NES NUCLEAR ENERGY SERVICES, INC.

ULTRASONIC EXAMINATION PROCEDURE

FOR

REACTOR VESSEL FEEDWATER

NOZZLE INNER RADIUS

FOR

VERMONT YANKEE

Project Application	Prepared By	Date
5545-200	M.E. Alling	1/27/83

APPROVALS

TITLE/DEPT.	SIGNATURE	DATE
Level III		1/27/83
Man. Ops. Dept. Mgr.		1/28/83
Proj. Mgr.		1/28/83
Q.A. Mgr.		1/28/83

REVISION LOG

NUCLEAR ENERGY SERVICES, INC.

DOCUMENT NO. 80A7616

REV. NO.	DATE	PAGE NO.	DESCRIPTION	APPROVAL
1	2/25/83	4	Para. 2.1 changing code year to "1974,	
			Summer 75"	
			Para. 2.2 reworded	
			Para. 2.8 added new para.	
		4-5	Para. 3.1 reworded second and fourth sen-	
			tence.	
			Para. 3.2 added new sentence.	
			Para. 4.0 reworded 2nd and 3rd lines.	
		6	Para. 5.2.5 reworded	
		6-7	Para. 5.3 add new para. and renumbered	
		8	Para 6.1.11 added new para.	
			Para 6.2.5 reworded	
		9	Para. 8.1.1 revised	
			Para 8.1.(2),(5) reworded	
		11	Para 8.2.5 add new para. and renumbered	
			Para. 8.3.1(A) (1) reworded	
		12	Para. 9.1(1), (3) reworded	
			Para. 9.2.1 delete "Note...level".	
		14	Para. 10.1.2 change " 25% to 20%"	
			Para. 10.1.3 add new para. and renumbered	
			Para. 10.2.1 revised	
		15	Para. 11.3 revised	
		16-19	Figure (1),(3),(4) revised	
		20-21	Figure 5 delete and add new Fig. 5 & 6	
			Refer to CRA No. 3165	

ULTRASONIC EXAMINATION PROCEDURE FOR REACTOR VESSEL FEEDWATER NOZZLE INNER RADIUS

1. SCOPE

1.1 AREA OF EXAMINATION

This document covers the ultrasonic examination procedure and application requirements for the examination of the feedwater nozzle inner radius area.

1.2 TYPE OF EXAMINATION

1. Volumetric examination, **from the shell,** shall be performed using ultrasonic pulse echo nominal 70° angle beam shear wave techniques applied to the OD surfaces of the shell adjacent to the nozzles at the proper tangential (skew) angle.

2. Volumetric examination, **from the barrel,** shall be performed using compound angle beam shear wave techniques (two angles simultaneously) applied to the OD surface of each nozzle barrel to be examined.

3. The examination shall be performed manually using contact search units (transducers) and/or scan fixtures.

4. The examination scan movement approach shall proceed no further than the beginning of the radius blend of each nozzle while on the vessel shell or nozzle barrel.

1.3 NOZZLE INNER RADIUS CONFIGURATION

Typical nozzle inner radius area configuration is shown in Figure 1.

1.4 MATERIALS

The reactor shell and nozzles are constructed of carbon steel with stainless steel cladding on the ID surface.

2. REFERENCES

1. Section V, including Article 5, "Ultrasonic Examination," 1974 Edition, up to and including the Summer of 1975 Addenda. 1

2. ASME Boiler and Pressure Vessel Code, Section XI, 1974 Edition through the Summer 1975 Addenda, invoking the provisions of IWA-2240.

3. SNT-TC-1A, "Nondestructive Testing Personnel Qualifications and Certification," 1975 Edition.

4. 80A9068 NES "Procedure for Qualification and Certification of Nondestructive Examination Personnel" (Latest Revision).

5. 80A9053 NES "Procedure for Ultrasonic Instrument Linearity Verification" (Latest Revision).

6. NUREG-0619; BWR Feedwater Nozzle and Control Rod Drive Return Line Nozzle Cracking.

7. 80A9060 NES "Inservice Inspection Field Change Procedure" (Latest Revision).

8. 80A9021 NES ISI Operations QA Manual (Latest Revision). 1

3. PERSONNEL AND MATERIAL REQUIREMENTS

1. Personnel shall be certified in accordance with references 2, 3 and 4. At least one member of an ultrasonic examination team shall have a minimum qualification of Level II. In addition to the certification referenced above, each person performing inner radius examinations shall receive an additional 10 hours 1

of training annually. This training shall be documented and retained in the individual's certification records. A copy of the examiner's certification summary and a current eye test as required by SNT-TC-1A and Section XI, shall be submitted to the Plant Owner, or his Agent, prior to starting examinations. 1

2. The ultrasonic couplant shall be Ultragel and be certified to contain less than 1% sulfur and halogens by weight. The couplant shall be supplied in clean containers of sufficient quantity for performance of the examination. Vaseline or equivalent may be utilized to couple the transducers to the wedges. 1

3. The search unit cable may be Microdot or BNC of any convenient length or combination of lengths. Record actual usage on the Calibration Data Sheet.

4. PROCEDURE COMPLIANCE

The examination procedure described in this document complies with Section XI of the ASME Boiler and Pressure Vessel Code 1974 Edition, Summer 1975 Addenda, invoking the provisions of IWA-2240, except where examination coverage is limited by part geometry or access. Such limitations shall be identified and described on the data sheets. 1

5. EXAMINATION REQUIREMENTS

5.1 EXAMINATION FREQUENCY

1. The nominal examination frequency shall be 1.0 MHz for all examinations performed from the shell. For examinations performed from the nozzle barrel, 2.25 MHz shall be used.

2. Other pulse frequencies may be used if such variables as material attenuation, grain structure, etc., necessitate their use to achieve penetration or resolution. This information shall be recorded on the data sheets.

5.2 EXAMINATION ANGLES AND COVERAGE

1. The intent of this procedure is to provide maximum examination coverage. Each nozzle inner radius shall be scanned with minimum 25% overlap of the transducer width (diameter) for each scan pass.

2. The rate of search unit movement shall not exceed 3" per second.

3. Each shell side examination (Zone 1) shall be performed, where part geometry and access permits, using 70° angle beam shear wave techniques. They shall be applied in two directions, CW and CCW, tangential to the inside radius of each nozzle from the OD surfaces of the shell. The scanning approach shall proceed only to the beginning of the OD radius blend of each nozzle, as proceeding onto the blend will cause lift-off and also distort beam angle entry for this area of examination.

4. Each barrel side examination (Zone 2) shall be performed, where part geometry and access permits, using compound angle beam shear wave techniques. They shall be applied in two directions, CW and CCW, 360° around the nozzle barrel OD surface. The scanning shall proceed no further than the beginning of OD radius blend, as proceeding onto the blend will cause lift-off and distort the entry angle for this examination.

5. Other angles may be used if required for aid in evaluation at the discretion of the Level III examiner. 1

5.3 BEAM SPREAD MEASUREMENTS 1

Beam spread measurements for the vertical plane of each angle beam search unit shall be made using a locating strip as follows:

1. Position search unit for maximum response from the 1/4 T hole. Set the amplitude response at 80% FSH and mark the location on a locating strip.

2. Increase instrument sensitivity 2X(6dB) over reference sensitivity and move the search unit toward the hole until signal amplitude is equal to the DAC curve drawn on the screen. Mark the strip where it crosses the scribe line over the 1/4 T hole. 1

3. Move the search unit away from the 1/4 T hole, through the maximum amplitude point, until the signal amplitude is again equal to the DAC curve drawn on the screen. Again, mark the strip.

4. Repeat steps 2 and 3 for 1/2 T, 3/4 T and 1-1/4 T holes, using small numbers "2", "3" and "5" respectively.

5. Using suitable beam plot forms for appropriate thicknesses, transfer the measurements from the block to the paper. Connect points to determine spread and angle information.

6. Beam spread plots shall become part of the examination record.

5.4 DATUM POINTS

Datum Points for the vessel nozzle inner radius areas shall be located at the highest point on the vessel to nozzle weld at the weld centerline.

6. EQUIPMENT REQUIREMENTS

6.1 EXAMINATION CONTRACTOR'S EQUIPMENT

The following test equipment or its equivalent shall be provided by the Examination Contractor (as a minimum) for the examination of the inner radius areas specified in this procedure.

1. Pulse-Echo ultrasonic instrument
2. Wedges: Std. 70° for shell side examinations
3. Wedges: predetermined compound angles for barrel side examinations
4. Wedge: Std. 45° for barrel calibration
5. Search units: 1.0 MHz, 1" diameter for shell side examinations
6. Search units: 2.25 MHz, 1/2" x 1" for barrel side examinations
7. Couplant
8. Miniature angle beam verification block
9. Camera
10. Thermometer
11. Any other equipment to aid in examination or evaluation. 1

6.2 PLANT OWNER'S EQUIPMENT

The Plant Owner, or his Agent, shall provide the following service facilities and equipment as required:

1. Scaffolding
2. Water, Air, and Electricity
3. Adequate Temporary Lighting
4. Moving or Lifting Devices
5. Calibration Blocks (VY-6-IR and RV-1) 1
6. Radiation Monitoring Equipment
7. Radiation Shielding Equipment
8. Vessel Layout Equipment and Supplies (as needed)
9. Test Surface Preparation (cleaning and finishing)
10. Post examination cleanup.

7. CALIBRATION REQUIREMENTS

7.1 CALIBRATION PACKAGES

Calibration Data Packages shall be numbered 7616-1, 7616-2, 7616-3, etc., and shall be signed by the examiner(s) upon completion noting applicable NDE Certification Levels. All Data Sheet(s) shall be annotated as either **"shell scan"** or **"barrel scan"** for the individual examination being performed.

7.2 INITIAL SENSITIVITY LEVEL

The initial sensitivity levels shall be the amplitude response from the ID notch within the calibration block.

8. EXAMINATION SYSTEM CALIBRATION

8.1 ANGLE BEAM CALIBRATION FOR EXAMINATIONS PERFORMED FROM THE SHELL

Angle beam calibration, using a standard 70° wedge and the appropriate calibration block, shall be performed as follows:

1. The instrument horizontal linear range, as displayed on the CRT, will be calibrated in inches by use of a miniature angle beam verification block or IIW block. 1

2. To establish the vertical linear range, obtain a maximum response from the opposite surface notch and adjust sensitivity controls to provide a signal amplitude of 80% FSH and mark location and amplitude on the CRT. The response from the 1/4 T and 3/4 T holes shall also be marked on the CRT for reference. 1

3 This is the initial sensitivity level. Record all sensitivity control settings on the appropriate Calibration Data Sheet.

4. Upon completion of calibration ensure that all data and instrument settings are recorded on the Calibration Data Sheet. Sign sheet upon completion, noting applicable NDE Certification Levels.

5. To establish scanning sensitivity, position the search unit at the 0° reference point of the nozzle. Using the sensitivity control, adjust the cladding interface signal response level to 20% FSH (this response shall not be less than the initial sensitivity level). All indications shall be evaluated and recorded at the scan sensitivity. 1

8.2 ANGLE BEAM CALIBRATION FOR EXAMINATIONS PERFORMED FROM THE NOZZLE BARREL

Angle beam calibration, using a standard 45° wedge and the appropriate calibration block, shall be performed as follows:

1. Horizontal linear range shall be established in inches of metal path as follows:

   A. Obtain a maximized indication from the long radius reflection surface of the "Miniature Angle Beam Verification Block" (2" metal path).

   B. Using the material calibration control and the delay control, align this signal at CRT position 2.

   C. Increase the instrument gain until secondary echos occur.

   D. Align the secondary echos shall be aligned at CRT positions 5 and 8.

   E. The CRT is now calibrated in inches of metal path (each major division equaling 1 inch). Make no further adjustments to the sweep range or delay controls.

2. Using the nozzle barrel calibration block, obtain a maximum response from the opposite surface notch. Adjust sensitivity controls to provide a signal amplitude of 100% FSH and mark location and amplitude on the CRT.

3. This is the initial sensitivity level. Record all sensitivity control settings on the appropriate Calibration Data Sheet.

4. Upon completion of calibration ensure that all data and instrument settings are recorded on the Calibration Data Sheet. Sign sheet upon completion, noting applicable NDE Certification Levels.

5. Remove the transducer from the standard 45° wedge and attach it to the appropriate barrel examination wedge, CW or CCW. 1

6. To establish scanning sensitivity, add 20 dB to the initial sensitivity. All indications shall be evaluated and recorded at the scan sensitivity.

8.3 CALIBRATION CHECKS

1. A system calibration check shall verify the DAC curve and the sweep range calibration at the start and finish of each examination, with any change in examination personnel, transducers, cables, shoes, batteries, couplants and at least every 4 hours during an examination. Calibration checks shall be performed at the initial sensitivity level. Signal response obtained during calibration check shall be within plus 20% of that established during basic system calibration.

   A. If any point on the DAC curve has changed by more than 20% of its amplitude, the Examiner shall:

      1. Void all nozzle inner radius scan data sheets since the previous calibration or calibration check. 1

      2. Recalibrate examination system.

      3. Reexamine voided areas.

   B. If any point on the DAC curve has moved horizontally more than 5% of the sweep line from its original settings, the Examiner shall:

      1. Correct the sweep calibration and note correction(s) on the Calibration Data Sheet.

      2. Void any recorded indication data taken since the previous calibration, or calibration check, and reexamine the applicable area using the corrected sweep.

3. The temperature of the calibration block shall be within 25°F of the component temperature. Calibration block and component temperatures shall be recorded on the Calibration Data Sheet.

4. The identity of the calibration block used for performing calibration shall be recorded on each Calibration Data Sheet.

9. EXAMINATION PROCEDURES

9.1 SCAN LAYOUT (360° AROUND EACH NOZZLE) FOR SHELL SIDE EXAMINATIONS

1. Using a suitable marker the ultrasonic examiner shall mark, in 10° increments, skew lines are necessary to aid in maintaining a tangential alignment with the nozzle inner radius area. △1

2. There should be as many divisions as necessary to visually aid the ultrasonic examiner to maintain a 25% overlap.

3. Refer to Figure 3 for scan path distances and tangential (skew) angles. △1

9.2 ANGLE BEAM EXAMINATION OF THE NOZZLE INNER RADIUS AREAS

1. Scanning Sensitivity for Examinations Performed from the Shell

   A. Select the proper tangential (skew) angle for the nozzle to be examined.

   B. Position the search unit at the 0° reference point of the nozzle, then using the sensitivity control, adjust the cladding interface signal response level to 20% FSH for clad nozzles. △1

   C. Record this sensitivity and the nozzle identification in the comments section of the Calibration Data Sheet.

D. During scanning adjust sensitivity as required to maintain a nominal 20% cladding interface response level signal for 360° around nozzle. Record changes in sensitivity and corresponding nozzle reference datum.

E. All indications shall be recorded at the scanning sensitivity.

2. Scanning Sensitivity for Examinations Performed from the Barrel

A. Using the initial sensitivity established in paragraph 8.2, add 20 dB. This is the scanning sensitivity. All indications shall be recorded at the scanning sensitivity.

B. Record this sensitivity and the nozzle identification in the comment section of the Calibration Data Sheet.

3. Scanning Procedures

A. With the transducer at the proper tangential (skew) angle (CW or CCW), scan the inner radius area 360° around the nozzle following the layout lines and scan paths limits.

B. Transducer movement shall not proceed onto the OD radius blend of the nozzle. The radius blend does not permit proper angle entry of the sound.

C. Repeat the foregoing paragraphs for the opposite tangential (skew) angle to complete the scanning requirements of two directions for each Nozzle Inner Radius area.

D. All information shall be recorded on the appropriate Data Sheet(s) and the Data Sheet(s) shall be annotated as follows: **Shell Scan for examinations performed from the shell, or Barrel Scan for examinations performed from the barrel.**

10. EVALUATION CRITERIA

10.1 RECORDING OF INDICATIONS

NOTE: All signals to be recorded must have metal path movement. Metal path movement of a signal is when the indication "walks" across the screen in a continuous sweep. For nozzles with cladding, the signal must be above the "clad roll."

1. All indications, during shell side examinations (Zone 1), within the zone specified for the nozzle inner radius area being examined showing a signal amplitude response $\geq$ 50% FSH (at the scan sensitivity) shall be recorded on the appropriate examination data sheet at the time of examination.

2. All indications, during barrel side examinations (Zone 2), within the zone specified for the nozzle inner radius area being examined showing a signal amplitude response $\geq$ 20% FSH (at the scan sensitivity) shall be recorded on the appropriate examination data sheet at the time of examination. 1

3. In addition to the requirements of 1 and 2, the examiner shall record all indications considered relevant for further evaluation. 1

4. All indications from all barrel side and shell side examinations shall be reported in inches and degrees CW or CCW from the datum point when looking towards the vessel and in inches away from the shell (for barrel side examinations) or away from the nozzle barrel (for shell side examinations) to the search unit exit point.

10.2 EVALUATION OF INDICATIONS

1. Evaluation of all indications shall be made at the scan sensitivity and in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, Article IWA-3000. In addition, indications shall be evaluated, with respect to the notch responses obtained in the calibration blocks for informational purposes at the initial sensitivity. 1

2. The results of this evaluation shall be reported to the Plant Owner, or his Agent, in accordance with the requirements of the referenced ASME Boiler and Pressure Vessel Code, Section XI, Article IWA-6000. All evaluations shall be performed by a Level III Examiner.

11. EXAMINATION RECORDS

11.1 CERTIFICATION OF RECORDS

The Examiner(s) shall complete and sign the appropriate scan data sheet(s) immediately upon the completion of each nozzle inner radius area examination, noting applicable NDE certification levels.

11.2 FILING OF RECORDS

1. Records of personnel qualifications shall be maintained by the Examination Contractor.

2. The Examination Contractor shall be responsible for submitting to the Plant Owner, or his Agent, a completely documented set of examination records, including certification of personnel qualifications with a current eye test report.

11.3 PROCEDURE CORRECTIONS AND ADDITIONS

All procedure corrections and/or additions required during the examinations may be initiated by either the Owner or the NES Site Supervisor. All such changes shall have the approval of the Plant Owner, or his Agent, and an NES Level III and the Authorized Inspector shall be notified of such changes and their approval obtained as required.

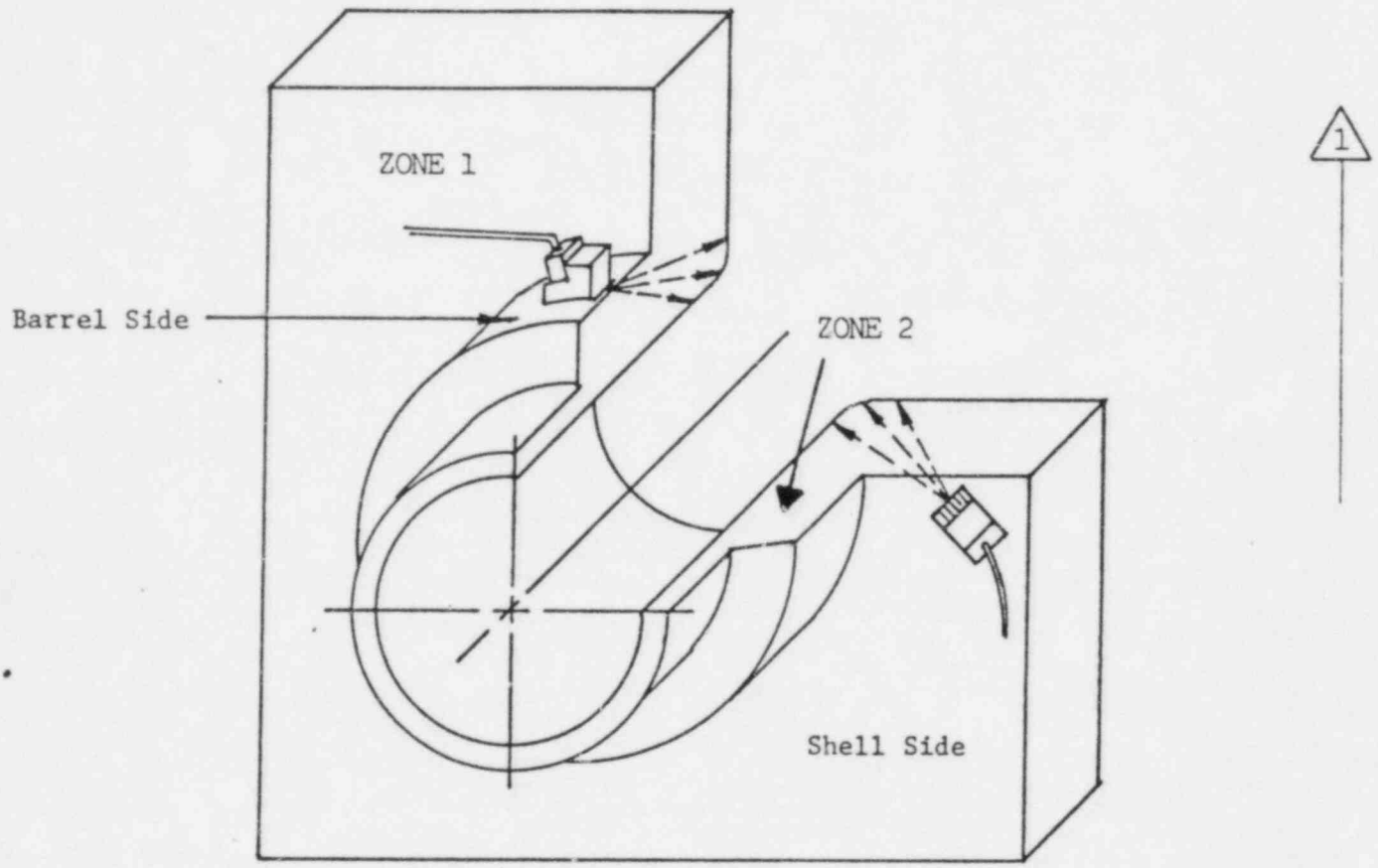


FIGURE 1. PICTORIAL VIEW OF THE ULTRASONIC EXAMINATION OF THE NOZZLE INNER RADIUS AREA FROM THE SHELL SIDE AND THE NOZZLE SIDE (CUT-A-WAY VIEW).

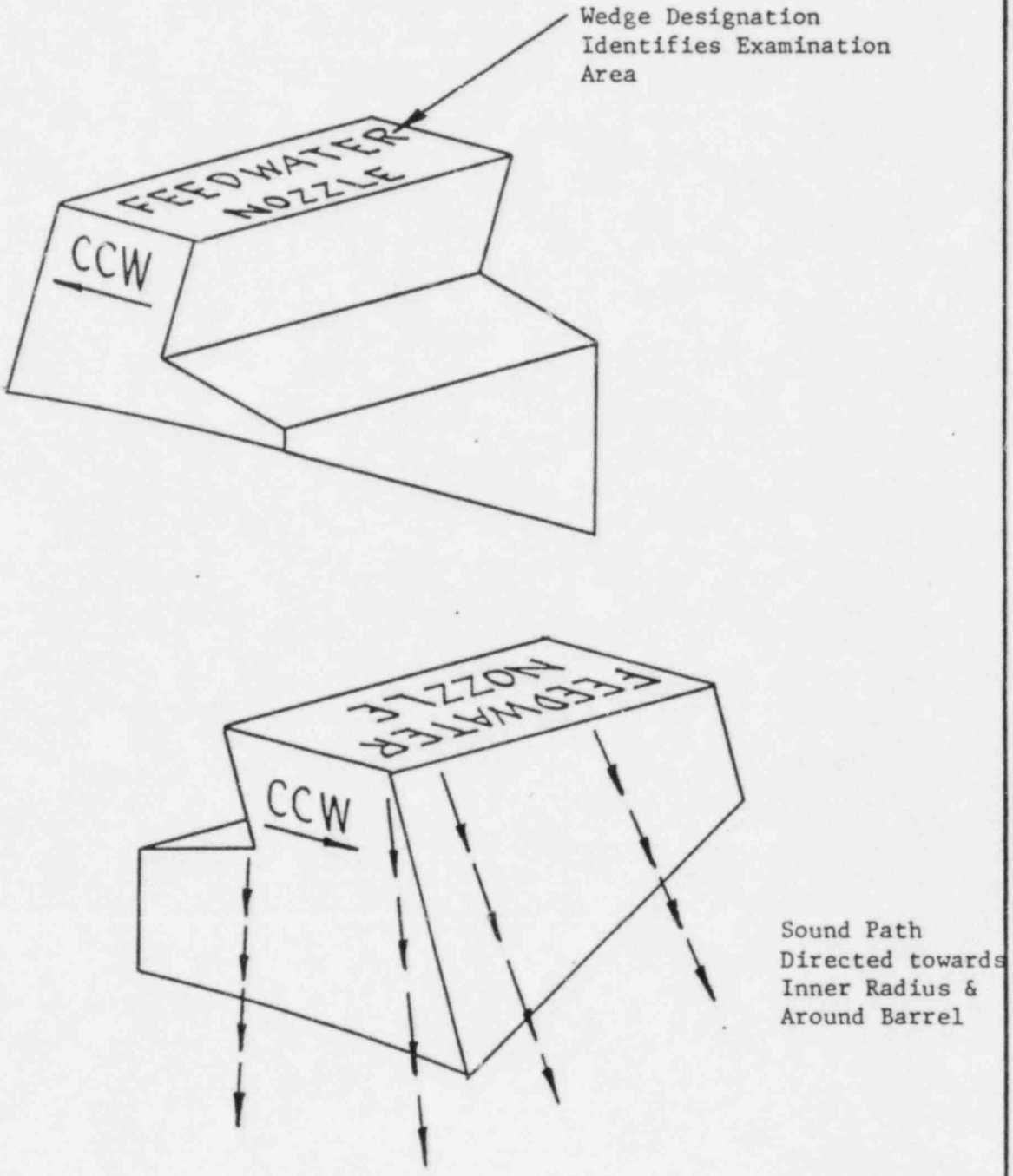
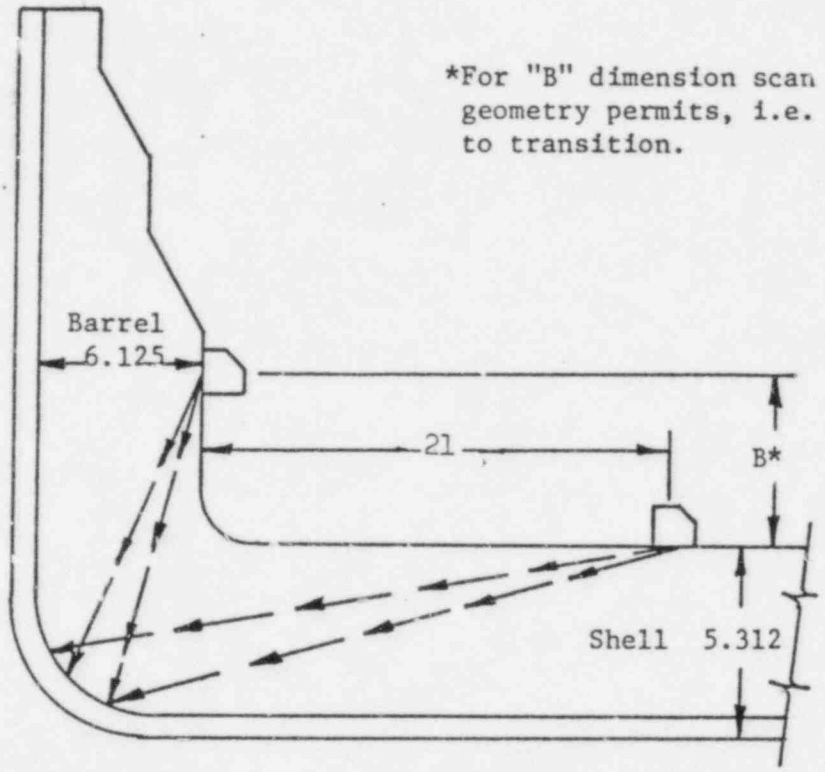


FIGURE 2. TYPICAL WEDGE CONFIGURATION USED FOR INNER RADIUS EXAMINATION PERFORMED FROM THE BARREL.



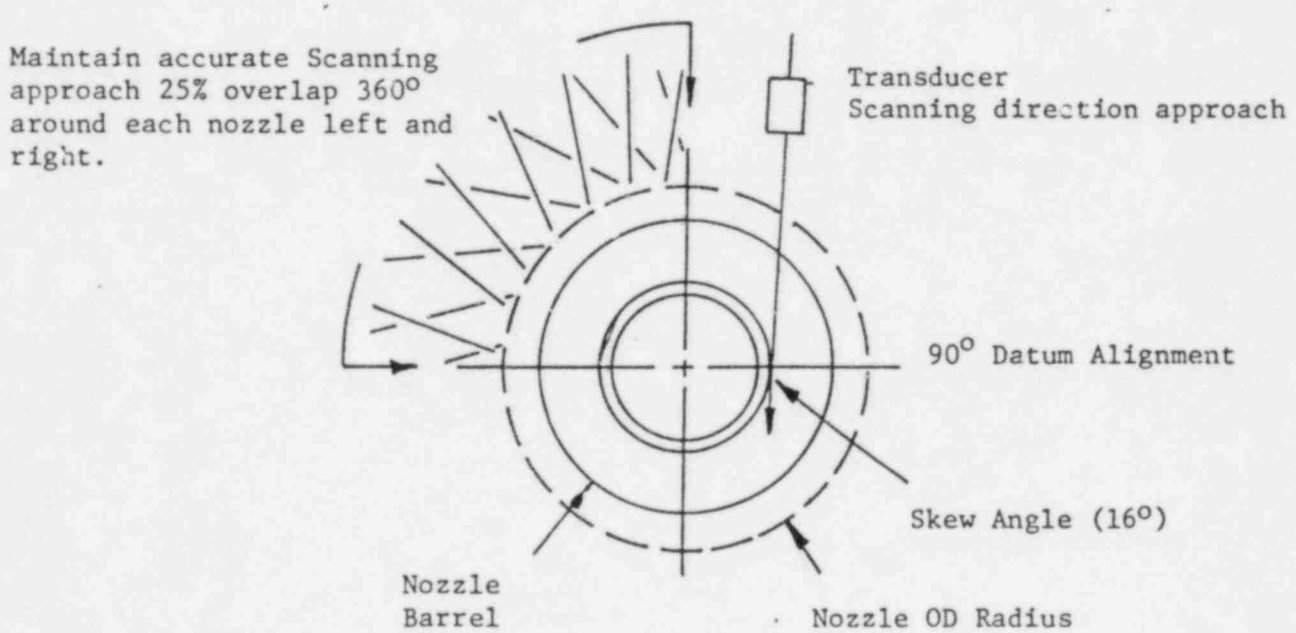
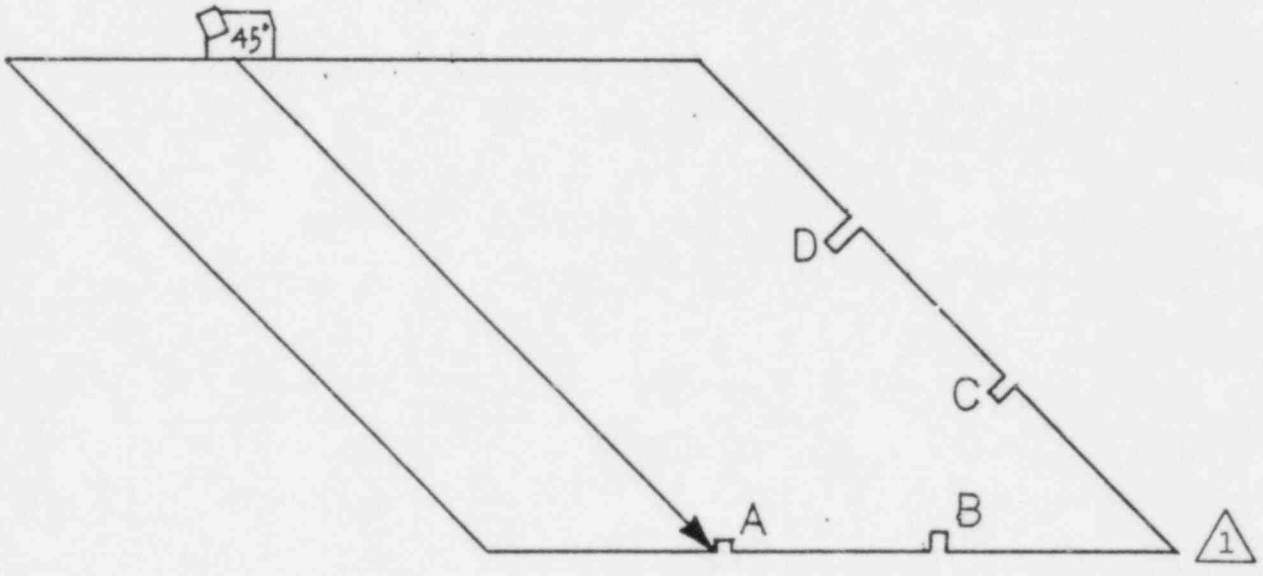


FIGURE 3. ULTRASONIC EXAMINATION OF NOZZLE INNER RADIUS AREAS

LATER

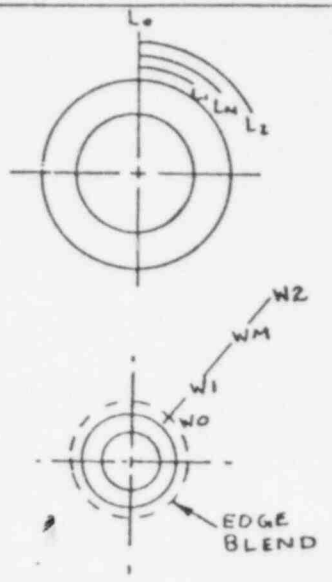
Calibration Block for Shell Side Examinations



Calibration Block for Barrel Side Examination

FIGURE 4. ULTRASONIC EXAMINATION CALIBRATION BLOCKS

Project No.	Nozzle:	Azimuth	Date
Plant	Skew Angle		Cal Data Pkg.
Unit	Wedge I.D.:		
Cal. Block:	Scanning dB:	Reference db	Page 20 of 21



MP - Metal Path
Lo - 0° Datum
Lm - Distance from Lo at max. response
L1 - Distance from Lo at 50% Endpoints
L2 - Distance from Lo at 50% Endpoints

Wo - Nozzle Barrel
Wm - Distance from Wo at max. response
W1 - Distance from Wo at 50% Endpoints
W2 - Distance from Wo at 50% Endpoints

IND. NO.	% of DAC	W. MAX.		INBOARD		OUTBOARD		L MAX.		CCW		CW		REMARKS
		W	MP	W_1	MP	W_2	MP	L	MP	L_1	MP	L_2	MP	

Note: All measurements are to be taken from transducer centerline

EXAMINER _____ Level ____ Date _____

EXAMINER _____ Level ____ Date _____

REVIEWER _____ Date _____

Sketch:

FIGURE 5. (1)

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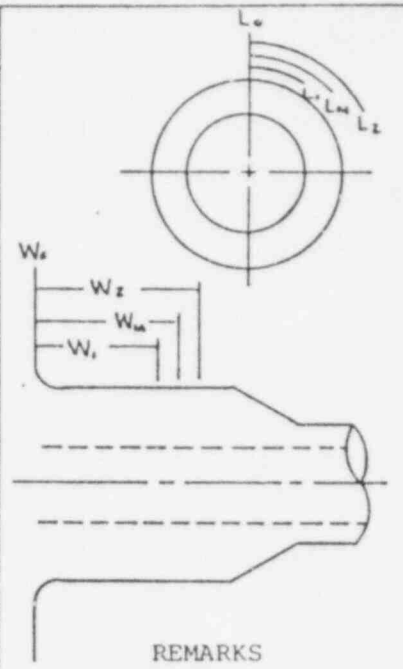
Project No.	Nozzle:	Date (Day/Mo./Year)
Plant	Azimuth:	Page 21 of 21
Unit	Wedge I.D.:	Attached Cal. Data Sheet
Cal. Block:	Scanning dB:	

MP - Metal Path
Lo - 0° Datum
Lm - Distance from Lo at max. response
L1 - Distance from Lo at 50% Endpoints
L2 - Distance from Lo at 50% Endpoints

Wo - Vessel Shell
Wm - Distance from Wo at max. response
W1 - Distance from Wo at 50% Endpoints
W2 - Distance from Wo at 50% Endpoints



IND. NO.	% of DAC	W. MAX.		INBOARD		OUTBOARD		L MAX.		CCW		CW		REMARKS
		W	MP	W_1	MP	W_2	MP	L	MP	L_1	MP	L_2	MP	

Note: All measurements are to be taken to transducer centerline.

Sketch:

Examiner _____ Level _____ Date _____
Examiner _____ Level _____ Date _____
Reviewer _____ Date _____
Reviewer _____ Date _____
Reviewer _____ Date _____

FIGURE 6. (1)

DATA SAMPLE

Plant/Unit VT YANKEE
Comp/System FEEDWATER
ISO N/A Loop A B

CALIBRATION DATA SHEET

Page 1 of 2
Data Sheet No. 7616-5
Procedure No. 80A7616
Subject: Feedwater Nozzle Inner Radius
Rev/Change No. 1 FC 1
Calibration Block No. RV 3
Fabrication No.
Surface OD
Block Temp 81 °F
Comp. Temp 84 °F
Thickness 5.6 inches
CRT Calibrated in 30 inches of metal path
Each Maj. Screen Div= 3.0"

ZONE I EXAM

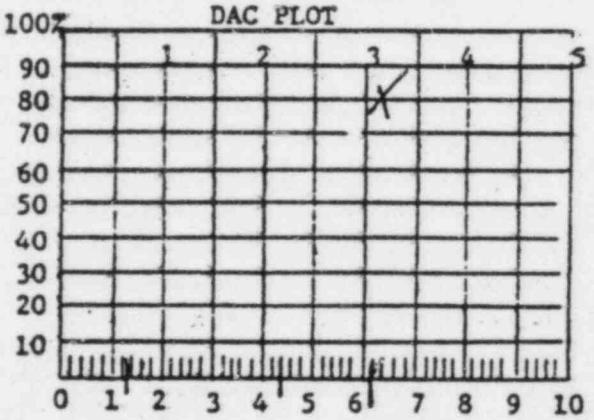
INSTRUMENT SETTINGS	
Mfg/Model No.:	SONIC MK1
Serial No. :	03178E
Sweep Length :	3.60
Sweep Delay :	1.67
Pulse Length/Damping:	MIN
Freq.: 1 Rep. Rate:	1K
Filter: Hi Video: Norm Jack:	R
DEC/Gate Switch: off Range:	50
Mode Select: Norm Reject:	off
Gain (coarse): 70 (fine):	10
Scan Sensitivity:	94

SEARCH UNIT	
Scan Angle: 70° Mode:	Shear
Fixturing (if any):	Lucite Wedge
Style or Type No.	GAMMA
Size & Shape:	1" Round
Frequency :	1.0 MHZ
Serial No/Brand:	A070:12 / AEROTECH
Measured Angle :	70°
Cable Type & Length:	2X6' BNC → BNC
Couplant Brand	Ultragel II
Couplant Batch:	8226

INSTR. LINEARITY CAL.

	Amplitude High	Low		High	Low
1	102	51	5	40	20
2	80	40	6	32	16
3	64	32	7	25	12
4	50	25	8	18	9

DAC PLOT



SCAN AREA	
0° WRV	N/A
0° Mat'l	N/A
= To Weld	N/A
⊥ To Weld	N/A
Calibration	
Axial	N/A
Circ	N/A

AMPL. CONTROL LINEARITY

Initial	dB	Result
80	-6	40
80	-12	18
40	+6	80
20	+12	84

EXAMINATION WELD/AREA	Recordable Indications Yes	No	Geom	COMMENTS/REASON FOR INCOMPLETED SCAN (S)
N4 A	N/A	X	N/A	complete, CW AND CCW SCANS Shell SIDE EXAM Zone I
N4 B	N/A	X	N/A	limited scan (see sketch) CW AND CCW SCANS Shell SIDE EXAM Zone I

CALIBRATION CHECKS	TIME
Initial Cal.	0900
Intermediate	N/A
Intermediate	N/A
Intermediate	N/A
Final Cal.	1145

EXAMINERS 1 Steven R. Miller Date 3/12/83 Level II
2 Richard L. Moore Date 3/13/83 Level I

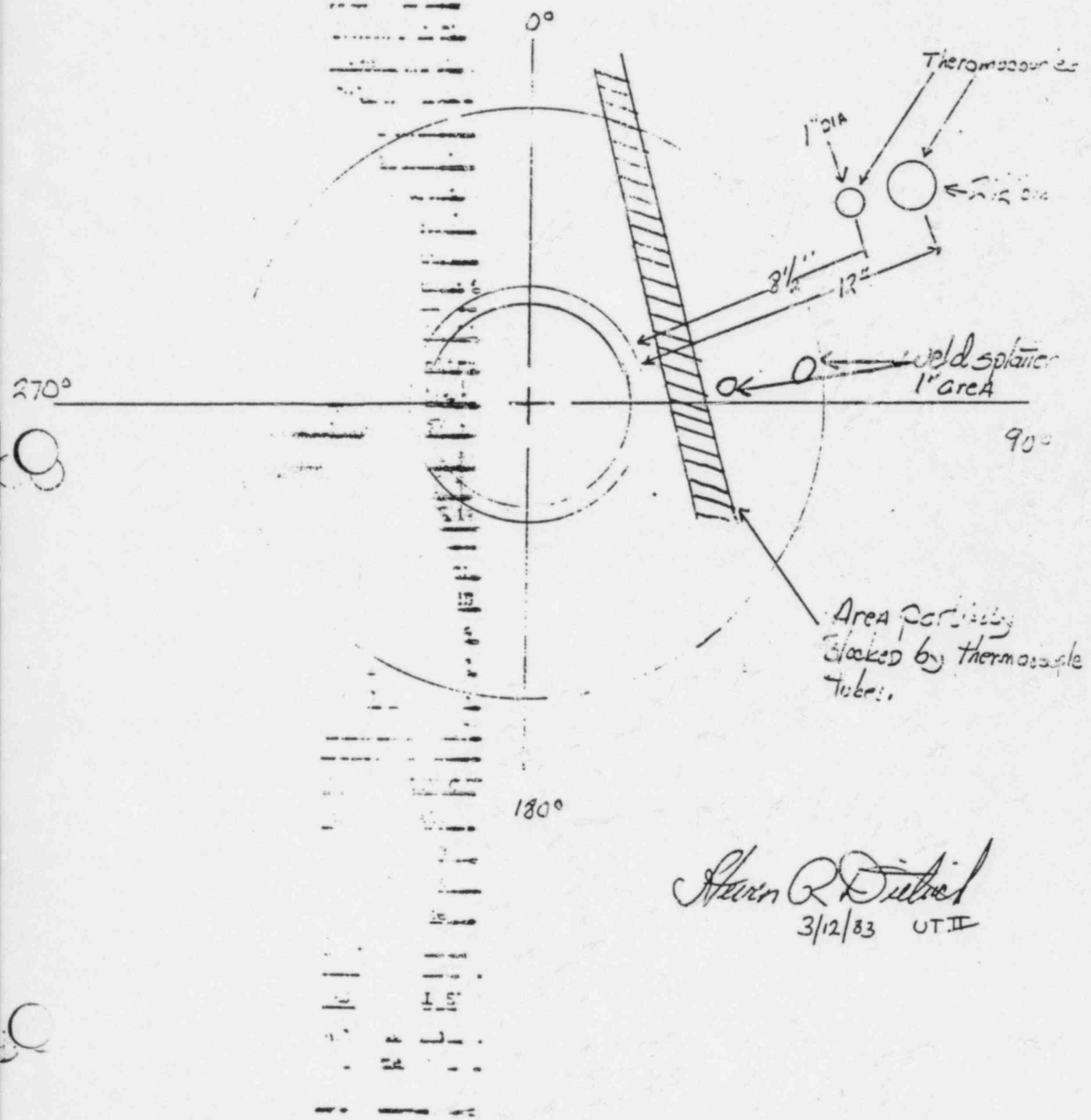
REVIEWERS 1 [illegible] Date 3/15/83
2 Date
3 Date

ADDITIONAL SHEETS? CHECK BOX			
Continuation	N/A	Beam Plot	N/A
Supplements	X	None	N/A

NUCLEAR ENERGY SERVICES, INC.

DATE 3/12/83
DATA SHEET NO. 7616-5

Feedwater Nozzle N4B



Steven R Dittel
3/12/83 UT II

Zone II

Plant/Unit VT. Yankee
Comp/System Feedwater
ISO N/A Loop A

CALIBRATION DATA SHEET

Page 1 of 3
Data Sheet No. 7616-7
Procedure No. 80A7616
Subject: Feedwater Nozzle Inner Radius
Rev/Change No. 1/FC-1
Calibration Block No. VY-6-IR
Fabrication No. N/A
Surface OD
Block Temp 95 °F
Comp. Temp 94 °F
Thickness 4.3"
CRT Calibrated in 10 inches of metal PATH
Each Maj. Screen Div= 1.0"

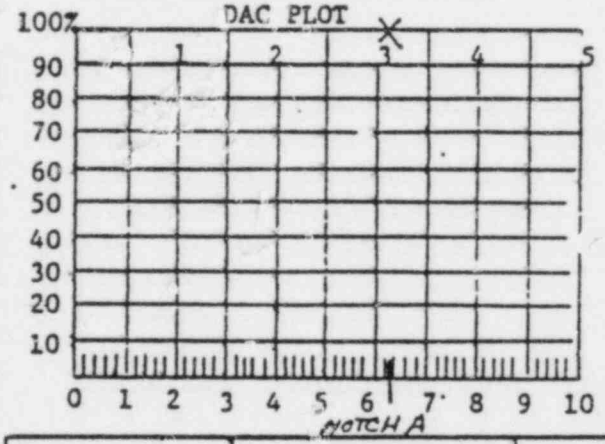
INSTRUMENT SETTINGS	
Mfg/Model No.	Sonic MK1
Serial No.	03178E
Sweep Length	4.54
Sweep Delay	1.92
Pulse Length/Damping	Min
Freq.: 2 Rep. Rate	1K
Filter: Hi Video: N/A Jack: P	
DEC/Gate Switch: off Range: 10	
Mode Select: Norm Reject: off	
Gain (coarse) 50 (fine): 12	
Scan Sensitivity: 82	

SEARCH UNIT	
Scan Angle: 45 FIXED Mode:	Shear
Fixturing (if any):	Lucite Wedge
Style or Type No. :	GAMMA
Size & Shape:	.50"X1.0"
Frequency :	2.25 MHZ
Serial No/Brand:	C18133 AEROTECH
Measured Angle :	45°
Cable Type & Length:	2X6' BNC to BNC
Couplant Brand:	UltraGel II
Couplant Batch:	8226

ZONE 2 EXAM

SCAN AREA	
0° WRV	N/A
0° Mat'l	N/A
= To Weld	N/A
⊥ To Weld	N/A
Calibration	
Axial	N/A
Circ	N/A

DAC PLOT



INSTR. LINEARITY CAL.

Amplitude

	High	Low		High	Low
1	102	52	5	38	19
2	80	40	6	30	15
3	64	33	7	24	12
4	50	26	8	18	9

AMPL. CONTROL LINEARITY

Initial	dB	Result
80	-6	40
80	-12	19
40	+6	82
20	+12	82

EXAMINATION WELD/AREA	Recordable Indications Yes	No	Geom	COMMENTS/REASON FOR INCOMPLETED SCAN (S)
N/A	N/A	X	N/A	Limited Scan (see sketch)
				Barrel side Exam Zone II
				CW and CCW SCANS

CALIBRATION CHECKS	TIME
Initial Cal.	1115
Intermediate	N/A
Intermediace	N/A
Intermediate	N/A
Final Cal.	1350

EXAMINERS 1 Steven R. Tuttle Date 3/11/83 Level II
2 Reginald Moore Date 3/12/83 Level I

REVIEWERS 1 [signature] Date 3/15/83
2 _____ Date _____
3 _____ Date _____

ADDITIONAL SHEETS? CHECK BOX			
Continuation	N/A	Beam Plot	N/A
Supplements	X	None	N/A

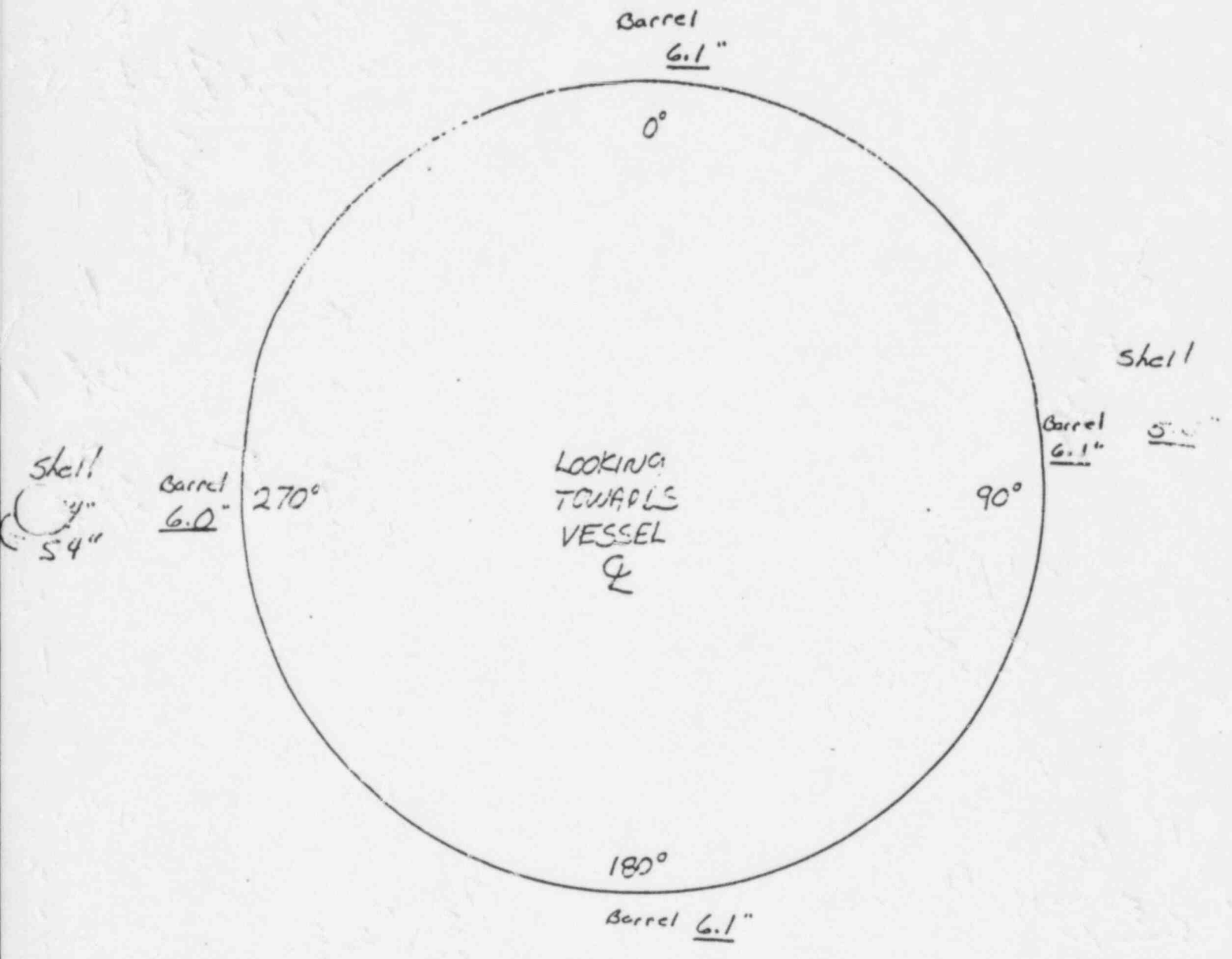
NES NUCLEAR ENERGY SERVICES, INC.

DATE 3/11/93
DATASHEET NO. 70K-2

NOZZLE N1A

T.O. Thickness profile

Shell 5.5"

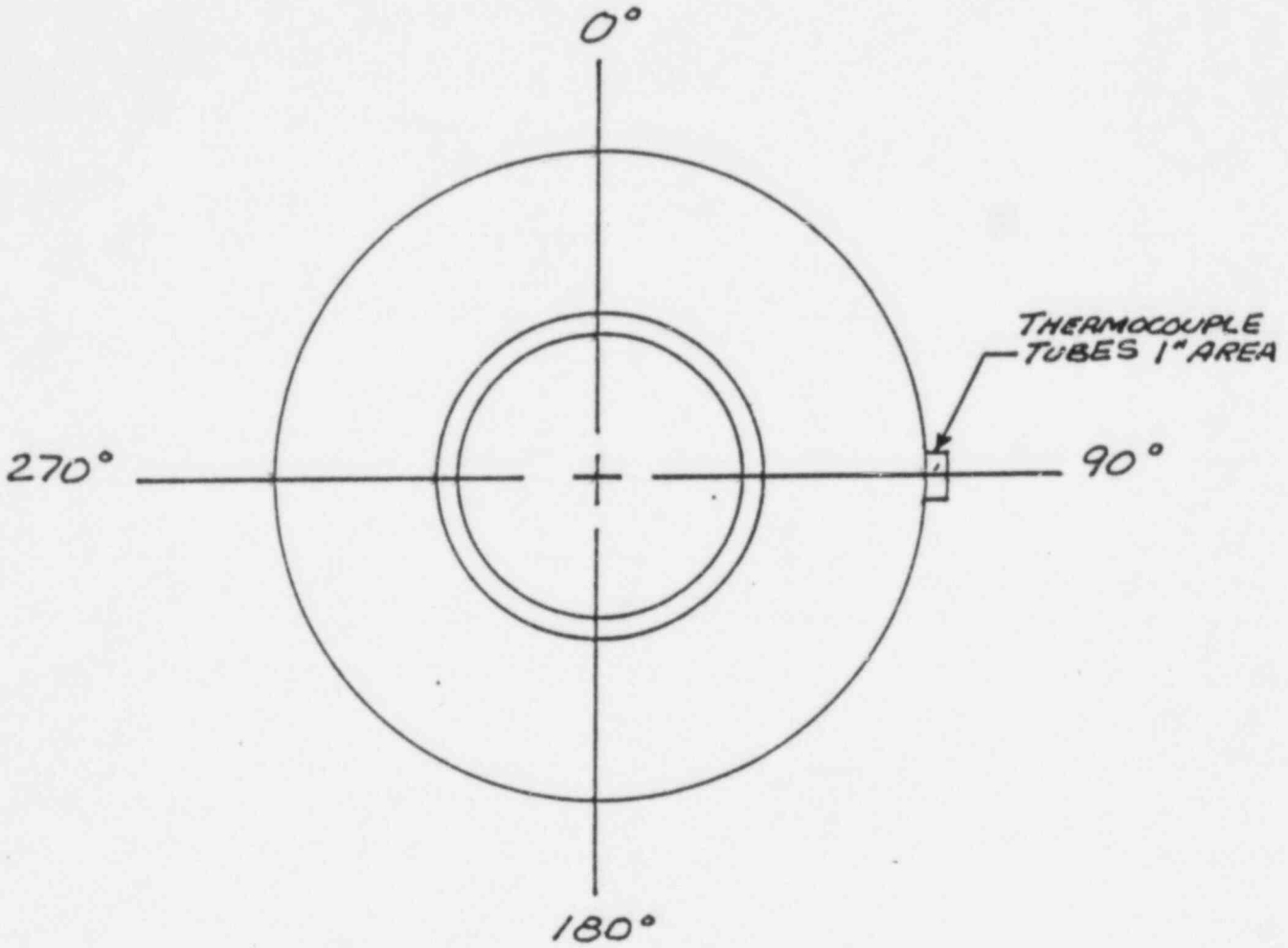


Shell 5.5"

Jeffrey T. Hawkins Civil II

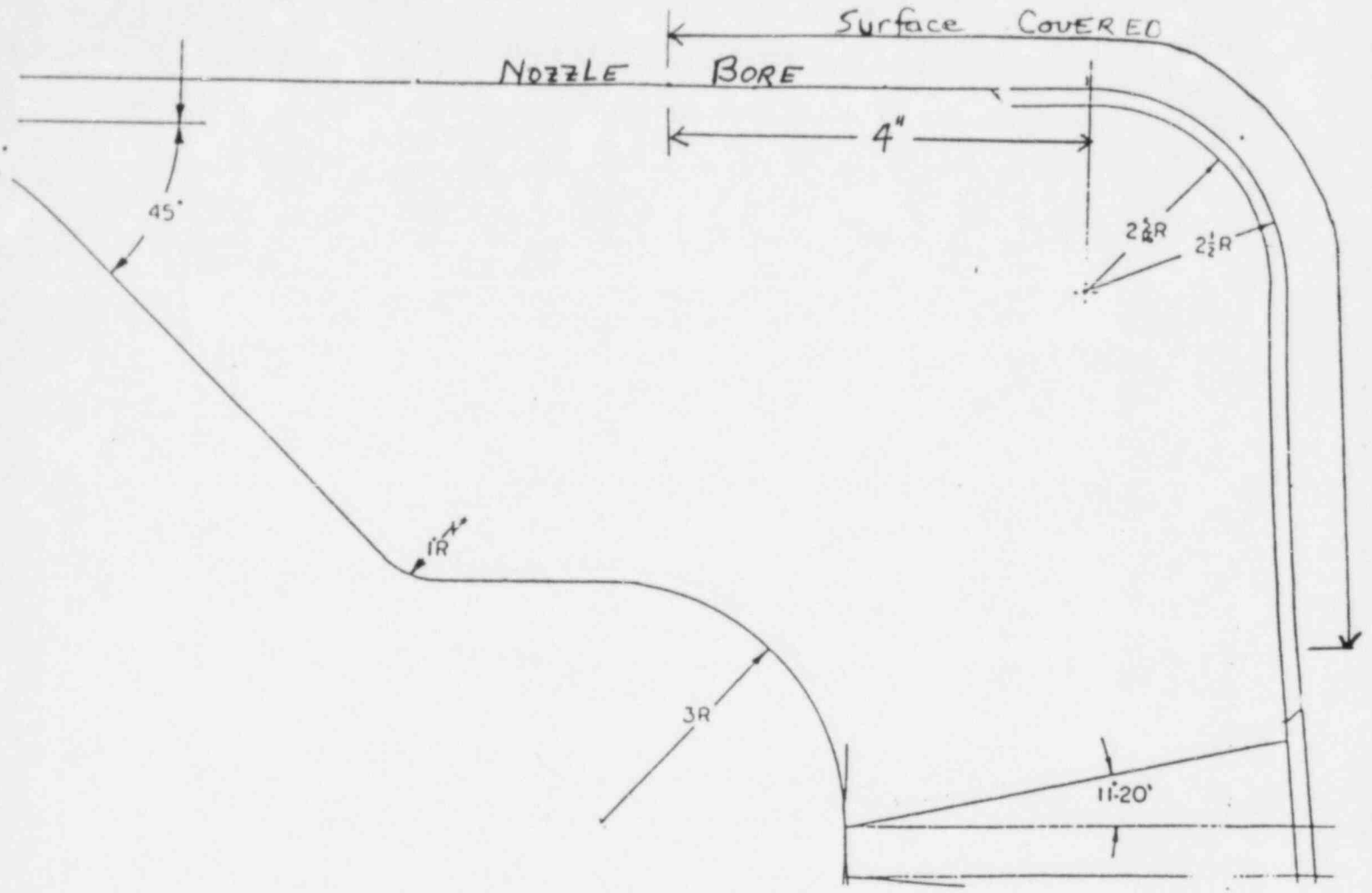
DATE 3/11/93
DATA SHEET NO. 7616-2

FEEDWATER NOZZLE N4A



Steven R. Dittick UT-II
3/11/93

DIAGRAM OF THE AREA OF COVERAGE
ON THE INNER RADIUS AND
BORE OF THE NOZZLE



THIS FIGURE SHOWS THE EXTENT OF THE
INNER RADIUS COVERED BY THE EXAMINATION PROCEDURE
FOR THE FEEDWATER NOZZLES

LEAK DETECTION
SYSTEM DATA
FOR 1982

NORMALIZED TEMPERATURES
PLOTTED ON FOLLOWING
PAGES ARE CALCULATED AS FOLLOWS

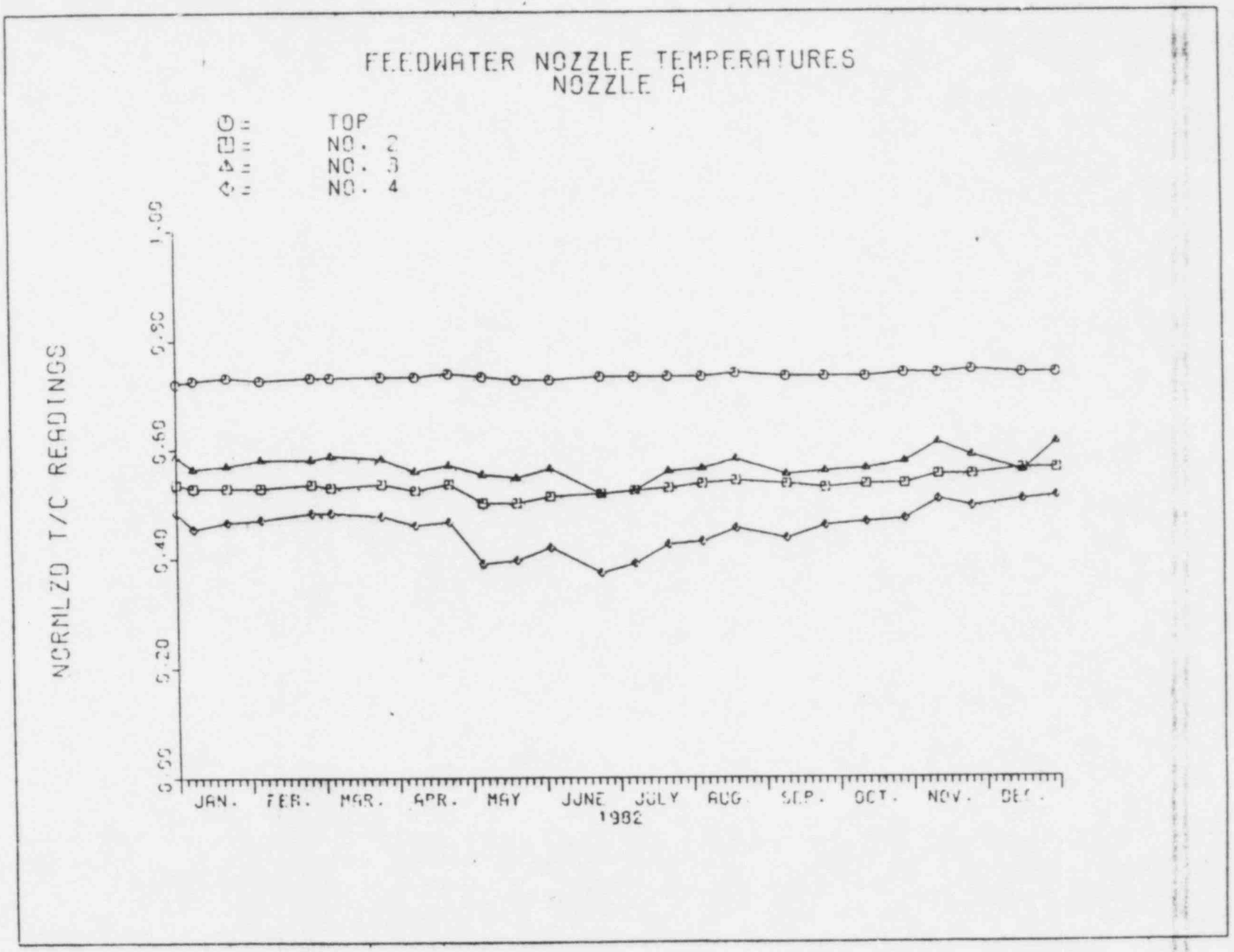
$$T_N = \frac{T_{Nodal} - T_{FW}}{T_{Reactor} - T_{FW}}$$

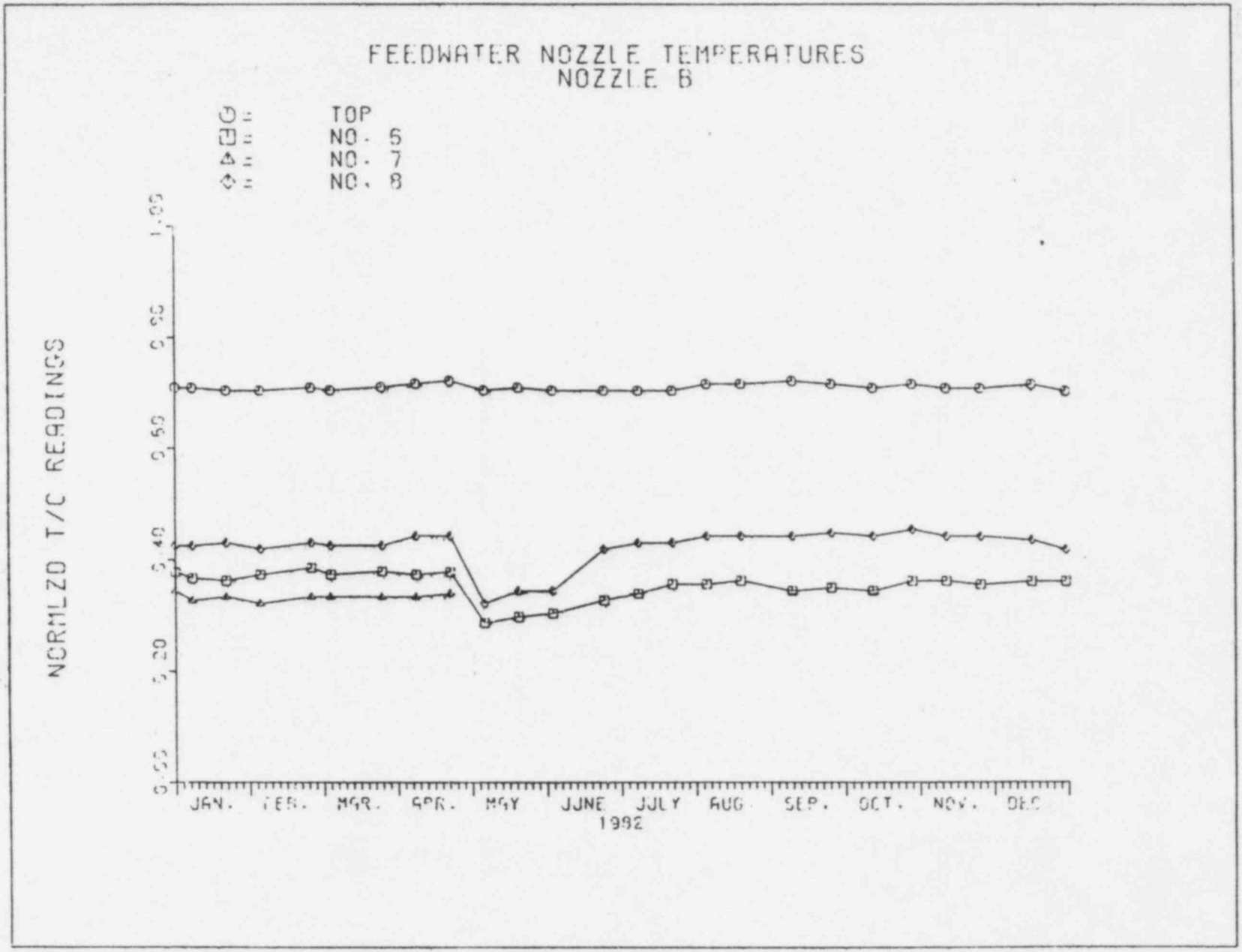
where:

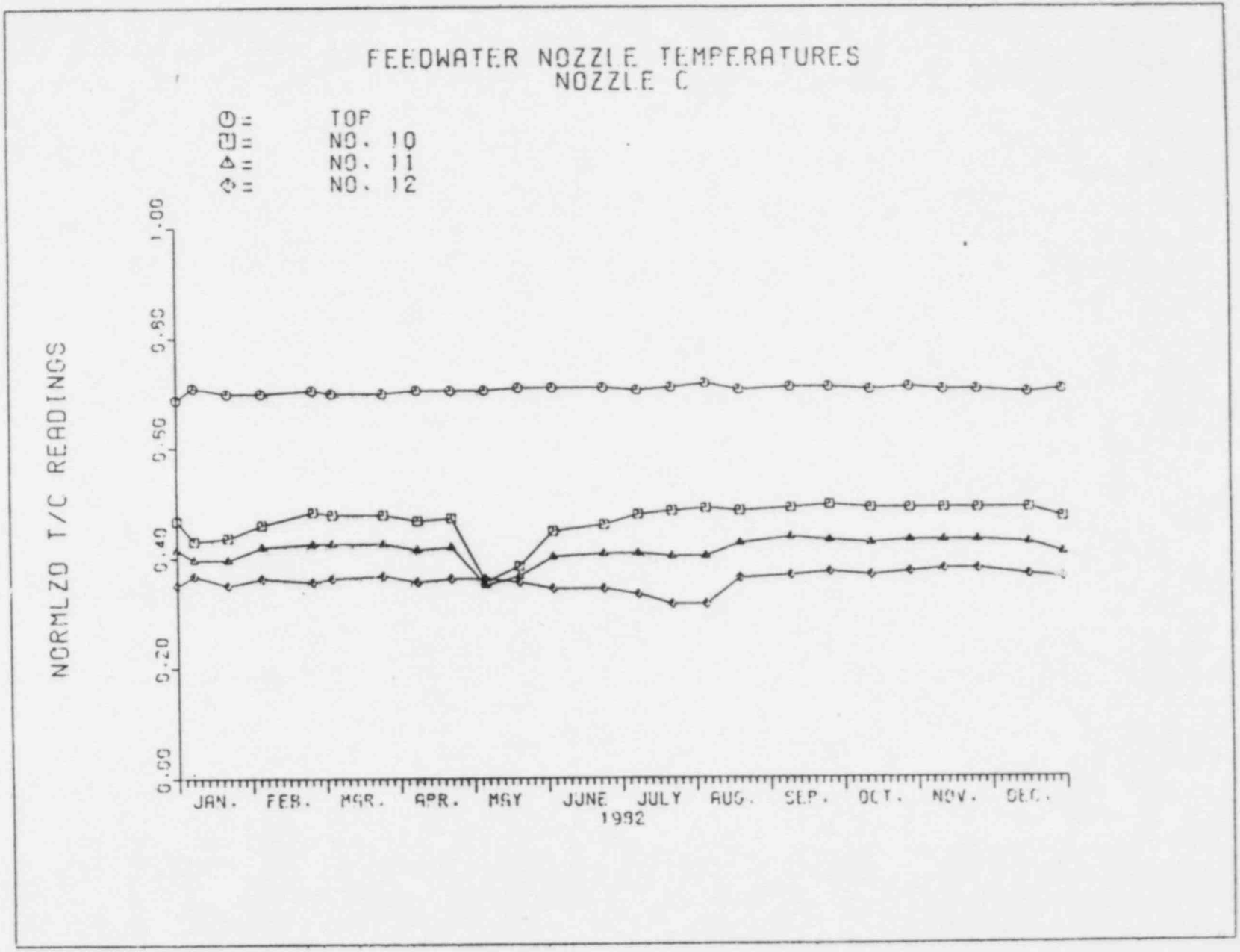
T_N = Normalized temperature

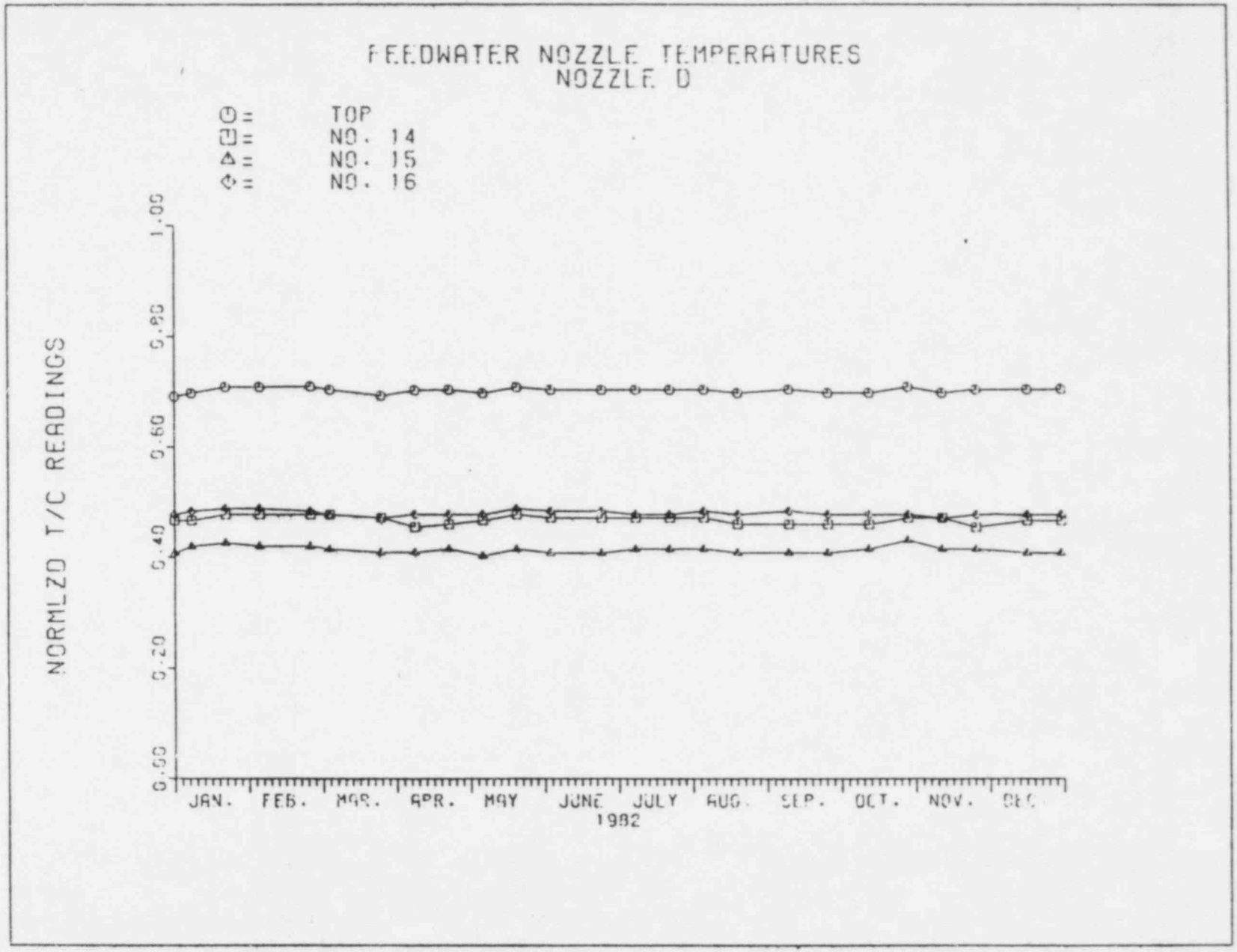
T_{FW} = Feedwater temperature

$T_{Reactor}$ = Reactor temperature

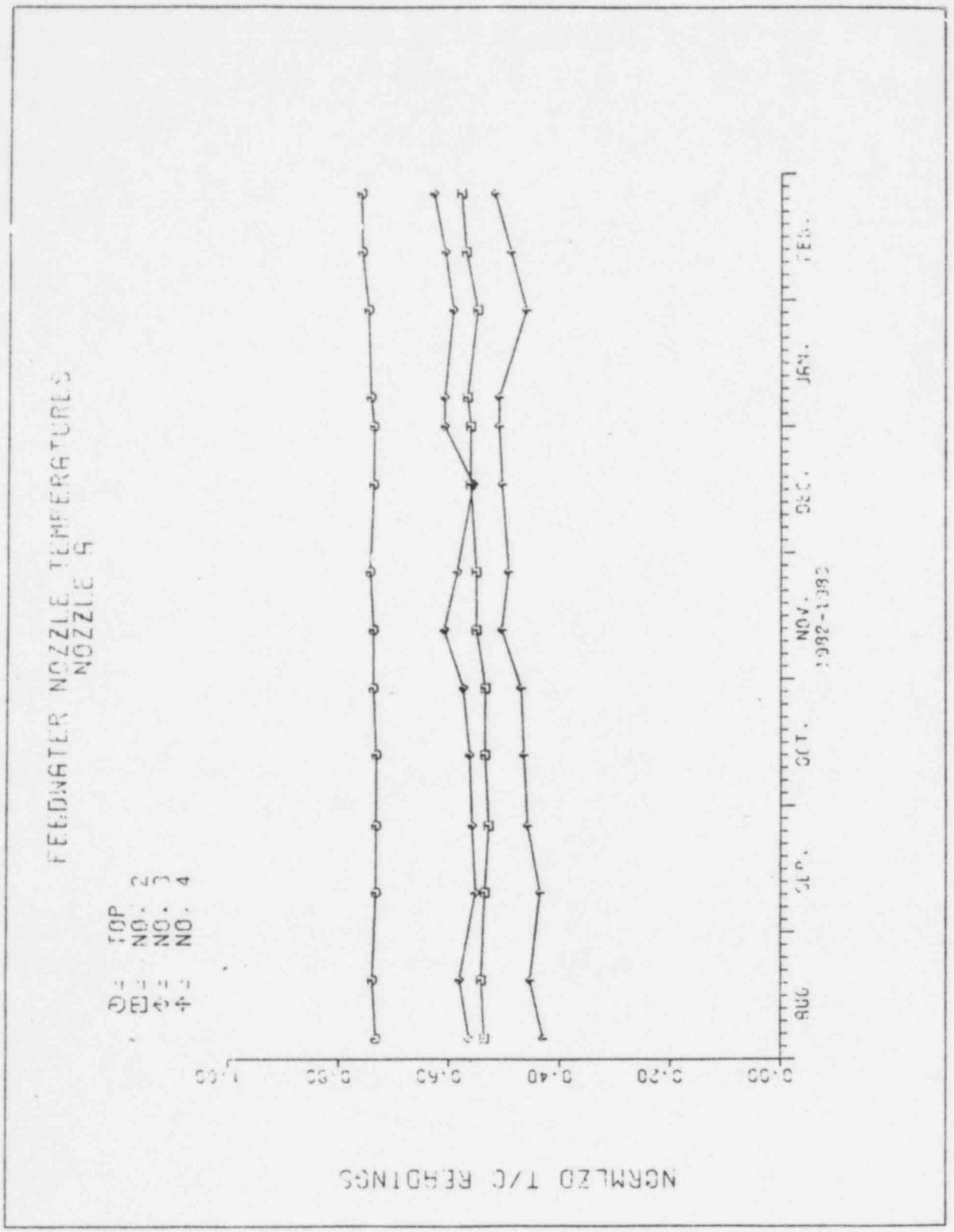

FEEDWATER NOZZLE TEMPERATURES
NOZZLE A
TOP
NO. 2
NO. 3
NO. 4
NORMLZD T/C READINGS
1.00
0.80
0.60
0.40
0.20
0.00
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG
SEP.
OCT.
NOV.
DEC.
1982

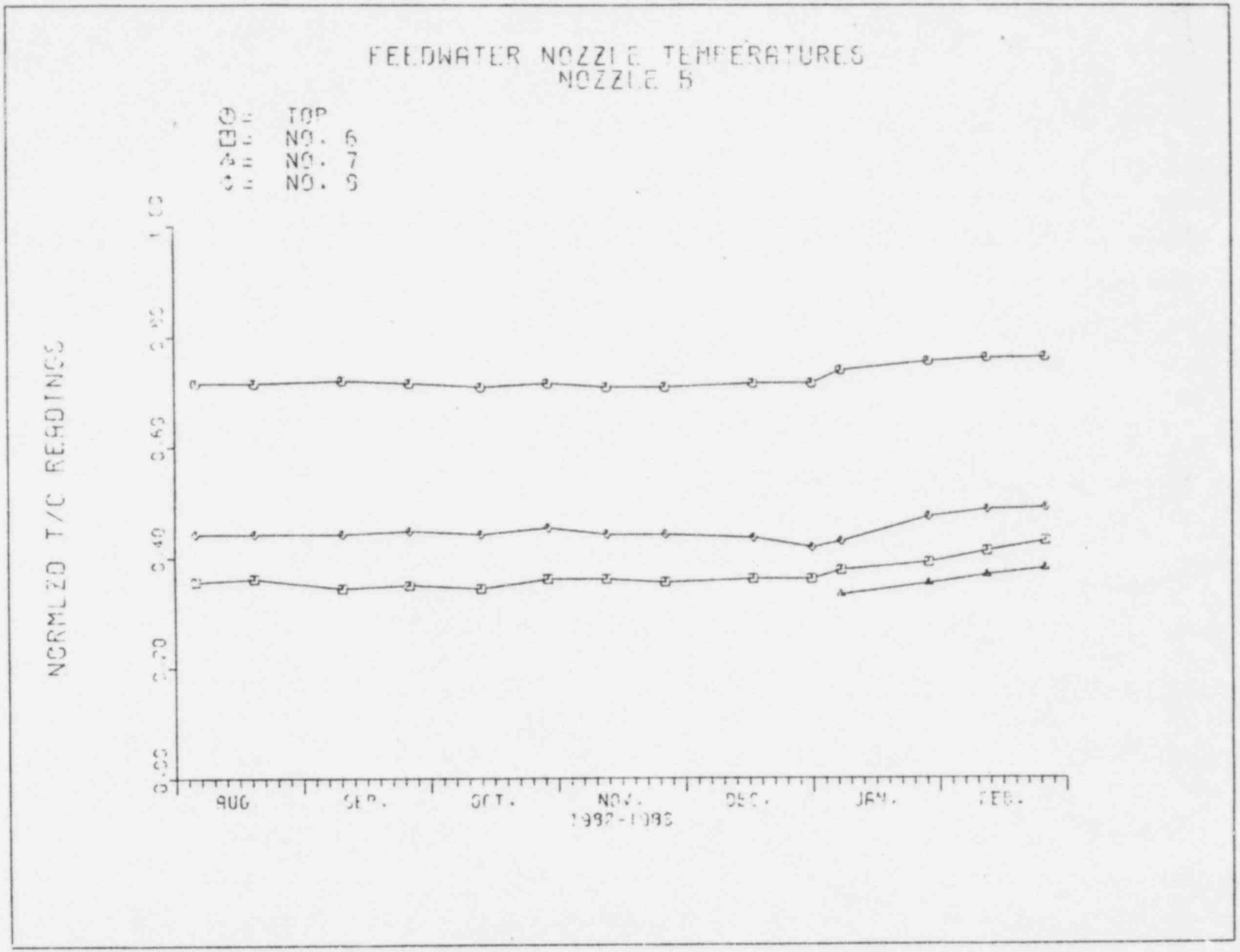

FEEDWATER NOZZLE TEMPERATURES
NOZZLE B
TOP
NO. 6
NO. 7
NO. 8
NORMLZD T/C READINGS
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG
SEP.
OCT.
NOV.
1992

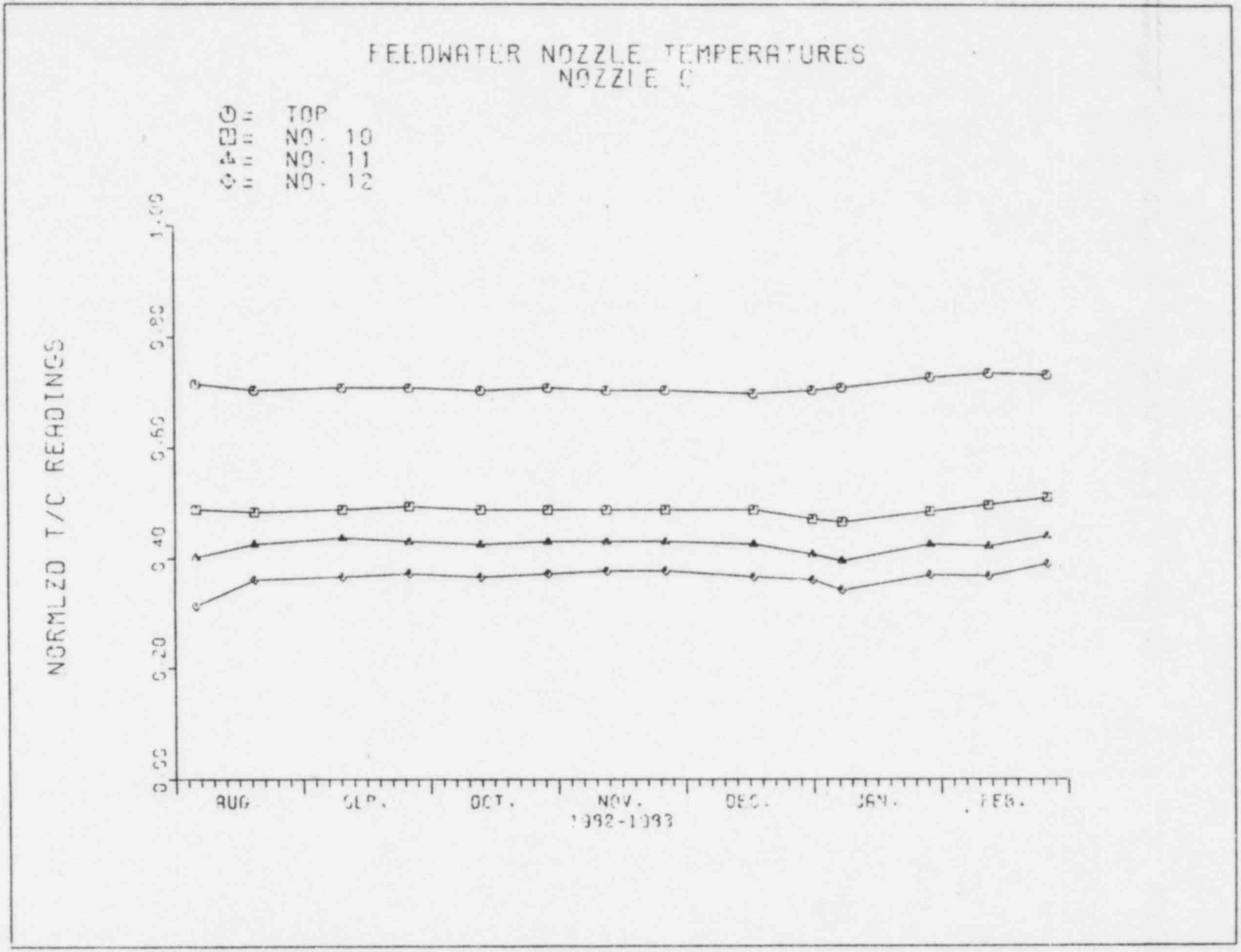

FEEDWATER NOZZLE TEMPERATURES
NOZZLE C
TOP
NO. 10
NO. 11
NO. 12
NORMLZD T/C READINGS
1.00
0.80
0.60
0.40
0.20
0.00
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.
SEP.
OCT.
NOV.
DEC.
1992

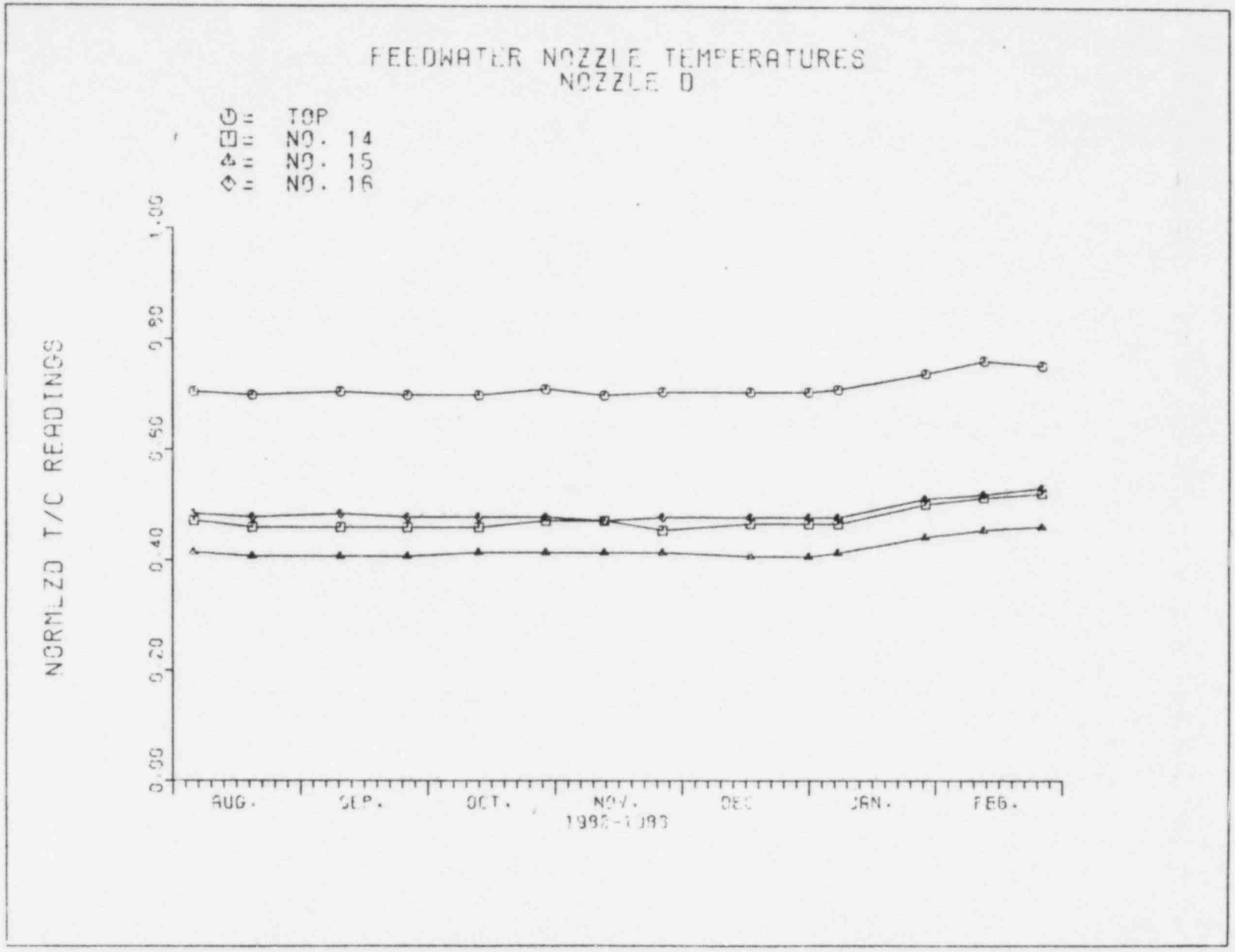

FEEDWATER NOZZLE TEMPERATURES
NOZZLE D
= TOP
= NO. 14
= NO. 15
= NO. 16
NORMLZD T/C READINGS
1.00
0.80
0.60
0.40
0.20
0.00
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.
SEP.
OCT.
NOV.
DEC.
1982

LEAK DETECTION SYSTEM
DATA FOR 1983 UP
TO THE REFUELING
OUTAGE


FEEDWATER NOZZLE TEMPERATURES
NOZZLE 9
TOP
NO. 2
NO. 3
NO. 4
NORMLZD T/C READINGS
0.00
0.20
0.40
0.60
0.80
1.00
AUG.
SEP.
OCT.
NOV.
DEC.
JAN.
FEB.
1982-1983


FEEDWATER NOZZLE TEMPERATURES
NOZZLE 5
TOP
NO. 6
NO. 7
NO. 8
NORMLZD T/C READINGS
1.00
0.80
0.60
0.40
0.20
0.00
AUG
SEP.
OCT.
NOV.
DEC.
JAN.
FEB.
1982-1983


FEEDWATER NOZZLE TEMPERATURES
NOZZLE C
TOP
NO. 10
NO. 11
NO. 12
NORMLZD T/C READINGS
1.00
0.80
0.60
0.40
0.20
0.00
AUG
SEP.
OCT.
NOV.
DEC.
JAN.
FEB.
1992-1993


FEEDWATER NOZZLE TEMPERATURES
NOZZLE D
= TOP
= NO. 14
= NO. 15
= NO. 16
NORMLZD T/C READINGS
1.00
0.80
0.60
0.40
0.20
0.00
AUG.
SEP.
OCT.
NOV.
DEC
JAN.
FEB.
1993