FRAMATOME ANP

Davis Besse

13RF0

CRDM Nozzle

Examination Report

PROPRIETARY

March 9, 2002

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UT-Level III
Framatome ANP

Automated ultrasonic examinations of 69 CRDM nozzles were performed from beneath the head using the ARAMIS inspection tool and a "Circ." blade probe. Framatome ANP examination procedure 54-ISI-100-08, "Remote Ultrasonic Examination of Reactor Head Penetrations" was used to perform the examination. This procedure was revised by change authorizations #FRA-02-002 and #DB-02-012 and governs the remote automated contact ultrasonic examination of CRDM nozzles using the ACCUSONEX™ automated data acquisition and analysis system.

The techniques utilized for this examination are intended for the detection and through-wall (depth) sizing of circumferential ID and OD initiating flaws in the nozzle base metal only. Forward scatter (TOFD), longitudinal-wave techniques are used. The examinations were conducted from the bore of the CRDM nozzles in the J-groove weld region of the nozzle.

The examinations performed with the blade probe consisted of scanning for circumferential and significant axial flaws within the nozzle wall. The tooling consisted of a blade containing a nominal 5 MHz, 50 degree TOFD transducer set. The circ. blade probe provides flaw detection (axial and circ. flaws) and sizing (non-axial flaws) information. For the forward scatter transducers, flaw detection is identified by loss of signal response either from the lateral wave or backwall responses as well as the presence of crack tip diffracted responses.

Prior to the examinations, demonstrations were performed using the EPRI/MRP samples removed from Oconee. This demonstration showed that circumferential as well as axial flaws could be detected with the circ. blade probe.

The ARAMIS tool was positioned beneath each nozzle examined with the "Y" axis (axial) zeroed at the bottom of the nozzle with the positive direction extending up the nozzle. The "Theta" axis was zeroed at the downhill side of the nozzle with the positive direction proceeding in the clockwise direction while looking down from the top of the nozzle. Following the initial examination, some nozzles had areas where the gap was too narrow to insert the probe. All of these exclusion areas were rescanned after the initial inspection by moving the lead screw support tube to open the gap for examination.

The examination with the blade probe identified flaw indications in six nozzles (1, 2, 3, 5, 47, and 58). Because almost all of the flaws detected on these nozzles were characterized as axial, only limited information was available with the circ. blade probe. These axial flaws could have been characterized using axial blade probes, however, because there was a high probability that these nozzles would require repair, the drives for these nozzles were removed in order to perform additional UT examination using the Top-Down tool. The Top-Down tool contains 10 transducers and provides the ability to detect and characterize axial and circumferential flaws and also provides additional information in the nozzle

tube required for the repair activity. Images of the nozzles identified for repair are included in this report and identify the various landmarks required to implement the repair. These generally include the location of the head OD, the elevation of the proposed cut line, and the location of the top of the j-groove weld.

Automated ultrasonic examinations of six CRDM nozzles (1, 2, 3, 5, 47, and 58) were performed using the Top-Down inspection tool and Framatome ANP examination procedure 54-ISI-100-08. The techniques utilized for the examination are intended for the detection and through-wall (depth) sizing of axial and circumferential ID and OD initiating flaws in the nozzle base metal only. Forward scatter, longitudinal-wave and backward scatter shear wave techniques are used. The examinations were conducted from the bore of the CRDM nozzles in the J-groove weld region of the nozzle.

The inspections consisted of scanning for axial and circumferential flaws within the nozzle. The tooling consisted of a transducer head that holds 10 individual search units. These search units were divided into two sets, one for the axial beam direction and one for the circumferential beam direction. The axial beam direction set of search units consisted of 5.0 MHz, longitudinal wave forward scatter time of flight search units with angles of 30° and 45°; backward scatter pulse echo, 2.25 MHz 60° shear wave search units; and a 5.0 MHz 0° search unit (see Appendix A for calibrations files and scan parameters). The circumferential beam direction set of search units consisted of 5.0 MHz, longitudinal wave forward scatter time of flight search units with angles of 45°, 55°, and 65°; backward scatter pulse echo, 2.25 MHz 60° shear wave search units; and a 5.0 MHz 0° search unit (see Appendix B for calibrations files and scan parameters).

The detection of flaw indications is based upon the expected responses for each search unit and technique. The 0° transducer provides weld position information and also provide positional information due to lack of backwall response in the region of the flaw. The forward scatter time of flight techniques provides flaw detection and sizing information. For the forward scatter transducers, flaw detection is identified by loss of signal response either from the lateral wave or backwall responses as well as detection of crack tip diffracted responses. The 60° shear wave transducer provides detection by means of corner trap responses between the flaw and nozzle surface and sizing with tip diffracted signals.

The top-down tool was positioned with the "Z" axis (axial) zeroed at the top of the nozzle flange with the positive direction extending down the nozzle. The "Theta" (rotational) axis was zeroed at the dowel pinhole in the flange with the positive direction in the clockwise direction while looking down from the top of the nozzle. The ultrasonic data is adjusted for individual transducer offsets in the transducer head to provide actual reflector location in the nozzle.

This report contains the data sheets from ultrasonic examination of the 6 CRDM nozzles that were identified as having flaws with the blade probe. Included in this report are the data sheets for the blade UT and the rotating UT from the Top-Down tool. Images of the UT data are also included to show the features identifying detected flaws.

The data was also reviewed for evidence of a leak path in the penetration bore with the blade and rotating UT techniques. Leak paths were detected in nozzles 1, 2, and 3 with blade and rotating UT. Images of the leak paths are included in this report.

Review of the attached data sheets for the circ. blade and Top-Down UT examinations will show that not all of the axial flaws identified with the circ. blade probe were confirmed with the rotating probe. In each case, axial flaws were identified with the circ. blade probe but could not be substantiated with the rotating UT. This is primarily due to the means required to identify an axial flaw when the beam is directed along the axis of the nozzle with the circ. blade probe. Detection of an axial flaw with the circ. blade is made based on lack of signal amplitude and pattern of the signal loss observed in the C-scan. This loss of signal can either be due to interruption of the sound energy by an axial flaw in the beam path or by external factors affecting probe contact such as nozzle ovality or weld shrinkage.

The rotating UT also has conventional backward scatter transducers in both the axial and circumferential beam directions. These transducers rely on direct reflection from the flaw to provide detection. This is the opposite of the method used for the circ. blade probe and provides confirmation that a real flaw is detected. This is the reason that some of the flaw signals detected using the circ. blade probe were subsequently listed as non-relevant using the Top-Down tool. These axial flaw signals detected with the circ. blade probe could have also been dispositioned with the axial blade probes but, because they were likely candidates for repair, it was more efficient to use the rotating UT with the Top-Down tool for final disposition. Therefore the data from the Top-Down tool is considered the final result for each nozzle. Both data sheets are provided in this report for comparison.

A summary of the examination results is presented in the following table. The ultrasonic instrumentation calibration parameters are also included at the end of this report.

Nozzle #	Summary of Results
1	9 Axial Flaws
2	8 Axial Flaws, 1 Circ. Flaw
3	4 Axial Flaws
5	1 Axial Flaw
47	1 Axial Flaw
58	No Recordable Indications

See CRDM Nozzle Flaw Reports for each nozzle for specifics.

FRAMATOME ANP

CRDM Nozzle Ultrasonic Examination Data Sheet

Customer: FENOC	Plant: Davis Besse	Unit: n/a	Nozzle: 1
Procedure: 54-ISI-100-08 CA: FRA-02-002, DB-02-012	Nozzle Dimensions: (in.)	ID: 2.765 OD: 4.06	Thickness: 0.649
Downhill Side of Nozzle (deg.): 0	End of Noz. (in. 0	robe Serial No.'s: Ch 1 S0382CN	Ch 6
Axial Scan Start: -1.5, .22	Stop: 366, 9.8 Setup: 3	Ch 2	Ch 7
Files: B2058_17.43.33		Ch 3	Ch 8
Circ. Scan Start:	Stop: Setup:	Ch 4	Ch 9
Files:		Ch 5	Ch 10

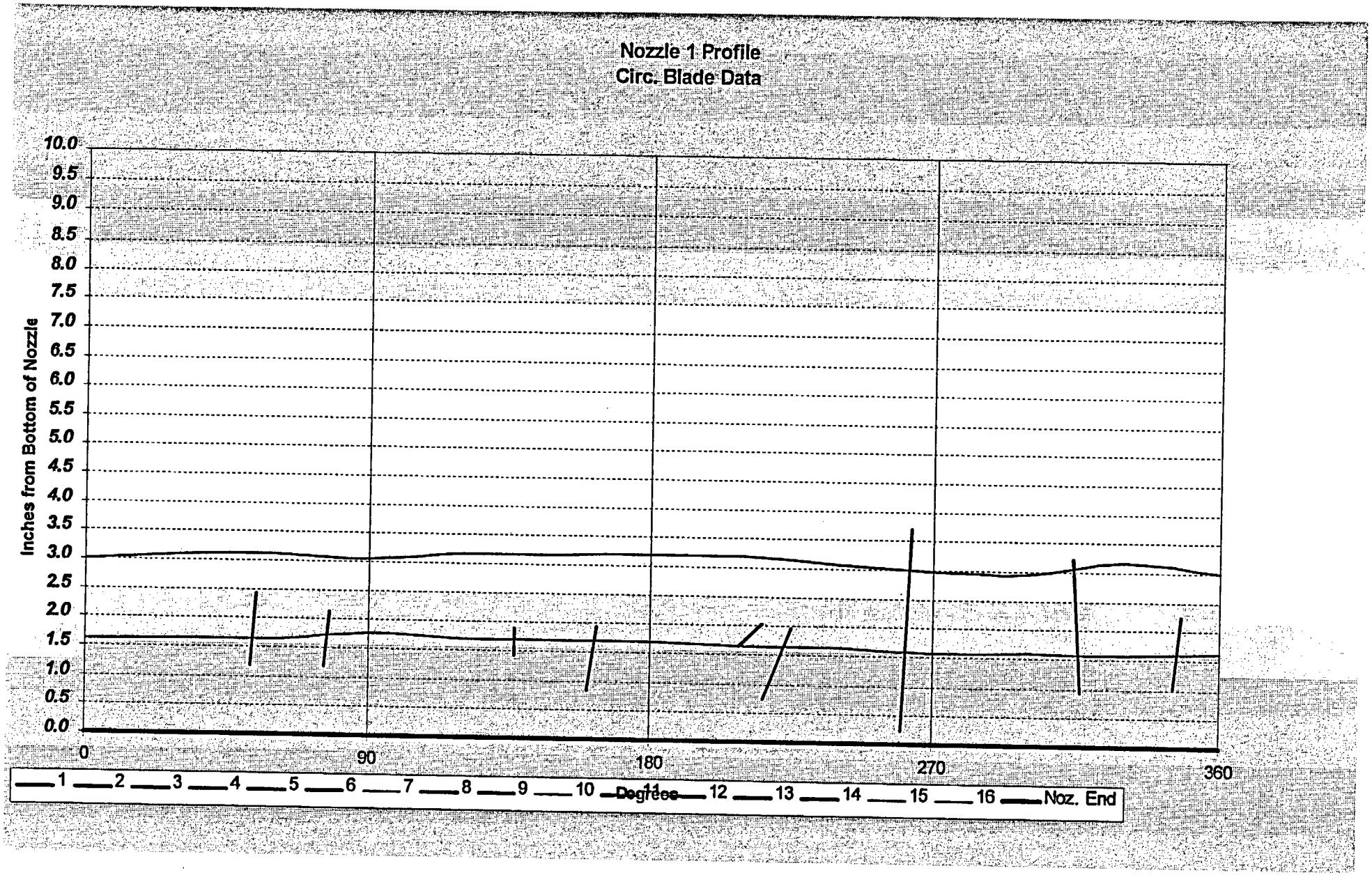
Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1 Min (in.)	End Point 1 Min (deg.)	End Point 2 Max (in.)	End Point 2 Max (deg.)	Axial Total (in.)	Adjusted Circ. Extent Min (deg.)	Adjusted Circ. Extent Max (deg.)	Adjusted Circ. Extent Total (in.)	Flaw Length (in.)	Flaw Angle (deg.)	Flaw TWD (in.)	Flaw Aspect Ratio	Flaw Orientation	Weld Location @ Flaw Min	Weld Location @ Flaw Max
1	OD		1.19	52.38	2.41	54.10	1.22	52.4	54.1	0.06	1.22	3			AXIAL		
2	OD		1.18	75.66	2.13	77.38	0.95	75.7	77.4	0.06	0.95	4			AXIAL		
3	OD		1.43	136.87	1.88	136.87	0.45	136.9	136.9	0.00	0.45	0			AXIAL		
4	OD		0.84	160.15	1.93	162.74	1.09	160.2	162.7	0.09	1.09	5			AXIAL		
5	OD		1.65	208.44	2.03	215.83	0.38	208.4	215.8	0.26	0.46	35			AXIAL		
6	OD		0.76	216.20	1.97	224.82	1.21	216.2	224.8	0.31	1.25	14			AXIAL		
7	OD		0.24	260.17	3.70	262.75	3.46	260.2	262.8	0.09	3.46	2			AXIAL		
8	OD		0.94	316.24	3.21	313.62	2.27	316.2	313.6	-0.09	2.27	178			AXIAL		
9	OD		1.02	345.56	2.24	348.11	1.22	345.6	348.1	0.09	1.22	4			AXIAL		
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	

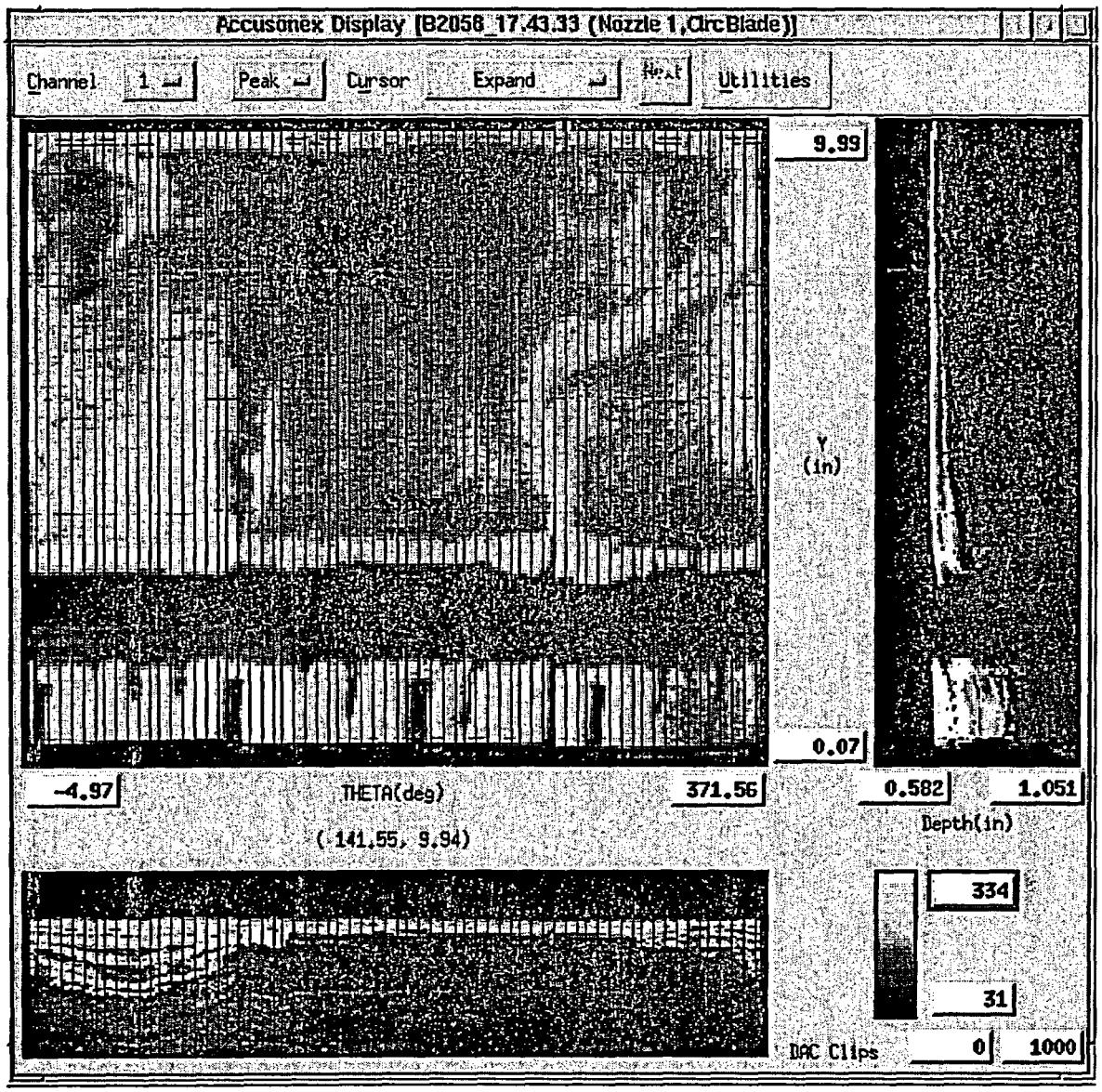
WELD PROFILE															
	Data Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
	Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
	Noz. End	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Inches
	MAX	3.00	3.10	3.12	3.05	3.17	3.17	3.19	3.19	3.08	2.98	2.96	3.17	3.00	Inches
	MIN.	1.62	1.64	1.64	1.76	1.69	1.69	1.69	1.64	1.64	1.58	1.60	1.57	1.62	Inches

Notes: Adjusted Circ. Extent is relative to downhill side of nozzle; clockwise looking down. TWD is Through-Wall Dimension

Comments: These flaws are axial in the weld region. Flaw #7 is are believed to be throughwall and creates the leak path through the weld region. Several other axial flaws are detected in the weld region but are not able to be fully characterized using the circ. blade probe. Full characterization of all flaws in this nozzle will be performed using the top-down tool. This report will be revised when the top-down data becomes available.

Analyzed by: C. E. MARTIN Date: 2/28/02 Analyzed by: Date:


Nozzle 1 Profile
Circ. Blade Data
Inches from Bottom of Nozzle
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
90
180
270
360
Degrees
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Noz. End



This scan provided the initial detection of flaws in the nozzle wall using the circ. blade probe. Leak Path patterns are observed in this image. The vent holes (at 90 deg. intervals) are also detected as well as several axial flaws starting below the weld and extending into the J-groove weld region of the nozzle. At least one flaw extends above the J-groove weld region.

Nozzle 1
Circ. Blade UT Data

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CRDM Nozzle Ultrasonic Examination Data Sheet

Customer:	FENOC				**Plant:**	Davis Besse			**Unit:**	n/a				**Nozzle:**	1				
Procedure:	54-ISI-100-08	CA: FRA-02-002, DB-02-012			**Nozzle Dimensions: (in.)**				**ID:** 2.765		**OD:** 4.06			**Thickness:**	0.649				
Downhill Side of Nozzle (deg.):	183	**End of Noz. (in.**	29.6		robe Serial No.'s:	Ch 1	2078-01002-0L		Ch 6	21GB-01002-45L									
Axial Scan	Start: -6, 15.06		Stop: 360, 29.63		**Setup:**	1			Ch 2	21GF-01004-30L				Ch 7	21GC-01001-55L				
Files:	T2061_12.36.51								Ch 3	21GA-01004-45L				Ch 8	22CD-01001-65L				
Circ. Scan	Start: -5, 19.23		Stop: 360, 29.63		**Setup:**	2			Ch 4	2623-01002-60S				Ch 9	2624-01005-60S				
Files:	T2061_11.11.08								Ch 5	2623-01002-60S				Ch 10	2624-01005-60S				

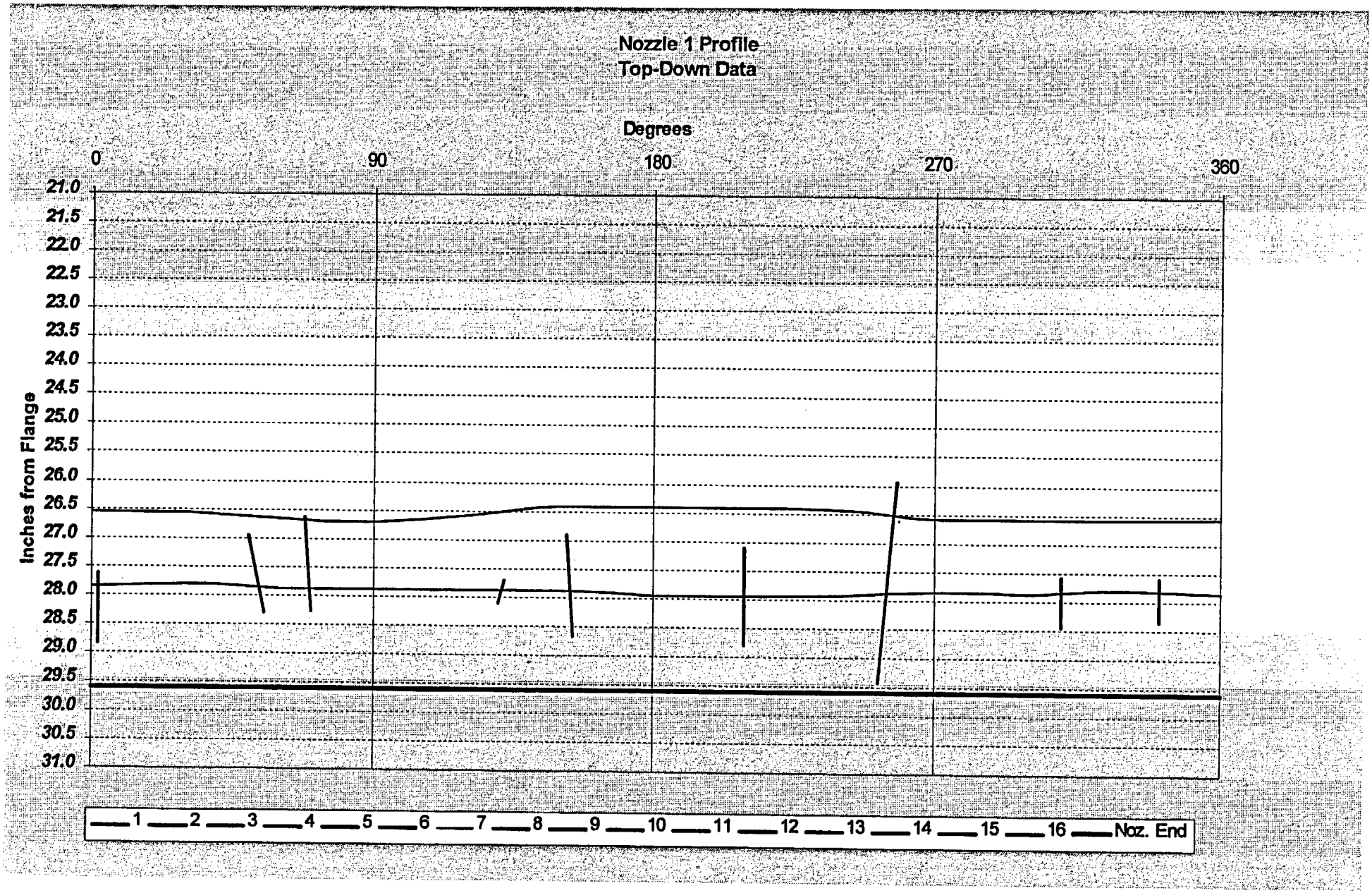
Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1		End Point 2		Axial Total (in.)	Adjusted Circ. Extent			Flaw Length (in.)	Flaw Angle (deg.)	Flaw TWD (in.)	Flaw Aspect Ratio	Flaw Orientation	Weld Location @ Flaw	
			Min (in.)	Min (deg.)	Max (in.)	Max (deg.)		Min (deg.)	Max (deg.)	Total (in.)						Min	Max
1	OD	0.29	26.97	133	28.31	128	1.34	50.0	55.0	0.18	1.35	8	0.36	0.27	AXIAL	In Weld Region	
2	OD	0.24	26.63	115	28.29	113	1.66	68.0	70.0	0.07	1.66	2	0.41	0.24	AXIAL	In Weld Region	
3	OD	0.63	27.71	51	28.11	53	0.40	132.0	130.0	0.07	0.41	10	0.02	0.05	AXIAL	In Weld Region	
4	OD	TW	26.9	31	28.67	29	1.77	152.0	154.0	0.07	1.77	2	0.65	0.37	AXIAL	In Weld Region	
5																	
6	OD	0.04	27.1	334	28.8	334	1.70	209.0	209.0	0.00	1.70	0	0.61	0.36	AXIAL	In Weld Region	
7	OD	TW	25.95	285	29.43	291	3.48	258.0	252.0	0.21	3.49	3	0.65	0.19	AXIAL	In Weld Region	
8	OD	0.32	27.58	233	28.45	233	0.87	310.0	310.0	0.00	0.87	0	0.33	0.38	AXIAL	In Weld Region	
9	OD	0.28	27.6	202	28.35	202	0.75	341.0	341.0	0.00	0.75	0	0.37	0.49	AXIAL	In Weld Region	
10	OD	0.24	27.64	181	28.86	181	1.22	2.0	2.0	0.00	1.22	0	0.41	0.34	AXIAL	In Weld Region	
11																	
12																	
13																	
14																	
15																	
16																	
17																	
WELD PROFILE		Data Loc.	183	213	243	273	303	333	3	33	63	93	123	153	183	Degrees	
		Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees	
		Noz. End	29.60	29.60	29.60	29.60	29.60	29.60	29.60	29.60	29.60	29.60	29.60	29.60	29.60	Inches	
		MAX.	27.85	27.82	27.89	27.89	27.89	27.89	27.97	27.97	27.93	27.85	27.89	27.82	27.85	Inches	
		MIN.	26.55	26.55	26.67	26.71	26.59	26.40	26.40	26.40	26.44	26.59	26.59	26.59	26.55	Inches	

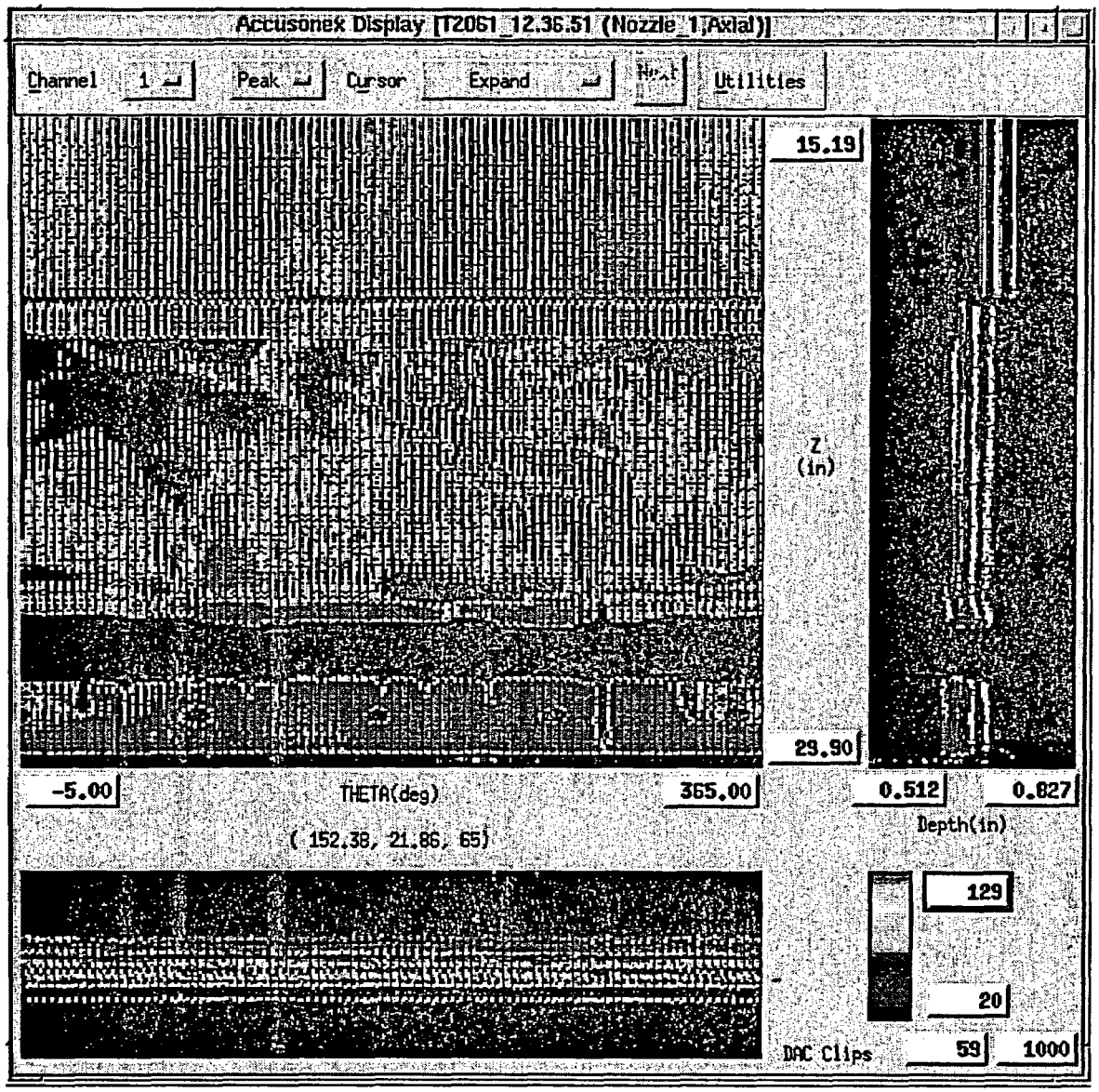
Notes: Adjusted Circ. Extent is relative to downhill side of nozzle;clockwise looking down. TWD is Through-Wall Dimension

Comments: Data was encoded with positive Theta going counterclockwise. Adjusted circ. positions have corrected the position to read clockwise looking down.

Flaw # 5 was identified as an axial flaw using the circ. blade probe but is not confirmed with the rotating UT. Therefore, flaw #5 is not relevant.

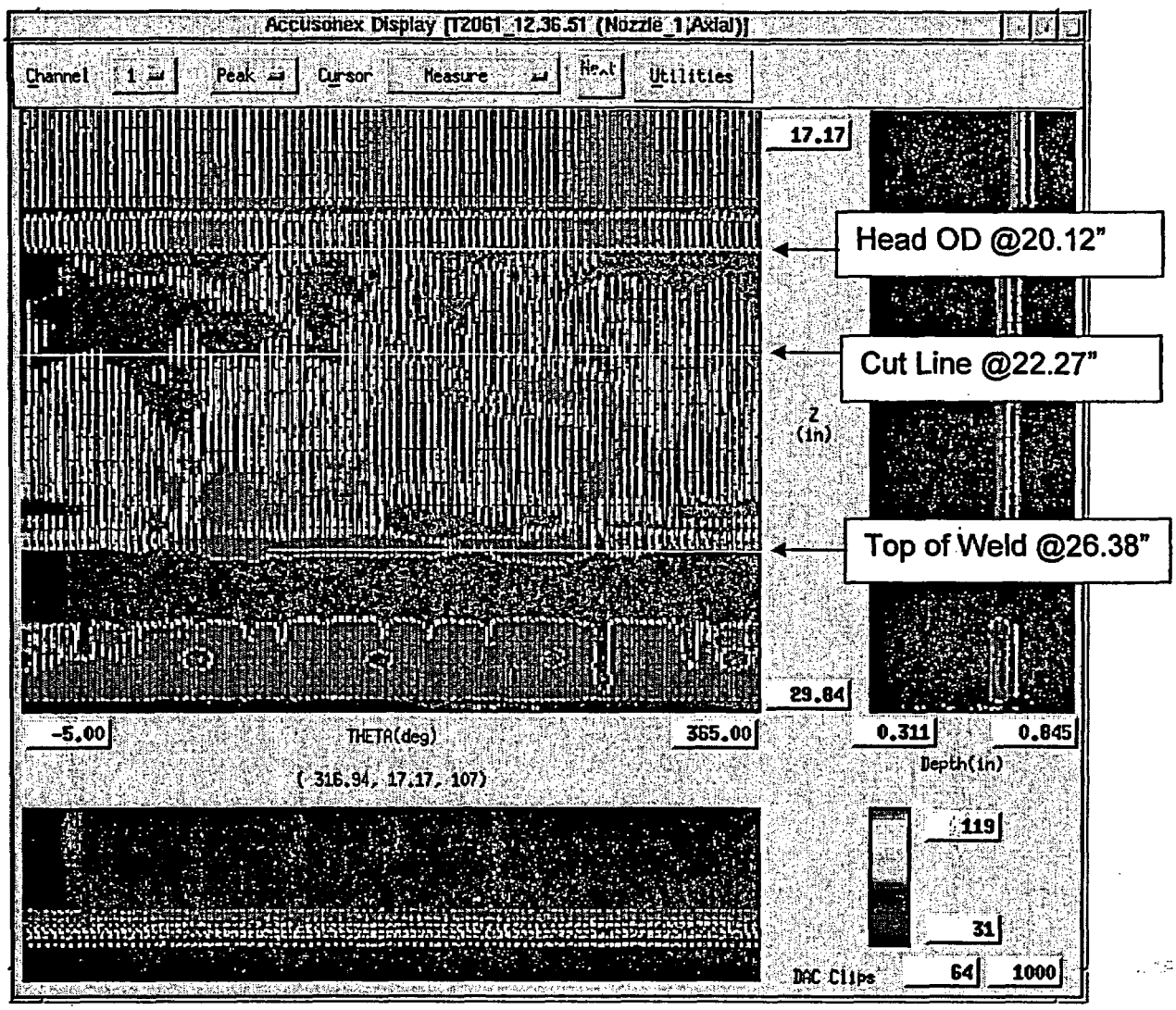
Analyzed by: K.C.Gebetsberger **Date:** 3/5/02 **Analyzed by:** M.G. Hacker **Date:** 3/5/02


Nozzle 1 Profile
Top-Down Data
Degrees
0
90
180
270
360
Inches from Flange
21.0
21.5
22.0
22.5
23.0
23.5
24.0
24.5
25.0
25.5
26.0
26.5
27.0
27.5
28.0
28.5
29.0
29.5
30.0
30.5
31.0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Noz. End

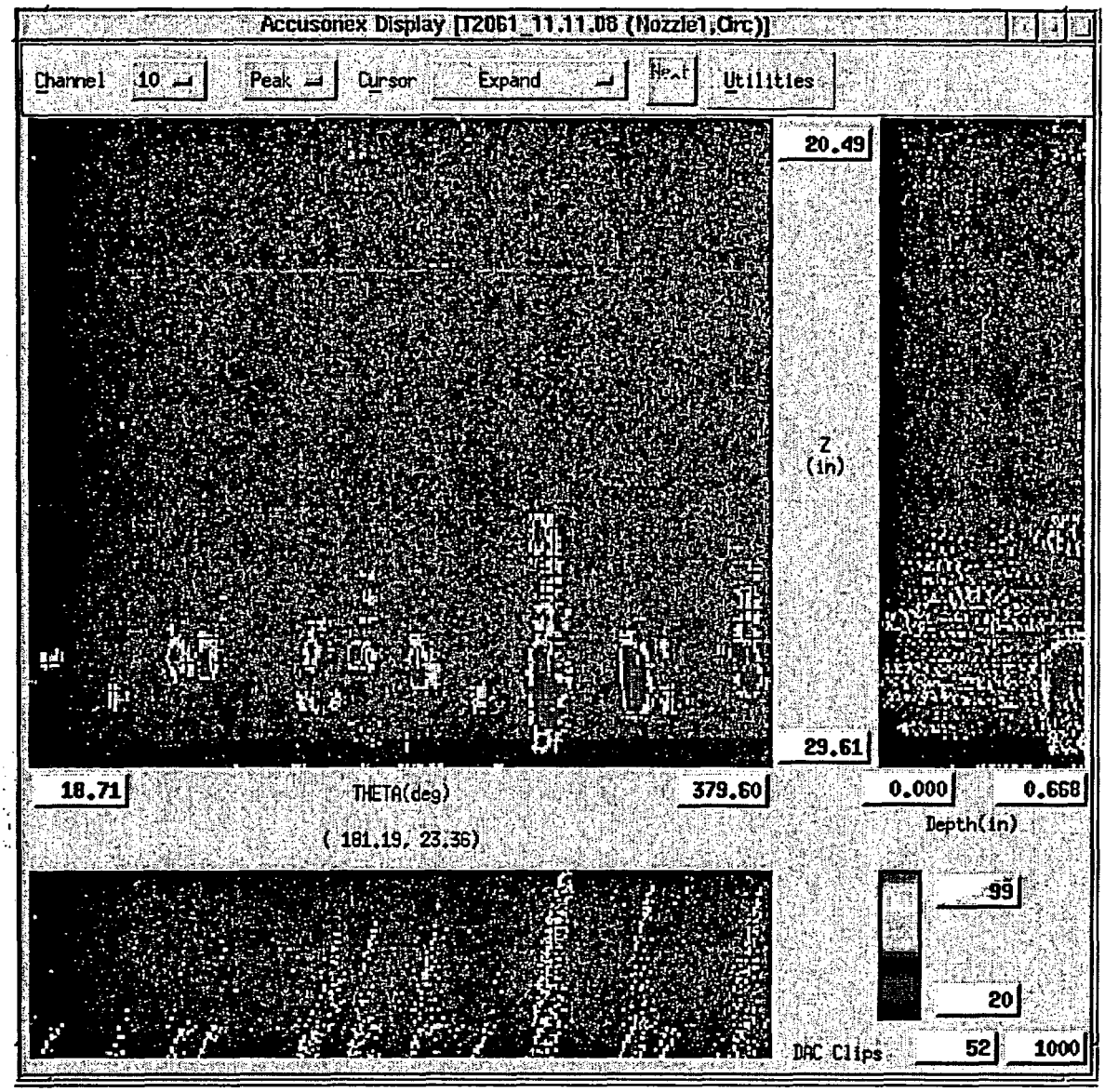


This scan provides more comprehensive characterization of the axial indications detected using the circ. blade probe and provides elevation dimensions for repair activities. This scan also provides characterization of the region of the nozzle surrounding the location of the new ID temperbead weld to assure sound material for welding. Leak Path patterns are observed in this image. The vent holes (at 90 deg. intervals) are also detected as well as several axial flaws starting below the weld and extending into the J-groove weld region of the nozzle. At least one flaw extends above the J-groove weld region.

Nozzle 1
Rotating UT, 0-deg. Data

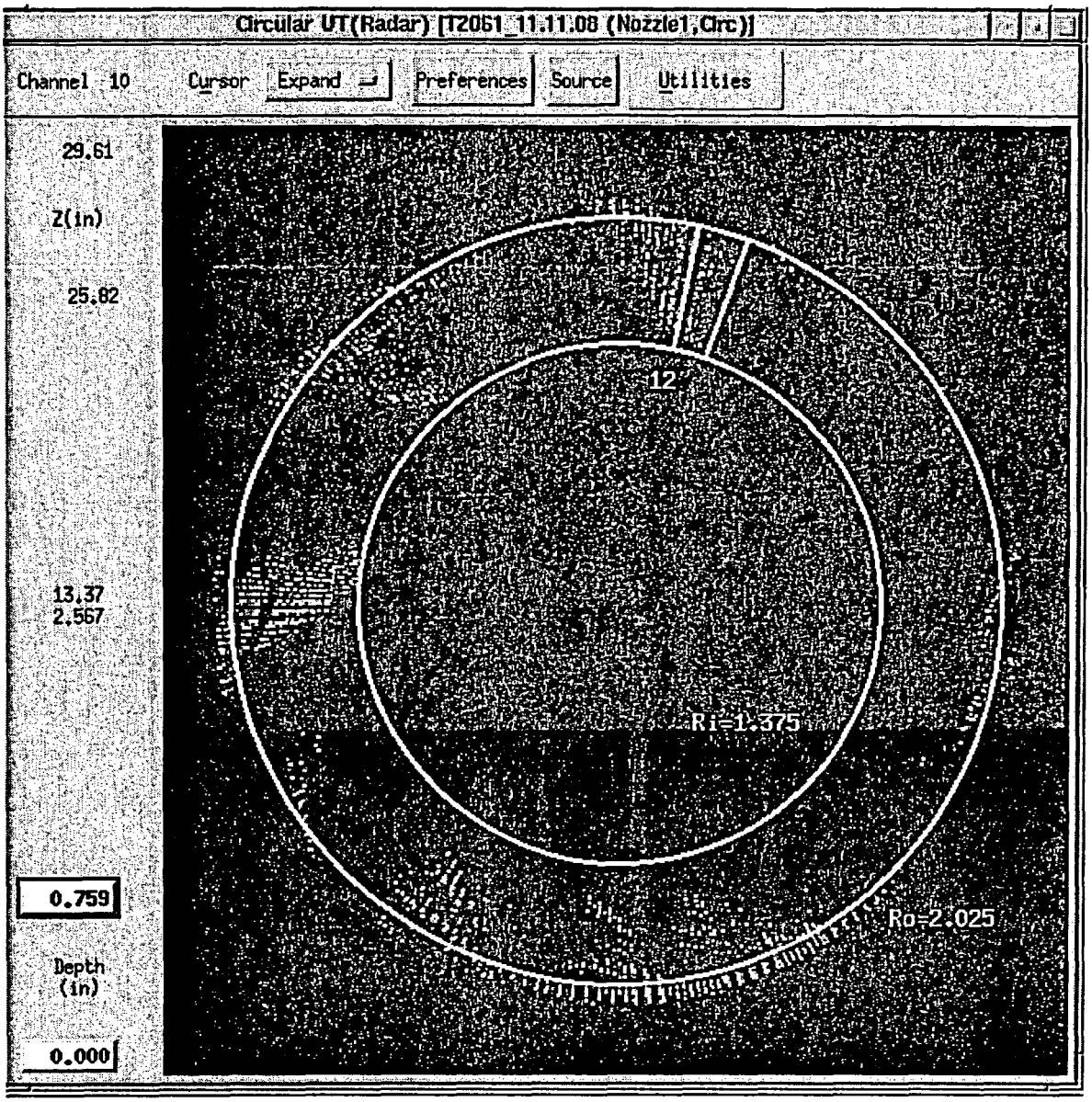


Nozzle 1
Elevations



This scan provides more comprehensive characterization of the axial indications detected using the circ. blade probe. This image is from one of the 60-deg. shear wave transducers with the beam directed circumferentially. The B-scan and D-scan show the relative depths of the OD initiated cracks. Several axial flaws are detected starting below the weld and extending into the J-groove weld region of the nozzle. At least one flaw extends above the J-groove weld region.

Nozzle 1
Circ. Blade UT Data



This image is from one of the 60-deg. shear wave transducers with the beam directed circumferentially. This is a cross-sectional view of the nozzle wall using the 60-deg. shear wave transducer showing the relative angular position and the depths of the flaws.

Nozzle 1
Rotating UT 60-deg. Data

FRAMATOME ANP

CRDM Nozzle Ultrasonic Examination Data Sheet

Customer: FENOC	**Plant:** Davis Besse	**Unit:** N/A		**Nozzle:** 2	
Procedure: 54-ISI-100-08 CA: FRA-02-002, DB-02-012	**Nozzle Dimensions: (in.)**	**ID:** 2.765	**OD:** 4.06	**Thickness:** 0.649	
Downhill Side of Nozzle (deg.): 0	**End of Noz. (in.** 0.12	**robe Serial No.'s:**	Ch 1 S0385CN	Ch 6	
Axial Scan Start: 2, .55	Stop: 366, 10	**Setup:** 3	Ch 2	Ch 7	
Files: B2059_15.33.08, B2059_16.59.12			Ch 3	Ch 8	
Circ. Scan Start:	Stop:	**Setup:**	Ch 4	Ch 9	
Files:			Ch 5	Ch 10	

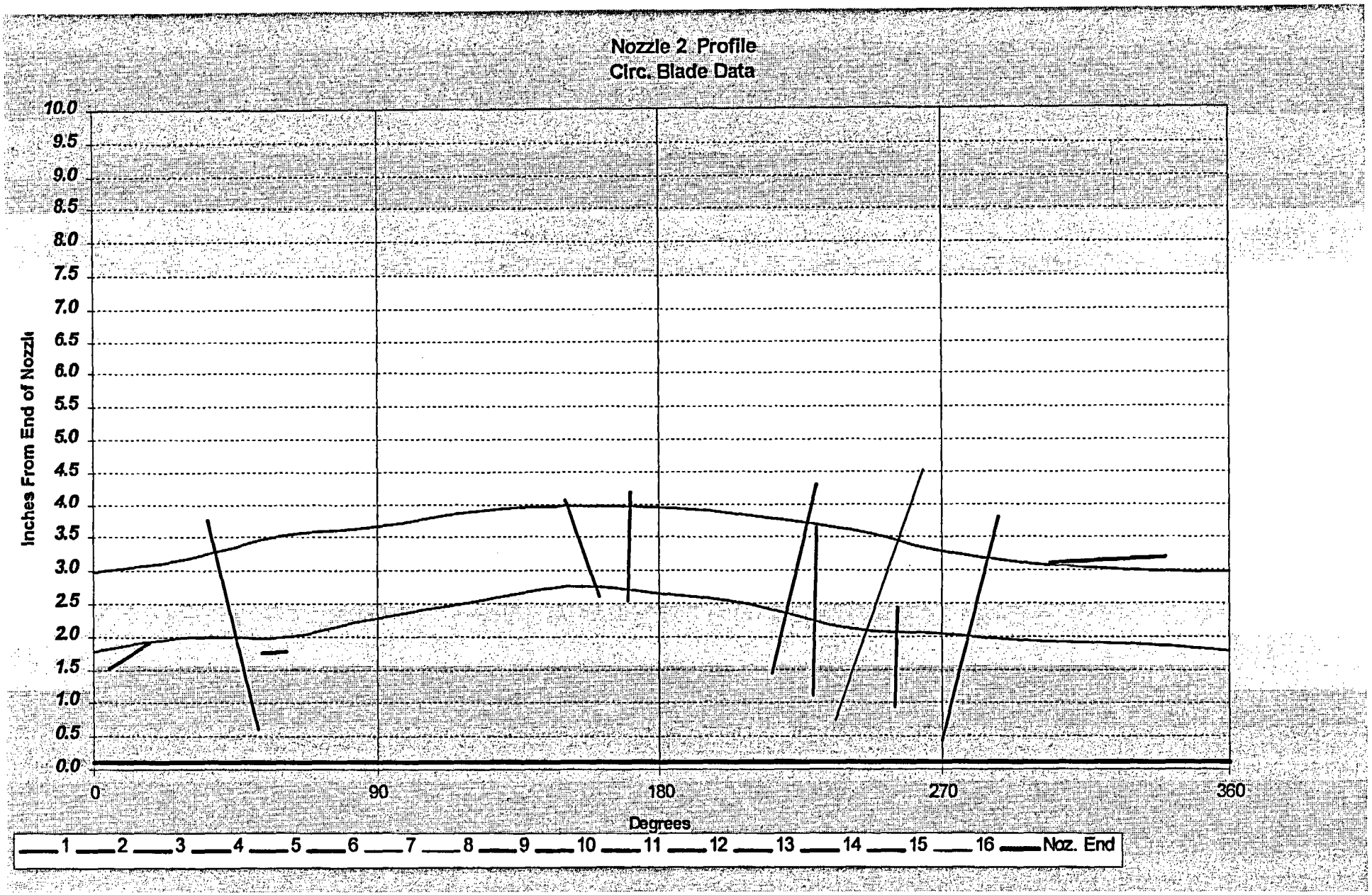
Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1 Min (in.)	End Point 1 Min (deg.)	End Point 2 Max (in.)	End Point 2 Max (deg.)	Axial Total (in.)	Adjusted Circ. Extent Min (deg.)	Adjusted Circ. Extent Max (deg.)	Adjusted Circ. Extent Total (in.)	Flaw Length (in.)	Flaw Angle (deg.)	Flaw TWD (in.)	Flaw Aspect Ratio	Flaw Orientation	Weld Location @ Flaw Min	Weld Location @ Flaw Max
1	OD	0.35	1.51	5.0	1.91	17.7	0.40	5.0	17.7	0.45	0.60	48	0.30	0.50	CIRC.		
2	OD		3.76	36.0	0.62	52.0	3.14	36.0	52.0	0.57	3.19	10			AXIAL		
3	OD	0.34	1.75	53.0	1.77	61.0	0.02	53.0	61.0	0.28	0.28	86	0.31	1.09	CIRC.		
4	OD		2.62	161.0	4.06	150.0	1.44	161.0	150.0	-0.39	1.49	165			AXIAL		
5	OD		2.55	170.0	4.18	171.0	1.63	170.0	171.0	0.04	1.63	1			AXIAL		
6	OD		1.44	216	4.29	230	2.85	216.0	230.0	0.50	2.89	10			AXIAL		
7	OD		1.11	229	3.63	230	2.52	229.0	230.0	0.04	2.52	1			AXIAL		
8	OD		0.75	236	4.51	264	3.76	236.0	264.0	0.99	3.89	15			AXIAL		
9	OD		0.94	255	2.44	256	1.50	255.0	256.0	0.04	1.50	1			AXIAL		
10	OD		0.43	270	3.79	288	3.36	270.0	288.0	0.64	3.42	11			AXIAL		
11	OD	0.26	3.11	304	3.21	340	0.10	304.0	340.0	1.28	1.28	86	0.39	0.30	CIRC.		
12																	
13																	
14																	
15																	
16																	
17																	

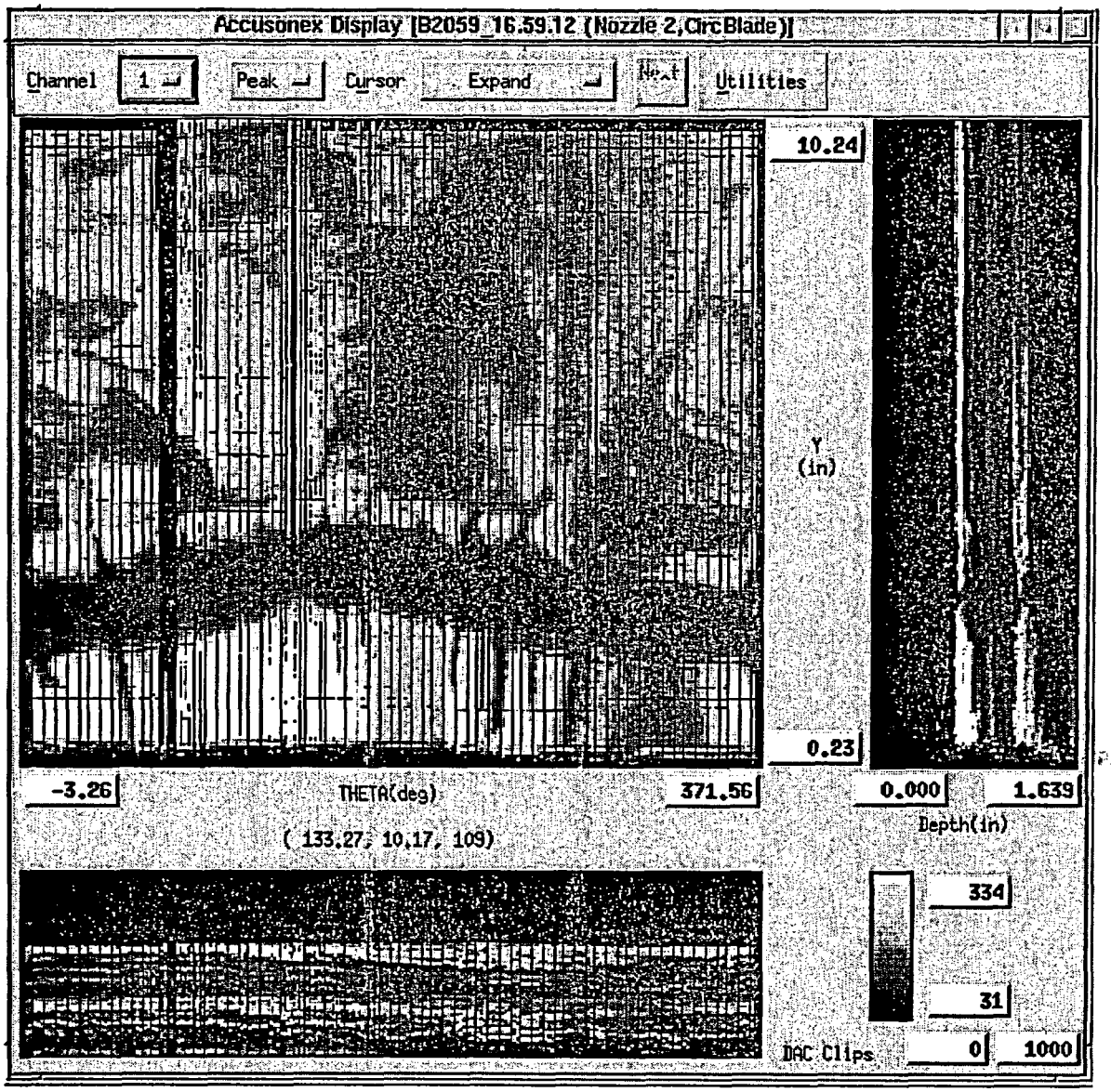
WELD PROFILE	Data Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
	Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
	Noz. End	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	Inches
	MAX.	2.98	3.19	3.54	3.67	3.88	3.97	3.94	3.81	3.61	3.29	3.10	3.01	2.98	Inches
	MIN.	1.78	1.99	1.99	2.27	2.53	2.76	2.65	2.47	2.13	2.03	1.94	1.88	1.78	Inches

Notes: Adjusted Circ. Extent is relative to downhill side of nozzle;clockwise looking down. TWD is Through-Wall Dimension

Comments: These flaws are axial in the weld region. Flaws #2, #6, #8, #10 is are believed to be throughwall and creates the leak path through the weld region. Several other axial flaws are detected in the weld region but are not able to be fully characterized using the circ. blade probe. Full characterization of all flaws in this nozzle will be performed using the top-down tool. This report will be revised when the top-down data becomes available.

Analyzed by: K. C. Gebetsberger **Date:** 2/28/02 **Analyzed by:** M.G.Hacker **Date:** 2/28/02


Nozzle 2 Profile
Circ. Blade Data
Inches From End of Nozzle
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
90
180
270
360
Degrees
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 Noz. End



This scan provided the initial detection of flaws in the nozzle wall using the circ. blade probe. Leak Path patterns are observed in this image. Several axial flaws are detected starting below the weld and extending into the J-groove weld region of the nozzle. Several flaws extend above the J-groove weld region.

Nozzle 2
Circ. Blade UT Data

FRAMATOME ANP

CRDM Nozzle Ultrasonic Examination Data Sheet

Customer:	FENOC				**Plant:**	Davis Besse			**Unit:**	N/A				**Nozzle:**	2				
Procedure:	54-ISI-100-08	CA: FRA-02-002, DB-02-012			**Nozzle Dimensions: (in.)**				**ID:** 2.765		**OD:** 4.06			**Thickness:**	0.649				
Downhill Side of Nozzle (deg.):	315	**End of Noz. (in.**	30.78						robe Serial No.'s:		Ch 1	2078-01002-0L		Ch 6	21GB-01002-45L				
Axial Scan	Start: -5, 16.1		Stop: 360, 30.77		**Setup:**	1					Ch 2	21GF-01004-30L		Ch 7	21GC-01001-55L				
Files:	T2061_09.12.19										Ch 3	21GA-01004-45L		Ch 8	22CD-01001-65L				
Circ. Scan	Start: 0, 18.95		Stop: 360, 29.52		**Setup:**	2					Ch 4	2623-01002-60S		Ch 9	2624-01005-60S				
Files:	T2061_07.25.10										Ch 5	2623-01002-60S		Ch 10	2624-01005-60S				

Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1 Min (in.)	End Point 1 Min (deg.)	End Point 2 Max (in.)	End Point 2 Max (deg.)	Axial Total (in.)	Adjusted Circ. Extent Min (deg.)	Adjusted Circ. Extent Max (deg.)	Adjusted Circ. Extent Total (in.)	Flaw Length (in.)	Flaw Angle (deg.)	Flaw TWD (in.)	Flaw Aspect Ratio	Flaw Orientation	Weld Location @ Flaw Min	Weld Location @ Flaw Max
1	OD	0.236	27.46	291.0	29.51	275.0	2.05	24.0	40.0	-0.57	2.13	165	0.41	0.19	AXIAL	In Weld Region	
2	OD	TW	26.59	262.0	30.37	240.0	3.78	53.0	75.0	-0.78	3.86	168	0.65	0.17	AXIAL	In Weld Region	
3																	
4	OD	TW	26.69	148.0	29.39	141.0	2.70	167.0	174.0	-0.25	2.71	175	0.65	0.24	AXIAL	In Weld Region	
5	OD	0.33	27.87	130.0	28.7	127.0	0.83	185.0	188.0	-0.11	0.84	173	0.32	0.38	AXIAL	In Weld Region	
6	OD	TW	26.8	67	29.36	78	2.56	248.0	237.0	0.39	2.59	9	0.65	0.25	AXIAL	In Weld Region	
7																	
8	OD	TW	26.35	32	30.16	61	3.81	283.0	254.0	1.03	3.95	15	0.65	0.16	AXIAL	In Weld Region	
9																	
10	OD	TW	27.39	7	30.35	26	2.96	308.0	289.0	0.67	3.04	13	0.65	0.21	AXIAL	In Weld Region	
11	OD	0.344	27.9	314	27.75	347	0.15	347.0	328.0	1.17	1.18	83	0.31	0.26	CIRC.	0.1	0.1
12	OD	0.572	29.02	320	29.6	327	0.58	5.0	12.0	0.25	0.63	23	0.08	0.12	AXIAL	In Weld Region	
13																	
14																	
15																	
16																	
17																	

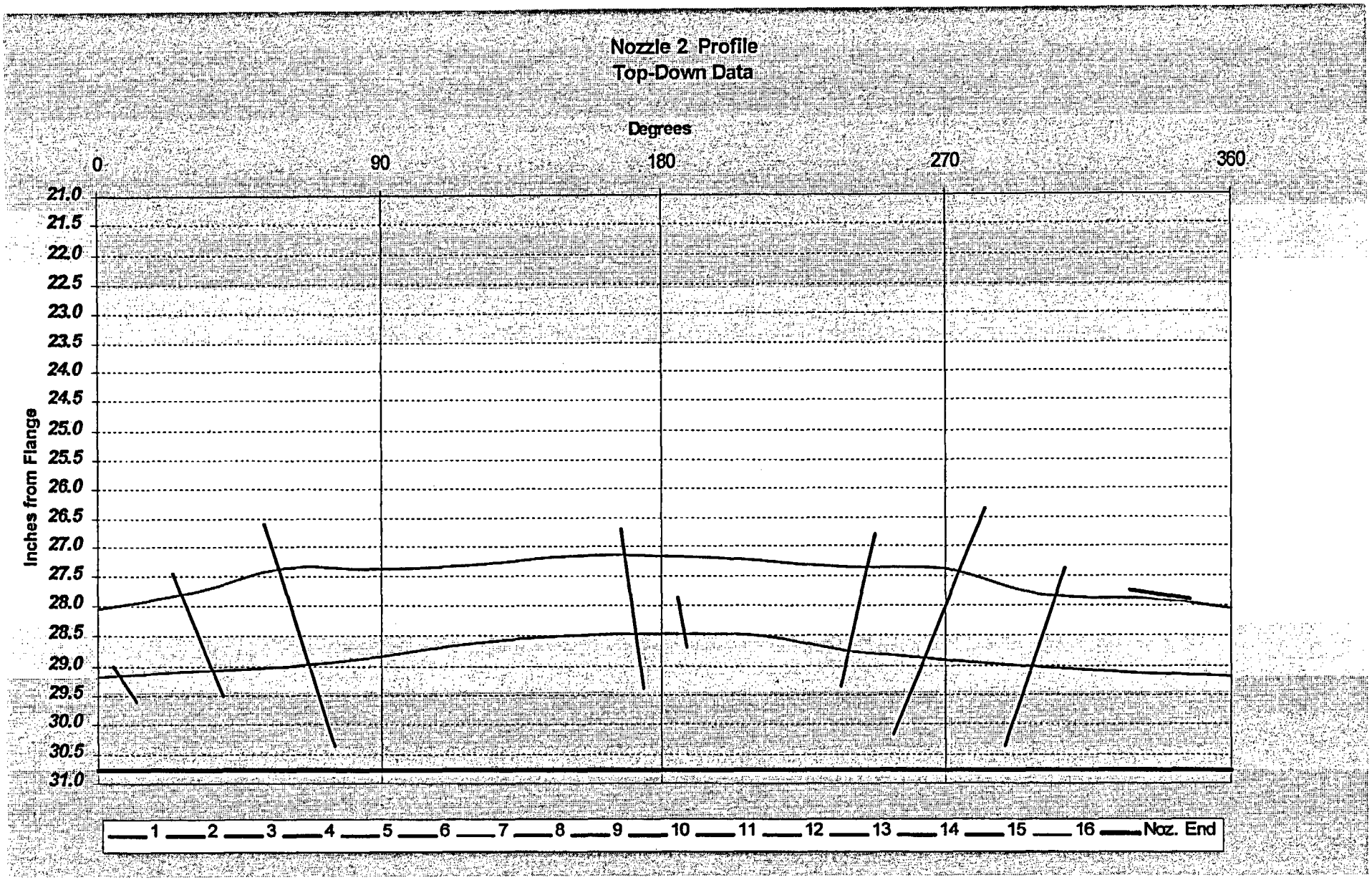
WELD PROFILE	Data Loc.	315	345	15	45	75	105	135	165	195	225	255	285	315	Degrees
	Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
	Noz. End	30.78	30.78	30.78	30.78	30.78	30.78	30.78	30.78	30.78	30.78	30.78	30.78	30.78	Inches
	MAX.	29.17	29.09	29.02	28.84	28.61	28.49	28.46	28.49	28.76	28.92	29.04	29.14	29.17	Inches
	MIN.	28.06	27.79	27.36	27.39	27.31	27.16	27.16	27.24	27.36	27.39	27.84	27.89	28.06	Inches

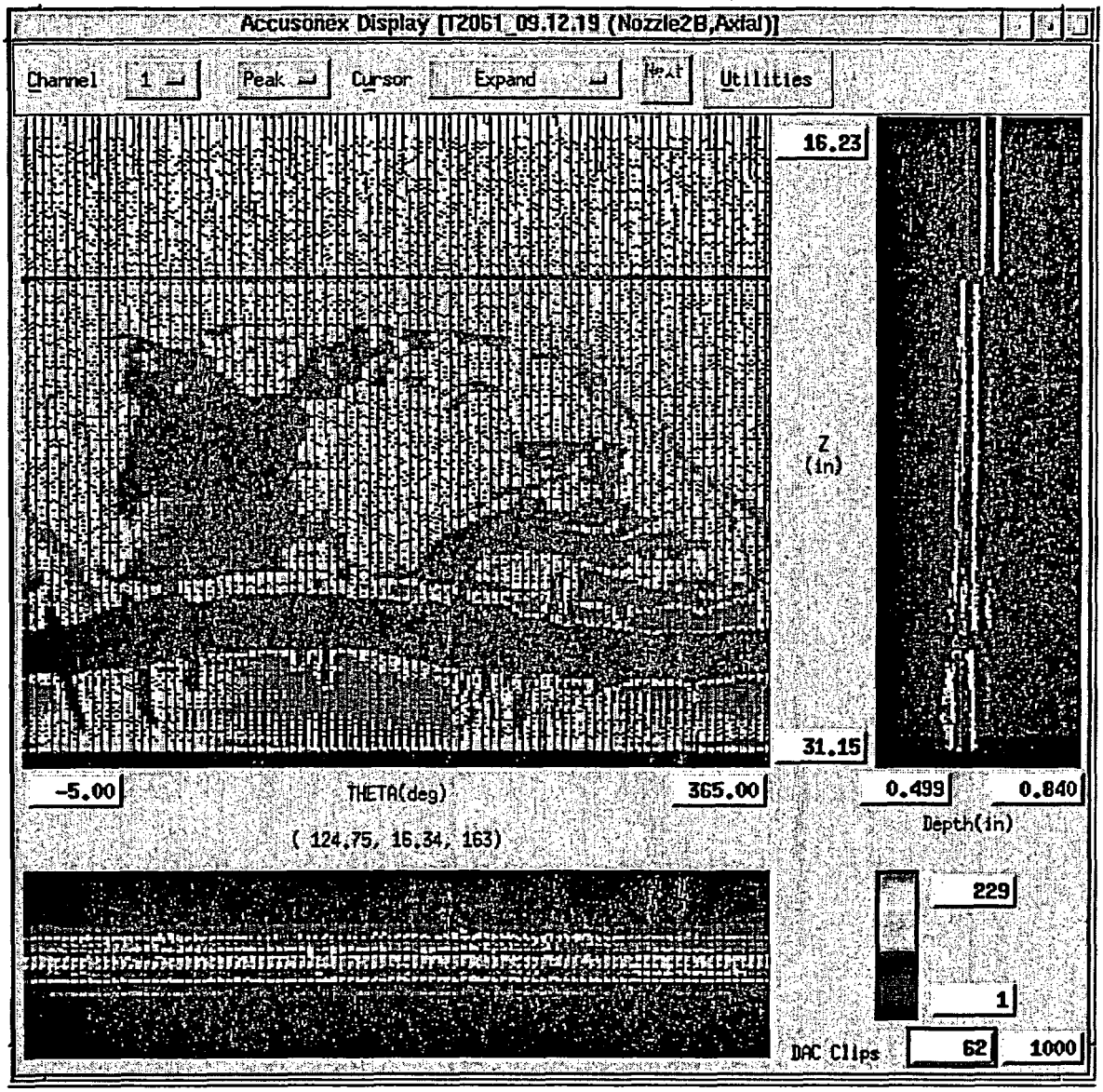
Notes: Adjusted Circ. Extent is relative to downhill side of nozzle;clockwise looking down. TWD is Through-Wall Dimension

Comments: Data was encoded with positive Theta going counterclockwise. Adjusted circ. positions have corrected the position to read clockwise looking down.

Flaws #3, 7,and 9 were identified as axial flaws using the circ. blade probe but are not confirmed with the rotating UT. Therefore, flaws #3, 7, and 9 are not relevant.

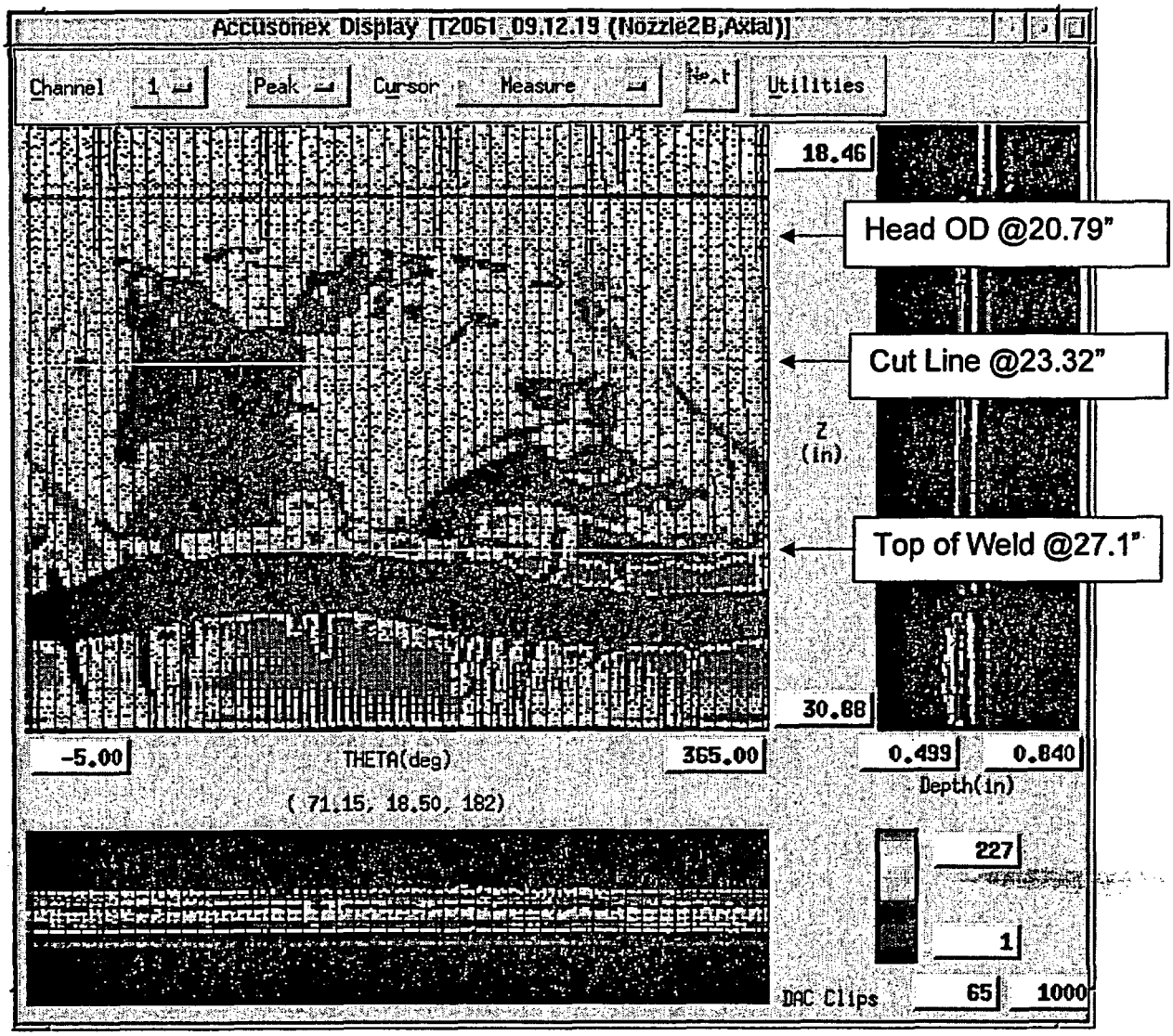
Analyzed by: K.C.Gebetsberger **Date:** 3/5/02 **Analyzed by:** M.G. Hacker **Date:** 3/5/02


Nozzle 2 Profile
Top-Down Data
Degrees
0
90
180
270
360
Inches from Flange
21.0
21.5
22.0
22.5
23.0
23.5
24.0
24.5
25.0
25.5
26.0
26.5
27.0
27.5
28.0
28.5
29.0
29.5
30.0
30.5
31.0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Noz. End

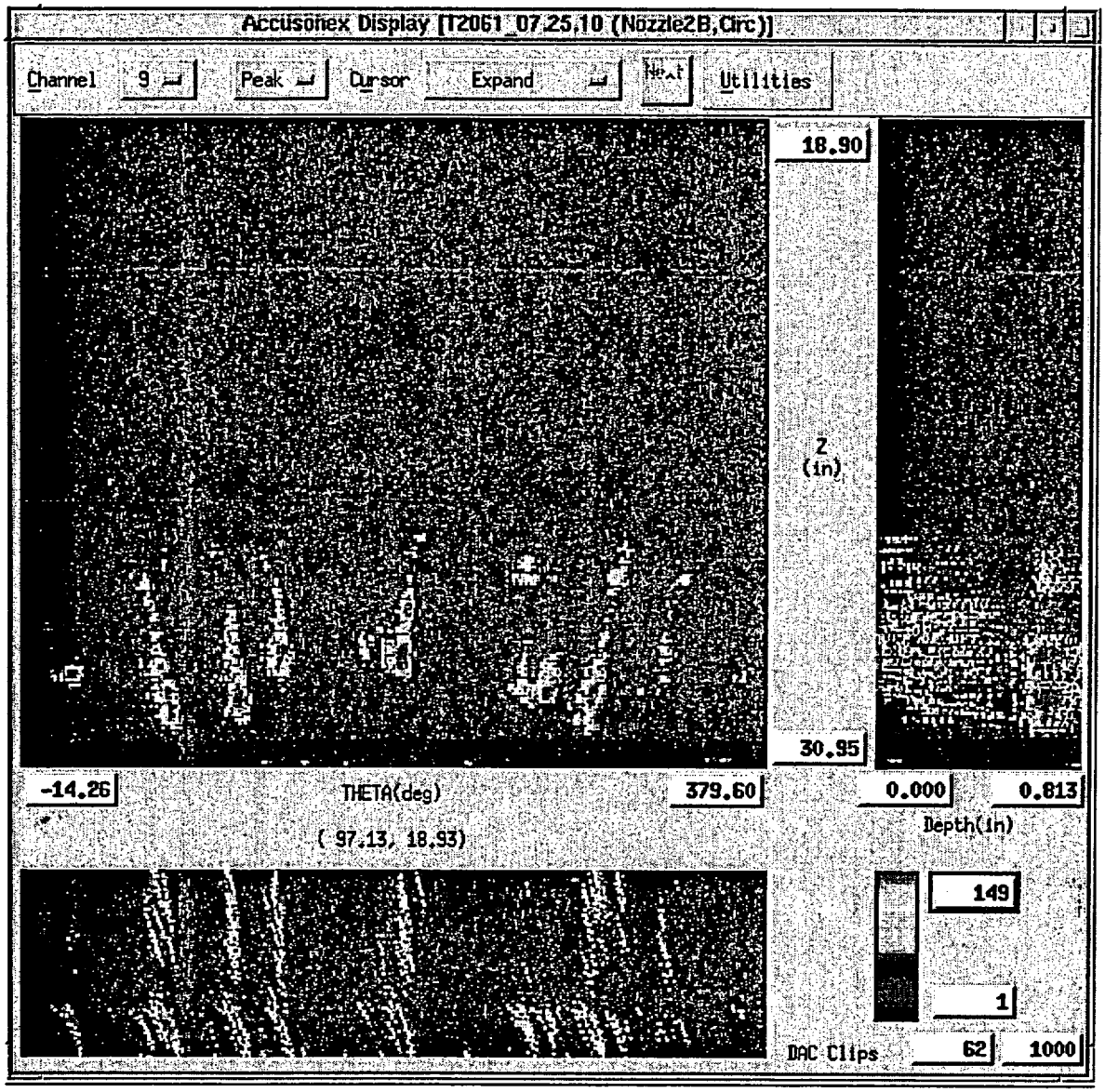


This scan provides more comprehensive characterization of the axial indications detected using the circ. blade probe and provides elevation dimensions for repair activities. This scan also provides characterization of the region of the nozzle surrounding the location of the new ID temperbead weld to assure sound material for welding. Leak Path patterns are observed in this image. Several axial flaws are detected starting below the weld and extending into the J-groove weld region of the nozzle. Several of these flaws extend above the weld region.

Nozzle 2
Rotating UT 0-deg. Data

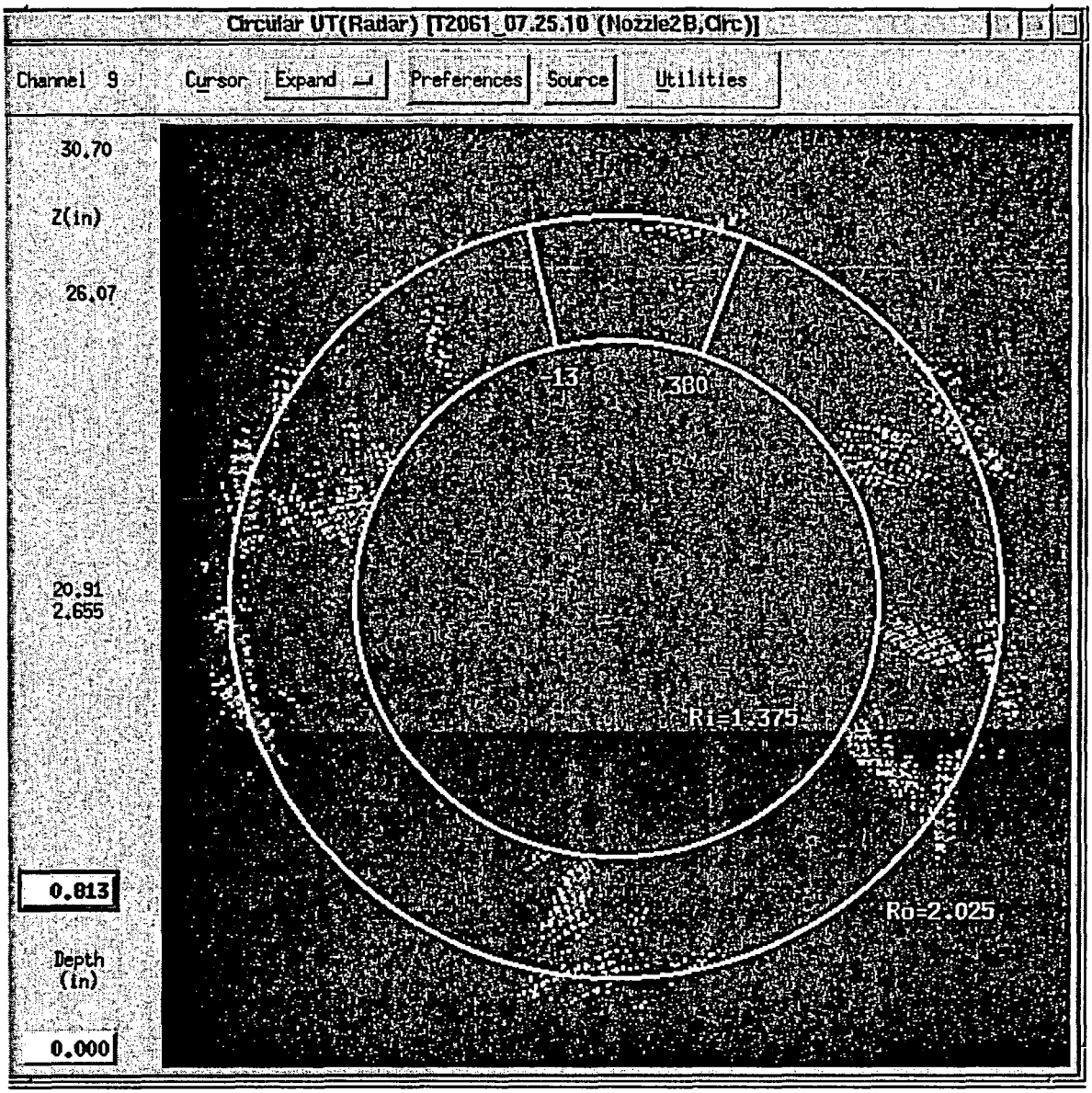


Nozzle 2
Elevations



This scan provides more comprehensive characterization of the axial indications detected using the circ. blade probe. This image is from one of the 60-deg. shear wave transducers with the beam directed circumferentially. The B-scan and D-scan show the relative depths of the OD initiated cracks. Several axial flaws are detected starting below the weld and extending into the J-groove weld region of the nozzle. At least one flaw extends above the J-groove weld region.

Nozzle 2
Rotating UT 60-deg. Data



This image is from one of the 60-deg. shear wave transducers with the beam directed circumferentially. This is a cross-sectional view of the nozzle wall using the 60-deg. shear wave transducer showing the relative angular position and the depths of the flaws.

Nozzle 2
Rotating UT, 60-deg. Data

FRAMATOME ANP

CRDM Nozzle Ultrasonic Examination Data Sheet

Customer: FENOC		**Plant:** Davis Besse	**Unit:** n/a		**Nozzle:** 3
Procedure: 54-ISI-100-08	CA: FRA-02-002, DB-02-012	**Nozzle Dimensions: (in.)**	ID: 2.765	OD: 4.06	**Thickness:** 0.649
Downhill Side of Nozzle (deg.): 0	**End of Noz. (in.** 0.11	robe Serial No.'s:	Ch 1	S0382CN	Ch 6
Axial Scan Start: -1.9, .36	Stop: 372, 11.47	**Setup:** 3	Ch 2		Ch 7
Files: B2058_07.30.36			Ch 3		Ch 8
Circ. Scan Start:	Stop:	**Setup:**	Ch 4		Ch 9
Files:			Ch 5		Ch 10

Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1 Min (in.)	End Point 1 Min (deg.)	End Point 2 Max (in.)	End Point 2 Max (deg.)	Axial Total (in.)	Adjusted Circ. Extent Min (deg.)	Adjusted Circ. Extent Max (deg.)	Adjusted Circ. Extent Total (in.)	Flaw Length (in.)	Flaw Angle (deg.)	Flaw TWD (in.)	Flaw Aspect Ratio	Flaw Orientation	Weld Location @ Flaw Min	Weld Location @ Flaw Max
1	OD		0.42	4.0	4.54	0.3	4.12	4.0	0.3	-0.13	4.12	178			AXIAL		
2	OD		2.81	94.0	4.06	92.2	1.25	94.0	92.2	-0.06	1.25	177			AXIAL		
3	OD		1.82	126.6	3.14	136.9	1.32	126.6	136.9	0.37	1.37	15			AXIAL		
4	OD		1.21	189.0	4.38	192.2	3.17	189.0	192.2	0.11	3.17	2			AXIAL		
5	OD		1.45	347.7	3.32	344.8	1.87	347.7	344.8	-0.10	1.87	177			AXIAL		
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	

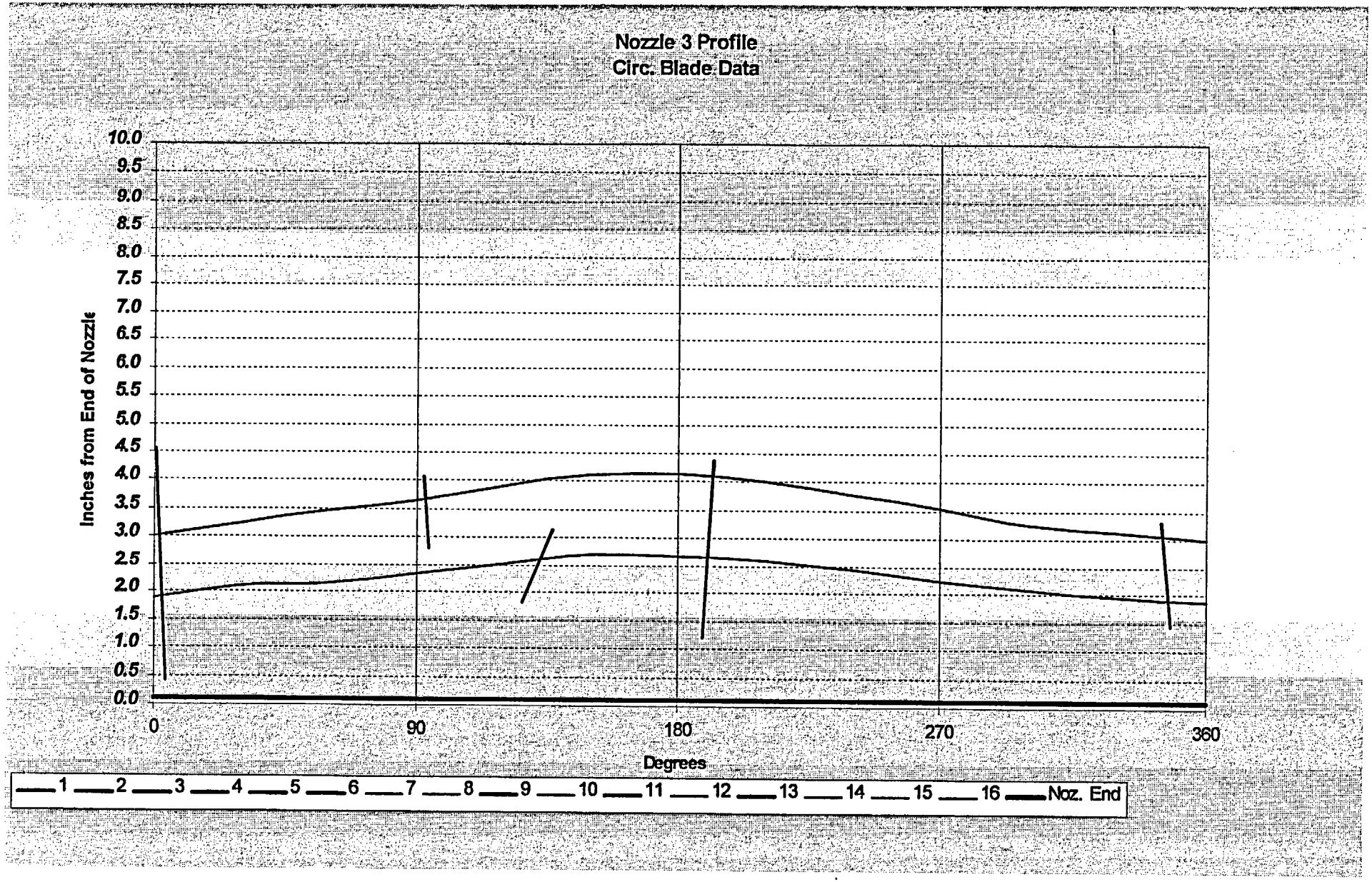
WELD PROFILE														
Data Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
Noz. End	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	Inches
MAX.	3.00	3.25	3.47	3.65	3.91	4.12	4.15	4.00	3.77	3.55	3.27	3.14	3.00	Inches
MIN.	1.87	2.10	2.16	2.35	2.51	2.71	2.67	2.59	2.45	2.23	2.07	1.95	1.87	Inches

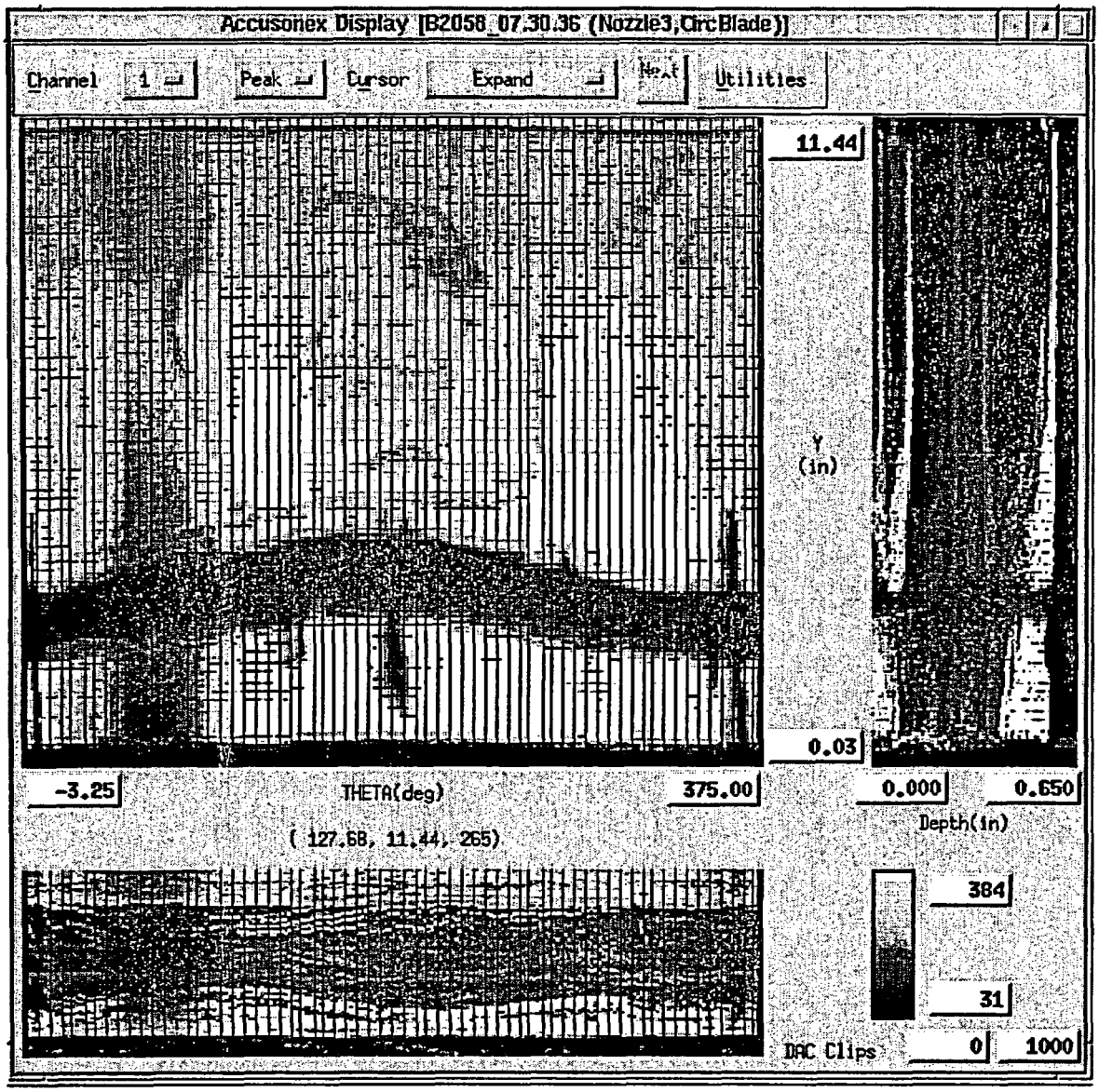
Notes: Adjusted Circ. Extent is relative to downhill side of nozzle;clockwise looking down. TWD is Through-Wall Dimension

Comments: This is an axial flaw below the weld region.

This flaw is not able to be fully characterized using the circ. blade probe. Full characterization of all flaws in this nozzle will be performed using the top-down tool or axial blade probes. This report will be revised when additional data becomes available.

Analyzed by: M. G. Hacker **Date:** 2/27/02 **Analyzed by:** **Date:**


Nozzle 3 Profile
Circ. Blade Data
Inches from End of Nozzle
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
90
180
270
360
Degrees
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Noz. End



This scan provided the initial detection of flaws in the nozzle wall using the circ. blade probe. Leak Path patterns are observed in this image. Several axial flaws are detected starting below the weld and extending into the J-groove weld region of the nozzle. Several flaws extend above the J-groove weld region.

Nozzle 3
Circ. Blade UT Data

FRAMATOME ANP

CRDM Nozzle Ultrasonic Examination Data Sheet

Customer:	FENOC					**Plant:**	Davis Besse			**Unit:**	n/a					**Nozzle:**	3		
Procedure:	54-ISI-100-08	CA: FRA-02-002, DB-02-012				**Nozzle Dimensions: (in.)**				**ID:**	2.765	**OD:**	4.06			**Thickness:**	0.649		
Downhill Side of Nozzle (deg.):		150	**End of Noz. (in.**	30.75						robe Serial No.'s:		Ch 1	2078-01002-0L			Ch 6	21GB-01002-45L		
Axial Scan	Start: -5, 16		Stop: 360, 30.81		**Setup:**	1						Ch 2	21GF-01004-30L			Ch 7	21GC-01001-55L		
Files:	T2061_15.39.37											Ch 3	21GA-01004-45L			Ch 8	22CD-01001-65L		
Circ. Scan	Start: 6, 20.3		Stop: 360, 30.88		**Setup:**	2						Ch 4	2623-01002-60S			Ch 9	2624-01005-60S		
Files:	T2061_14.09.39											Ch 5	2623-01002-60S			Ch 10	2624-01005-60S		

Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1		End Point 2		Axial	Adjusted Circ. Extent			Flaw Length	Flaw Angle	Flaw TWD	Flaw Aspect	Flaw Orientation	Weld Location @ Flaw	
			Min (in.)	Min (deg.)	Max (in.)	Max (deg.)	Total (in.)	Min (deg.)	Max (deg.)	Total (in.)	(in.)	(deg.)	(in.)	Ratio		Min	Max
1	OD	IW	26.6	151.0	30.68	156.0	4.08	1.0	6.0	0.18	4.08	2	0.65	0.16	AXIAL	In Weld Region	
2																	
3	OD	0.234	28.07	275.0	29.19	280.0	1.12	125.0	130.0	0.18	1.13	9	0.42	0.37	AXIAL	In Weld Region	
4	OD	IW	26.07	319.0	29.89	330.0	3.82	169.0	180.0	0.39	3.84	6	0.65	0.17	AXIAL	In Weld Region	
5	OD	0.212	28.4	136.0	29.46	143.0	1.06	346.0	353.0	0.25	1.09	13	0.44	0.40	AXIAL	In Weld Region	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	

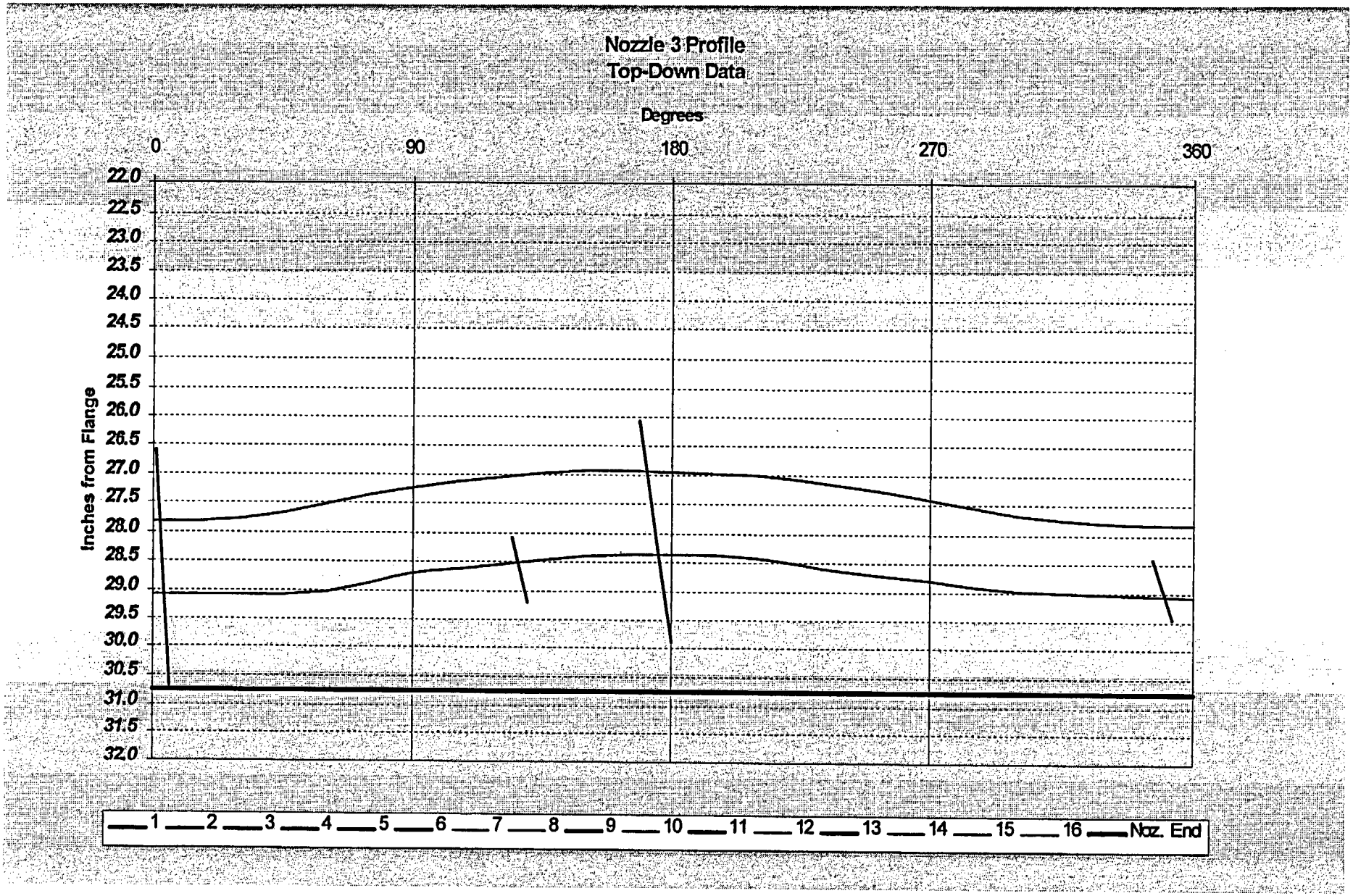
WELD PROFILE	Data Loc.	150	180	210	240	270	300	330	360	30	60	90	120	150	Degrees
	Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
	Noz. End	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	Inches
	MAX.	29.08	29.08	29.02	28.70	28.54	28.38	28.35	28.41	28.63	28.80	28.96	29.02	29.08	Inches
	MIN.	27.83	27.77	27.51	27.23	27.07	26.94	26.95	27.00	27.19	27.42	27.67	27.80	27.83	Inches

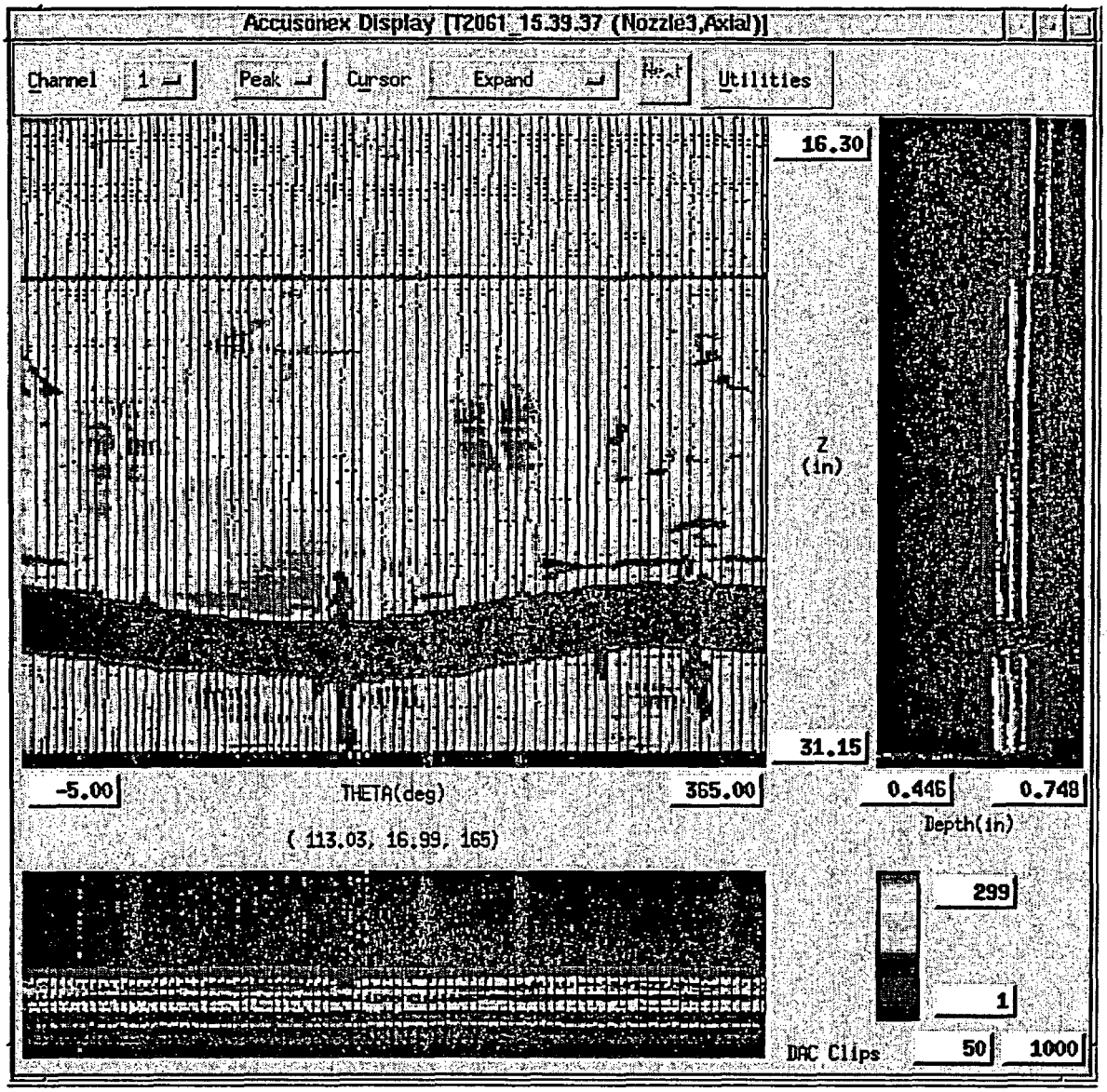
Notes: Adjusted Circ. Extent is relative to downhill side of nozzle;clockwise looking down. TWD is Through-Wall Dimension

Comments: These are axial flaws that extend from below the weld region into the weld region. They were also detected with the circ. blade probe.

Flaw # 2 was identified as an axial flaw using the circ. blade probe but is not confirmed with the rotating UT. Therefore, flaw #2 is not relevant.

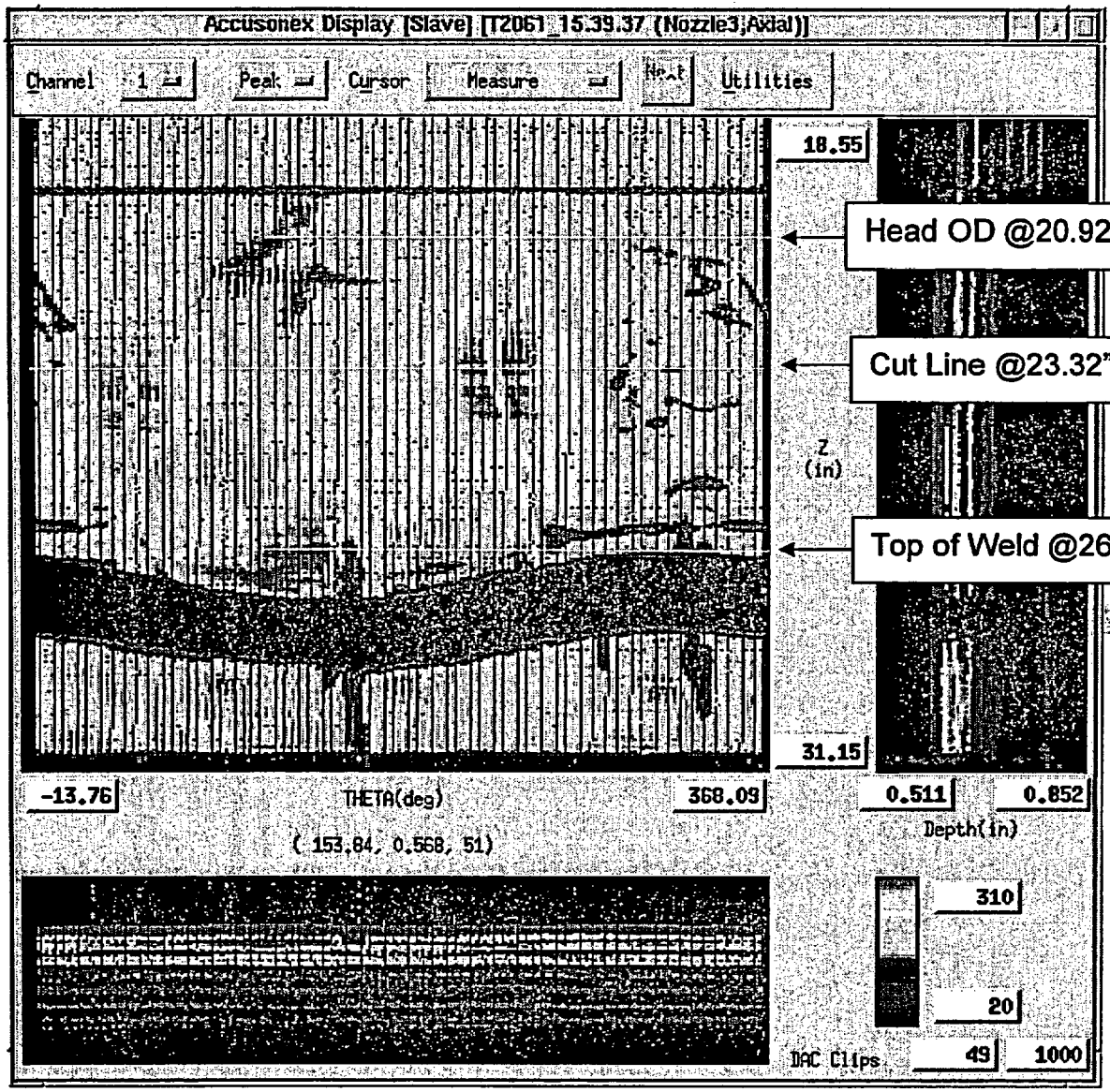
Analyzed by: K.C. Gebetsberger **Date:** 3/5/02 **Analyzed by:** M.G. Hacker **Date:** 3/5/02


Nozzle 3 Profile
Top-Down Data
Degrees
0
90
180
270
360
Inches from Flange
22.0
22.5
23.0
23.5
24.0
24.5
25.0
25.5
26.0
26.5
27.0
27.5
28.0
28.5
29.0
29.5
30.0
30.5
31.0
31.5
32.0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Noz. End

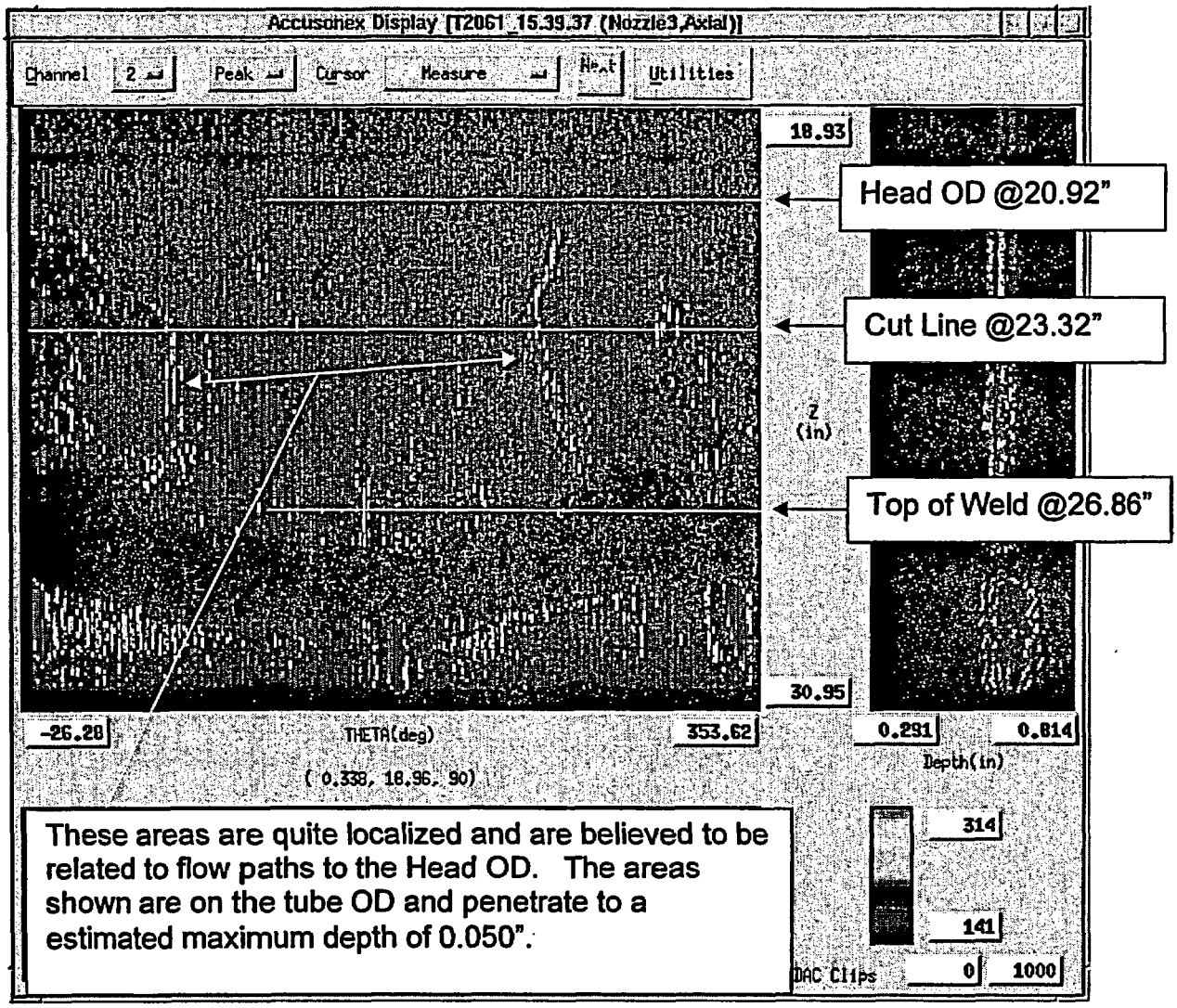


This scan provides more comprehensive characterization of the axial indications detected using the circ. blade probe and provides elevation dimensions for repair activities. This scan also provides characterization of the region of the nozzle surrounding the location of the new ID temperbead weld to assure sound material for welding. Leak Path patterns are observed in this image. Several axial flaws are detected starting below the weld and extending into the J-groove weld region of the nozzle. Two of these flaws extend above the weld region.

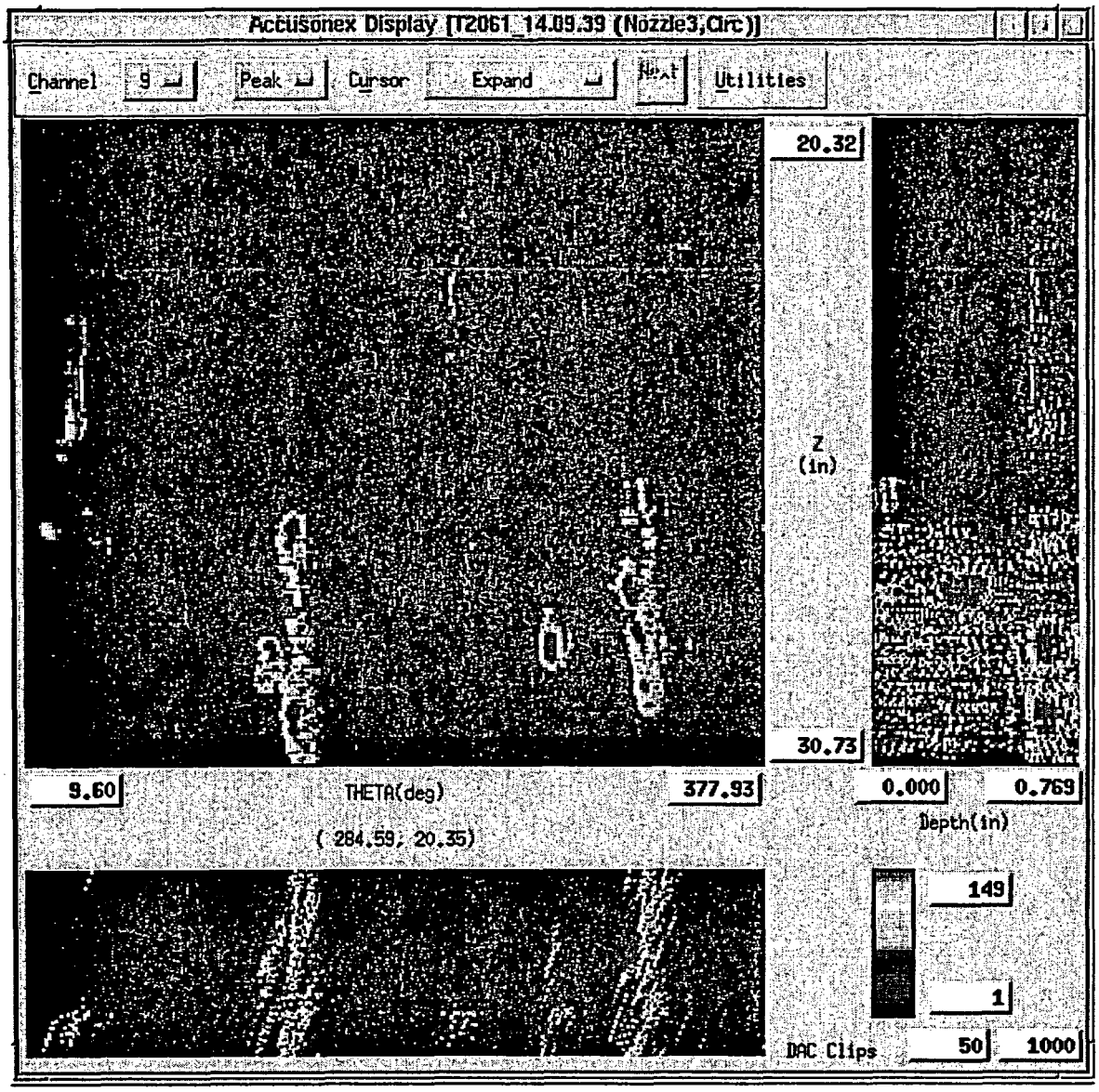
Nozzle 3
Rotating UT, 0-deg. Data



Nozzle 3
Elevations

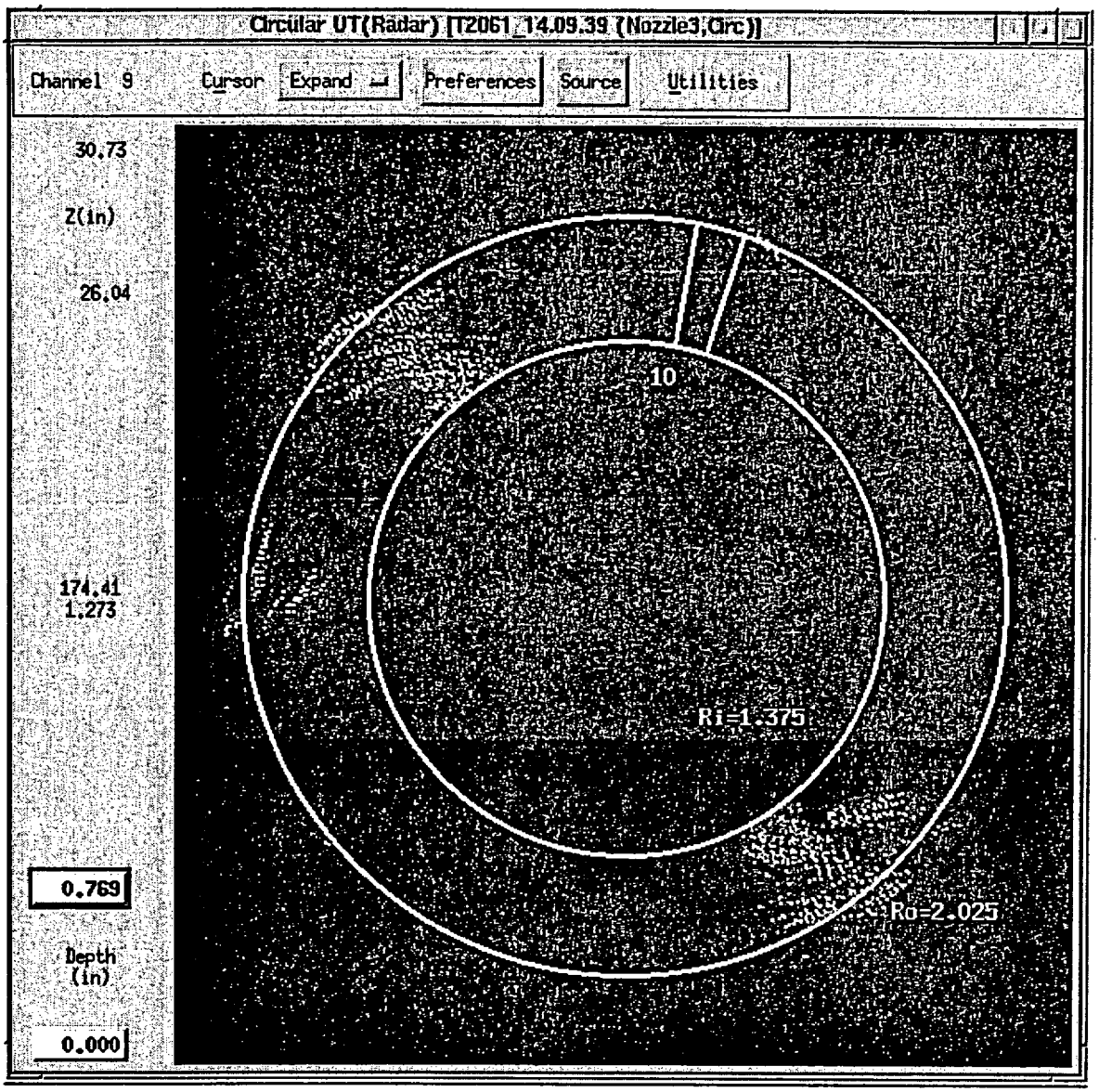


Nozzle 3
Elevations



This scan provides more comprehensive characterization of the axial indications detected using the circ. blade probe. This image is from one of the 60-deg. shear wave transducers with the beam directed circumferentially. The B-scan and D-scan show the relative depths of the OD initiated cracks. Several axial flaws are detected starting below the weld and extending into the J-groove weld region of the nozzle. At least two of the flaws extend above the J-groove weld region.

Nozzle 3
Rotating UT 60-deg. Data



This image is from one of the 60-deg. shear wave transducers with the beam directed circumferentially. This is a cross-sectional view of the nozzle wall using the 60-deg. shear wave transducer showing the relative angular position and the depths of the flaws.

Nozzle 3
Rotating UT, 60-deg. Data

FRAMATOME ANP

CRDM Nozzle Ultrasonic Examination Data Sheet

Customer: FENOC	**Plant:** Davis Besse	**Unit:** N/A		**Nozzle:** 5	
Procedure: 54-ISI-100-08 CA: FRA-02-002, DB-02-012	**Nozzle Dimensions: (in.)**	**ID:** 2.765	**OD:** 4.06	**Thickness:** 0.649	
Downhill Side of Nozzle (deg.): 0	**End of Noz. (in.** 0.23	probe Serial No.'s:	Ch 1 S0385CN	Ch 6	
Axial Scan Start: -57, .6	Stop: 372, 10.13	**Setup:** 3	Ch 2	Ch 7	
Files: B2059_17.34.32			Ch 3	Ch 8	
Circ. Scan Start:	Stop:	**Setup:**	Ch 4	Ch 9	
Files:			Ch 5	Ch 10	

Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1 Min (in.)	End Point 1 Min (deg.)	End Point 2 Max (in.)	End Point 2 Max (deg.)	Axial Total (in.)	Adjusted Circ. Extent Min (deg.)	Adjusted Circ. Extent Max (deg.)	Adjusted Circ. Extent Total (in.)	Flaw Length (in.)	Flaw Angle (deg.)	Flaw TWD (in.)	Flaw Aspect Ratio	Flaw Orientation	Weld Location @ Flaw Min	Weld Location @ Flaw Max
1	OD		1.37	308.0	2.18	310.0	0.81	308.0	310.0	0.07	0.81	5			AXIAL		
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	
		Data Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees	
WELD		Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees	
		Noz. End	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	Inches	
PROFILE		MAX.	3.03	3.09	3.26	3.41	3.69	3.91	3.99	3.87	3.76	3.60	3.44	3.20	3.03	Inches	
		MIN.	1.97	2.01	2.12	2.29	2.42	2.57	2.64	2.55	2.44	2.23	2.16	1.97	1.97	Inches	

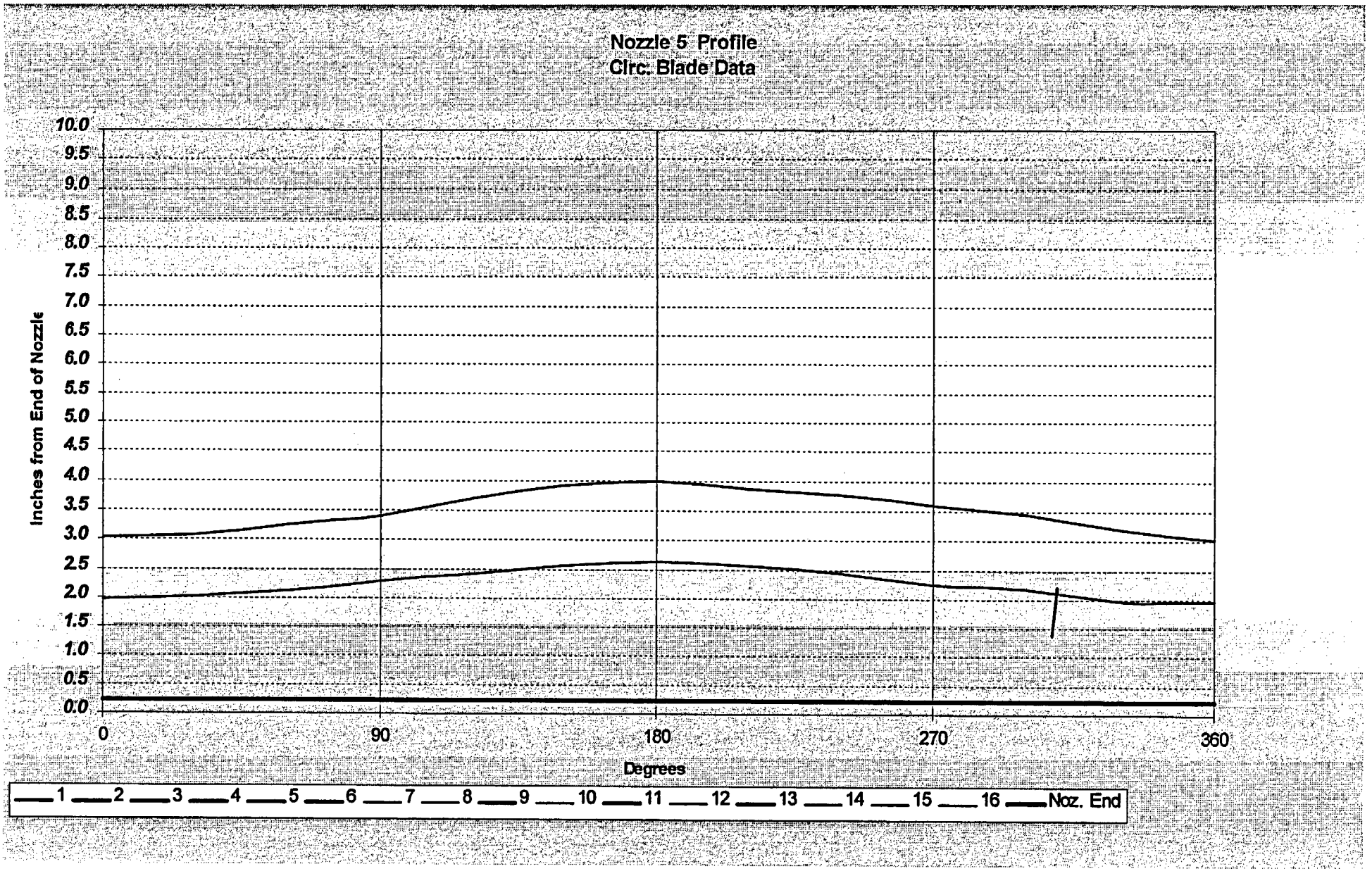
Notes: Adjusted Circ. Extent is relative to downhill side of nozzle;clockwise looking down. TWD is Through-Wall Dimension

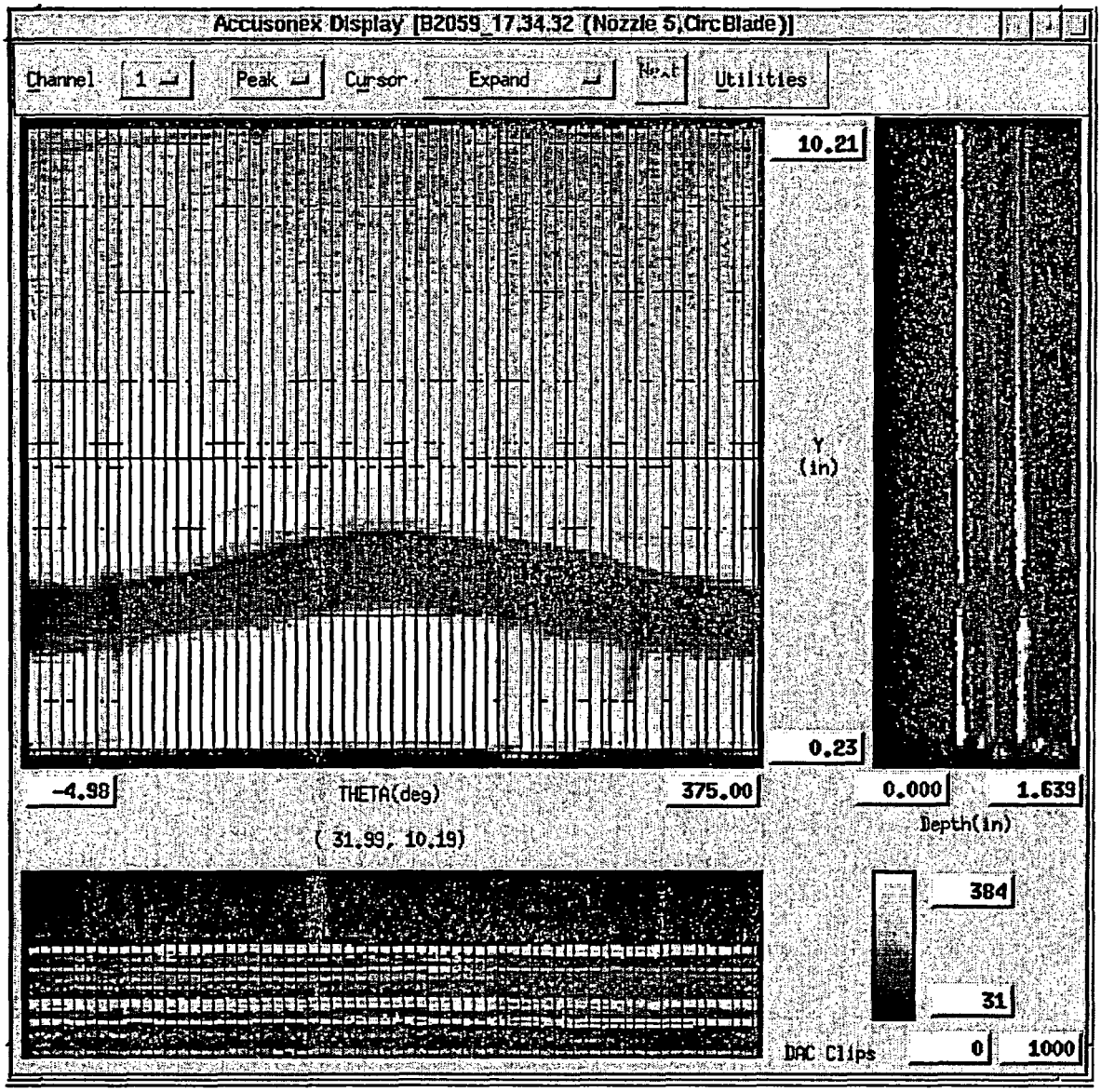
Comments: This is an axial flaw below the weld region.

This flaw is not able to be fully characterized using the circ. blade probe. Full characterization will be performed using the top-down tool or axial blade probes.

This report will be revised when additional data becomes available.

Analyzed by: **Date:** **Analyzed by:** M.G.Hacker **Date:** 3/1/02


Nozzle 5 Profile
Circ. Blade Data
Inches from End of Nozzle
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
90
180
270
360
Degrees
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 Noz. End



This scan provided the initial detection of a flaw in the nozzle wall using the circ. blade probe. Leak Path patterns are not observed in this image. One axial flaw is detected starting below the weld and extending into the J-groove weld region of the nozzle. This flaw does not extend above the J-groove weld.

Nozzle 5
Circ. Blade UT Data

FRAMATOME ANP

CRDM Nozzle Ultrasonic Examination Data Sheet

Customer: FENOC		**Plant:** Davis Besse	**Unit:** N/A		**Nozzle:** 5
Procedure: 54-ISI-100-08	CA: FRA-02-002, DB-02-012	**Nozzle Dimensions: (in.)**	ID: 2.765	OD: 4.06	**Thickness:** 0.649
Downhill Side of Nozzle (deg.): 320	**End of Noz. (in.** 30.75	robe Serial No.'s:	Ch 1 2078-01002-0L		Ch 6 21GB-01002-45L
Axial Scan Start: -4, 16.11	Stop: 360, 30.78	**Setup:** 1	Ch 2 21GF-01004-30L		Ch 7 21GC-01001-55L
Files: T2061_18.30.12			Ch 3 21GA-01004-45L		Ch 8 22CD-01001-65L
Circ. Scan Start: -6, 19	Stop: 360, 29.41	**Setup:** 2	Ch 4 2623-01002-60S		Ch 9 2624-01005-60S
Files: T2061_16.53.38			Ch 5 2623-01002-60S		Ch 10 2624-01005-60S

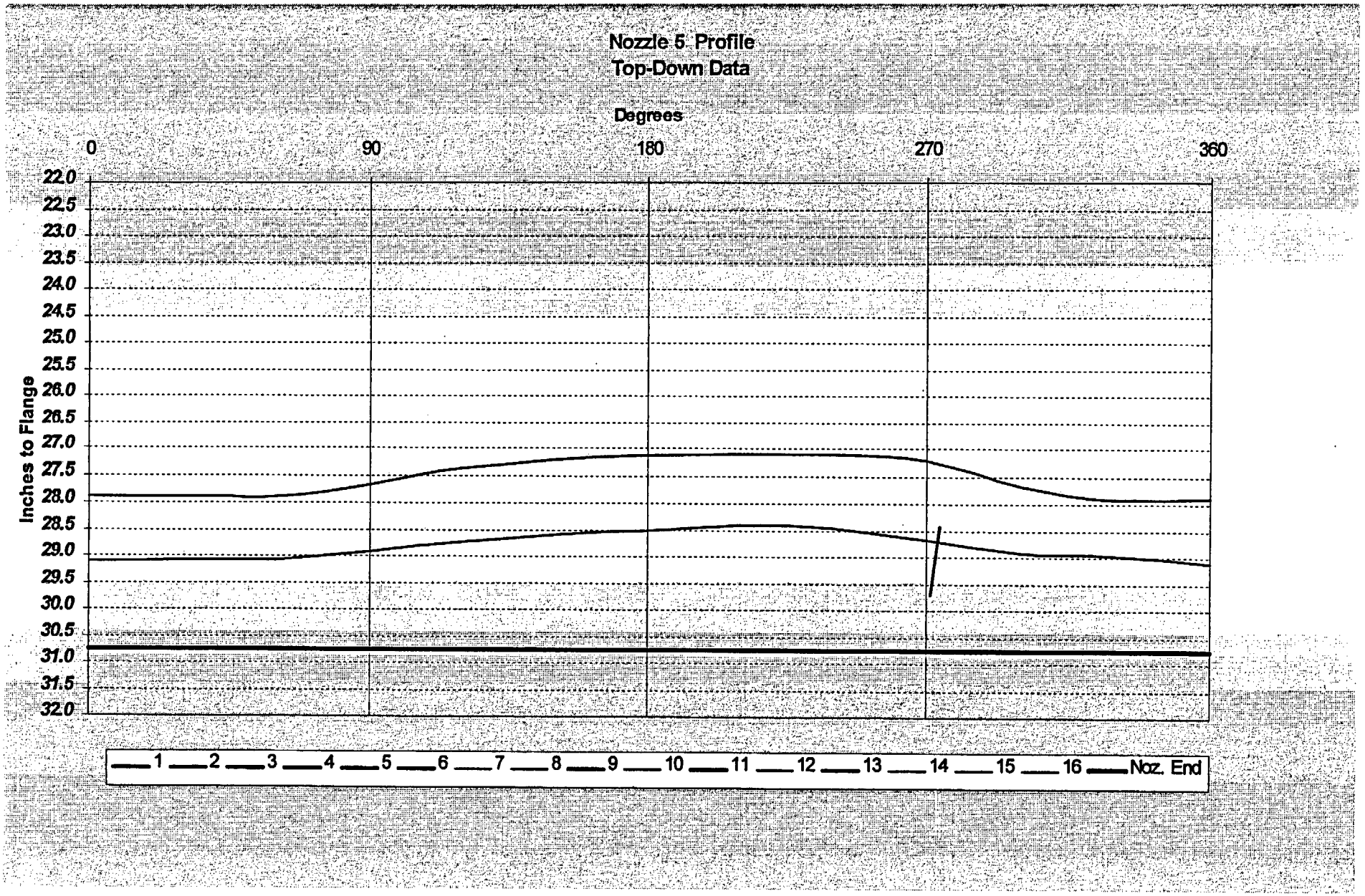
Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1 Min (in.)	End Point 1 Min (deg.)	End Point 2 Max (in.)	End Point 2 Max (deg.)	Axial Total (in.)	Adjusted Circ. Extent Min (deg.)	Adjusted Circ. Extent Max (deg.)	Adjusted Circ. Extent Total (in.)	Flaw Length (in.)	Flaw Angle (deg.)	Flaw TWD (in.)	Flaw Aspect Ratio	Flaw Orientation	Weld Location @ Flaw Min	Weld Location @ Flaw Max
1	OD	0.2	28.44	274.0	29.69	271.0	1.25	274.0	271.0	-0.11	1.25	6	0.45	0.36	AXIAL	In Weld Region	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	

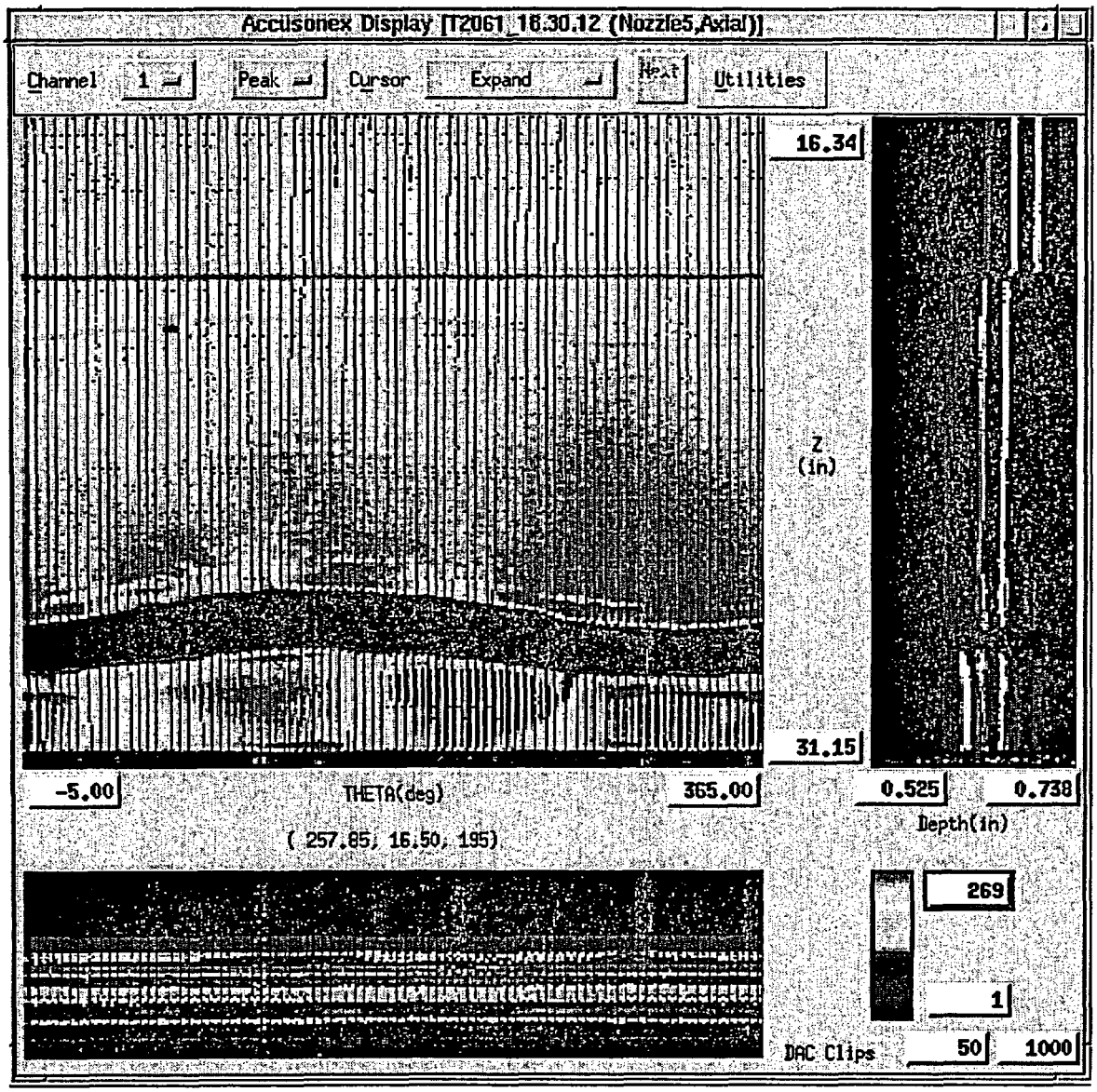
WELD PROFILE	Data Loc.	320	350	20	50	80	110	140	170	200	230	260	290	320	Degrees
	Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
	Noz. End	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	Inches
	MAX	29.10	29.07	29.07	28.91	28.73	28.60	28.52	28.40	28.46	28.67	28.91	28.96	29.10	Inches
	MIN.	27.90	27.89	27.89	27.68	27.39	27.21	27.13	27.10	27.10	27.21	27.68	27.91	27.90	Inches

Notes: Adjusted Circ. Extent is relative to downhill side of nozzle;clockwise looking down. TWD is Through-Wall Dimension

Comments: This is an axial flaw that extends into the weld region. This flaw was also detected sing the circ. blade probe.

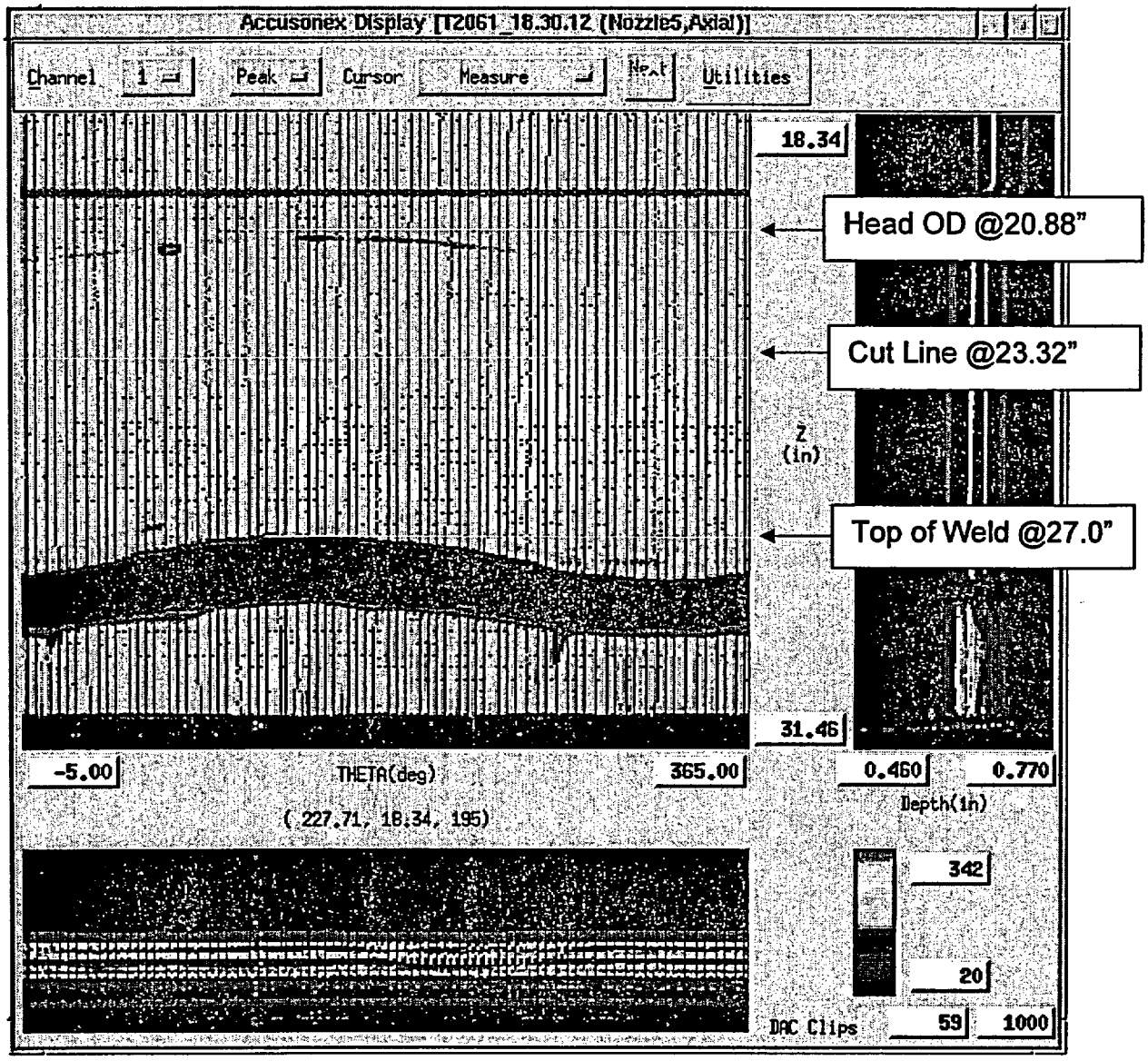
Analyzed by: K. C. Gebetsberger **Date:** 3/5/02 **Analyzed by:** M.G.Hacker **Date:** 3/5/02


Nozzle 5 Profile
Top-Down Data
Degrees
0
90
180
270
360
Inches to Flange
22.0
22.5
23.0
23.5
24.0
24.5
25.0
25.5
26.0
26.5
27.0
27.5
28.0
28.5
29.0
29.5
30.0
30.5
31.0
31.5
32.0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Noz. End

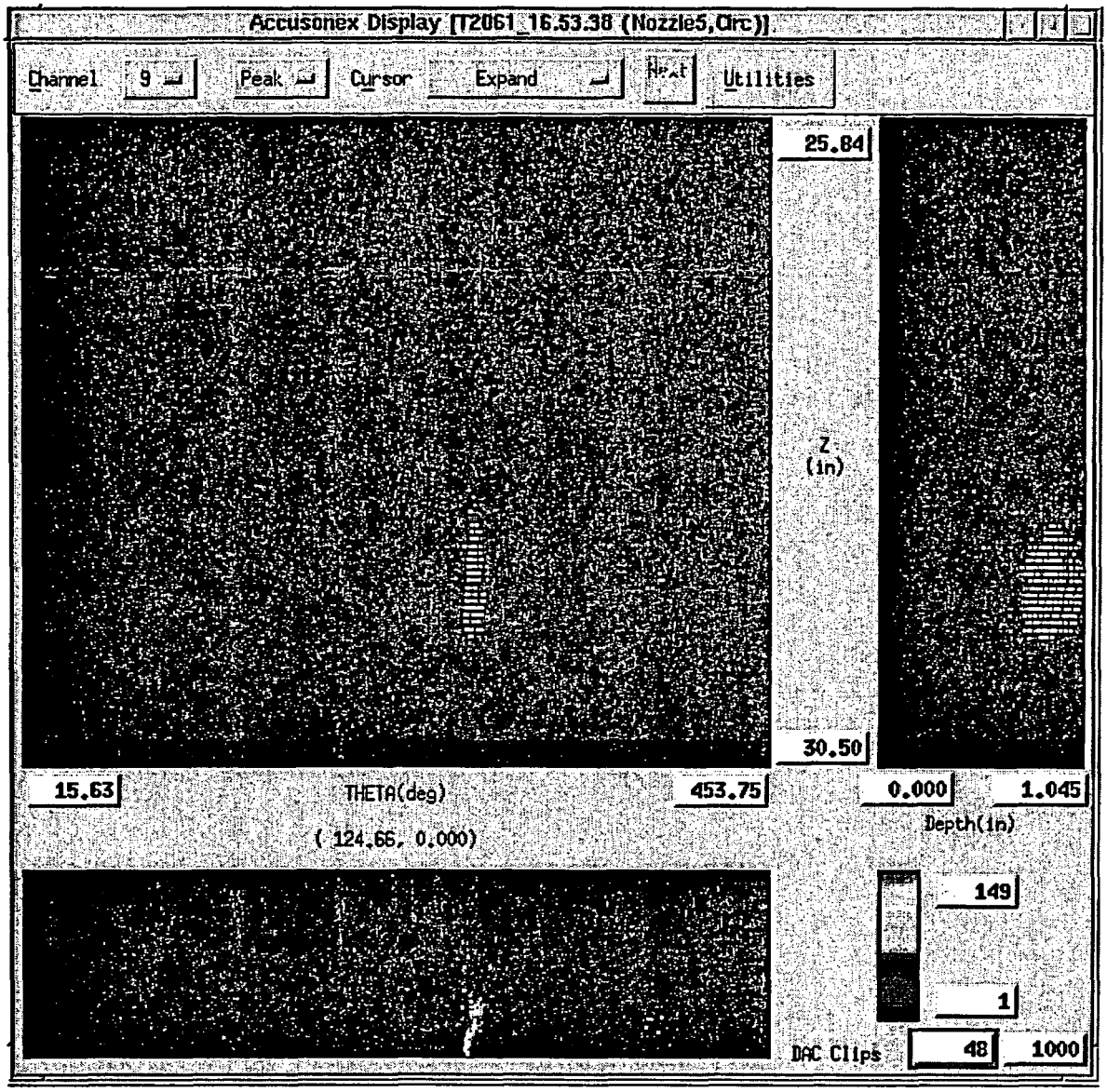


This scan provides more comprehensive characterization of the axial indication detected using the circ. blade probe and provides elevation dimensions for repair activities. This scan also provides characterization of the region of the nozzle surrounding the location of the new ID temperbead weld to assure sound material for welding. Leak Path patterns are not observed in this image. One axial flaw is detected starting below the weld and extending into the J-groove weld region of the nozzle. This flaw has not yet breached the pressure boundary.

Nozzle 5
Rotating UT 0-deg. Data

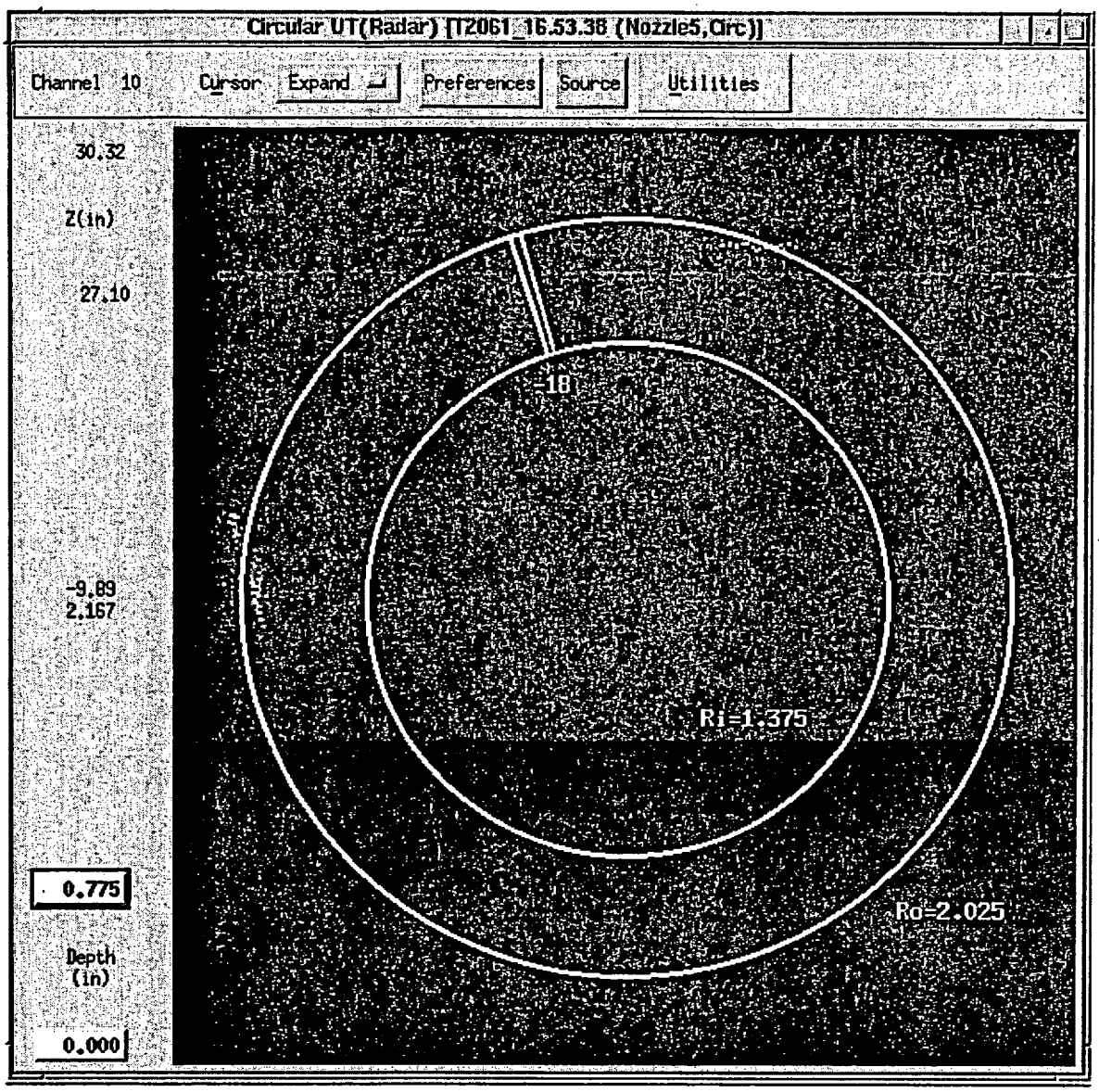


Nozzle 5
Elevations



This scan provides more comprehensive characterization of the axial indications detected using the circ. blade probe. This image is from one of the 60-deg. shear wave transducers with the beam directed circumferentially. The B-scan and D-scan show the relative depths of the OD initiated crack. One axial flaw is detected starting below the weld and extending into the J-groove weld region of the nozzle.

Nozzle 5
Rotating UT, 60-deg. Data



This image is from one of the 60-deg. shear wave transducers with the beam directed circumferentially. This is a cross-sectional view of the nozzle wall using the 60-deg. shear wave transducer showing the relative angular position and the depths of the flaws.

Nozzle 5
Rotating UT, 60-deg. Data

Davis Besse CRDM Nozzle Examination
February / March 2002 ~~PROPRIETARY~~

FRAMATOME ANP

FRAMATOME ANP

CRDM Nozzle Ultrasonic Examination Data Sheet

Customer: FENOC	**Plant:** Davis Besse	**Unit:** N/A		**Nozzle:** 47	
Procedure: 54-ISI-100-08 CA: FRA-02-002, DB-02-012	**Nozzle Dimensions: (in.)**		**ID:** 2.765 **OD:** 4.06	**Thickness:** 0.649	
Downhill Side of Nozzle (deg.): 0	**End of Noz. (in.** 0.1	**robe Serial No.'s:**	Ch 1 S0382CN	Ch 6	
Axial Scan Start: -3.08, .35	Stop: 373.10, 11.44	**Setup:** 3	Ch 2	Ch 7	
Files: B2058_21.22.49 ;B2058_22.13.59; B2058_22.46.12			Ch 3	Ch 8	
Circ. Scan Start:	Stop:	**Setup:**	Ch 4	Ch 9	
Files:			Ch 5	Ch 10	

Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1 Min (in.)	End Point 1 Min (deg.)	End Point 2 Max (in.)	End Point 2 Max (deg.)	Axial Total (in.)	Adjusted Circ. Extent Min (deg.)	Adjusted Circ. Extent Max (deg.)	Adjusted Circ. Extent Total (in.)	Flaw Length (in.)	Flaw Angle (deg.)	Flaw TWD (in.)	Flaw Aspect Ratio	Flaw Orientation	Weld Location @ Flaw Min	Weld Location @ Flaw Max
1	OD		1.06	9.5	2.41	12.2	1.35	9.5	12.2	0.10	1.35	4			AXIAL		
2	OD		1.61	23.4	2.19	24.2	0.58	23.4	24.2	0.03	0.58	3			AXIAL		
3	OD		2.5	33.7	0.96	45.9	1.54	33.7	45.9	0.43	1.60	16			AXIAL		
4	OD		1.76	56.0	2.01	50.9	0.25	56.0	50.9	-0.18	0.31	144			AXIAL		
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	

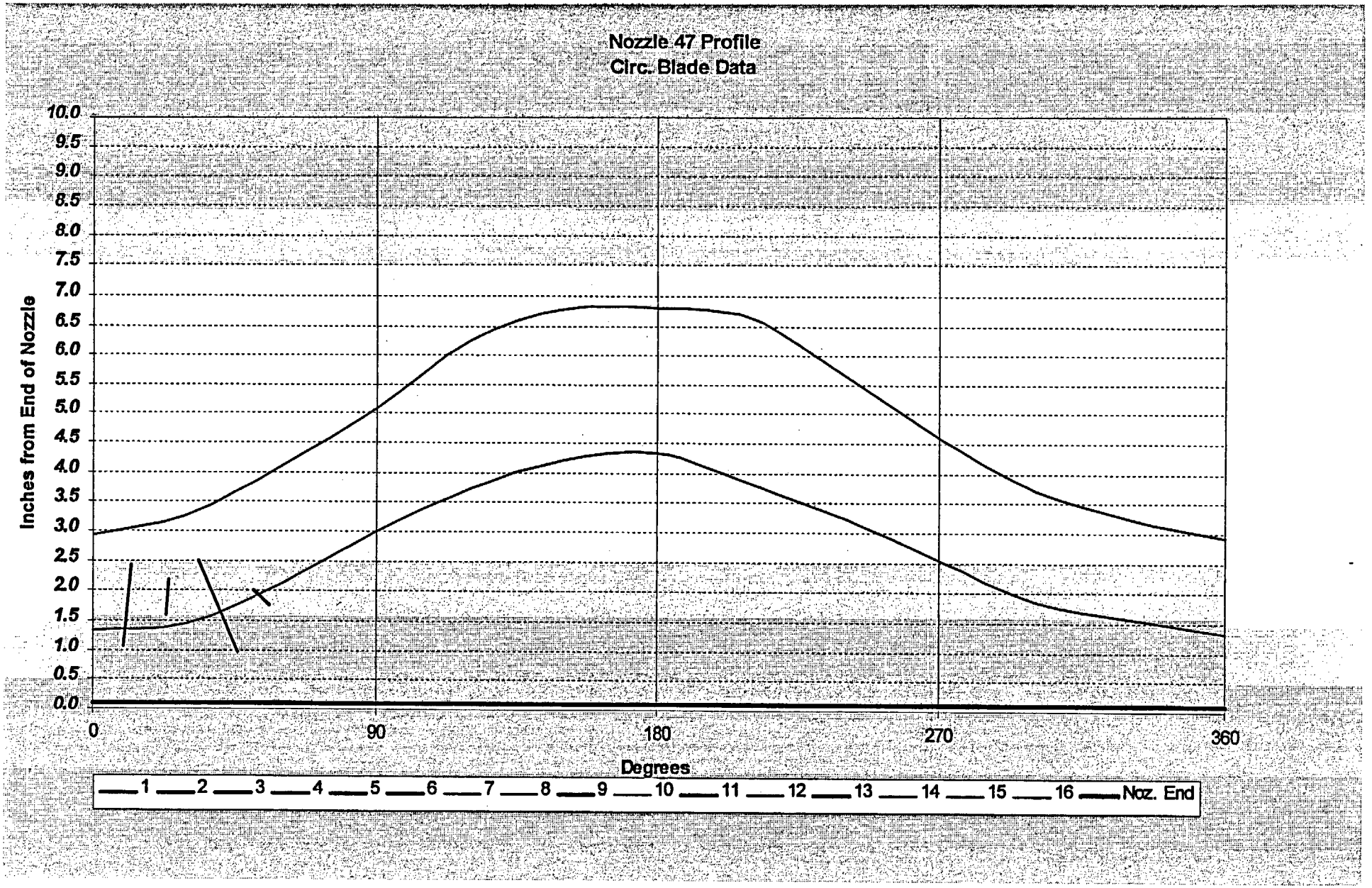
WELD PROFILE	Data Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
	Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
	Noz. End	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	Inches
	MAX.	2.93	3.26	4.12	5.08	6.24	6.79	6.81	6.63	5.67	4.59	3.73	3.24	2.93	Inches
	MIN.	1.32	1.45	2.13	3.01	3.73	4.22	4.33	3.83	3.24	2.54	1.87	1.58	1.32	Inches

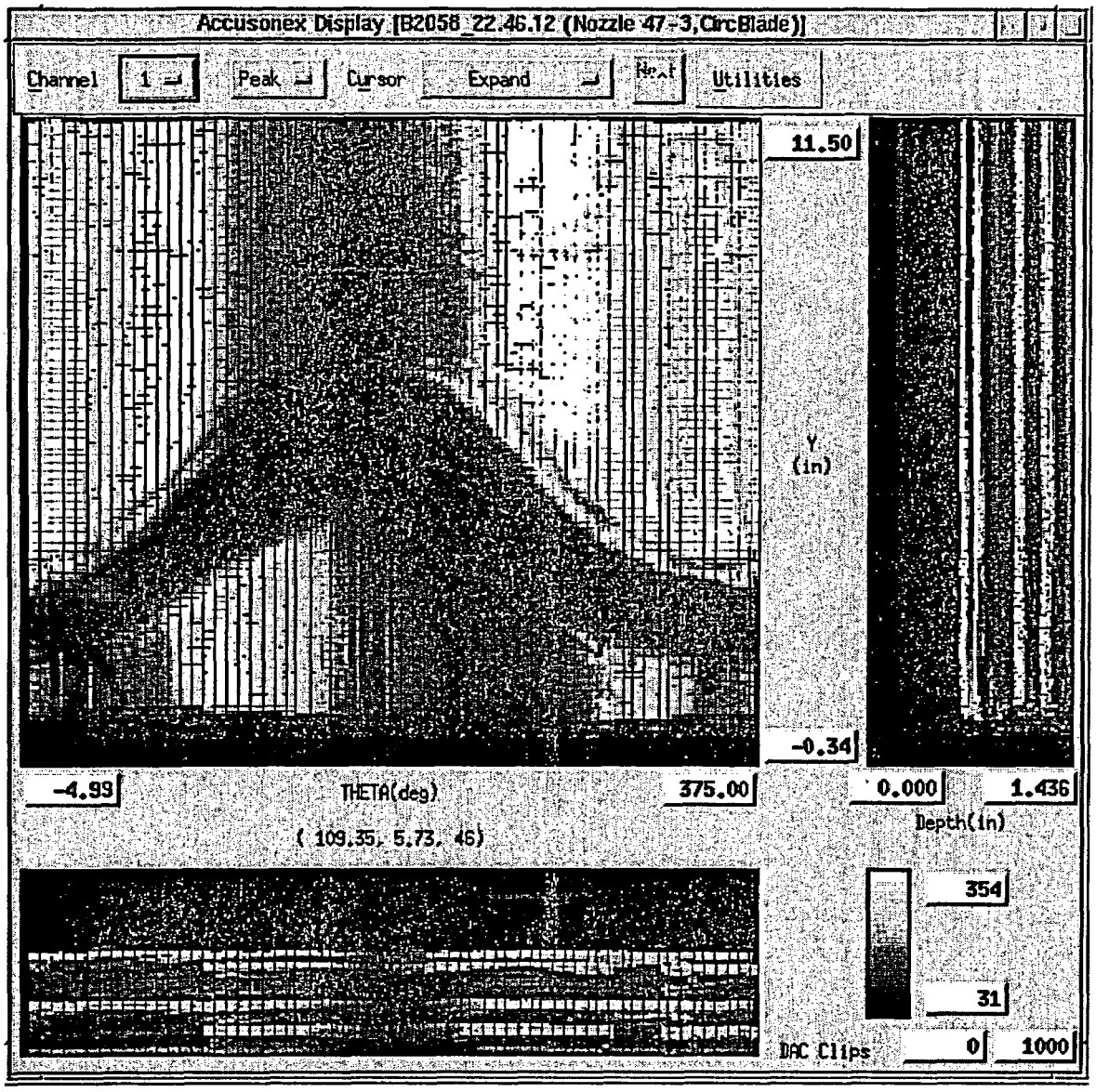
Notes: Adjusted Circ. Extent is relative to downhill side of nozzle;clockwise looking down. TWD is Through-Wall Dimension

Comments: These flaws are axial in the weld region.

These flaws are not able to be fully characterized using the circ. blade probe. Full characterization of all flaws in this nozzle will be performed using the top-down tool or axial blade probes. This report will be revised when additional data becomes available.

Analyzed by: CE Martin **Date:** 2/28/02 **Analyzed by:** **Date:**


Nozzle 47 Profile
Circ. Blade Data
Inches from End of Nozzle
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
90
180
270
360
Degrees
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Noz. End



This scan provided the initial detection of axial flaws in the nozzle wall using the circ. blade probe. Leak Path patterns are not observed in this image. The flaws are detected starting below the weld and extending into the J-groove weld region of the nozzle. The rotating UT determined that this area only contained one axial flaw.

Nozzle 47
Circ. Blade UT Data

Davis Besse CRDM Nozzle Examination
February / March 2002 ~~PROPRIETARY~~

FRAMATOME ANP

FRAMATOME ANP

CRDM Nozzle Ultrasonic Examination Data Sheet

Customer:	FENOC				**Plant:**	Davis Besse			**Unit:**	N/A				**Nozzle:**	47				
Procedure:	54-ISI-100-08	CA: FRA-02-002, DB-02-012			**Nozzle Dimensions: (in.)**				**ID:** 2.765		**OD:** 4.06			**Thickness:**	0.649				
Downhill Side of Nozzle (deg.):	143	**End of Noz. (in.**	45.9						robe Serial No.'s:		Ch 1	2078-01002-0L		Ch 6	21GB-01002-45L				
Axial Scan	Start: -6, 29.9		Stop: 360, 45.9		**Setup:**	1					Ch 2	21GF-01004-30L		Ch 7	21GC-01001-55L				
Files:	T2062_01.40.41										Ch 3	21GA-01004-45L		Ch 8	22CD-01001-65L				
Circ. Scan	Start: -6, 34		Stop: 360, 46		**Setup:**	2					Ch 4	2623-01002-60S		Ch 9	2624-01005-60S				
Files:	T2062_23.53.48										Ch 5	2623-01002-60S		Ch 10	2624-01005-60S				

Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1 Min (in.)	End Point 1 Min (deg.)	End Point 2 Max (in.)	End Point 2 Max (deg.)	Axial Total (in.)	Adjusted Circ. Extent Min (deg.)	Adjusted Circ. Extent Max (deg.)	Adjusted Circ. Extent Total (in.)	Flaw Length (in.)	Flaw Angle (deg.)	Flaw TWD (in.)	Flaw Aspect Ratio	Flaw Orientation	Weld Location @ Flaw Min	Weld Location @ Flaw Max
1																	
2																	
3	OD	0.06	43.23	181.0	45	202.0	1.77	38.0	59.0	0.74	1.92	23	0.59	0.31	AXIAL	In Weld Region	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	

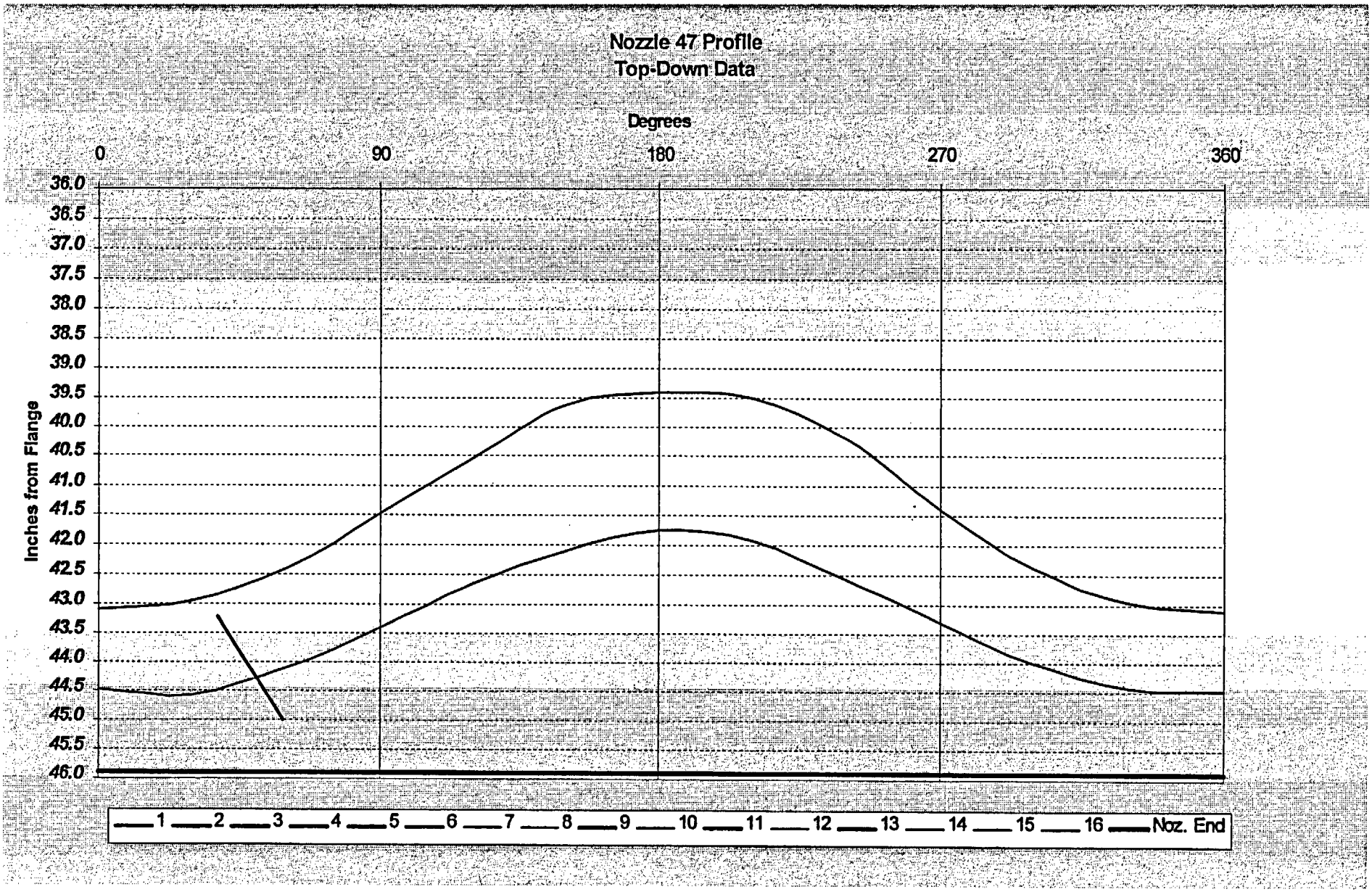
	Data Loc.	143	173	203	233	263	293	323	353	23	53	83	113	143	Degrees	
WELD	Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees	
	Noz. End	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	Inches	
PROFILE	MAX.	44.48	44.58	44.10	43.40	42.67	42.10	41.75	41.94	42.58	43.31	44.01	44.42	44.48	Inches	
	MIN.	43.10	42.96	42.42	41.49	40.54	39.62	39.39	39.49	40.19	41.40	42.38	42.96	43.10	Inches	

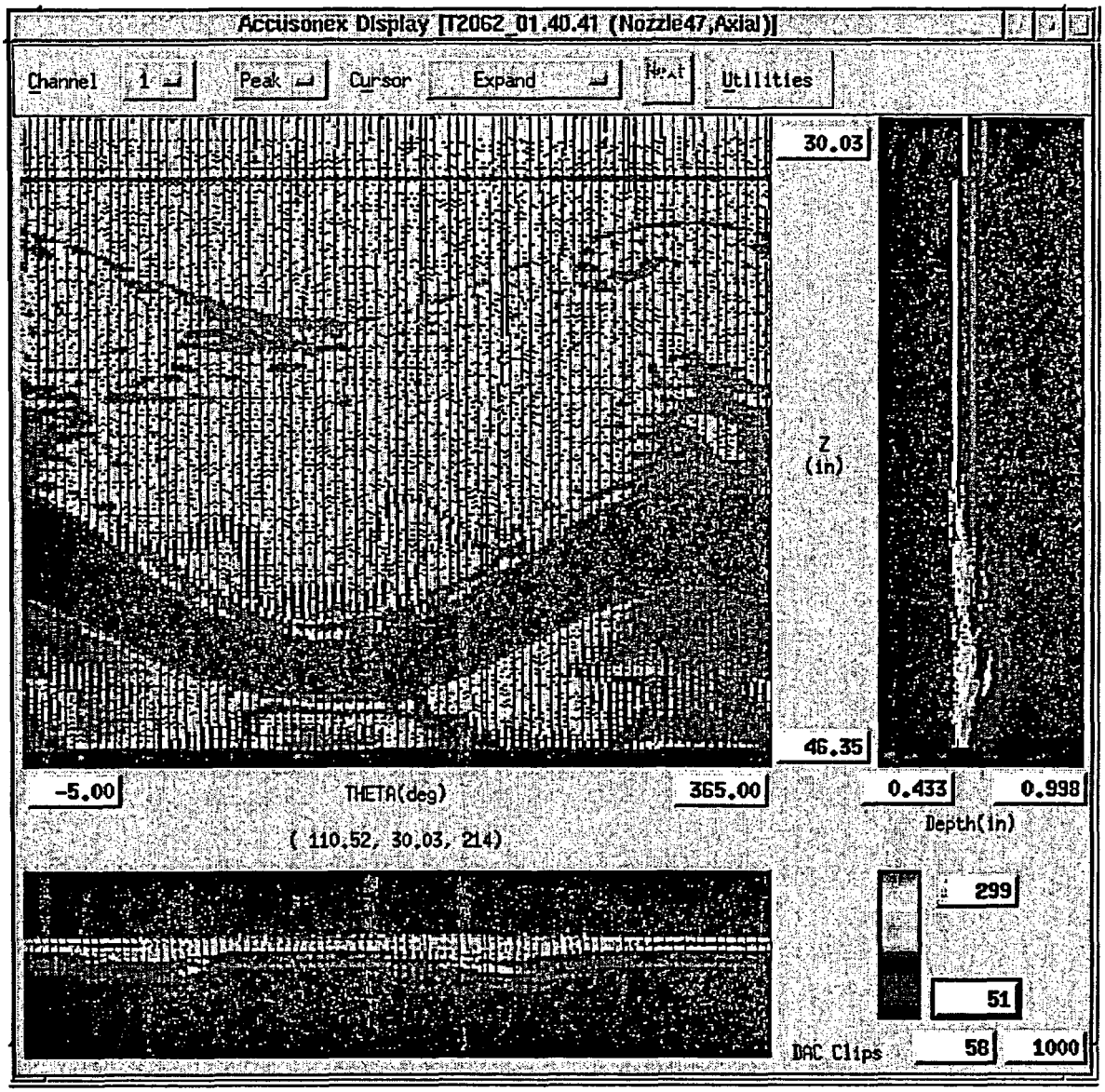
Notes: Adjusted Circ. Extent is relative to downhill side of nozzle;clockwise looking down. TWD is Through-Wall Dimension

Comments: Flaw #3 is an axial flaw that extends into the weld region. This flaw was also detected with the circ. blade probe.

Flaws #1 and #2 were identified with the circ. blade probe but were determined not to be valid detections with the rotating UT. Nozzle ovality in the location of these indications is the source of these false indications. Flaw #4 was detected with the rotating UT but it is located in the J-groove weld fillet and outside the nozzle wall and is therefore outside the scope of this procedure.

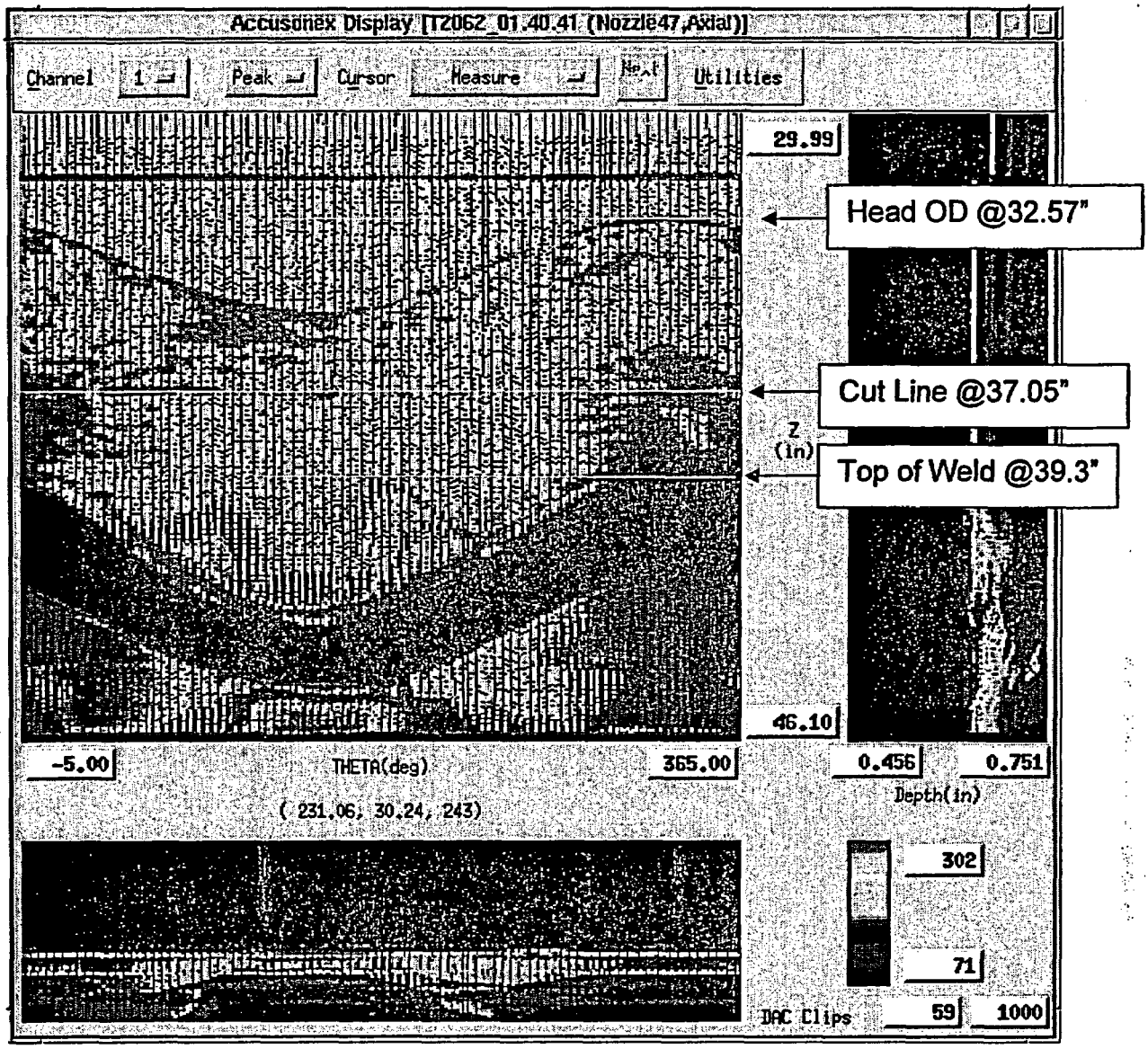
Analyzed by: K. C. Gebetsberger **Date:** 3/4/02 **Analyzed by:** M. G. Hacker **Date:** 3/4/02


Nozzle 47 Profile
Top-Down Data
Degrees
0
90
180
270
360
Inches from Flange
36.0
36.5
37.0
37.5
38.0
38.5
39.0
39.5
40.0
40.5
41.0
41.5
42.0
42.5
43.0
43.5
44.0
44.5
45.0
45.5
46.0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Noz. End

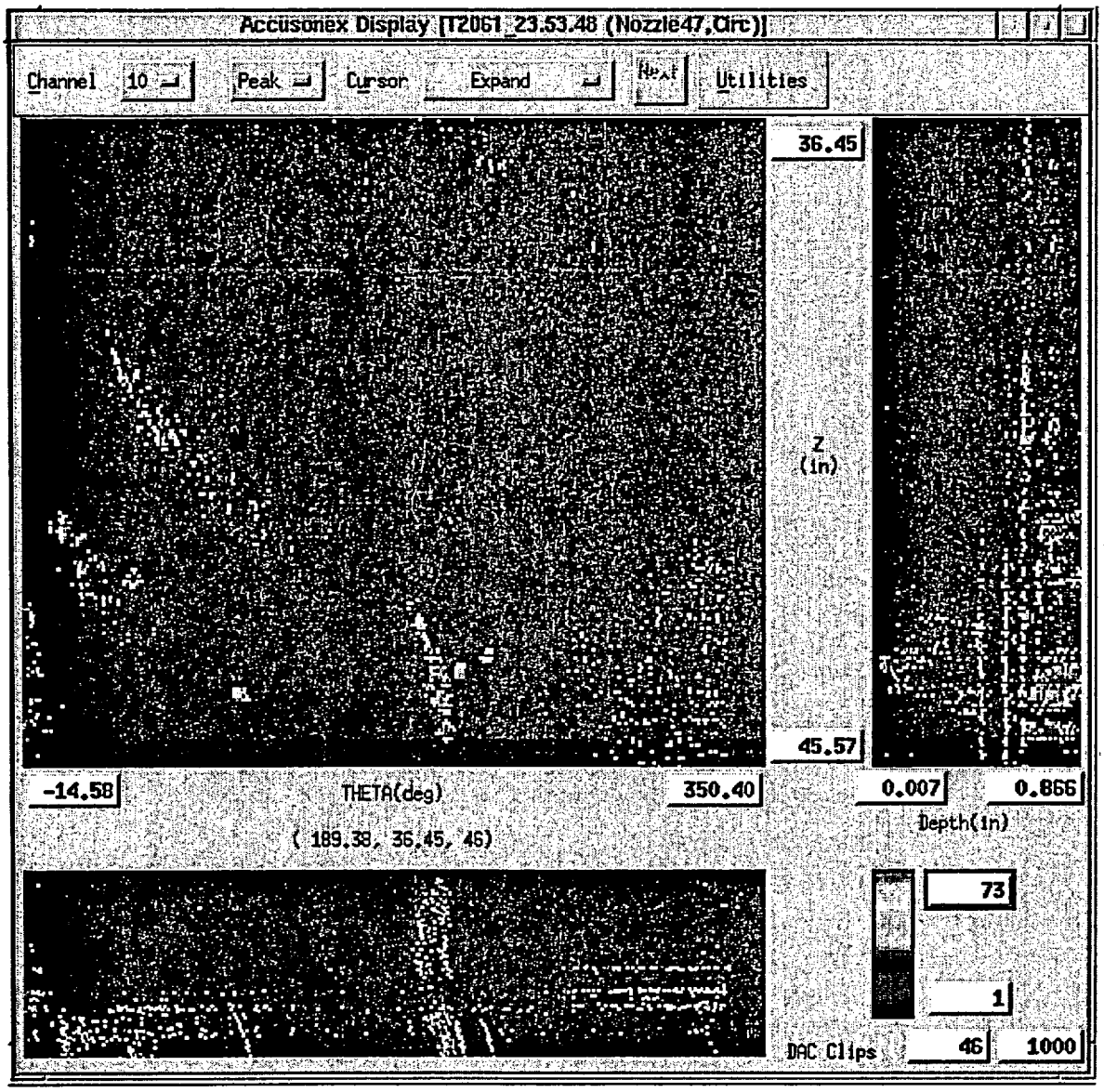


This scan provides more comprehensive characterization of the axial indication detected using the circ. blade probe and provides elevation dimensions for repair activities. This scan also provides characterization of the region of the nozzle surrounding the location of the new ID temperbead weld to assure sound material for welding. Leak Path patterns are not observed in this image. One axial flaw is detected starting below the weld and extending into the J-groove weld region of the nozzle. This flaw has not yet breached the pressure boundary.

Nozzle 47
Rotating UT, 0-deg. Data

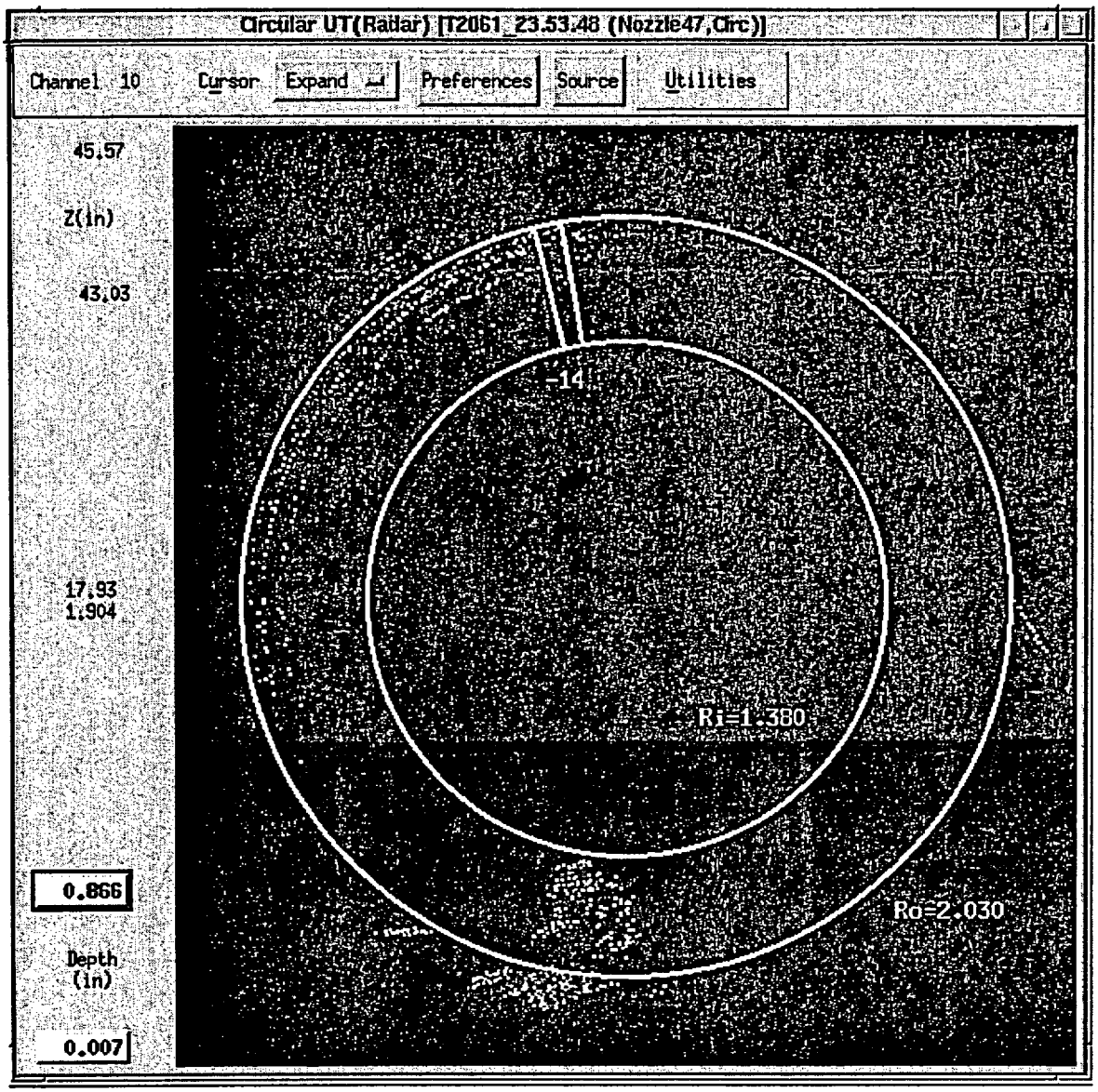


Nozzle 47
Elevations



This scan provides more comprehensive characterization of the axial indications detected using the circ. blade probe. This image is from one of the 60-deg. shear wave transducers with the beam directed circumferentially. The B-scan and D-scan show the relative depths of the OD initiated crack. One axial flaw is detected starting below the weld and extending into the J-groove weld region of the nozzle.

Nozzle 47
Rotating UT, 60-deg. Data



This image is from one of the 60-deg. shear wave transducers with the beam directed circumferentially. This is a cross-sectional view of the nozzle wall using the 60-deg. shear wave transducer showing the relative angular position and the depths of the flaws.

Nozzle 47
Rotating UT, 60-deg. Data

FRAMATOME ANP

CRDM Nozzle Ultrasonic Examination Data Sheet

Customer: FENOC						**Plant:** Davis Besse				**Unit:** n/a					**Nozzle:** 58				
Procedure: 54-ISI-100-08 CA: FRA-02-002, DB-02-012						**Nozzle Dimensions: (in.)**				ID: 2.765		OD: 4.06			**Thickness:** 0.649				
Downhill Side of Nozzle (deg.): 0						**End of Noz. (in.** 0.14				robe Serial No.'s:		Ch 1 S0319CN			Ch 6				
Axial Scan Start: -1, 6						Stop: 370, 11.4				**Setup:** 3		Ch 2			Ch 7				
Files: B2059_05.56.14												Ch 3			Ch 8				
Circ. Scan Start:						Stop:				**Setup:**		Ch 4			Ch 9				
Files:												Ch 5			Ch 10				

Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1		End Point 2		Axial Total (in.)	Adjusted Circ. Extent			Flaw Length (in.)	Flaw Angle (deg.)	Flaw TWD (in.)	Flaw Aspect Ratio	Flaw Orientation	Weld Location @ Flaw	
			Min (in.)	Min (deg.)	Max (in.)	Max (deg.)		Min (deg.)	Max (deg.)	Total (in.)						Min	Max
1	ID		1.02	82.0	2.56	87.0	1.54	82.0	87.0	0.12	1.54	4			AXIAL		
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	

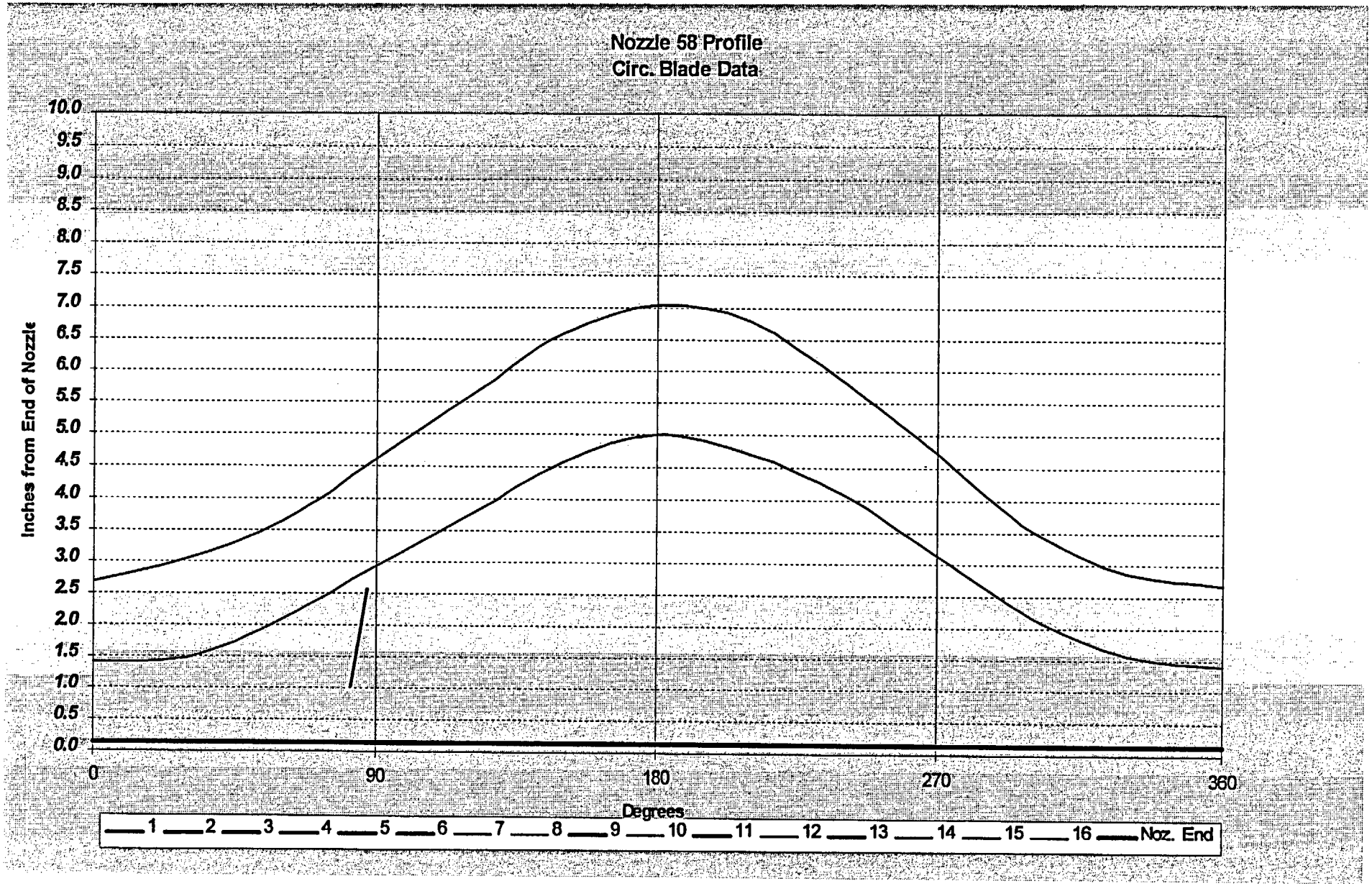
	Data Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
WELD	Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
	Noz. End	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	Inches
PROFILE	MAX.	2.69	3.05	3.64	4.62	5.60	6.60	7.05	6.80	5.85	4.73	3.53	2.86	2.69	Inches
	MIN.	1.42	1.48	2.10	2.94	3.75	4.56	5.01	4.70	4.09	3.14	2.16	1.57	1.42	Inches

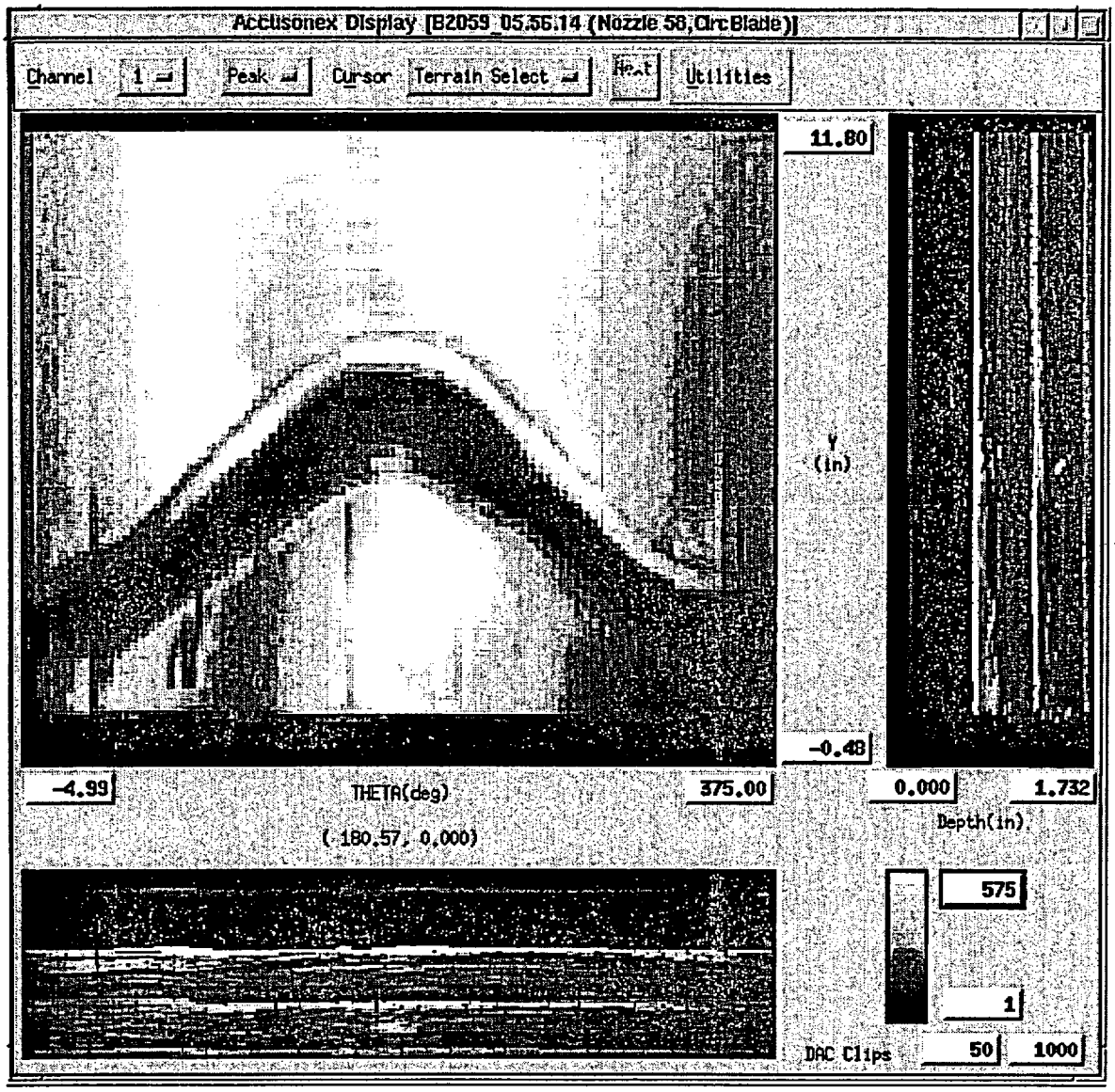
Notes: Adjusted Circ. Extent is relative to downhill side of nozzle; clockwise looking down. TWD is Through-Wall Dimension

Comments: This is an axial flaw below the weld region.

This flaw is not able to be fully characterized using the circ. blade probe. Full characterization of all flaws in this nozzle will be performed using the top-down tool or axial blade probes. This report will be revised when additional data becomes available.

Analyzed by: K. C. Gebetsberger **Date:** 2/28/02 **Analyzed by:** **Date:**


Nozzle 58 Profile
Circ. Blade Data
Inches from End of Nozzle
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
90
180
270
360
Degrees
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 Noz. End



This scan provided the initial detection of an axial flaw in the nozzle wall using the circ. blade probe. Leak Path patterns are not observed in this image. The flaw is detected starting below the weld and extending up to the J-groove weld region of the nozzle. The rotating UT determined that this area did not contain any flaws. The indication was determined to be non-relevant caused by nozzle ovality interfering with probe contact.

Nozzle 58
Circ. Blade UT Data

FRAMATOME ANP

FRAMATOME ANP

CRDM Nozzle Ultrasonic Examination Data Sheet

Customer:	FENOC				**Plant:**	Davis Besse			**Unit:**	n/a				**Nozzle:**	58				
Procedure:	54-ISI-100-08	CA: FRA-02-002, DB-02-012			**Nozzle Dimensions: (in.)**				ID: 2.765		OD: 4.06			**Thickness:**	0.649				
Downhill Side of Nozzle (deg.):		109	**End of Noz. (in.**	48.11				**robe Serial No.'s:**	Ch 1	2078-01002-0L				Ch 6	21GB-01002-45L				
Axial Scan	**Start:**	-5, 31.85	**Stop:**	365, 48.65	**Setup:**	1			Ch 2	21GF-01004-30L				Ch 7	21GC-01001-55L				
Files:	T2061_20.48.11								Ch 3	21GA-01004-45L				Ch 8	22CD-01001-65L				
Circ. Scan	**Start:**	-6, 36	**Stop:**	366, 48	**Setup:**	2			Ch 4	2623-01002-60S				Ch 9	2624-01005-60S				
Files:	T2061_21.47.33								Ch 5	2623-01002-60S				Ch 10	2624-01005-60S				

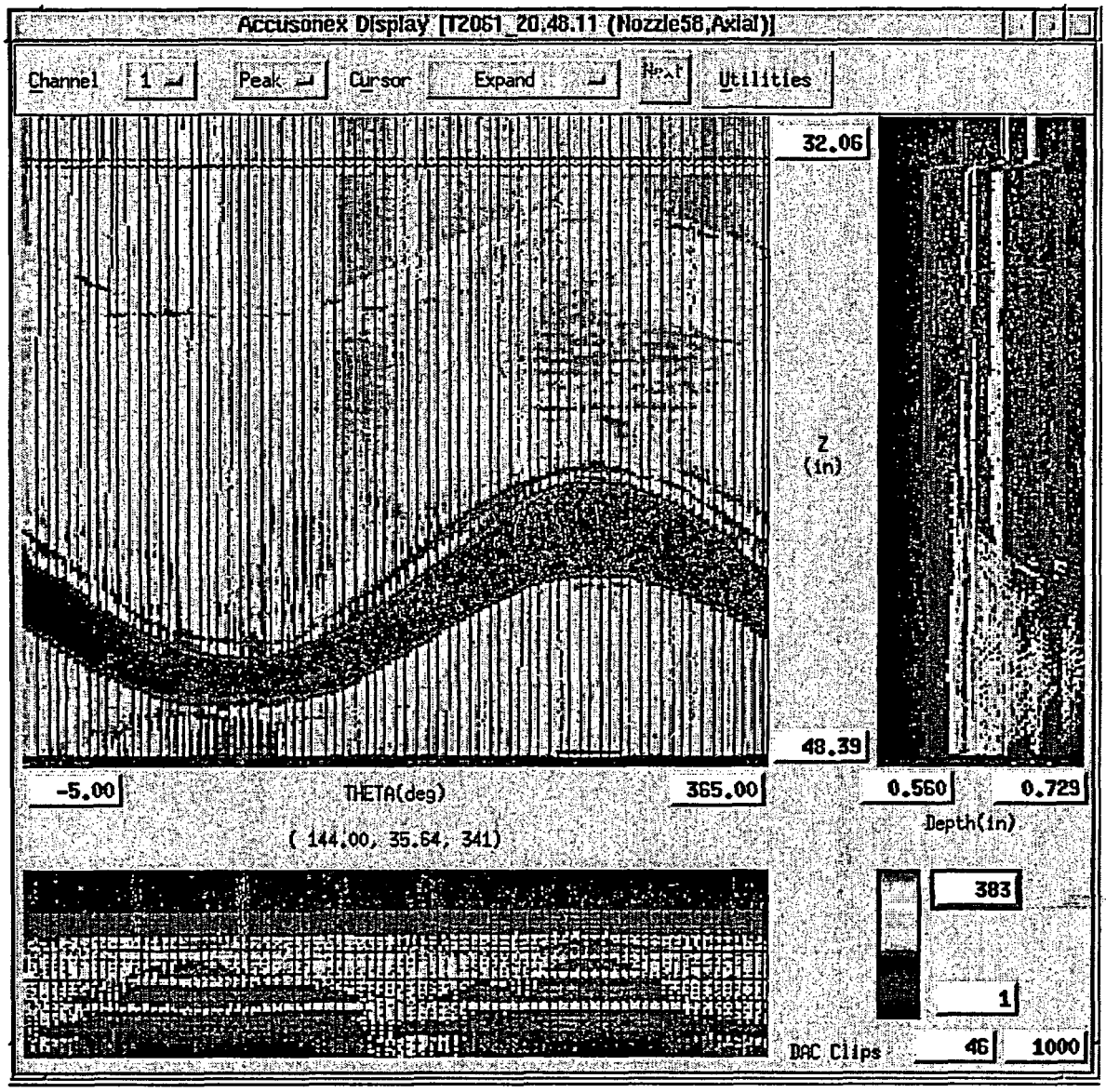
Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1 Min (in.)	End Point 1 Min (deg.)	End Point 2 Max (in.)	End Point 2 Max (deg.)	Axial Total (in.)	Adjusted Circ. Extent Min (deg.)	Adjusted Circ. Extent Max (deg.)	Adjusted Circ. Extent Total (in.)	Flaw Length (in.)	Flaw Angle (deg.)	Flaw TWD (in.)	Flaw Aspect Ratio	Flaw Orientation	Weld Location @ Flaw Min	Weld Location @ Flaw Max
1																	
2																	
3																	
4		No Recordable Indications															
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	
		Data Loc.	109	139	169	199	229	259	289	319	349	19	49	79	109	Degrees	
WELD		Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees	
		Noz. End	48.11	48.11	48.11	48.11	48.11	48.11	48.11	48.11	48.11	48.11	48.11	48.11	48.11	Inches	
PROFILE		MAX.														Inches	
		MIN.														Inches	

Notes: Adjusted Circ. Extent is relative to downhill side of nozzle;clockwise looking down. TWD is Through-Wall Dimension

Comments: This examination was performed to characterize an axial indication detected below the weld with the Circ. Blade probe.

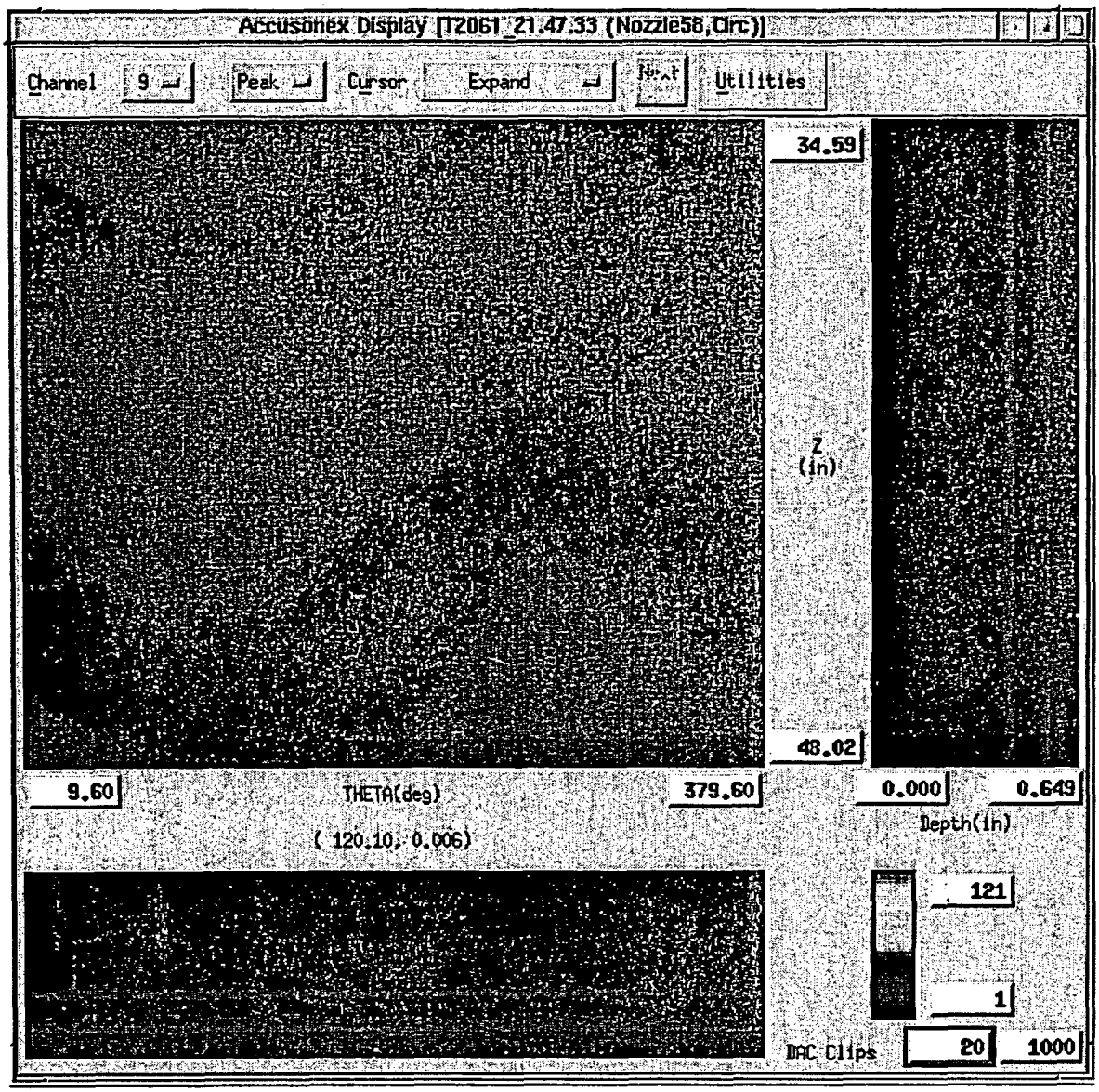
This flaw is not confirmed with any of the transducers used with the top-down tool and therefore the indication detected with the blade probe is considered non-relevant.

Analyzed by: K. C. Gebetsberger **Date:** 3/4/02 **Analyzed by:** M. G. Hacker **Date:** 3/4/02



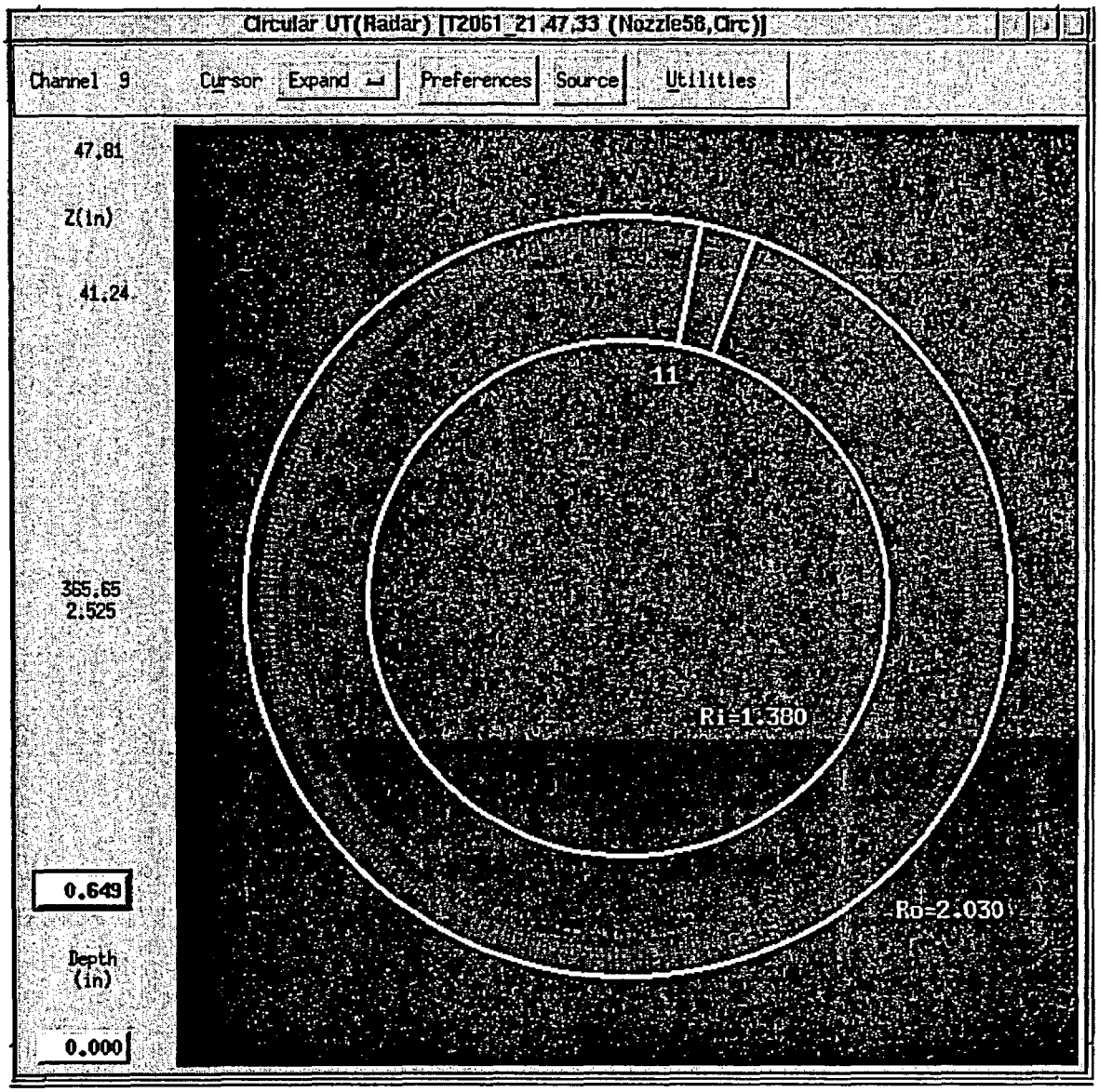
This scan provides more comprehensive characterization of the axial indication detected using the circ. blade probe and provides elevation dimensions for repair activities. Leak Path patterns are not observed in this image. The indication detected with the Circ. blade probe is not detected with any of the 10 transducers used with the rotating UT.

Nozzle 58
Rotating UT, 0-deg. Data



This scan provides more comprehensive characterization of the axial indications detected using the circ. blade probe. This image is from one of the 60-deg. shear wave transducers with the beam directed circumferentially. All views with all transducers show the absence of signals that can be correlated with the blade UT results. Therefore the indication detected with blade probe is considered non-relevant.

Nozzle 58
Rotating UT, 60-deg. Data



This image is from one of the 60-deg. shear wave transducers with the beam directed circumferentially. This is a cross-sectional view of the nozzle wall using the 60-deg. shear wave transducer. Note that there are no flaw signals observed.

Nozzle 58
Rotating UT 60-deg. Data

Calibration Data for Circ. Blade

Auxiliary Header Information

File Edit

```
SYS_ID            : B
DATA PATH         : NONE
CALIB_ID          :   3
SIN/SUBSCAN       : Nozzle 1/CircBlade
SCAN_AXIS(mn,mx)  :     Y(  -0.48,  11.00)
INDEX_AXIS(mn,mx) : THETA(  -4.97, 375.00)
DISPLAY_CHANNEL   :   1
SYNCH(MODE)       : 200(counts)
Gain boost(dB)    :   0
Pulser voltage    : 100
Indx/Scan Speed(%):  21     11
Active Channels   :   1
PEAK WIDTHS       :  25
RECT MODES        : FW
DELAYS(ms)        :   0.0
PulseReceive Mode : Dual
Pulse(nanoSec)    : 100
Frequency(MHz)    :  50
ACQ START(uSec)   :  3.6
ACQ LENGTH(uSec)  : 10.0
COINCIDENCE       :   1
RUN GAIN(dB,*)    : 32;1
CAL GAIN(db)      :  26
Thrshld(%FS R.G.):   5
Thrshld(%FS C.G.):   0
```

DAC Editor

Setup No: 3, Channel 1

Gain Offset(db): 0 Cal gain: 26, Run Gain: 32

Set Flat DAC 10% 50% 100%

Pt.	Location(count)	Threshold(%FS)	Depth(in)
1	82	80	0.180
2	115	80	0.340
3	164	80	0.490
4	0	0	0.000
5	0	0	0.000

Acquisition Parameters(060)

Frequency(MHz) : 50.0 Gain Mode : Dual

Gate 1 Delay(us) : 3.6 Window(us) : 9.9

Calibration Data for Top-Down Axial Beams

Auxiliary Header Information

File Edit

SYS_ID	: T					
DATA PATH	: NONE					
CALIB_ID	: 1					
SIN/SUBSCAN	: Nozzle2B/Axial					
SCAN_AXIS(mn,mx)	: Z(14.80, 29.80)					
INDEX_AXIS(mn,mx)	: THETA(-5.00, 365.00)					
DISPLAY_CHANNEL	: 1					
SYNCH(MODE)	: 200(counts)					
Gain boost(dB)	: 0					
Pulser voltage	: 200					
Indx/Scan Speed(%)	: 10.909	-1.420				
Active Channels	: 1	2	3	4	5	
PEAK WIDTHS	: 25	25	25	25	25	
RECT MODES	: FW	FW	FW	FW	FW	
DELAYS(ms)	: 0.0	0.0	0.0	0.0	0.0	
PulseReceive Mode	: Sngl	Dual	Dual	Dual	Dual	
Pulse(nanoSec)	: 100	100	100	222	222	
Frequency(MHz)	: 50	50	50	25	25	
ACQ START(uSec)	: 8.4	7.4	0.8	0.4	0.5	
ACQ LENGTH(uSec)	: 17.1	11.3	20.8	41.3	40.6	
COINCIDENCE	: 1	1	1	1	1	
RUN GAIN(dB,*)	: 26;1	42;1	46;1	36;1	34;1	
CAL GAIN(db)	: 20	36	40	30	28	
Thrshld(%FS R.G.)	: 5	5	5	5	5	
Thrshld(%FS C.G.)	: 0	0	0	0	0	

DAC Editor

Setup No: 1, Channel 1

Gain Offset(db): 0 Cal gain: 20, Run Gain: 26

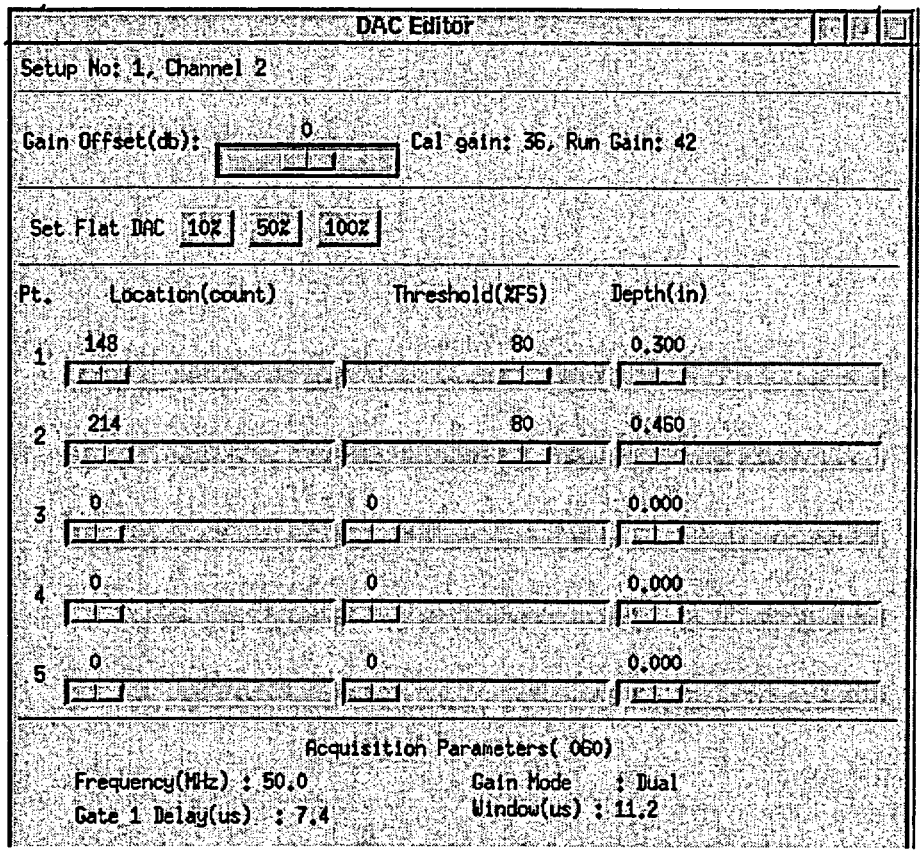
Set Flat DAC 10% 50% 100%

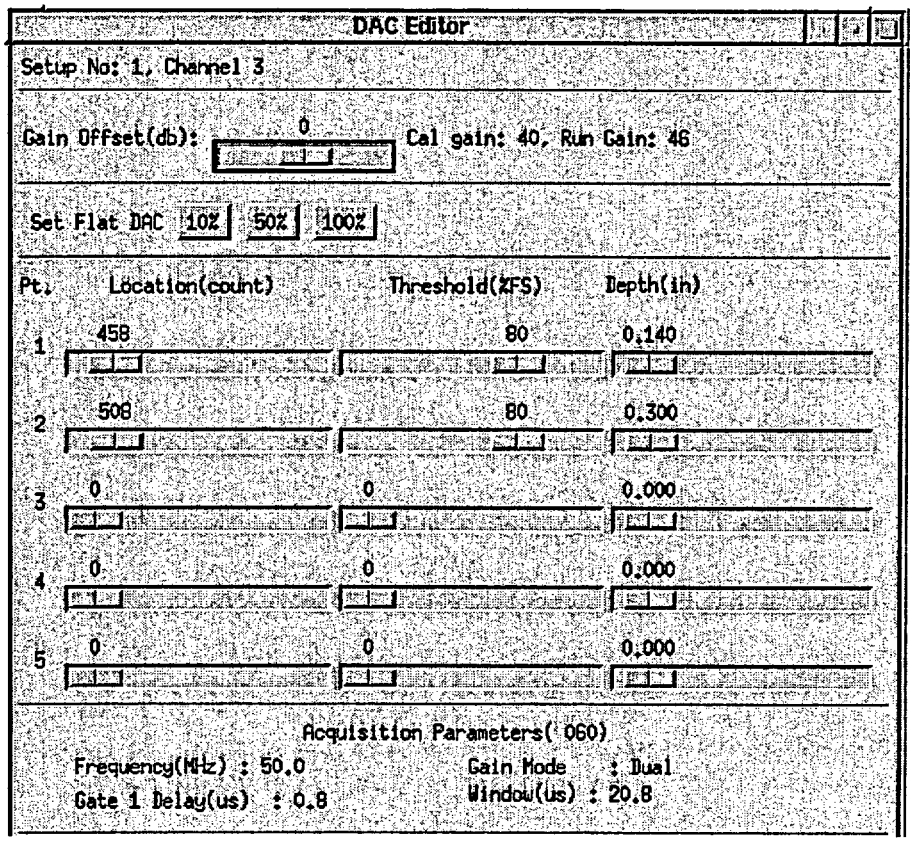
Pt.	Location(count)	Threshold(%FS)	Depth(in)
1	261	80	0.300
2	334	80	0.450
3	0	0	0.000
4	0	0	0.000
5	0	0	0.000

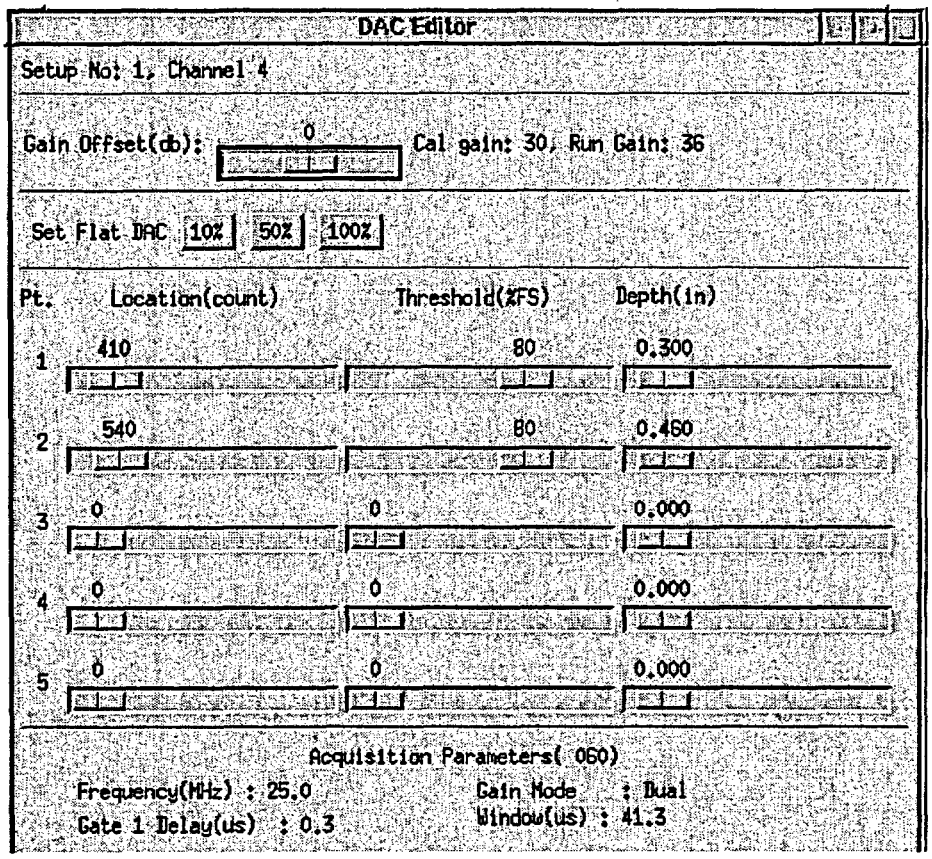
Acquisition Parameters(060)

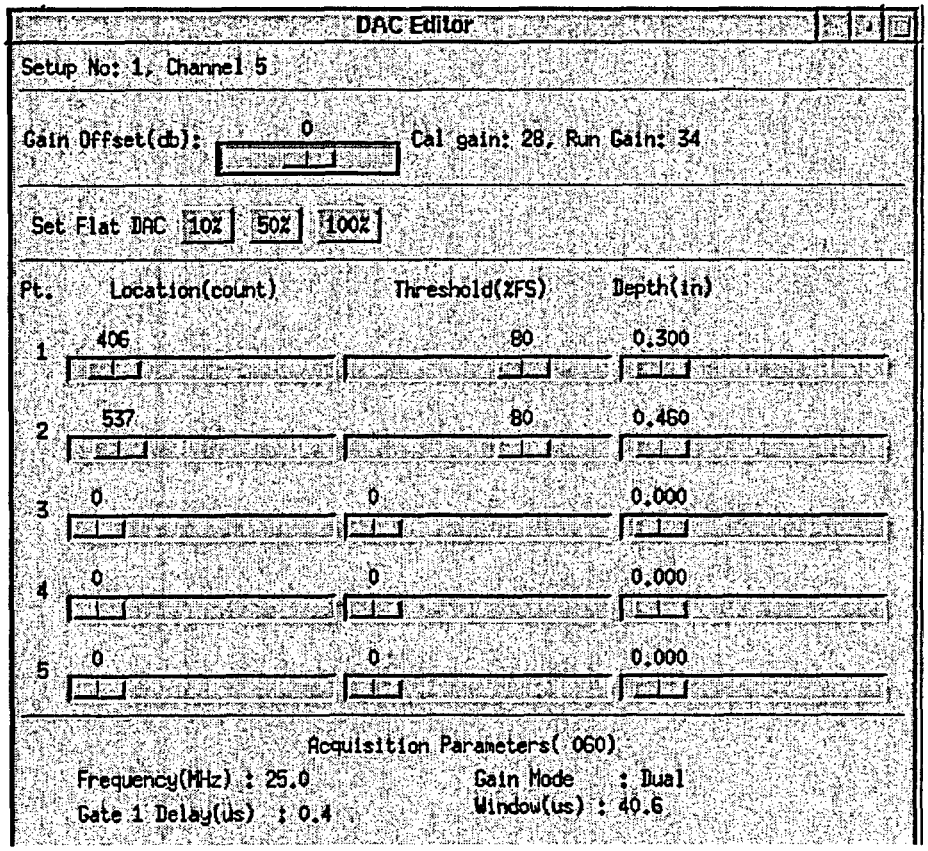
Frequency(MHz) : 50.0 Gain Mode : Dual

Gate 1 Delay(us) : 8.4 Window(us) : 17.1

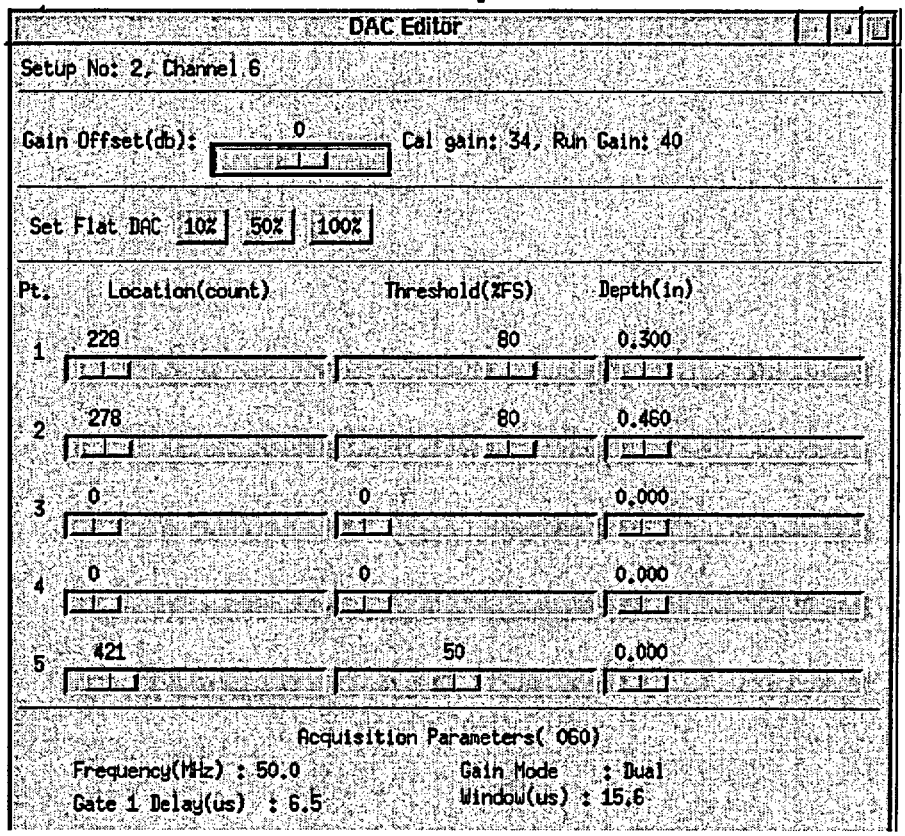

DAC Editor
Setup No: 1, Channel 2
Gain Offset(db): 0
Cal gain: 36, Run Gain: 42
Set Flat DAC 10% 50% 100%
Pt. Location(count) Threshold(%FS) Depth(in)
1 148 80 0.300
2 214 80 0.450
3 0 0 0.000
4 0 0 0.000
5 0 0 0.000
Acquisition Parameters(060)
Frequency(MHz) : 50.0
Gain Mode : Dual
Gate 1 Delay(us) : 7.4
Window(us) : 11.2

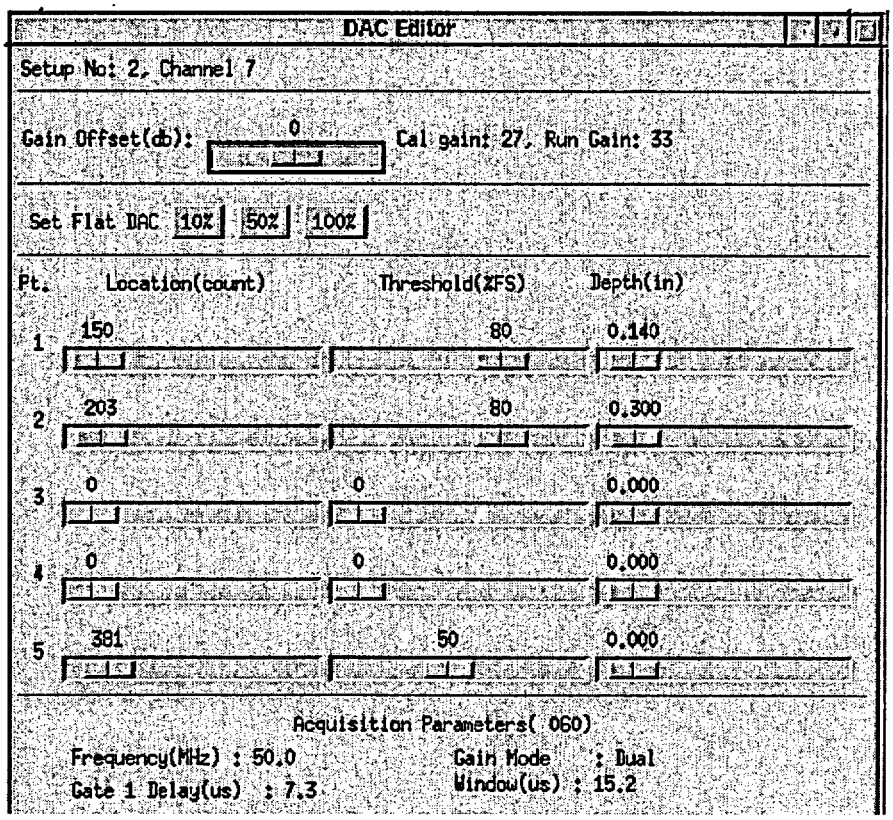

DAC Editor
Setup No: 1, Channel 3
Gain Offset(db): 0
Cal gain: 40, Run Gain: 46
Set Flat DAC 10% 50% 100%
Pt. Location(count) Threshold(%FS) Depth(in)
1 458 80 0.140
2 508 80 0.300
3 0 0 0.000
4 0 0 0.000
5 0 0 0.000
Acquisition Parameters(060)
Frequency(MHz) : 50.0
Gain Mode : Dual
Gate 1 Delay(us) : 0.8
Window(us) : 20.8

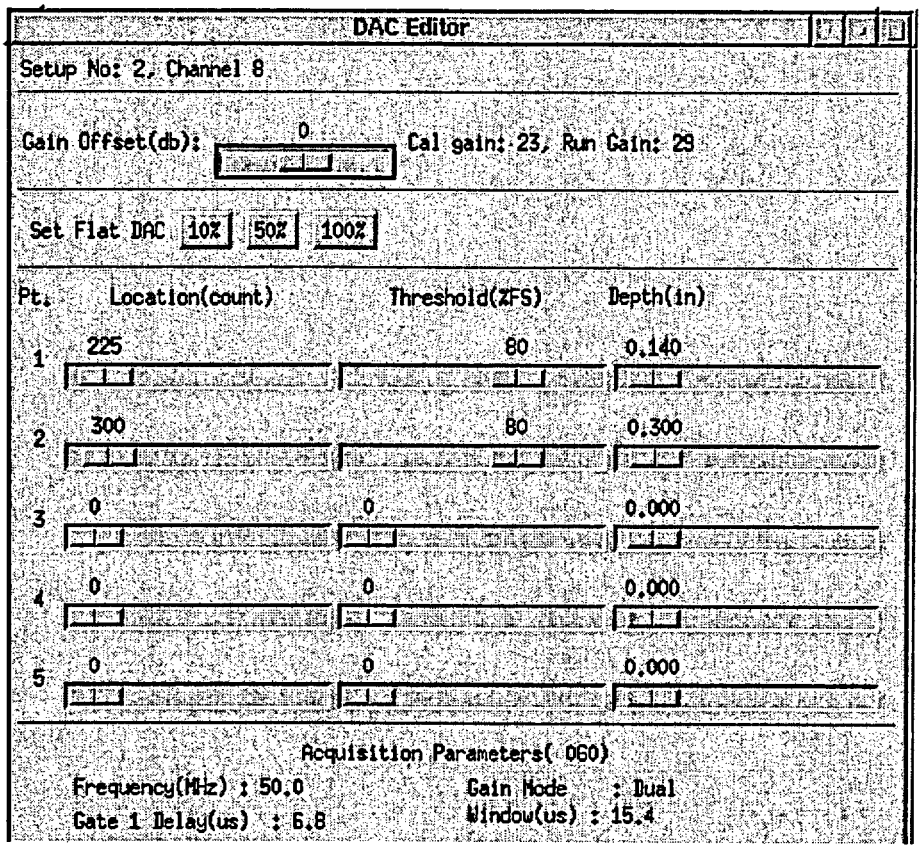

DAC Editor
Setup No: 1, Channel 4
Gain Offset(db): 0
Cal gain: 30, Run Gain: 36
Set Flat DAC 10% 50% 100%
Pt. Location(count) Threshold(%FS) Depth(in)
1 410 80 0.300
2 540 80 0.460
3 0 0 0.000
4 0 0 0.000
5 0 0 0.000
Acquisition Parameters(060)
Frequency(MHz) : 25.0
Gain Mode : Dual
Gate 1 Delay(us) : 0.3
Window(us) : 41.3

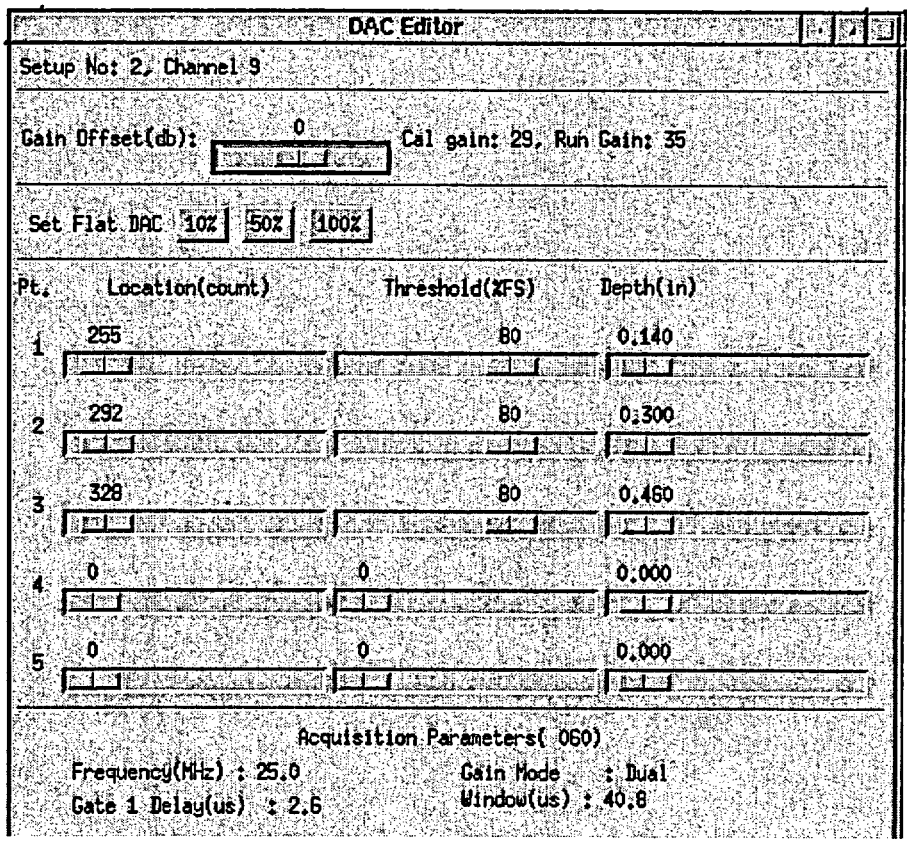

DAC Editor
Setup No: 1, Channel 5
Gain Offset(db): 0
Cal gain: 28, Run Gain: 34
Set Flat DAC 10% 50% 100%
Pt. Location(count) Threshold(%FS) Depth(in)
1 406 80 0.300
2 537 80 0.460
3 0 0 0.000
4 0 0 0.000
5 0 0 0.000
Acquisition Parameters(060)
Frequency(MHz) : 25.0
Gain Mode : Dual
Gate 1 Delay(us) : 0.4
Window(us) : 40.6

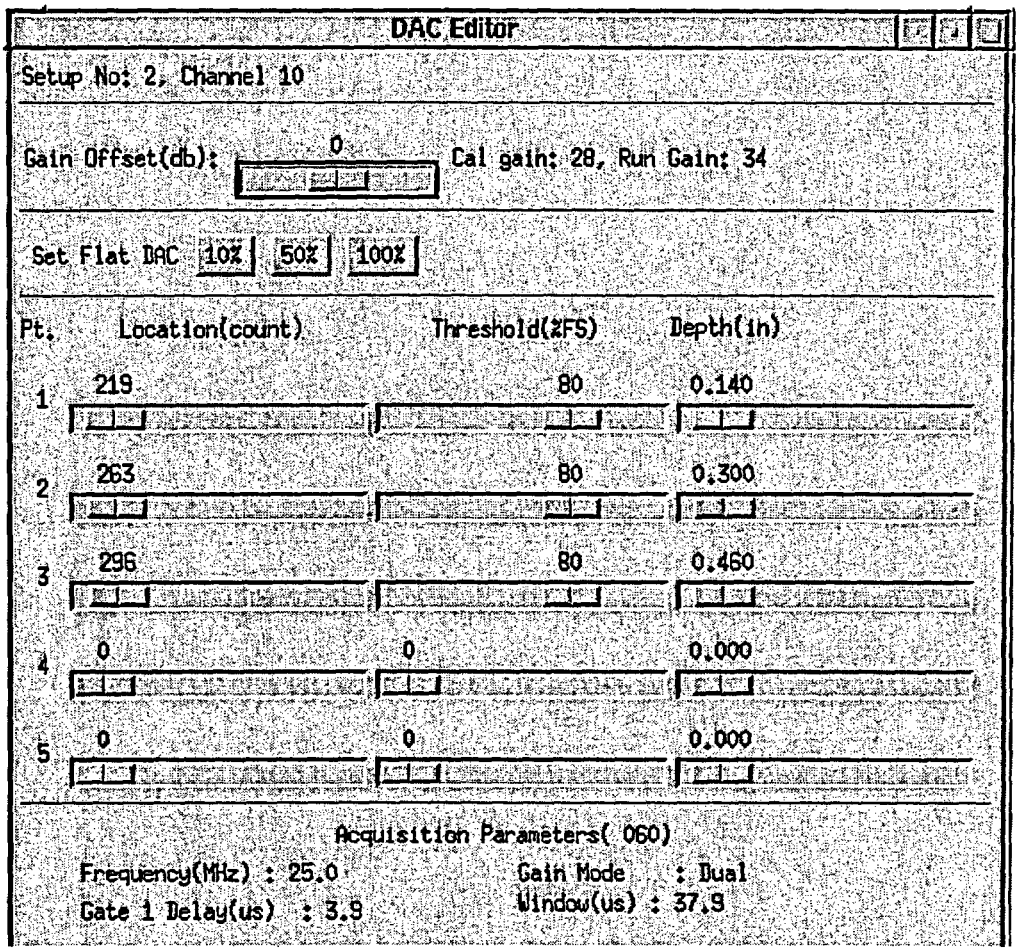
Calibration Data for Top-Down Circ. Beams






DAC Editor
Setup No: 2, Channel 8
Gain Offset(db): 0
Cal gain: 23, Run Gain: 29
Set Flat DAC 10% 50% 100%
Pt. Location(count) Threshold(%FS) Depth(in)
1 225 80 0.140
2 300 80 0.300
3 0 0 0.000
4 0 0 0.000
5 0 0 0.000
Acquisition Parameters(060)
Frequency(MHz) : 50.0
Gate 1 Delay(us) : 6.8
Gain Mode : Dual
Window(us) : 15.4


DAC Editor
Setup No: 2, Channel 9
Gain Offset(db): 0
Cal gain: 29, Run Gain: 35
Set Flat DAC 10% 50% 100%
Pt. Location(count) Threshold(%FS) Depth(in)
1 255 80 0.140
2 292 80 0.300
3 328 80 0.460
4 0 0 0.000
5 0 0 0.000
Acquisition Parameters(060)
Frequency(MHz) : 25.0
Gate 1 Delay(us) : 2.6
Gain Mode : Dual
Window(us) : 40.8


DAC Editor
Setup No: 2, Channel 10
Gain Offset(db): 0
Cal gain: 28, Run Gain: 34
Set Flat DAC 10% 50% 100%
Pt. Location(count) Threshold(%FS) Depth(in)
1 219 80 0.140
2 263 80 0.300
3 296 80 0.460
4 0 0 0.000
5 0 0 0.000
Acquisition Parameters(060)
Frequency(MHz) : 25.0
Gain Mode : Dual
Gate 1 Delay(us) : 3.9
Window(us) : 37.9