # 3
601 BLOCK
LENGTH = 0.40"
xb 18.84 | yb 323.31° | zb 0.44 | Amp 29.8 | Sweep 99 | Ascan 1093 | MPL 81
Chan 2 - Tops - Dual 30mm FS : circsize6012
xb 18.84 | yb 323.20° | zb 0.44 | Amp 2.0 | Sweep 99 | Ascan 1083 | MPL 81
Chan 1 - A-Scan - Dual 30mm FS : circsize6012
AMP MPL
29.8 81
xb 18.84 | yb 323.31° | zb 0.44 | Amp 29.8 | Sweep 99 | Ascan 1093 | MPL 81


Chan 1 - Tops - Dual 30mm FS :
Z= 0.784, A= 69%, Y=18.364
601 IND # 12
xb 16.97° yb 22.37 zb 1.71 Amp 1.6 Sweep 29 Ascan 200 MPL 179
Chan 1 - A-Scan - Dual 30mm FS :
AMP MPL
69.4 107
Chan 1 - Profile - Dual 30mm FS :
-0.5
0.0
0.5
1.0
1.5
2.0
16.0
17.0
18.0
19.0
20.0
21.0
Profile Corrected Yb Zb
Current 18.34 0.79
601 BLOCK IND # 12
LENGTH = 3.25"
xb 16.97° yb 18.36 zb 0.78 Amp 69.4 Sweep 29 Ascan 159 MPL 108

ATTACHMENT 4:

Inlay Block UT 70° Detection Results

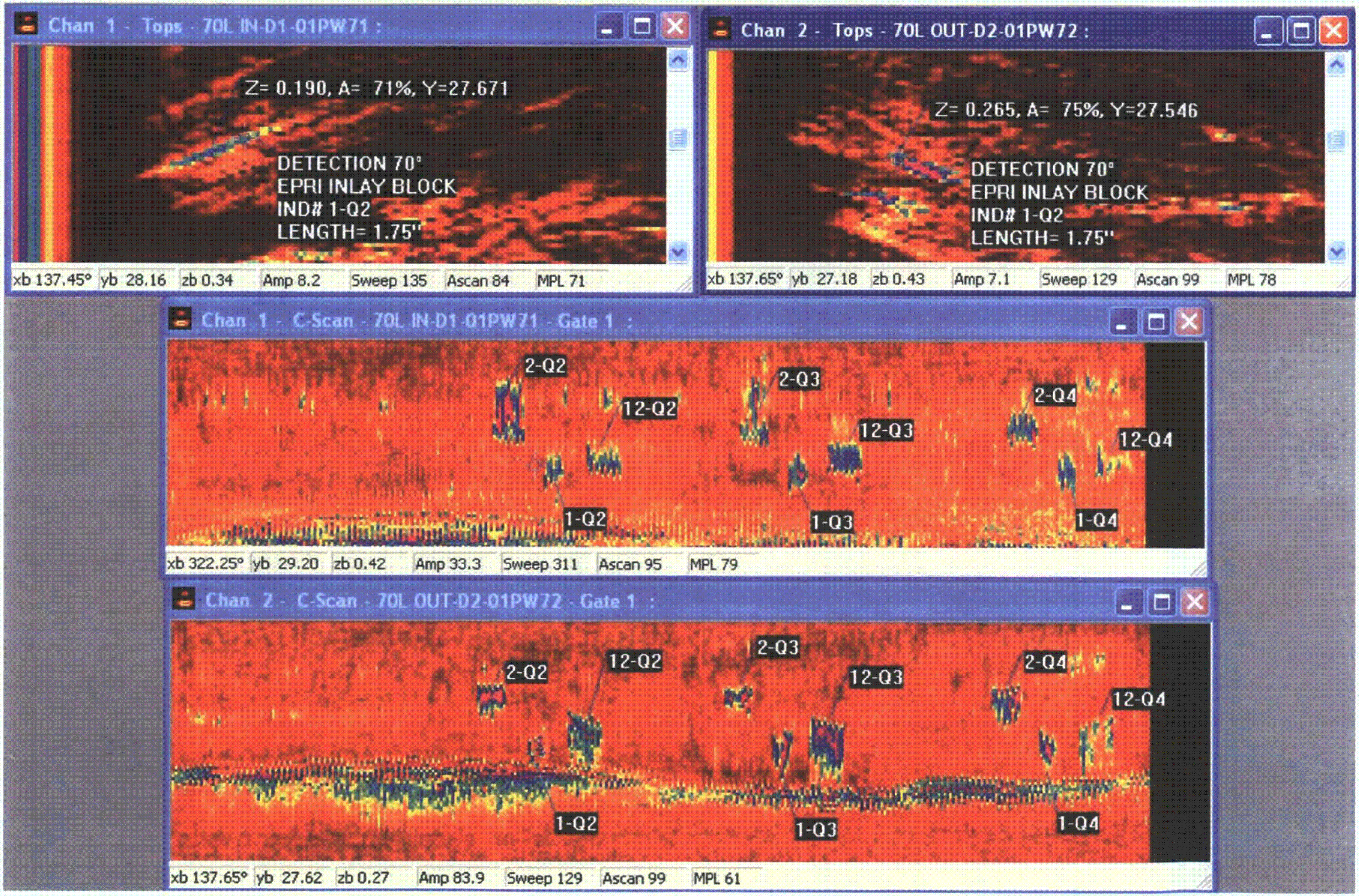
WESDYNE INTERNATIONAL

INDICATION ASSESSMENT

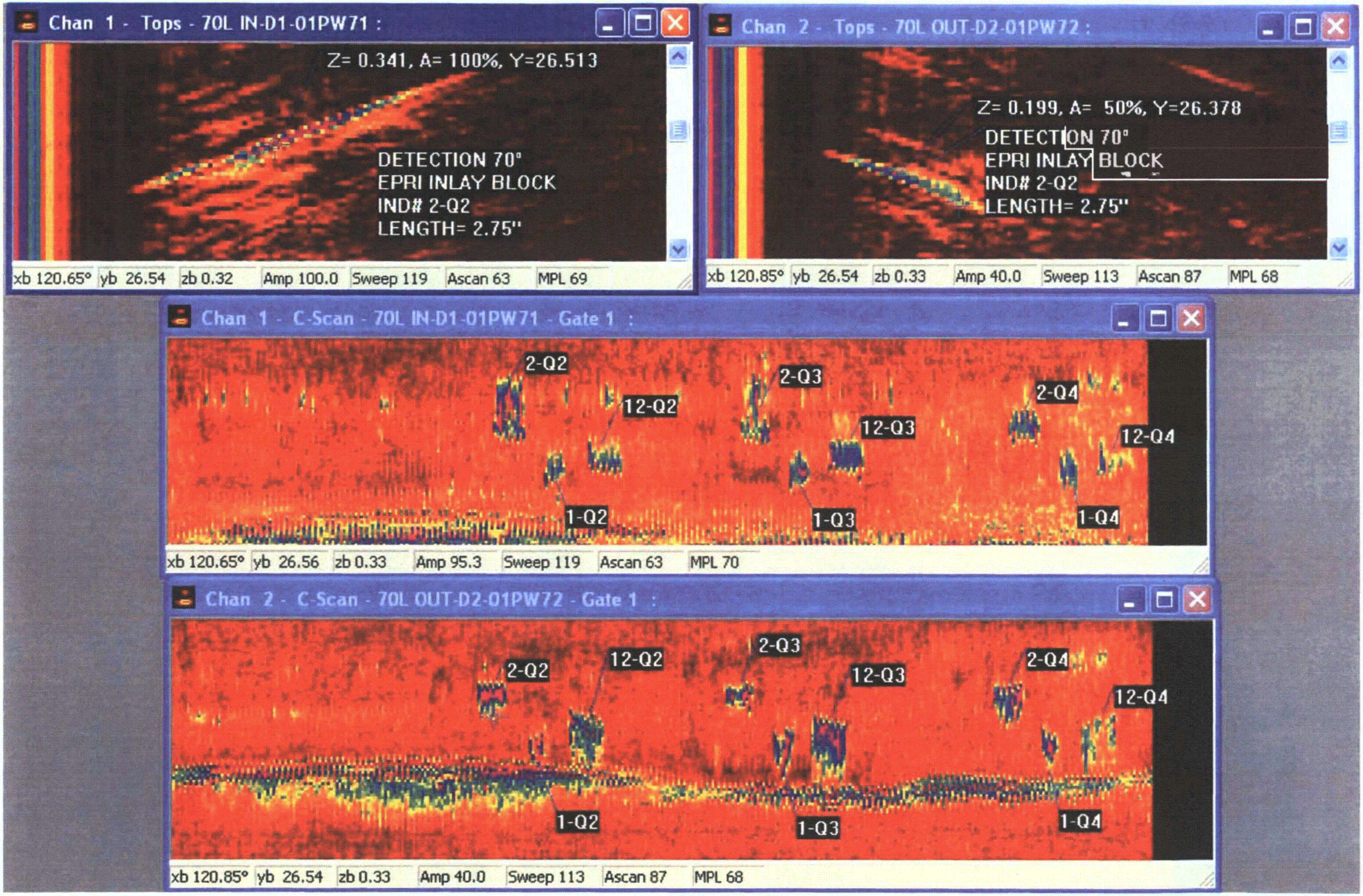
PLANT: PDI Supplement 2 10 Demonstration
PROCEDURE: PDI -ISI-254-SE Rev. 2
COMPONENT: Inlay Test Mockup
ANALYST: [signature] 12-5-07

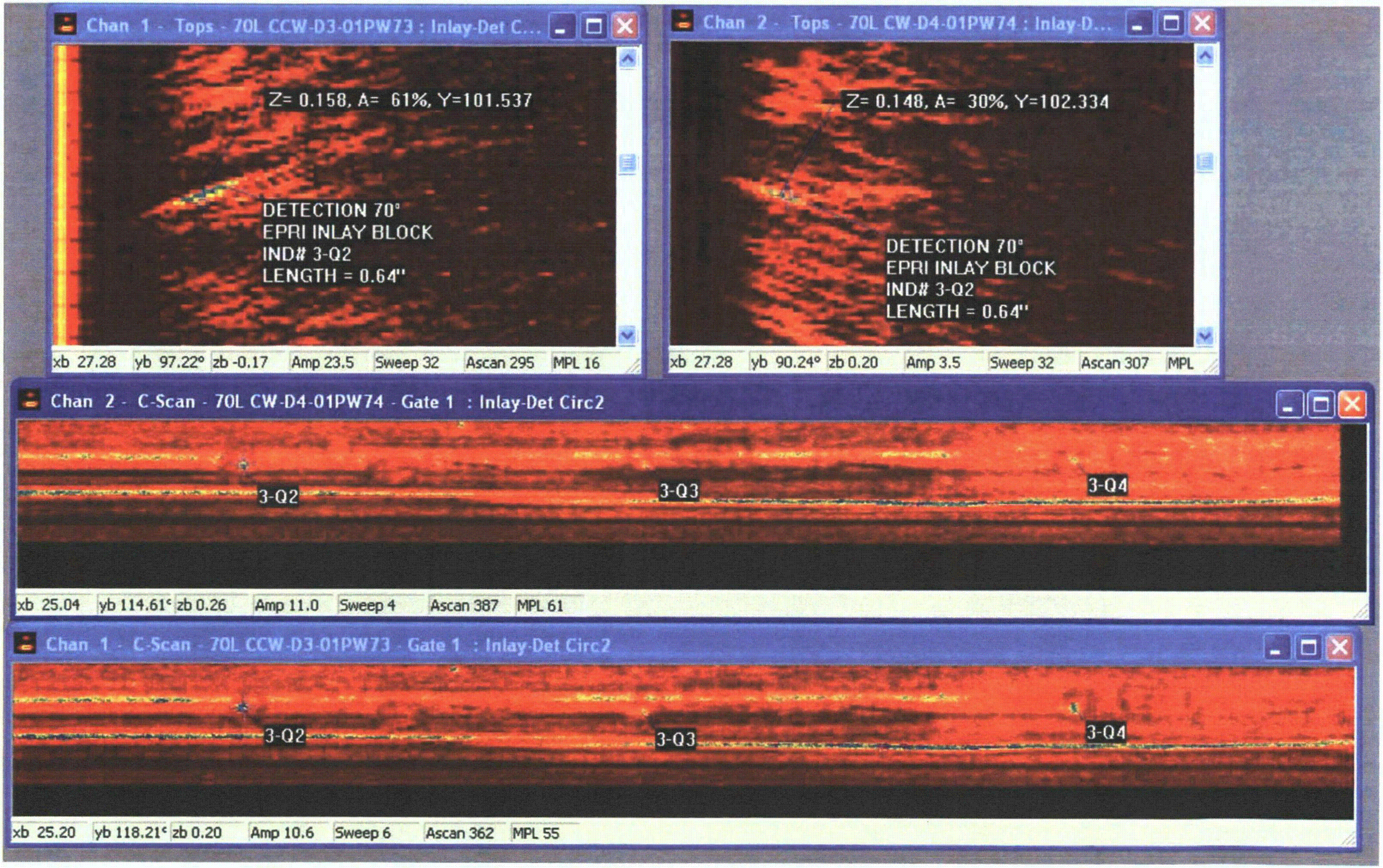
FILE NAME	INDICATION NO.	BEAM ANGLE	BEAM/ DIRECTION In, out, cw, ccw	MIN SWP#	MAX SWP #	TOTAL# SWPS	XB MIN	XB MAX	CENTER LINE= XB MIN + XB MAX / 2	AVERAGE YB (average of two consecutive sweeps) for in out scan = distance from cl of vessel for cw ccw scan = theta	LENGTH PER PROCEDURE(L) (inches) (number of sweeps X increment value)	TOTAL THROUGH WALL BOTTOM TIP ZB (corrected from profilometry view)
Inlay-Det-Ax2	1-Q2	70	IN/OUT	133	139	7	135.35°	141.65°	138.5°	27.60"	1.75"	detection only
Inlay-Det-Ax2	2-Q2	70	IN/OUT	115	125	11	116.45°	126.95°	121.70°	26.40"	2.75"	detection only
Inlay-Det-Circ2	3-Q2	70	CW/CCW	29	36	8	27.04"	27.6"	27.32"	101.70°	0.64"	detection only
Inlay-Det-Ax2	12-Q2	70	IN/OUT	148	159	12	151.10°	162.65°	156.88°	27.30"	3.00"	detection only
Inlay-Det-Ax2	1-Q3	70	IN/OUT	219	225	7	225.65°	231.95°	228.8°	27.60"	1.75"	detection only
Inlay-Det-Ax2	2-Q3	70	IN/OUT	194	204	11	205.90°	216.4°	211.15°	26.40"	2.75"	detection only
Inlay-Det-Circ2	3-Q3	70	CW/CCW	31	38	8	27.20"	27.76"	27.48"	193.5°	0.64"	detection only
Inlay-Det-Ax2	12-Q3	70	IN/OUT	225	236	12	238.45°	250°	244.23°	27.30"	3.00"	detection only
Inlay-Det-Ax2	1-Q4	70	IN/OUT	313	319	7	323.35°	330.65°	327.0°	27.60"	1.75"	detection only
Inlay-Det-Ax2	2-Q4	70	IN/OUT	289	299	11	305.65°	316.16°	310.9°	26.40"	2.75"	detection only
Inlay-Det-Circ2	3-Q4	70	CW/CCW	27	35	9	26.88"	27.52"	27.20"	293°	0.72"	detection only
Inlay-Det-Ax2	12-Q4	70	IN/OUT	320	331	12	338.2°	349.75°	343.98°	27.30"	3.00"	detection only

NOTES

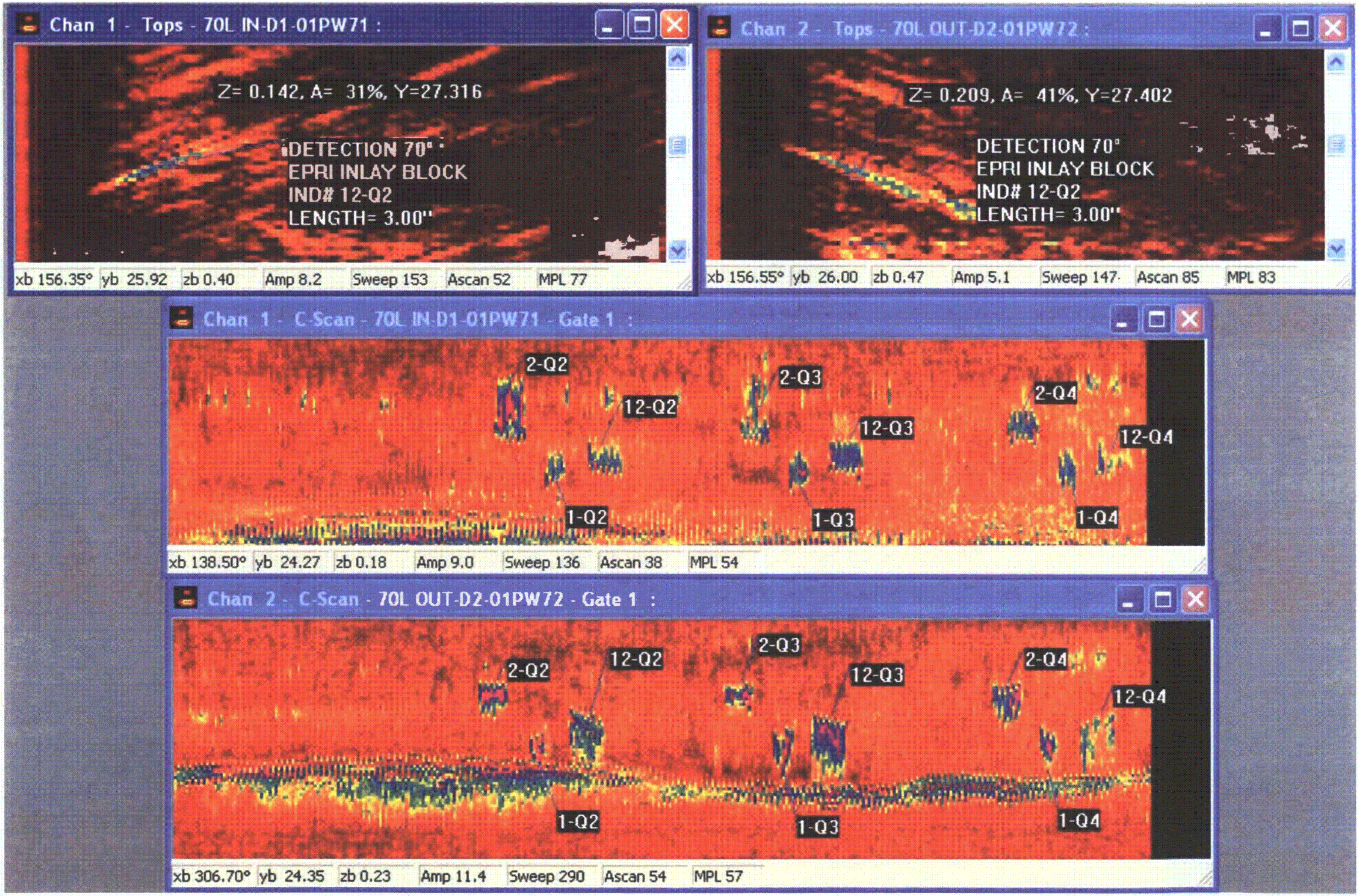


Chan 1 - Tops - 70L IN-D1-01PW71 :
Z= 0.190, A= 71%, Y=27.671
DETECTION 70°
EPRI INLAY BLOCK
IND# 1-Q2
LENGTH= 1.75"
xb 137.45° yb 28.16 zb 0.34 Amp 8.2 Sweep 135 Ascan 84 MPL 71
Chan 2 - Tops - 70L OUT-D2-01PW72 :
Z= 0.265, A= 75%, Y=27.546
DETECTION 70°
EPRI INLAY BLOCK
IND# 1-Q2
LENGTH= 1.75"
xb 137.65° yb 27.18 zb 0.43 Amp 7.1 Sweep 129 Ascan 99 MPL 78
Chan 1 - C-Scan - 70L IN-D1-01PW71 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 322.25° yb 29.20 zb 0.42 Amp 33.3 Sweep 311 Ascan 95 MPL 79
Chan 2 - C-Scan - 70L OUT-D2-01PW72 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 137.65° yb 27.62 zb 0.27 Amp 83.9 Sweep 129 Ascan 99 MPL 61

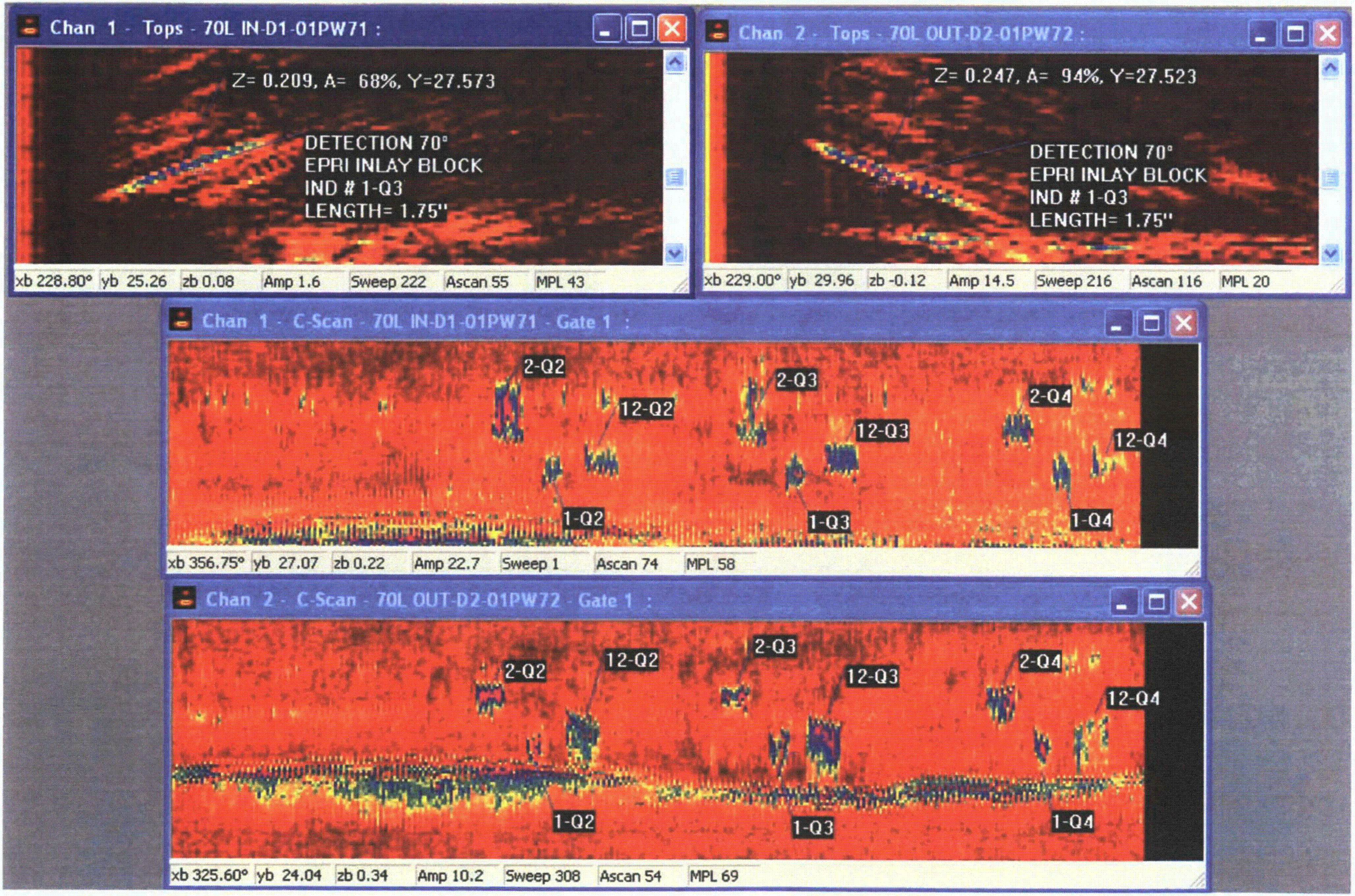

Chan 1 - Tops - 70L IN-D1-01PW71 :
Z= 0.341, A= 100%, Y=26.513
DETECTION 70°
EPRI INLAY BLOCK
IND# 2-Q2
LENGTH= 2.75"
xb 120.65° yb 26.54 zb 0.32 Amp 100.0 Sweep 119 Ascan 63 MPL 69
Chan 2 - Tops - 70L OUT-D2-01PW72 :
Z= 0.199, A= 50%, Y=26.378
DETECTION 70°
EPRI INLAY BLOCK
IND# 2-Q2
LENGTH= 2.75"
xb 120.85° yb 26.54 zb 0.33 Amp 40.0 Sweep 113 Ascan 87 MPL 68
Chan 1 - C-Scan - 70L IN-D1-01PW71 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 120.65° yb 26.56 zb 0.33 Amp 95.3 Sweep 119 Ascan 63 MPL 70
Chan 2 - C-Scan - 70L OUT-D2-01PW72 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 120.85° yb 26.54 zb 0.33 Amp 40.0 Sweep 113 Ascan 87 MPL 68

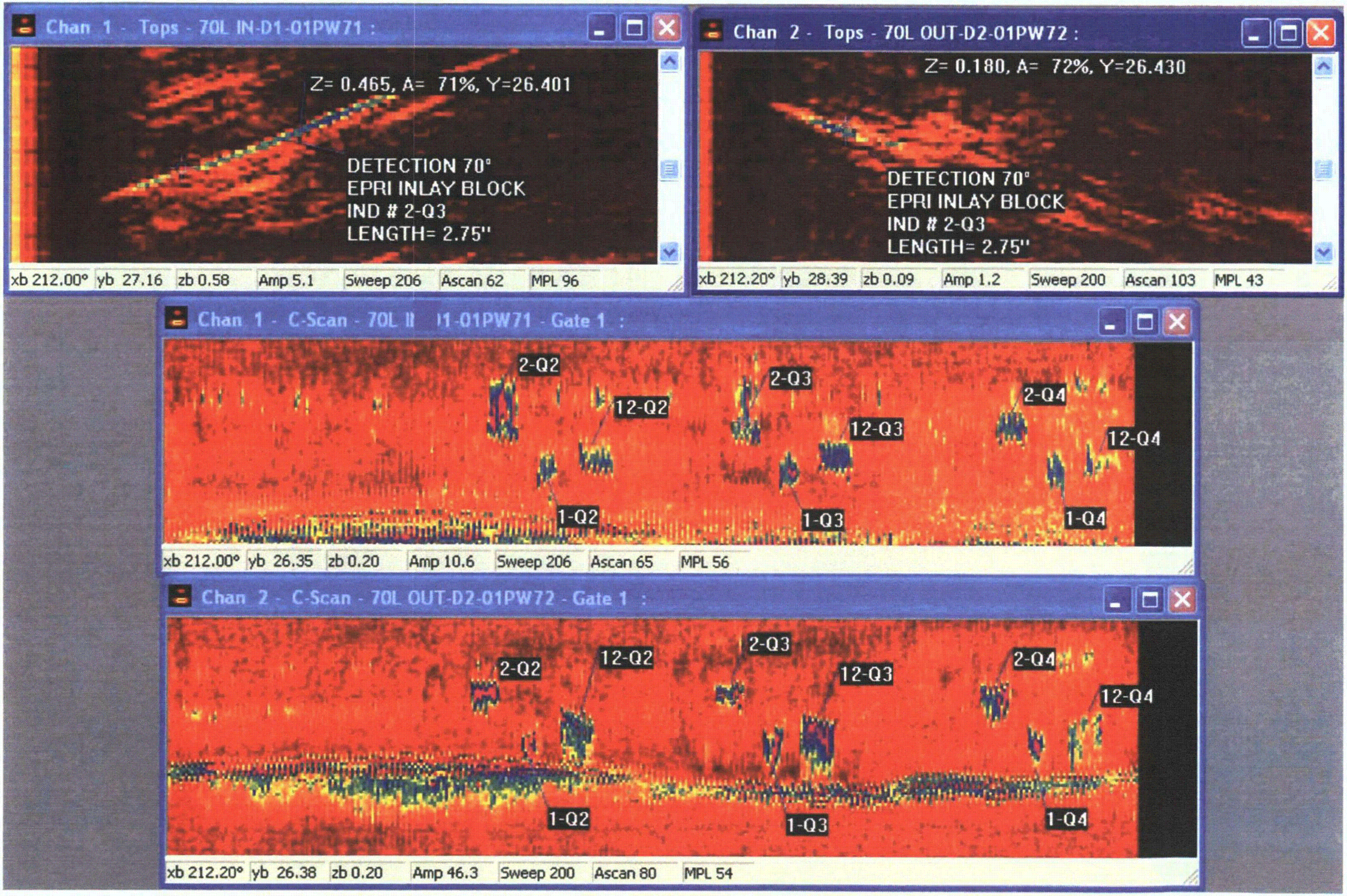


Chan 1 - Tops - 70L CCW-D3-01PW73 : Inlay-Det C...
Z= 0.158, A= 61%, Y=101.537
DETECTION 70°
EPRI INLAY BLOCK
IND# 3-Q2
LENGTH = 0.64"
xb 27.28 yb 97.22° zb -0.17 Amp 23.5 Sweep 32 Ascan 295 MPL 16
Chan 2 - Tops - 70L CW-D4-01PW74 : Inlay-D...
Z= 0.148, A= 30%, Y=102.334
DETECTION 70°
EPRI INLAY BLOCK
IND# 3-Q2
LENGTH = 0.64"
xb 27.28 yb 90.24° zb 0.20 Amp 3.5 Sweep 32 Ascan 307 MPL
Chan 2 - C-Scan - 70L CW-D4-01PW74 - Gate 1 : Inlay-Det Circ2
3-Q2
3-Q3
3-Q4
xb 25.04 yb 114.61° zb 0.26 Amp 11.0 Sweep 4 Ascan 387 MPL 61
Chan 1 - C-Scan - 70L CCW-D3-01PW73 - Gate 1 : Inlay-Det Circ2
3-Q2
3-Q3
3-Q4
xb 25.20 yb 118.21° zb 0.20 Amp 10.6 Sweep 6 Ascan 362 MPL 55

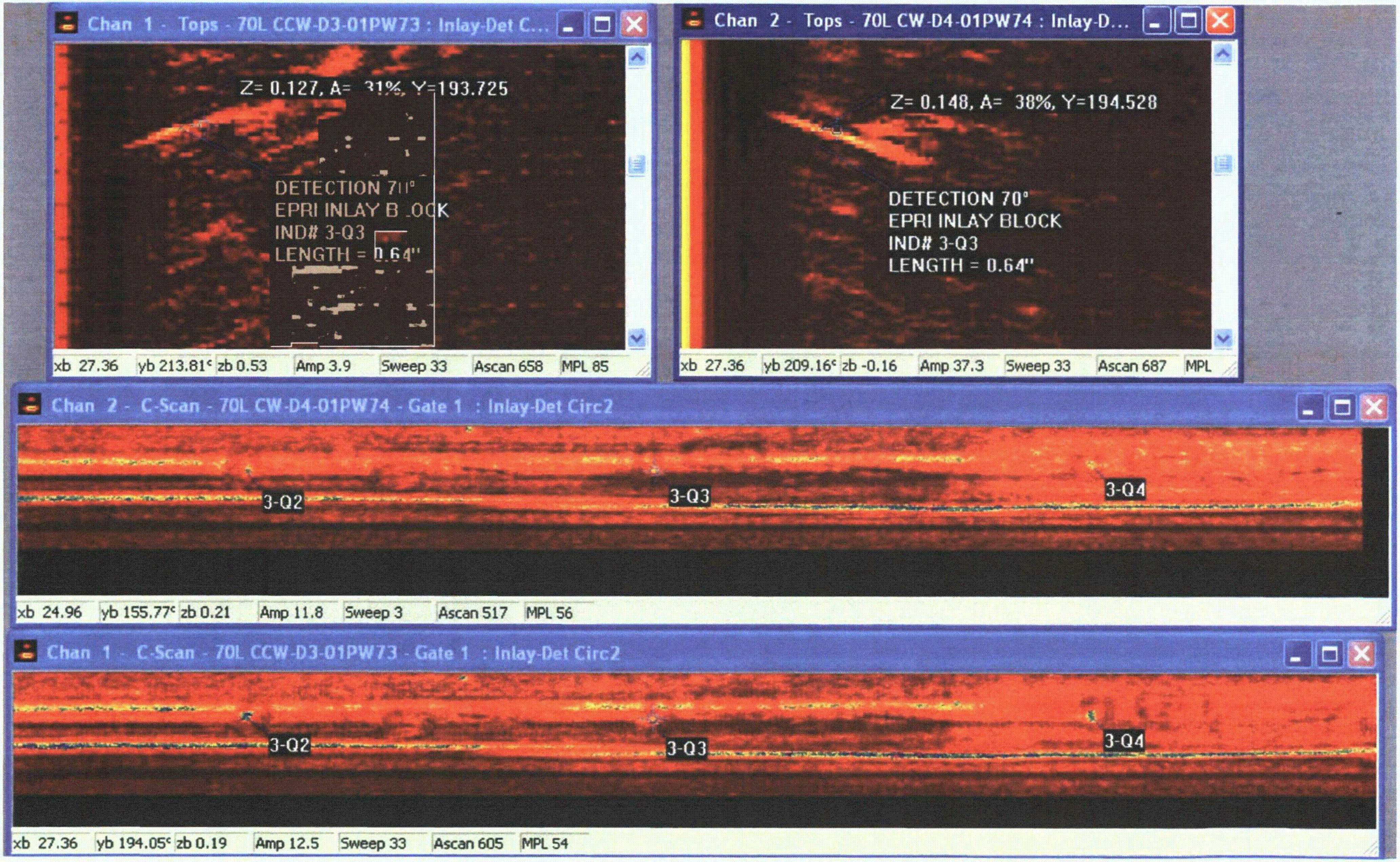


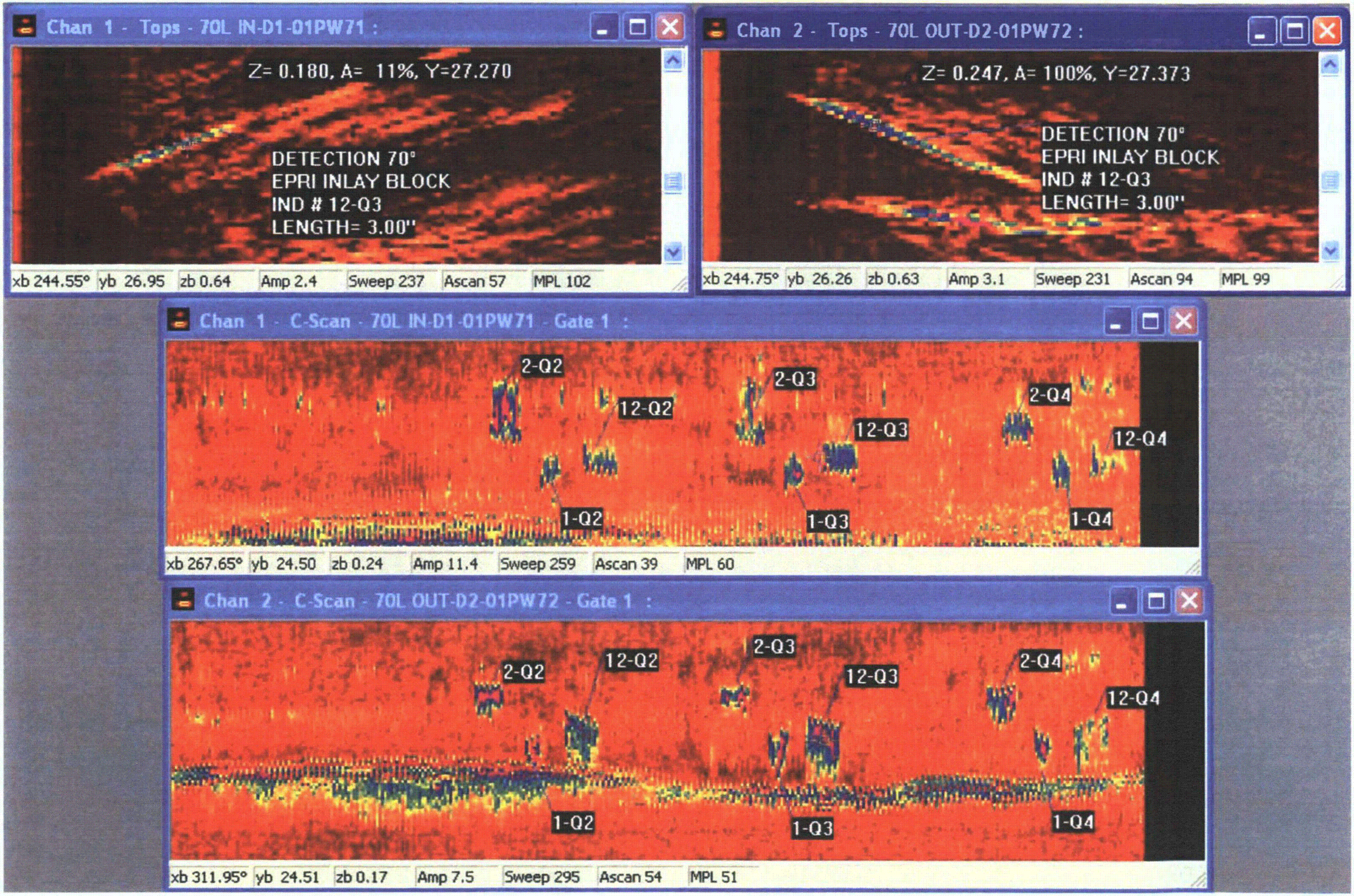
Chan 1 - Tops - 70L IN-D1-01PW71 :
Z= 0.142, A= 31%, Y=27.316
DETECTION 70°
EPRI INLAY BLOCK
IND# 12-Q2
LENGTH= 3.00"
xb 156.35° yb 25.92 zb 0.40 Amp 8.2 Sweep 153 Ascan 52 MPL 77
Chan 2 - Tops - 70L OUT-D2-01PW72 :
Z= 0.209, A= 41%, Y=27.402
DETECTION 70°
EPRI INLAY BLOCK
IND# 12-Q2
LENGTH= 3.00"
xb 156.55° yb 26.00 zb 0.47 Amp 5.1 Sweep 147 Ascan 85 MPL 83
Chan 1 - C-Scan - 70L IN-D1-01PW71 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 138.50° yb 24.27 zb 0.18 Amp 9.0 Sweep 136 Ascan 38 MPL 54
Chan 2 - C-Scan - 70L OUT-D2-01PW72 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 306.70° yb 24.35 zb 0.23 Amp 11.4 Sweep 290 Ascan 54 MPL 57

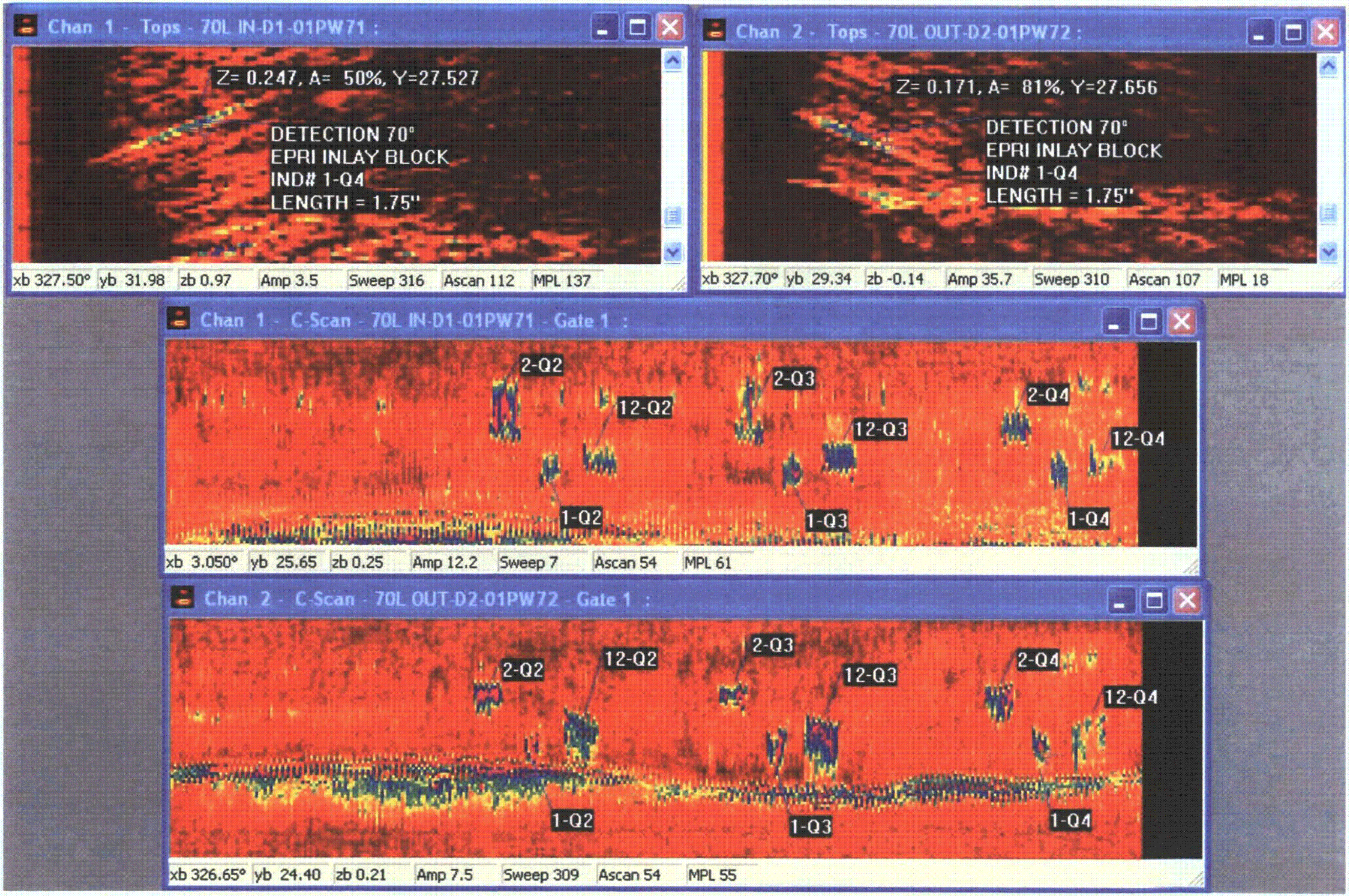

Chan 1 - Tops - 70L IN-D1-01PW71 :
Z= 0.209, A= 68%, Y=27.573
DETECTION 70°
EPRI INLAY BLOCK
IND # 1-Q3
LENGTH= 1.75"
xb 228.80° yb 25.26 zb 0.08 Amp 1.6 Sweep 222 Ascan 55 MPL 43
Chan 2 - Tops - 70L OUT-D2-01PW72 :
Z= 0.247, A= 94%, Y=27.523
DETECTION 70°
EPRI INLAY BLOCK
IND # 1-Q3
LENGTH= 1.75"
xb 229.00° yb 29.96 zb -0.12 Amp 14.5 Sweep 216 Ascan 116 MPL 20
Chan 1 - C-Scan - 70L IN-D1-01PW71 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 356.75° yb 27.07 zb 0.22 Amp 22.7 Sweep 1 Ascan 74 MPL 58
Chan 2 - C-Scan - 70L OUT-D2-01PW72 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 325.60° yb 24.04 zb 0.34 Amp 10.2 Sweep 308 Ascan 54 MPL 69

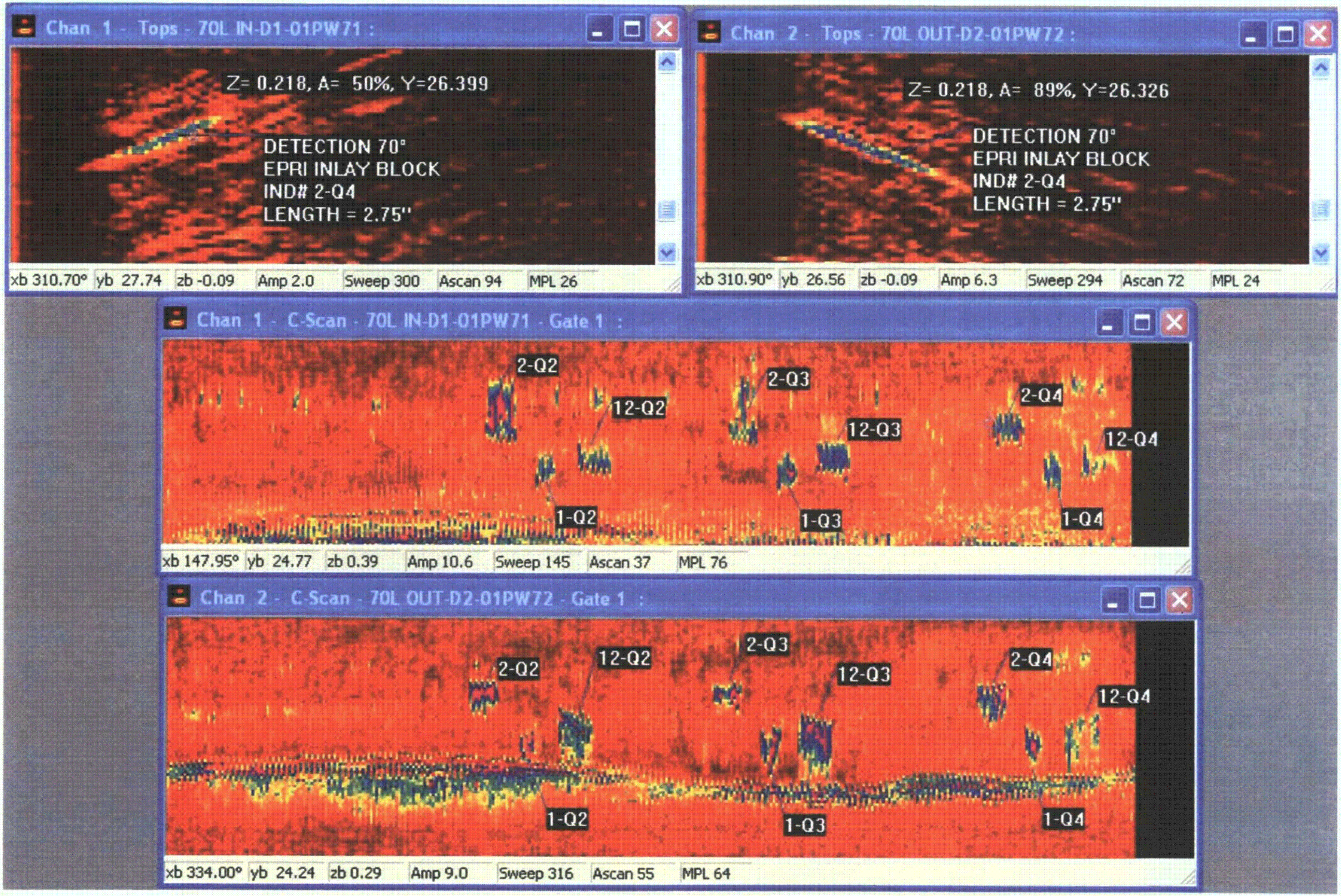


Chan 1 - Tops - 70L IN-D1-01PW71 :
Z= 0.465, A= 71%, Y=26.401
DETECTION 70°
EPRI INLAY BLOCK
IND # 2-Q3
LENGTH= 2.75"
xb 212.00° yb 27.16 zb 0.58 Amp 5.1 Sweep 206 Ascan 62 MPL 96
Chan 2 - Tops - 70L OUT-D2-01PW72 :
Z= 0.180, A= 72%, Y=26.430
DETECTION 70°
EPRI INLAY BLOCK
IND # 2-Q3
LENGTH= 2.75"
xb 212.20° yb 28.39 zb 0.09 Amp 1.2 Sweep 200 Ascan 103 MPL 43
Chan 1 - C-Scan - 70L
1-01PW71 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 212.00° yb 26.35 zb 0.20 Amp 10.6 Sweep 206 Ascan 65 MPL 56
Chan 2 - C-Scan - 70L OUT-D2-01PW72 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 212.20° yb 26.38 zb 0.20 Amp 46.3 Sweep 200 Ascan 80 MPL 54

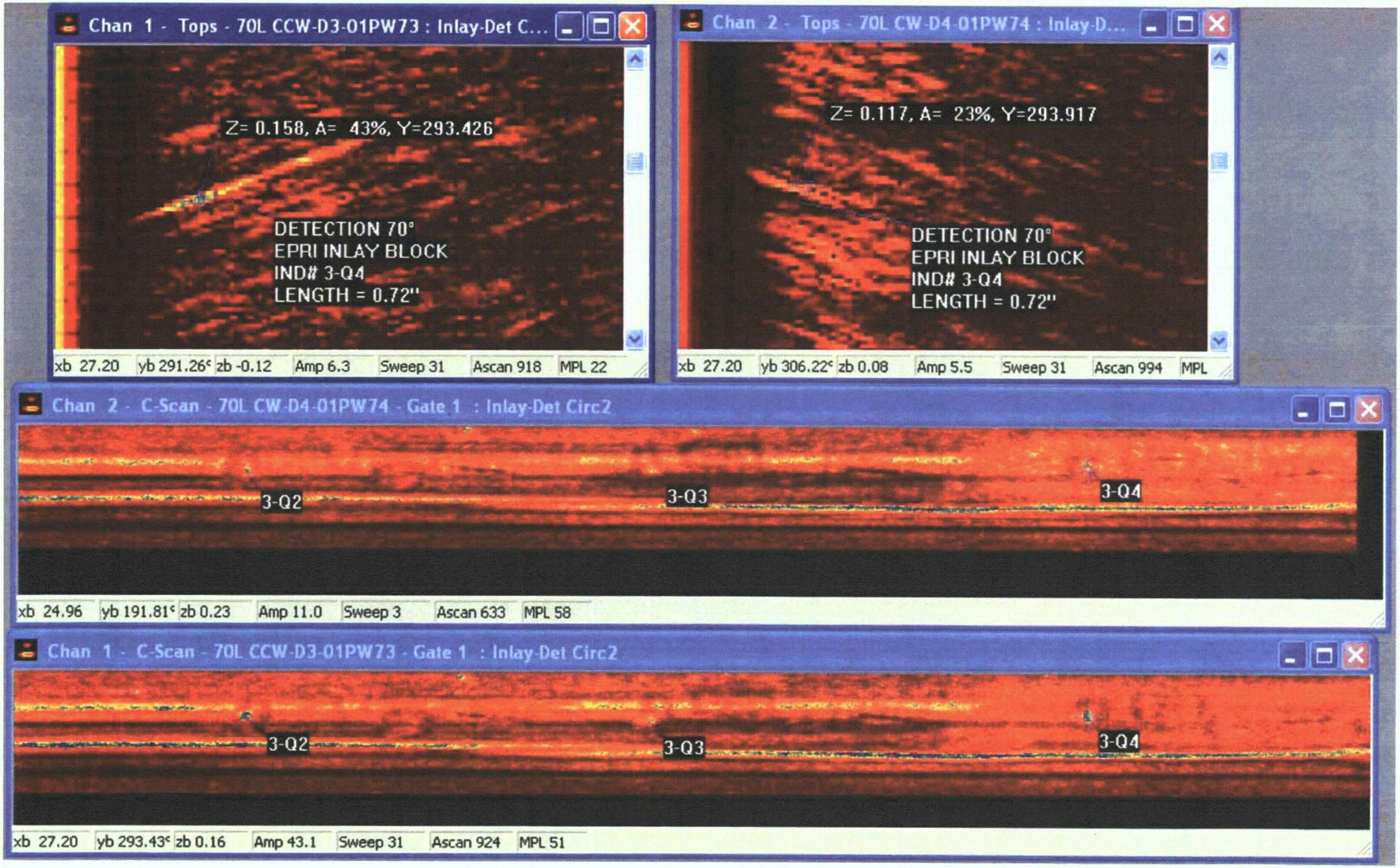

Chan 1 - Tops - 70L CCW-D3-01PW73 : Inlay-Det C...
Z= 0.127, A= 31%, Y=193.725
DETECTION 70°
EPRI INLAY BLOCK
IND# 3-Q3
LENGTH = 0.64"
xb 27.36 yb 213.81° zb 0.53 Amp 3.9 Sweep 33 Ascan 658 MPL 85
Chan 2 - Tops - 70L CW-D4-01PW74 : Inlay-D...
Z= 0.148, A= 38%, Y=194.528
DETECTION 70°
EPRI INLAY BLOCK
IND# 3-Q3
LENGTH = 0.64"
xb 27.36 yb 209.16° zb -0.16 Amp 37.3 Sweep 33 Ascan 687 MPL
Chan 2 - C-Scan - 70L CW-D4-01PW74 - Gate 1 : Inlay-Det Circ2
3-Q2
3-Q3
3-Q4
xb 24.96 yb 155.77° zb 0.21 Amp 11.8 Sweep 3 Ascan 517 MPL 56
Chan 1 - C-Scan - 70L CCW-D3-01PW73 - Gate 1 : Inlay-Det Circ2
3-Q2
3-Q3
3-Q4
xb 27.36 yb 194.05° zb 0.19 Amp 12.5 Sweep 33 Ascan 605 MPL 54

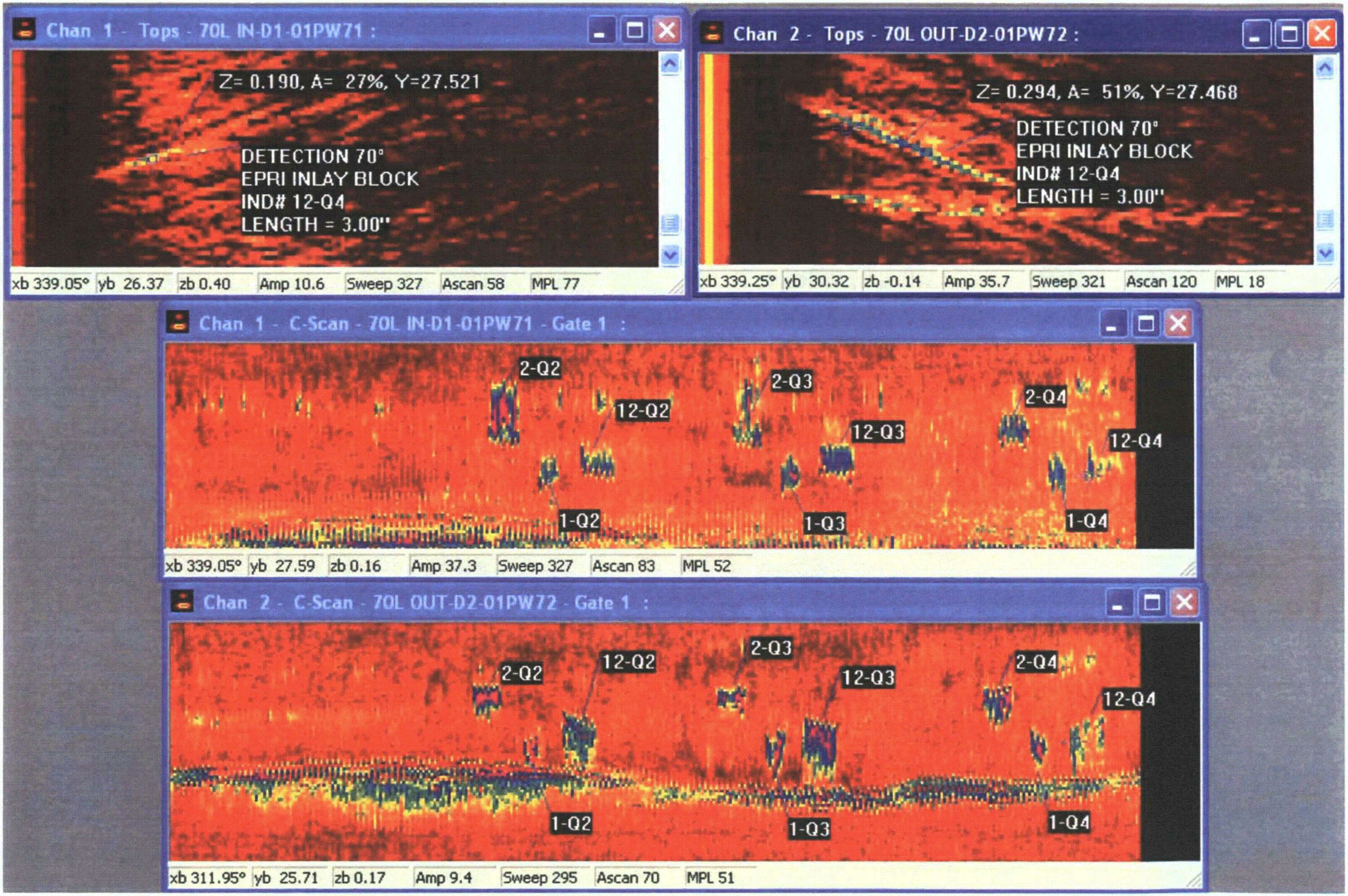

Chan 1 - Tops - 70L IN-D1-01PW71 :
Z= 0.180, A= 11%, Y=27.270
DETECTION 70°
EPRI INLAY BLOCK
IND # 12-Q3
LENGTH= 3.00"
xb 244.55° yb 26.95 zb 0.64 Amp 2.4 Sweep 237 Ascan 57 MPL 102
Chan 2 - Tops - 70L OUT-D2-01PW72 :
Z= 0.247, A= 100%, Y=27.373
DETECTION 70°
EPRI INLAY BLOCK
IND # 12-Q3
LENGTH= 3.00"
xb 244.75° yb 26.26 zb 0.63 Amp 3.1 Sweep 231 Ascan 94 MPL 99
Chan 1 - C-Scan - 70L IN-D1-01PW71 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 267.65° yb 24.50 zb 0.24 Amp 11.4 Sweep 259 Ascan 39 MPL 60
Chan 2 - C-Scan - 70L OUT-D2-01PW72 - Gate 1 :
2-Q3
2-Q2
12-Q2
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 311.95° yb 24.51 zb 0.17 Amp 7.5 Sweep 295 Ascan 54 MPL 51


Chan 1 - Tops - 70L IN-D1-01PW71 :
Z= 0.247, A= 50%, Y=27.527
DETECTION 70°
EPRI INLAY BLOCK
IND# 1-Q4
LENGTH = 1.75"
xb 327.50° yb 31.98 zb 0.97 Amp 3.5 Sweep 316 Ascan 112 MPL 137
Chan 2 - Tops - 70L OUT-D2-01PW72 :
Z= 0.171, A= 81%, Y=27.656
DETECTION 70°
EPRI INLAY BLOCK
IND# 1-Q4
LENGTH = 1.75"
xb 327.70° yb 29.34 zb -0.14 Amp 35.7 Sweep 310 Ascan 107 MPL 18
Chan 1 - C-Scan - 70L IN-D1-01PW71 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 3.050° yb 25.65 zb 0.25 Amp 12.2 Sweep 7 Ascan 54 MPL 61
Chan 2 - C-Scan - 70L OUT-D2-01PW72 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 326.65° yb 24.40 zb 0.21 Amp 7.5 Sweep 309 Ascan 54 MPL 55



Chan 1 - Tops - 70L IN-D1-01PW71 :
Z= 0.218, A= 50%, Y=26.399
DETECTION 70°
EPRI INLAY BLOCK
IND# 2-Q4
LENGTH = 2.75"
xb 310.70° yb 27.74 zb -0.09 Amp 2.0 Sweep 300 Ascan 94 MPL 26
Chan 2 - Tops - 70L OUT-D2-01PW72 :
Z= 0.218, A= 89%, Y=26.326
DETECTION 70°
EPRI INLAY BLOCK
IND# 2-Q4
LENGTH = 2.75"
xb 310.90° yb 26.56 zb -0.09 Amp 6.3 Sweep 294 Ascan 72 MPL 24
Chan 1 - C-Scan - 70L IN-D1-01PW71 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 147.95° yb 24.77 zb 0.39 Amp 10.6 Sweep 145 Ascan 37 MPL 76
Chan 2 - C-Scan - 70L OUT-D2-01PW72 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 334.00° yb 24.24 zb 0.29 Amp 9.0 Sweep 316 Ascan 55 MPL 64


Chan 1 - Tops - 70L CCW-D3-01PW73 : Inlay-Det C...
Z= 0.158, A= 43%, Y=293.426
DETECTION 70°
EPRI INLAY BLOCK
IND# 3-Q4
LENGTH = 0.72"
xb 27.20 yb 291.26 zb -0.12 Amp 6.3 Sweep 31 Ascan 918 MPL 22
Chan 2 - Tops - 70L CW-D4-01PW74 : Inlay-D...
Z= 0.117, A= 23%, Y=293.917
DETECTION 70°
EPRI INLAY BLOCK
IND# 3-Q4
LENGTH = 0.72"
xb 27.20 yb 306.22 zb 0.08 Amp 5.5 Sweep 31 Ascan 994 MPL
Chan 2 - C-Scan - 70L CW-D4-01PW74 - Gate 1 : Inlay-Det Circ2
3-Q2
3-Q3
3-Q4
xb 24.96 yb 191.81 zb 0.23 Amp 11.0 Sweep 3 Ascan 633 MPL 58
Chan 1 - C-Scan - 70L CCW-D3-01PW73 - Gate 1 : Inlay-Det Circ2
3-Q2
3-Q3
3-Q4
xb 27.20 yb 293.43 zb 0.16 Amp 43.1 Sweep 31 Ascan 924 MPL 51


Chan 1 - Tops - 70L IN-D1-01PW71 :
Z= 0.190, A= 27%, Y=27.521
DETECTION 70°
EPRI INLAY BLOCK
IND# 12-Q4
LENGTH = 3.00"
xb 339.05° yb 26.37 zb 0.40 Amp 10.6 Sweep 327 Ascan 58 MPL 77
Chan 2 - Tops - 70L OUT-D2-01PW72 :
Z= 0.294, A= 51%, Y=27.468
DETECTION 70°
EPRI INLAY BLOCK
IND# 12-Q4
LENGTH = 3.00"
xb 339.25° yb 30.32 zb -0.14 Amp 35.7 Sweep 321 Ascan 120 MPL 18
Chan 1 - C-Scan - 70L IN-D1-01PW71 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 339.05° yb 27.59 zb 0.16 Amp 37.3 Sweep 327 Ascan 83 MPL 52
Chan 2 - C-Scan - 70L OUT-D2-01PW72 - Gate 1 :
2-Q2
12-Q2
2-Q3
12-Q3
2-Q4
12-Q4
1-Q2
1-Q3
1-Q4
xb 311.95° yb 25.71 zb 0.17 Amp 9.4 Sweep 295 Ascan 70 MPL 51