MANUAL ULTRASONIC EXAMINATION PROCEDURES FOR VESSEL NOZZLE SAFEENDS AND CLOSURE HEAD NOZZLE-FLANGE WELDS

LONG ISLAND LIGHTING COMPANY

SHOREHAM NUCLEAR POWER STATION

UNIT 1

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0	2-15-78
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1	7/27/79	Changed; 2.1(4) & (5), 5.2.3, 5.3.1, 6.1(2) & (3), 7.3.2, 5.2.7, 7.3.3, and Figures 2, 5, 6, and 7. Deleted; 2.3 Added; 5.1.3 CRA-972	General revision to incorporate latest NES requirements. Incorporated Field Change 1	F. T. Carr	FTC	8/7/79
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					NES	LILCO
3	2/3/81	Para. 11.1 changed shall to may Para. 11.2 changed examiner to NES	Customer Comment	S. L. Foote	(EO)	
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MANUAL ULTRASONIC EXAMINATION PROCEDURES FOR VESSEL NOZZLE SAFE ENDS AND CLOSURE HEAD NOZZLE-FLANGE WELDS

1. SCOPE

1.1 AREA OF EXAMINATION

This document covers the manual ultrasonic examination procedures for:

1. Main Steam (N3) nozzle to transition piece welds.
2. Jet Pump Instrumentation (JP1) (N8) nozzle to safe end piece welds.
3. Control Rod Drive (CRD) (N9) return nozzle to cap weld.
4. Core Differential Pressure (ΔP) (N10) nozzle to safeeend piece weld.
5. Closure Head Vent (N7) and Instrumentation (N6) nozzle to flange welds.
6. Feedwater (N4) nozzle to safe end welds.

1.2 TYPE OF EXAMINATION

1.2.1 Volumetric examination shall be performed using ultrasonic pulse echo nominal 30° or 45° angle beam shear wave, 45° refracted longitudinal wave, and 0° straight beam techniques applied to the outside surfaces of the piping, safe ends transition pieces and flanges.

1.2.2 The examination shall be performed manually using contact search units (transducers).

1.2.3 Other beam angles may be used as alternative examination techniques when they facilitate examination or evaluation.

1.3 TIME OF EXAMINATION

These procedures shall govern the preservice examination and reexamination of repaired areas of the pipe welds as required by the ASME Boiler and Pressure Vessel Code, Section XI.

1.4 WELD CONFIGURATION

1.4.1 The nozzle and safe end/transition piece/flange weld configurations covered by this procedure are shown in Figures 1 through 7.

1.4.2 Nominal weld thicknesses range from 0.28" to 1.78" and are specified in Figures 1 through 7.

1.5 MATERIALS

The nozzles, safe ends and fittings are contructed of austenitic stainless steel, carbon steel, or inconel, as designated in Figures 1 through 7.

2. REFERENCES

2.1 REFERENCE DOCUMENTS

2.1.1 ASME Boiler and Pressure Vessel Code, Section XI, 1971 Edition, and the Summer of 1972 Addenda.

2.1.2 ASME Boiler and Presssure Vessel code, Section III, 1971 Edition, and the Summer of 1972 Addenda.

2.1.3 ASNT Recommended Practice, SNT-TC-1A, 1975 Edition.

2.1.4 NES "Procedure for Ultrasonic Linearity Verification," 80A9053 (Latest Revision)

2.1.5 NES "Procedure for Training and Certification of Nondestructive Examination Personnel", 80A9068 (Latest Revision).

2.2 APPLICABLE DRAWINGS

The following drawings are part of this procedure:

1. CE Assembly Drawing E-234-233
2. CE Assembly Drawing E-234-229
3. CE Assembly Drawing E-234-275
4. CE Assembly Drawing E-234-245
5. CE Assembly Drawing E-234-470
6. GE Drawings 137C5644, 137C5632

3. PROCEDURES CERTIFICATION

The examination procedures described in this document comply with Section XI of the ASME Boiler and Pressure Vessel Code, 1971 Edition, including 1972 Summer Addenda, except where examination coverage is limited by part geometry or access.

4. PERSONNEL CERTIFICATION

4.1 PERSONNEL CERTIFICATION REQUIREMENTS

4.1.1 Each person performing ultrasonic examination governed by this procedure shall be certified in accordance with the documents referenced in paragraphs 2.1.1, 2.1.3, and 2.1.5 above.

4.1.2 An examination crew shall consist of one or two members as needed. At least one member of each crew shall have a minimum qualification of Level II in accordance with the above referenced documents. The remaining member(s) shall have a minimum qualification of Level I or Level I Trainee. △3

4.2 PERSONNEL RECORDS

4.2.1 Records of personnel qualification shall be maintained by the Examination Contractor.

4.2.2 A copy of the examiner's certification summary and a current eye test report as required by SNT-TC-1A shall be filed with each permanent examination record, with a copy available for the Plant Owner, or his Agent, prior to performing examinations per this procedure. △3

5. EXAMINATION REQUIREMENTS

5.1 EXAMINATION FREQUENCY

5.1.1 The nominal examination frequency shall be 2.25 MHz for all straight beam and angle beam examinations.

5.1.2 Other pulse frequencies shall 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.

5.1.3 5.0MHz transducer may be required to achieve resolution of the side drilled holes in the calibration standards. △1

5.2 EXAMINATION ANGLES AND COVERAGE

5.2.1 The intent of this procedure is to provide maximum coverage to ensure weld integrity. Each weld shall be scanned with a minimum of 25% overlap of the transducer element dimensional width (diameter) for each scan pass. The area to be examined shall be divided into two (2) zones; carbon and stainless steel. The instrument shall be properly calibrated for examination of each separate zone. △1 △3

5.2.2 The rate of search unit movement shall not exceed 6" per second. 2

5.2.3 Each weld and the volume of metal (WRV) for 1T on each side of the weld shall be ultrasonically examined using 30° or 45° shear wave or 45° refracted longitudinal wave angle beam techniques applied in two directions towards the weld and in two directions parallel with the weld, except where restricted by part geometry or access. 1

5.2.4 Straight beam techniques shall be applied, where part geometry permits, to all base material through which the angle beams will pass during angle beam examinations. Indications detected are to be recorded in accordance with paragraph 10.1.1 of this procedure.

Where laminations are found to interfere with the angle beam examination, the angle beam technique shall be modified to result in maximum examination of the specified required volume. In addition, straight beam techniques shall be applied to the WRV where part geometry permits. Indications shall be recorded in accordance with paragraph 10.1.2 of this procedure.

5.2.5 Other beam angles and or longitudinal waves may be used as determined necessary, i.e., for evaluation of reflectors, to compensate for geometric constraints, etc. All information shall be recorded on the data sheets.

5.2.6 Where the examination surface, geometry, or other conditions (weld, contour, access, etc.) do not permit a meaninful ultrasonic examination to be performed, the examiner shall record the area of non-examination and the particular interfering condition in the space provided ont the Weld Scan Data Sheet. In addition, he shall make a sketch of the weld and adjacent pipe and fitting conditions on a separate sheet of paper and attach to the Calibration Data Sheet (See Figure 10). Photos will be taken when possible and incorporated as part of the report. 1

5.2.7 All examination weld/areas shall be entered in the space provided on the Calibration Data Sheet. If there are no recordable indications, it shall be so recorded.

5.2.8 Coverage for the welds specified in this procedure is shown in Figures 1 through 7.

5.3 LIQUID COUPLANT

5.3.1 The ultrasonic couplant shall be suitable for use on nuclear plant materials and be certified not to eceed 50 ppm halogen and 200 ppm sulfur. 1

5.3.2 The couplant shall be supplied in clean containers of sufficient quantity to perform the examination.

5.3.3 The couplant shall be applied manually with a brush or other suitable device.

5.3.4 The examiner shall be responsible for removing couplant from the examination surface at the conclusion of the examination, when required. 4

5.4 SURFACE PREPARATION

All examination surfaces shall be clean and free of dirt, weld spatter, etc., or any other condition which would interfere with the examination or impair proper transmission of the sound beam.

5.5 WELD IDENTIFICATION

Each weld shall be located and identified per appropriate weld maps in the Program Plan Book.

5.6 DATUM POINT

5.6.1 The examiner shall verify that there has been marked a reference datum point on each weld from which all examination data and reported indications shall be referenced.

5.6.2 Datum points shall be marked by the use of low stress stamps or vibratooling and shall not be deeper than 1/32".

5.6.3 The datum point for all safe end/transition piece welds in horizontal lines shall be located on the top of the pipe at weld centerline.

5.6.4 Closure Head nozzle to flange weld datum points shall be on the weld centerline at Closure Head 0°.

5.6.5 Each weld datum point, along with respective weld reference points and divisions, shall be shown on each examination report.

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 examination of welds specified in this procedure.

1. Pulse echo ultrasonic instruments.
2. Search Units, 1/4" thru 1-1/8" dia., 2.25 MHz, 0°
3. Search Units, 1/4" thru 1-1/8" dia., 5.0 MHz 0°
4. Search Units, 2.25 MHz (all sizes) for angle beam wedges
5. Wedges: Assorted sizes to accomodate search units

6. Any additional angle wedges to aid in examination or evaluation △2

7. Couplant

8. 45° Dual refracted longitudinal wave for use on material ≥ .750" in thickness, when required △3

9. Miniature angle beam verification block

10. Camera

11. Thermometer

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. Temporary lighting

4. Crane or lifting devices

5. Calibration Standard No. STEAM

6. Calibration Standard No. JPI

7. Calibration Standard No. CRD

8. Calibration Standard No. ΔP

9. Calibration Standard No. VENT

10. Calibration Standard No. 131C8523 (feedwater) △2 △3

11. Test Surface Preparation (cleaning and finishing)

12. Drawings of each Examination Area

13. Post-examination cleanup of Test Area

7. CALIBRATION REQUIREMENTS

7.1 CALIBRATION DATA SHEETS

Calibration Data Sheets shall be numbered 475-1, 475-2, 475-3, etc., and shall be signed by the examiner(s) upon completion noting applicable SNT-TC-1A levels.

7.2 CALIBRATION STANDARDS

7.2.1 The miniature angle beam calibration standard designated in 6.1(9) shall be used to establish horizontal linear instrument range. (2)

7.2.2 The Calibration Standards designated in 6.2 (5) through 6.2 (10) shall be used for establishing reference sensitivity levels for examination of the specified welds.

7.2.3 Spot thickness checks of the components shall be made prior to preservice examinations to ensure that the proper Calibration Standard is used.

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

7.2.5 System calibration shall be performed using the material side which corresponds to the material which will be examined; i.e., carbon and carbon; stainless and stainless; of the Calibration Standard.

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

7.3 REFERENCE SENSITIVITY LEVEL

7.3.1 The reference sensitivity level shall be the distance-amplitude curve initially obtained directly from the calibration standard and shall be the sensitivity level used for evaluating and recording all indications.

7.3.2 During actual weld scanning, the reference sensitivity level shall be increased a minimum of 2X (6dB), but not more than 10dB. The actual scan sensitivity shall be recorded on the data sheets.

7.4 TIMES OF CALIBRATION

7.4.1 Basic instrument calibration shall be performed using the appropriate calibration standard, search units and instrumentation immediately prior to the examination of the welds specified in this procedure.

7.4.2 Instrument vertical linearity checks shall be performed at the beginning of each day of examination in accordance with the technique in the procedure referenced in paragraph 2.1.4 using an angle beam search unit applied to a code calibration standard. (1)

7.4.3 Examination system calibration checks shall be performed at least at the beginning and at the completion of each four (4) hour period of examination and/or at the change of Level II examination personnel, equipment, search units, coupler shoes, etc., and at the completion of the examination of each similar series of welds in accordance with Sections 8.3 and 8.5 of this procedure.

7.5 CALIBRATION RESPONSE

7.5.1 Calibration response shall be checked at the primary reference sensitivity level.

7.5.2 Signal response obtained during calibration check shall be within plus or minus 20% of that established during basic instrument calibration.

7.5.3 If any point on the Distance Amplitude Correction (DAC) curve is below the 20% limit, the examiner shall:

1. Mark all Weld Data Sheets since previous calibration "void".
2. Recalibrate examination system.
3. Reexamine voided areas.

7.5.4 If any point on the DAC curve is above the 20% limit, the examiner shall:

1. Recalibrate examination system.
2. Reevaluate all indications recorded since the previous calibration at the corrected sensitivity level.

7.5.5 If any point on the DAC curve has moved horizontally more than 5% of the sweep line from its original settings, the examiner shall: △4

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

8. EXAMINATION SYSTEM CALIBRATION

8.1 STRAIGHT BEAM CALIBRATION FOR INTERFERING CONDITIONS △2

Straight beam calibration for all base material through which the angle beams will pass shall be performed at a sensitivity level which gives an initial back reflection signal amplitude from the component safeends of at least 80% FSH.

8.2 STRAIGHT BEAM CALIBRATION FOR WELD AND REQUIRED VOLUME (WRV)

Straight beam sweep calibration and Distance-Amplitude Correction shall be performed as follows for each type of material which will be examined; i.e., carbon and carbon; stainless and stainless on the Safe end Calibration Standard. △3

1. Adjust the instrument sweep controls so that the examination area is displayed on the CRT screen. Mark the horizontal screen positions selected for the hole or holes directly on the CRT screen and on the chart on the Calibration Data Sheet.

2. Position search unit to obtain maximum response from the side drilled (1/4T if T >1" or 1/2T if T ≤1") calibration hole. Adjust sensitivity control to provide a signal amplitude of 80% of FSH and mark location and amplitude on CRT screen.

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

4. This completes calibration for thicknesses ≤1". No DAC is necessary.

5. For weld thicknesses >1" DAC curve shall be established as follows:

   A. Without changing the sensitivity obtained in (2) above, position the search unit for maximum response from the 3/4T hole and mark amplitude on the CRT screen.

   B. Plot a DAC curve by connecting the two signal response positions with a continuous line extending over the full examination range.

6. Upon completion of calibration, ensure that all data and instrument settings are recorded on the Calibration Data Sheet. The examiner(s) shall sign the completed data sheet, noting applicable SNT-TC-1A levels.

7. Repeat steps (1) thru (6) for each different weld thickness just prior to examination.

8.3 STRAIGHT BEAM CALIBRATION CHECK

Straight beam calibration check as required by paragraph 7.4.3 shall be performed as follows:

1. Position the search unit on the material side, i.e., carbon or stainless and adjust the sensitivity control settings to match those recorded in paragraph 8.2(5).

2. Reposition search unit at each respective test hole and observe maximum signal response amplitudes, and horizontal screen positions.

3. Position the search unit on the other material side of the safe end calibration standard and repeat step (2).

4. See Section 7.5 for signal response requirements during calibration check.

8.4 ANGLE BEAM CALIBRATION

Calibration shall be performed for each type of material which will be examined, i.e., carbon for carbon, stainless for stainless on the Safe end calibration block, as follows:

1. Adjust the instrument sweep comtrols so that the examination area is displayed on the CRT screen. Mark the horizontal screen positions selected for the hole(s) directly on the CRT screen and on the Calibration Data Sheet.

   Note: Due to the high attenuation of the stainless steel/inconel material or stainless steel cladding, it may be necessary to divide calibration into two zones. Use an additional Calibration Data Sheet to record this information.

2. Weld thicknesses $\leq$ 1":

   A. Position the search unit for maximum response from the calibration hole at the 1-1/2T position. Adjust the instrument sensitivity controls to provide a signal amplitude of 80% FSH and mark location and amplitude on the CRT screen.

   B. This is the primary reference sensitivity. Record all sensitivity control settings on the appropriate Calibration Data Sheet.

   C. Without changing sensitivity, position the search unit for maximum responses from the calibration hole at 1/2T, 2-1/2T, and 3-1/2T positions respectively and mark location and amplitudes on the CRT screen.

D. Plot a DAC curve by connecting the signal response positions with a continuous line extending over the full examination range. 4

Note: In bi-metalic calibration blocks (CRD and JPI) the gain setting shall be checked against the equivalent response from the weld hole ($\perp$ or =). If the gain setting is different, it shall be so recorded and used as the primary reference response. The difference in gain settings will establish a gain correction factor to be applied when calculating and recording indications found during the examination.

E. Note position and amplitude of ID and OD notch responses through 3T calibration range (ID at 1T and 3T; OD at 2T).

3. Weld thicknesses > 1":

A. Position the search unit for maximum response from the calibration hole at the 3/4T position. Adjust the instrument sensitivity controls to provide a signal amplitude of 80% FSH and mark location and amplitude on the CRT screen.

B. This is the primary reference sensitivity. Record all sensitivity control settings on the appropriate Calibration Data Sheet.

C. Without changing sensitivity, position the search unit for maximum responses from the calibration hole at the 1/4T, 1-1/4T, and 1-3/4T positions respectively and mark location and amplitudes on the CRT screen.

D. Plot a DAC curve by connecting the signal response positions with a continuous line extending over the full examination range.

E. Note position and amplitude of ID and OD notch responses (if available) through 2T calibration range (ID at 1T; OD at 2T).

4. Repeat steps A through E for each different weld thickness just prior to examination.

5. Record all data and instrument settings on the Calibration Data Sheet and sign upon completion, noting applicable SNT-TC-1A certification level(s).

8.5 ANGLE BEAM CALIBRATION CHECK

Angle beam calibration check as required by paragraph 7.4.3 shall be performed as follows:

1. Adjust the sensitivity control settings to match those recorded for the calibrated reference sensitivity.

2. Reposition search unit at each respective test hole and observe signal response amplitudes and horizontal screen positions.

3. See Section 7.5 for signal response requirements during calibration check.

9. EXAMINATION PROCEDURES

9.1 EXAMINATION FOR INTERFERING CONDITIONS

Straight beam examinations to detect laminar reflectors which might affect the interpretation of angle beam results shall be performed at a sensitivity level giving a back reflection from the component of 80% FSH as noted in Section 8.1.

9.2 STRAIGHT AND ANGLE BEAM EXAMINATION OF WRV

9.2.1 All straight and angle beam examination of weld and required volume shall be performed at a scanning sensitivity level, a minimum of 2X (6dB) but no more than 10dB greater than the calibrated reference sensitivity level. All scanning sensitivity levels shall be recorded on the Examination Data Sheets.

9.2.2 For straight beam examinations, a rectilinear scan pattern shall be used.

9.2.3 For angle beam examinations, the search unit shall be swivelled to ensure maximum coverage as it is moved along a rectilinear scan pattern.

9.2.4 For the location and numbers of the welds, refer to the Program Plan. Examinations shall not be considered complete until all recordable indications have been evaluated.

10. EVALUATION CRITERIA

10.1 RECORDING OF INDICATIONS

10.1.1 For straight beam examinations of base metal for laminations, all areas presenting indications equal to or greater than the remaining back reflection shall be recorded on the appropriate data sheet prior to angle beam examination of the weld and required volume.

1. Each recorded area shall be identified as to distance from surface, length and position relative to the weld datum point.

2. Pertinent recorded data shall be taken on each parallel scan pass at increments not to exceed that permitted by the 25% overlap of transducer element (width).

10.1.2 For straight beam examinations of weld and required volume, and angle beam examinations, all nongeometric indications showing a signal amplitude response equal to or greater than 50% of the reference response shall be recorded on the appropriate data sheet at the time of weld examination.

1. Each recorded nongeometric indication shall be identified as to depth, distance from surface, length, signal amplitude, and location relative to the weld datum point.

2. Recorded data shall be taken on each parallel scan pass at increments not to exceed that permitted by the 25% overlap of transducer element diameter (width).

3. The end points of recorded indications shall be determined by 50% DAC amplitude points.

4. Planar indications at or near the far surface shall be compared directly with the amplitude obtained from the notch if available.

10.1.3 Geometric indications shall be recorded at one location and noted as geometric caused by thickness change, ID geometry, etc.

10.1.4 Nongeometric Indications for straight beam examinations of weld and required volume and angle beam examinations, all indications showing a signal amplitude response equal to or greater than 50% of the reference response shall be recorded on the appropriate data sheet at the time of examinations.

10.1.5 Each recorded indication shall be identified as to depth, length, signal amplitude, and location relative to the weld datum point.

10.1.6 Indications from all welds shall be recorded in inches upstream or downstream in relation to the flow from the weld center line, and in inches CW or CCW from the datum point. 4

10.2 EVALUATION OF INDICATIONS

10.2.1 Evaluation of all indications shall be made at the reference sensitivity level and in accordance with the requirements of the referenced ASME Boiler and Pressure Vessel Code, Section XI, IS-300. All evaluations shall be performed by a Level II or Level III examiner.

10.2.2 Results of this evaluation shall be reported to the Plant Owner, or his Agent, in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, IS-600. Disposition of evaluation results shall be made in accordance with the Owner's Plant Procedures.

11. EXAMINATION RECORDS

11.1 CERTIFICATION OF RECORDS

The Examiner shall complete and sign all data sheets immediately upon completion of each weld examination. The data sheets may be reviewed by the authorized Code Inspector.

11.2 FILING OF RECORDS

NES 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 in accordance with SNT-TC-1A.

11.3 PROCEDURE CORRECTIONS AND ADDITIONS

11.3.1 All procedure corrections and/or additions required during the preservice examinations shall be made in accordance with requirements of NES QA Program Plan 80A0448.

11.3.2 The Examiner shall contact LILCO representatives on site to initiate all changes. All changes shall be documented in the record of revisions section of this procedure.

LEGEND

⊥ Perpendicular to Weld
= Parallel to Weld
* Base Material

WRV Weld and Required Volume

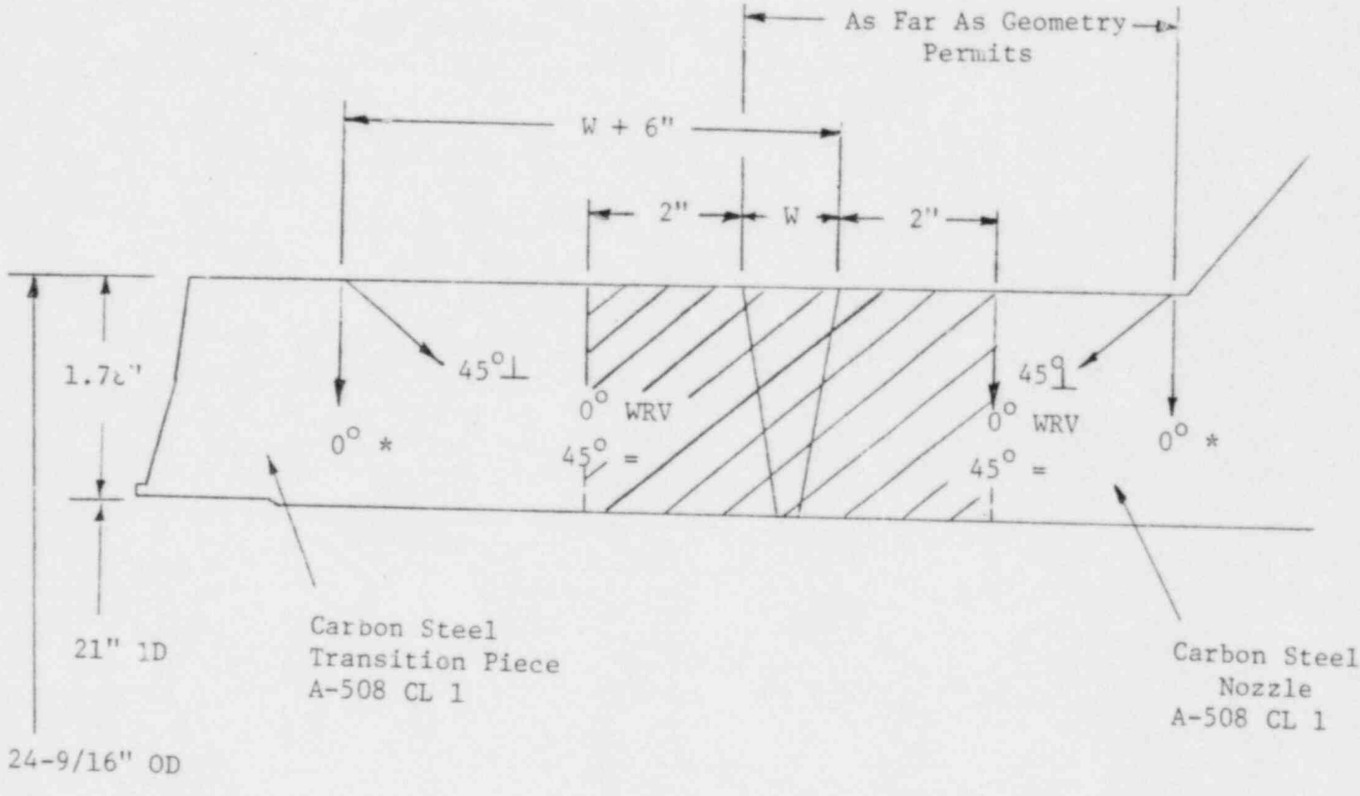


Figure 1 - Ultrasonic Examination Procedures for Main Steam (N3) Nozzle to Transition Piece Welds. Cal. Block "Steam"

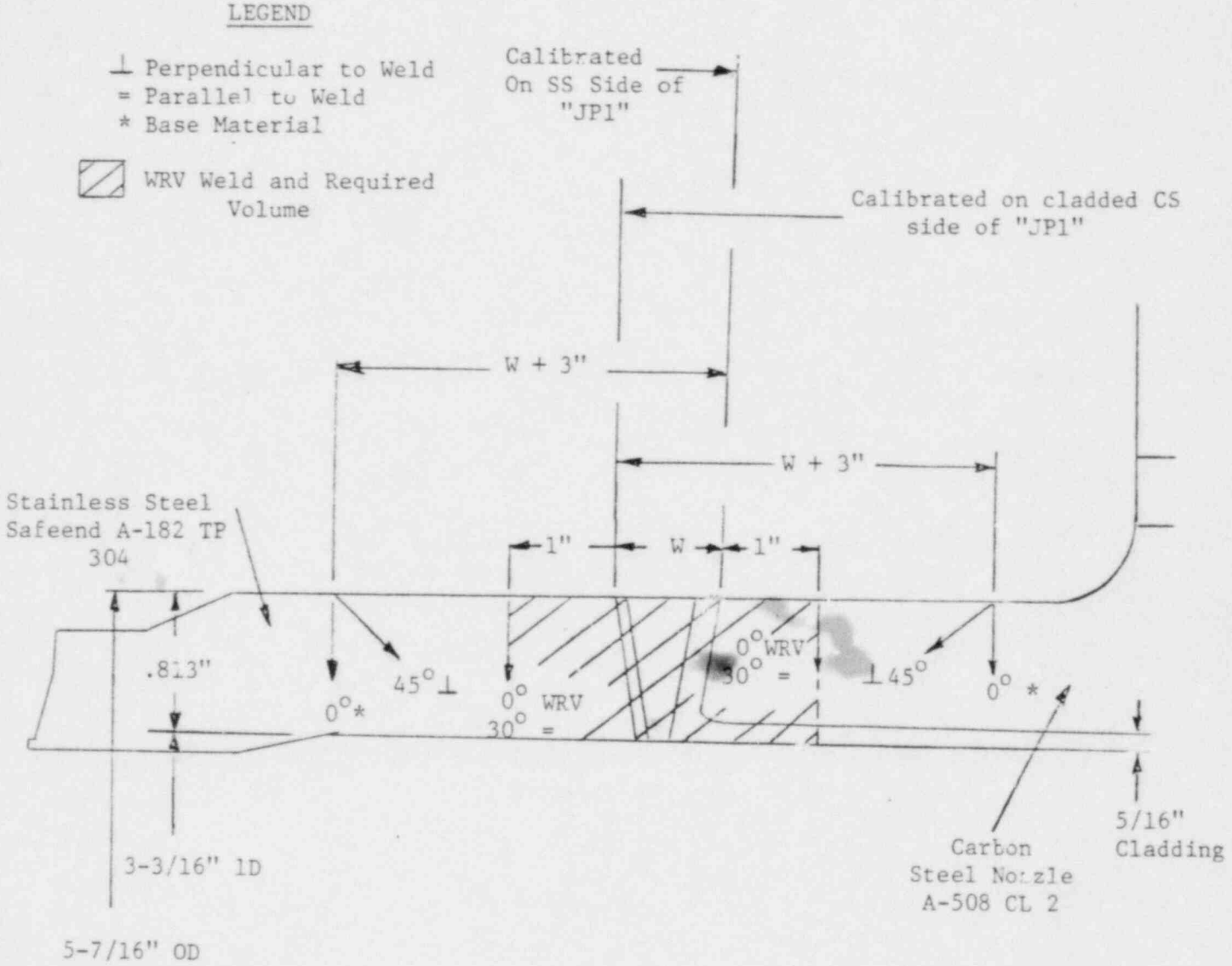


Figure 2 - Ultrasonic Examination Procedures for Jet Pump Instrumentation (N8) Nozzle to Safeend Welds, Cal. Block "JP1"

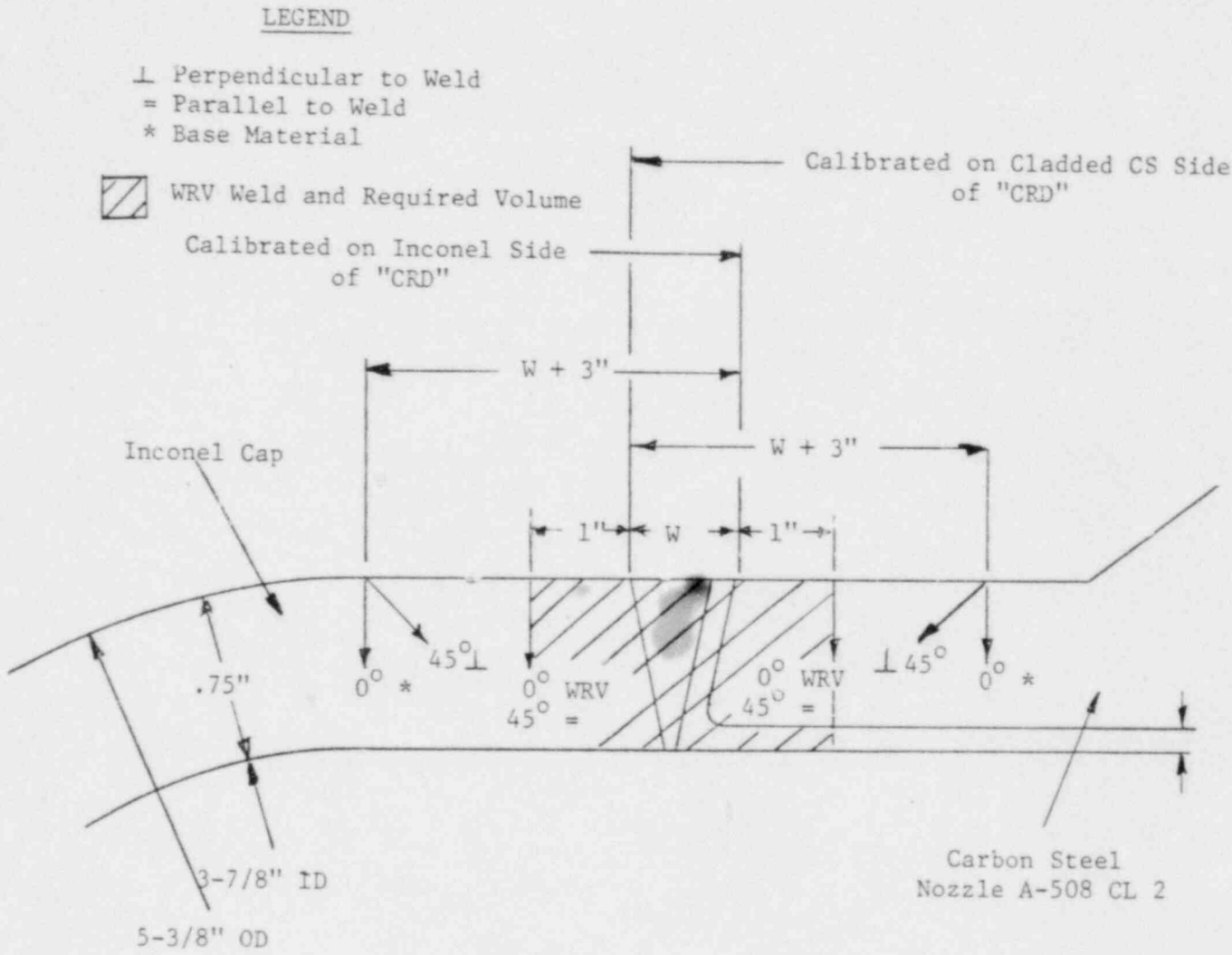


Figure 3 - Ultrasonic Examination Procedures for Control Rod Drive (N9) Nozzle to Cap Weld. Cal. Block "CRD"

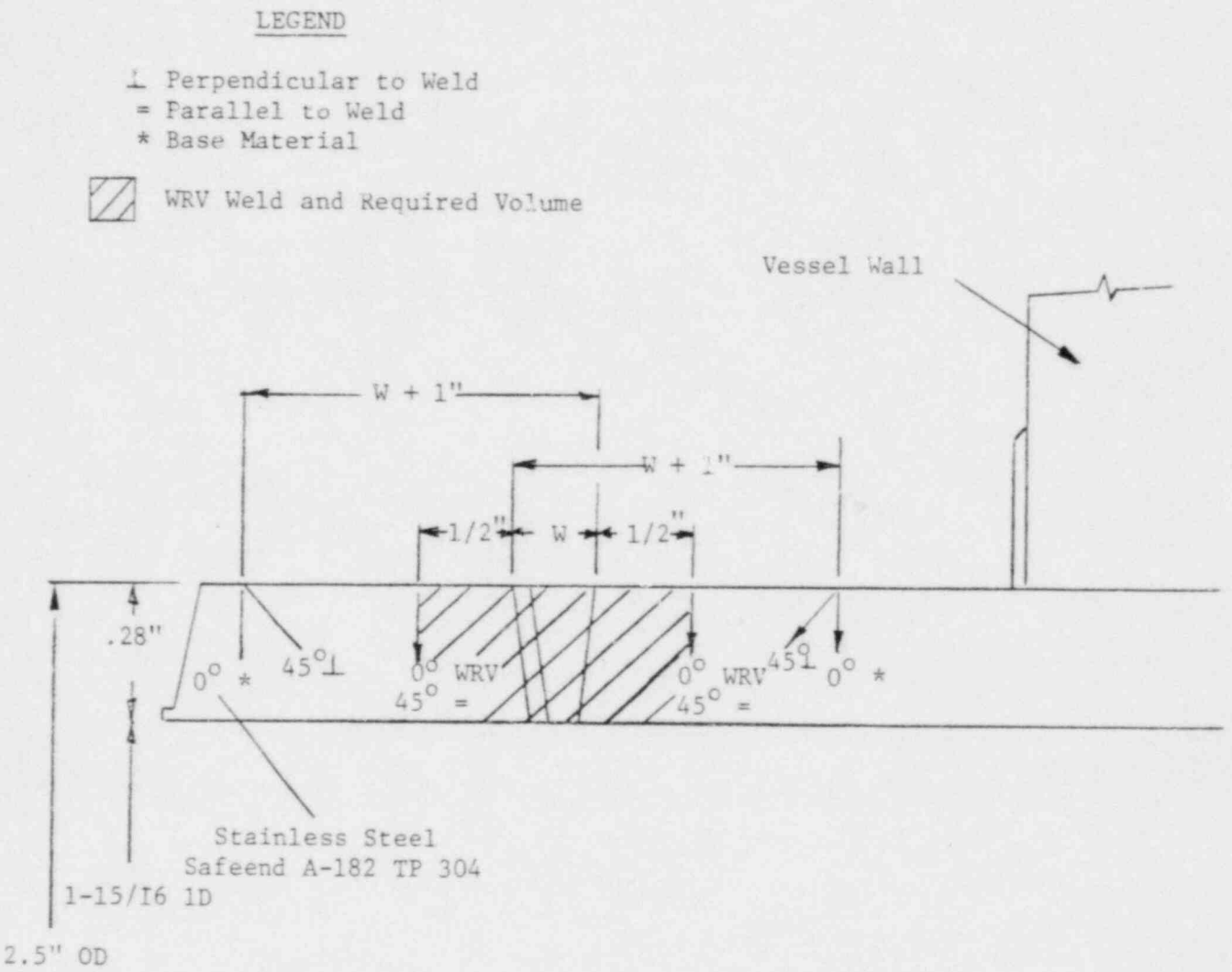


Figure 4 - Ultrasonic Examination Procedures for Pressure Differential (N10) Nozzle to Safeend Weld. Cal. Block " P"

LEGEND

⊥ Perpendicular to Weld
= Parallel to Weld
* Base Material

WRV Weld and Required Volume

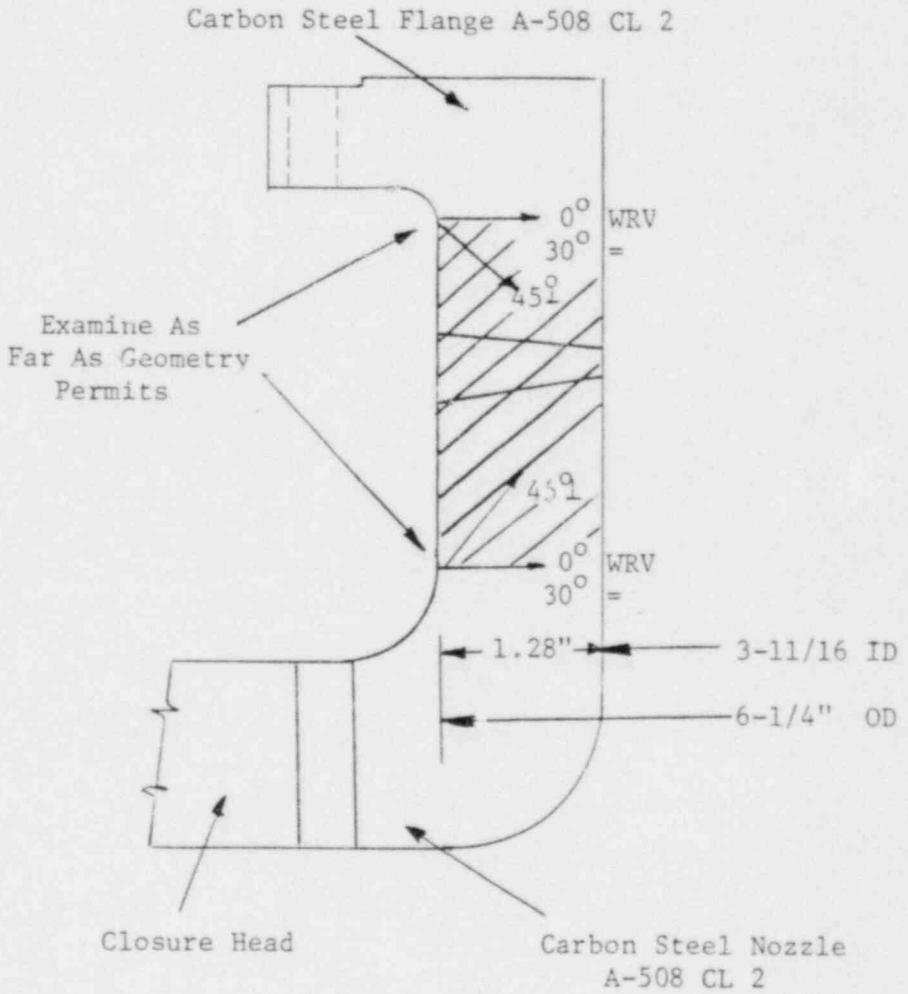


Figure 5 - Ultrasonic Examination Procedures for Closure Head Vent (N7) Nozzle to Flange Weld. Cal. Block "VENT"

LEGEND

⊥ Perpendicular to Weld
= Parallel to Weld
* Base Material

WRV Weld and Required Volume

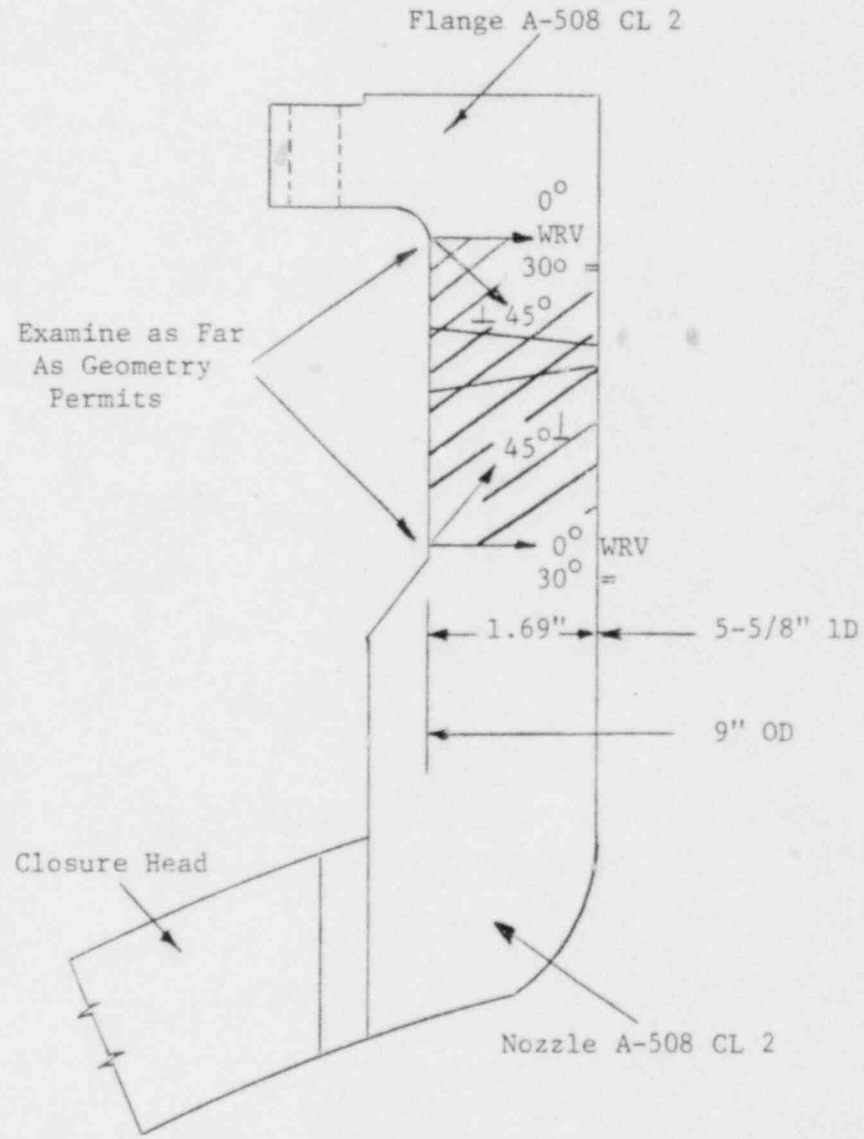


Figure 6 - Ultrasonic Examination Procedures for Closure Head Instrumentation (N6) Nozzle to Flange Welds. Cal. Block "VENT"

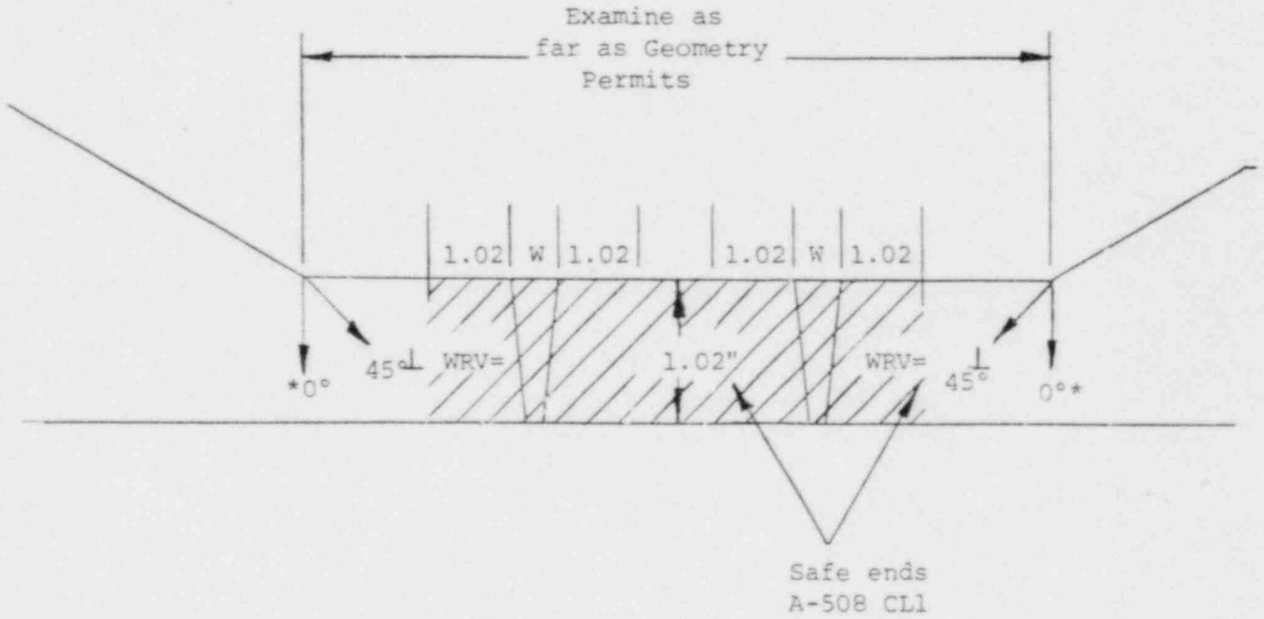
SCAN LEGEND

⊥ Perpendicular to Weld

= Parallel to Weld

* Base Material

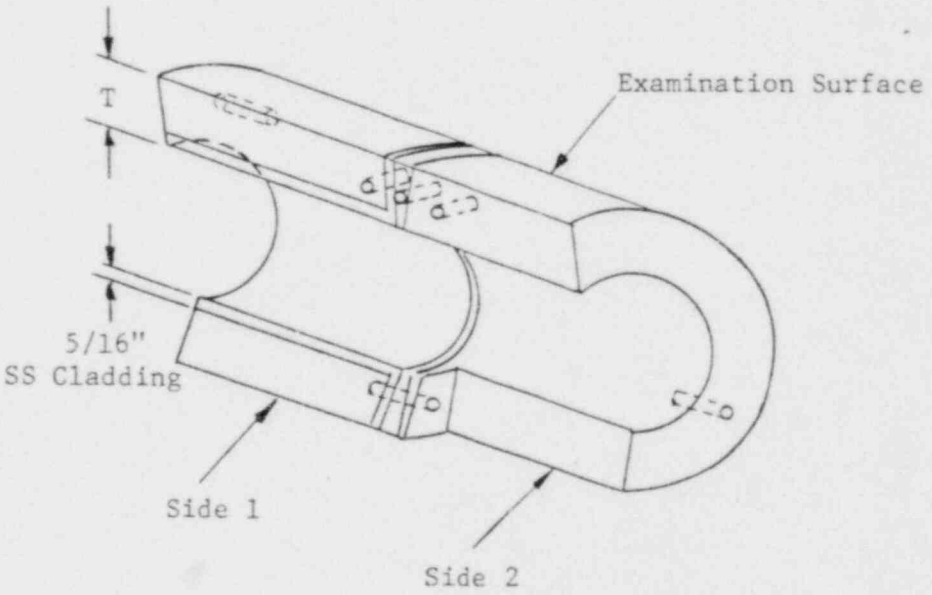
▨ WRV Weld and Required Volume



Note: Due to Configuration of Safe end extend scan path as far as geometry permits

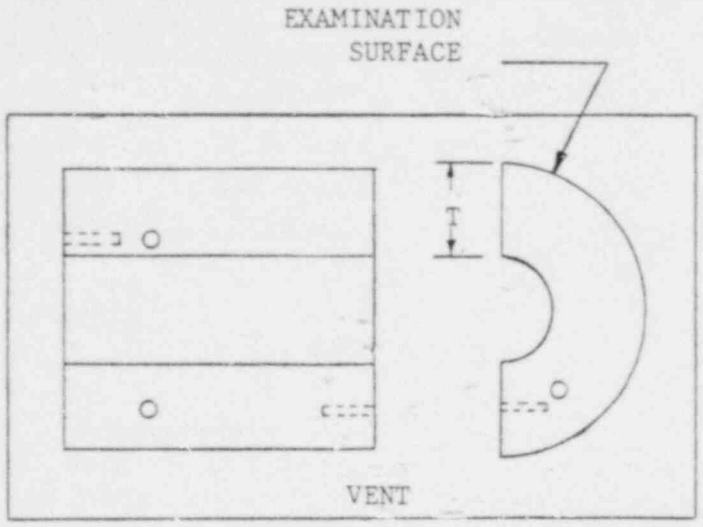
FIGURE 7. ULTRASONIC EXAMINATION PROCEDURE FOR FEEDWATER (N4) NOZZLE TO SAFE END WELDS. CAL BLOCK 131C8523 (FEEDWATER)

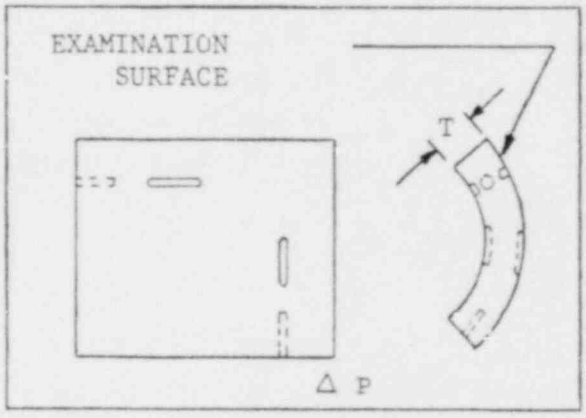
2 3 4

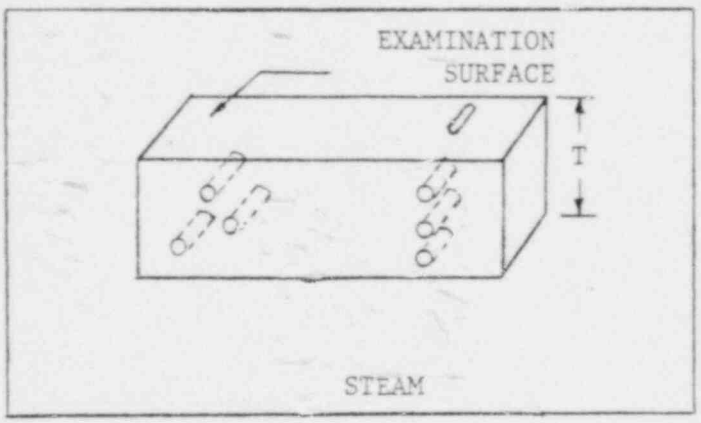


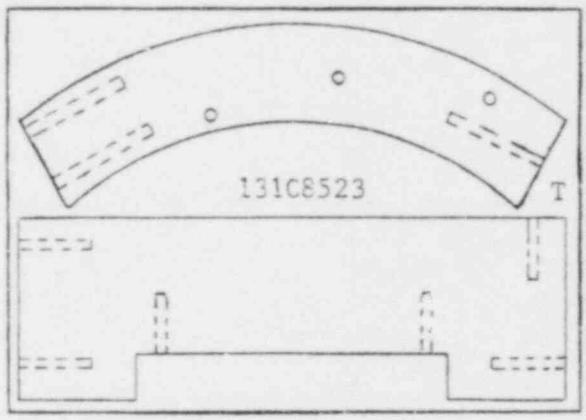
Cal. Block No.	Block T	OD	ID	1/2T	Hole Dia.	Hole Depth	Notch Depth	Side 1 MAT.	Side 2 MAT.
CRD	.75"	5-3/8"	3-7/8"	.375"	3/32"	1.5"	10%T	CS + SS Clad.	Inconel
JPI	.81"	5-7/16"	3-13/16	.405"	3/32"	1.5"	10%T	CS + SS Clad.	SS

Figure 8 - Ultrasonic Calibration Blocks "CRD" and "JPI"









CALIBRATION BLOCK NO.	BLOCK T	OD	ID	1/4T	1/2T	3/4T	HOLE DIA.	HOLE DEPTH	NOTCH DEPTH
STEAM	1.78"	-	-	.445"	.89"	1.335	.125"	3.0"	2% T
VENT	1.50"	6.25"	3.25"	.375"	.75"	1.125	.093"	1.5"	2% T
△ P	.28"	2.5"	1.94"	.07"	.140"	.210	.093"	1.5"	10% T
Feedwater 131C8523	.94"	14.12"	12.24"	.19"	.43"	.66"	.093"	1.5"	N/A

FIGURE 9. ULTRASONIC CALIBRATION BLOCKS

△3 △2

Plant/Unit
Comp/System
ISO Loop

FIGURE 10 (2)
CALIBRATION DATA SHEET

Data Sheet No.
Procedure No.
Subject:
Rev/Change No.
Calibration Block No.
Fabrication No.
Surface
Block Temp °F
Comp. Temp °F
Thickness
CRT Calibrated in

Each Maj. Screen Div=

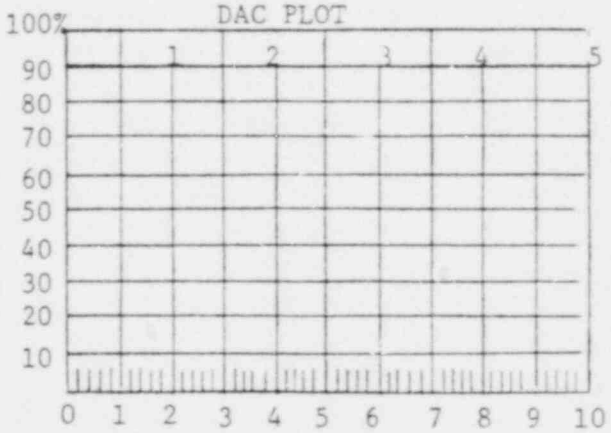
INSTRUMENT SETTINGS
Mfg/Model No.:
Serial No. :
Sweep Length :
Sweep Delay :
Pulse Length/Damping:
Freq.: Rep. Rate:
Filter: Video: Jack:
DEC/Gate Switch: Range:
Mode Select: Reject:
Gain (coarse): (fine):
Scan Sensitivity:

SEARCH UNIT
Scan Angle: Mode:
Fixturing (if any):
Style or Type No. :
Size & Shape:
Frequency :
Serial No/Brand:
Measured Angle :
Cable Type & Length:
Couplant Brand:
Couplant Batch:

SCAN AREA	
0° WRV	
0° Mat'l	
═ To Weld	
⊥ To Weld	
Calibration	
Axial	
Circ	

INSTR. LINEARITY CAL.					
	Amplitude				
	High	Low		High	Low
1			5		
2			6		
3			7		
4			8		

DAC PLOT



AMPL. CONTROL LINEARITY		
Initial	dB	Result
80	-6	
80	-12	
40	+6	
20	+12	

EXAMINATION WELD/AREA	Recordable Indications			COMMENTS/REASON FOR INCOMPLETED SCAN (S)
	Yes	No	Geom	

CALIBRATION CHECKS	TIME
Initial Cal.	
Intermediate	
Intermediate	
Intermediate	
Final Cal.	

ADDITIONAL SHEETS? CHECK BOX			
Continuation		Beam Plot	
Supplements		None	

EXAMINERS 1 _____ Date _____ Level _____
2 _____ Date _____ Level _____

REVIEWERS 1 _____ Date _____
2 _____ Date _____
3 _____ Date _____

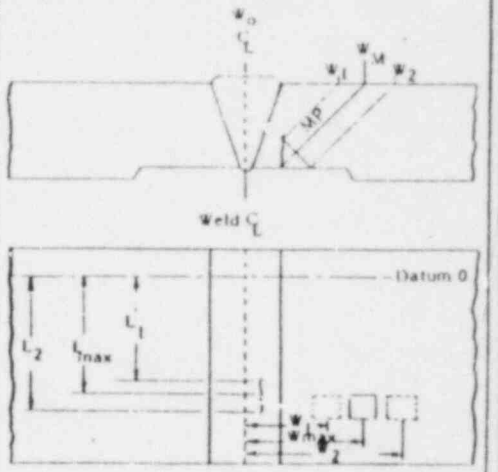
INDICATION REPORT SHEET (2)
FIGURE 11

NUCLEAR ENERGY SERVICES, INC.

Project No.	Site	L_o Location					Date: (Day/Mo/Yr)
Item Identification		W_o Location					Page 29 of 30
Examiner: TC-1A Level		Angle Used	0°	45°⊥	45°=		Attached Cal. Data Sheet
Examiner: TC-1A Level		Scanning dB					Thickness
							Diameter (nom.)

MP Metal Path
RBR Remaining Back Reflection
L Distance from Datum 0

W max Distance from $\mathcal{C}_L$ to S.U. at maximum response.
W_1 Distance from weld $\mathcal{C}_L$ at 50% of DAC (fwd)
W_2 Distance from weld $\mathcal{C}_L$ at 50% of DAC (backward)



Ind. No.	% of DAC	FWD W MAX W	FWD W MAX MP	FWD 50% DAC W_1	FWD 50% DAC MP	BACKWARD 50% DAC W_2	BACKWARD 50% DAC MP	L_1 50% DAC	L max	L_2 50% DAC	RBR amp	S.U. Loc.	REMARKS

DRAW FULL SCALE PLOT HERE:

REVIEWER _____ DATE _____
REVIEWER _____ DATE _____
REVIEWER _____ DATE _____

(3)

METAL PATH CALIBRATION TABLE

1&1/2 VEE SCAN PATH EXAMINATION

Metal Path Calibration Recommended	Material Thickness Range 45°	60°	70°
2.5"	≤ 0.5"	≤ 0.4"	N/A
5.0"	> 0.5" - ≤ 1.0"	> 0.4" - ≤ 0.8"	≤ 0.5"
10.0"	> 1.0" - ≤ 2.0"	> 0.8" - ≤ 1.6"	> 0.5" - ≤ 1.0"
20.0"	> 2.0" - ≤ 4.5"	1.6" - ≤ 3.3"	> 1.0" - ≤ 2.2"

FULL VEE SCAN PATH EXAMINATION

Metal Path Calibration Recommended	Material Thickness Range 45°	60°	70°
2.5"	≤ 0.8"	≤ 0.6"	≤ 0.4"
5.0"	> 0.8" - ≤ 1.7"	> 0.6" - ≤ 1.2"	> 0.4" - ≤ 0.8"
10.0"	> 1.7" - ≤ 3.5"	> 1.2" - ≤ 2.5"	> 0.8" - ≤ 1.6"
20.0"	> 3.5" - ≤ 7.0"	> 2.5" - ≤ 5.0"	> 1.6" - ≤ 3.3"

1/2 VEE SCAN PATH EXAMINATION

Metal Path Calibration Recommended	Material Thickness Range 45°	60°	70°
2.5"	≤ 1.7"	≤ 1.2"	≤ 0.8"
5.0"	> 1.7" - ≤ 3.5"	> 1.2" - ≤ 2.5"	> 0.8" - ≤ 1.6"
10.0"	> 3.5" - ≤ 7.0"	> 2.5" - ≤ 5.0"	> 1.6" - ≤ 3.3"
20.0"	> 7.0" - ≤ 14.0"	> 5.0" - ≤ 10.0"	> 3.3" - ≤ 6.6"

INSTRUCTIONS: The Vee Path and the examination angle are given in the specific procedure. Using the appropriate Vee Path Examination Chart (1/2 Vee, Full Vee, and 1-1/2 Vee Paths) and the appropriate examination angle column, find the thickness range that encompasses the thickness of the material being examined.

FIGURE 12

△2 △4