Form 244

CP&L

Carolina Power & Light Company

LAP-83-14

FEB 08 1983

Company Correspondence

Director of Nuclear Reactor Regulation
Attention: Mr. D. B. Vassallo, Chief
Operating Reactors Branch No. 2
Division of Licensing
United States Nuclear Regulatory Commission
Washington, DC 20555

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2
DOCKET NOS. 50-325 AND 50-324
LICENSE NOS. DPR-71 AND DPR-62
REQUEST FOR ADDITIONAL INFORMATION
GENERIC LETTER 81-04: IMPLEMENTATION OF NUREG-0313, REV. 1

Dear Mr. Vassallo:

This is in response to your November 8, 1982 letter which requested additional information concerning NUREG-0313, Rev. 1 for the Brunswick Steam Electric Plant (BSEP). Your questions (attached) are in regard to Carolina Power & Light Company's (CP&L) July 7, 1981 response to NRC's Generic Letter 81-04 concerning BWR/coolant pressure boundary piping.

The enclosures to this letter provide CP&L's response for BSEP Unit No. 1, which is presently shutdown for refueling. Information for Unit 2 is currently being compiled and will be provided by March 1983.

Please contact us should you have any questions regarding this information.

Yours very truly,

E. E. Utley
Executive Vice President
Power Supply and
Engineering & Construction

JAM/mag (6024C11T2)
Enclosure

cc: Mr. D. O. Myers (NRC-BSEP)
Mr. J. P. O'Reilly (NRC-RII)
Mr. S. D. MacKay (NRC)

EG&G Idaho, Inc.
P. O. Box 1625
Idaho Falls, Idaho 83415

A047

Brunswick Steam Electric Plant, Unit Nos. 1 and 2
Implementation of NUREG-0313, Rev. 1
NRC Request for ditional Information

Carolina Power & Light Company Responses

1. Refer to Table 1 (attached)

2a. and 2b. During the augmented Inservice Inspection (ISI) of the non-conforming Service Sensitive Pipe Southwest Research Institute (SWRI) NDT procedures 600-31 Revision 9 deviation 3, entitled "Manual Ultrasonic Examination of Austenitic Pressure Piping Welds" and SWRI-NDT-700-5/7 with deviation 4 entitled "Mechanized Ultrasonic Examination of Vessel Components, Vessel Welds and Piping Welds" will be used (copy attached). The methods and techniques of these procedures specify the use of 3/8" round 1.5 MHz single element tranducers and use 45 and 60 degree refracted shear waves for angle beam scanning of the weld volume. The procedures also employ an additional 45-degree tangential scan to ensure the detection of axial undercrown which may have initiated at the inside surface of the piping. The 45-degree tangential scan is performed from the adjacent base material with the 45-degree search unit adjacent to the weld crown and skewed approximately 45-degrees into the weld to detect cracks axial to the pipe, at the inside surface beneath the weld crown.

The procedures require the recording and investigation of all ultrasonic reflectors producing a response greater than 50 percent of the reference level. Additionally, they require recording and investigation of any ultrasonic reflectors not readily attributable to geometry by the examiner, regardless of amplitude. Scanning is to be performed with a minimum overlap of 10 percent of the search unit piezoelectric element dimension perpendicular to the direction of scan.

The basic calibration blocks conform to the requirements of ASME Boiler and Pressure Vessel Code, Section V, Article 5, 1977 edition with addenda through Summer 1978.

2c. The ultrasonic examiners for the augmented ISI will be certified to Level I or Level II. A Level II examiner (in accordance with the guidelines of Recommended Practice SNT-TC-IA) will be performing each examination. He may be assisted by a Level I examiner (in accordance with the guidelines of SNT-TC-IA). However, a Level I examiner may not independently carry out any calibrations, examinations, or evaluations. A Level III examiner will be provided, as necessary, for those indications which may be interpreted as crack-like. All examiners will have met the minimum training requirements specified in SNT-TC-IA. Additionally, all examiners will have received additional training in the detection of axial cracking including a laboratory session with welded specimens containing machined reflectors. Each examiner will have also satisfactorily demonstrated his/her ability to detect simulated cracking in a welded specimen. As available, examiners receive training on any available cracked specimens at their disposal.

During the augmented ISI of the nonconforming service sensitive pipe, procedure SWRI-NDT-600-31, Revision 9 entitled "Manual Ultrasonic Examination of Austenitic Pressure Piping Welds" will be used. This procedure incorporates an additional scanning technique over the procedure which was satisfactorily demonstrated at Battelle Memorial Institute in Columbus, Ohio. The procedure (600-31, Revision 9) requires recording and investigation of all ultrasonic reflectors producing a response greater than 50 percent of the reference level. Additionally, it requires recording and investigation of any ultrasonic reflectors not readily attributable to geometry by the examiner, regardless of amplitude. The procedure further specifies the use of a 3/8-inch round, 1.5 MHz, single-element transducer and the use of both 45-degree and 60-degree refracted shear waves for the angle-beam examination of the weld volume. The basic calibration blocks conform to the requirements of ASME Boiler and Pressure Vessel code, Section V, Article 5, 1977 Edition with Addenda through Summer 1978.

The scanning is to be performed at a minimum gain setting of two times the reference level sensitivity with scan overlap a minimum of 10 percent of the search unit piezoelectric element dimension perpendicular to the direction of scan. The search unit movement rate for scanning shall not exceed 6 inches per second. An additional 45-degree tangential scan will be employed to ensure the detection of any axial undercrown cracking which may have initiated at the inside surface of the piping. This 45-degree tangential scan is performed from the adjacent base material with the 45-degree search unit adjacent to the weld crown and skewed approximately 45-degrees into the weld in order to detect any cracks which may be axial to the pipe and located at the inside surface beneath the weld crown.

2d. Twenty-seven welds out of a total of 46 will be inspected.

2e. A portion of all the non-conforming service sensitive pipe welds on each system are inspected at each refueling outage.

2f. The welded joints and their associated Stress Rule Index Numbers for Unit 1 are listed in Tables 2 and 3.

3a. The methods used for nonconforming nonservice sensitive piping are the same as for nonconforming service sensitive piping (see 2a).

3b. Attachment 1, SWRI-NDT-600-31 Revision 9 will be used for the augmented ISI.

3c. See response 2c.

3d. Eight welds out of a total of 63 will be inspected on Unit 1.

3e. See response 2f.

3f. At least 25 percent of the welds in the nonconforming non-service sensitive piping in each system will be inspected within the 80-month interval as required by NUREG-0313 Rev. 1.

TABLE 1

INFORMATION REQUESTED ON LEAK DETECTION SYSTEM

Type of System	(1) Is System Operable (yes/no)	(2) Leak Rate Sensitivity (gpm)	(3) Time Required To Achieve Sensitivity (hours)	(4) Is System Functional After SSE (yes/no)	(5) Control Room Indications (alarms) (recorders)	(6) Calibration or Testing During Operation (yes/no)	(7) Document Reference for (1) Thru (6)
Primary Containment Atmospheric Particulate Radioactivity Monitoring System	yes	NA	0	yes	Alarm & Recorder	yes	PT4.1.6 SD-24
Primary Containment Gaseous Radioactivity Monitoring System	yes	NA	0	yes	Alarm & Recorder	yes	PT4.1.6 SD-24
Primary Containment Sump Flow Integrating System	yes	1 gpm	1-8 hrs	no	Alarm & Recorder	yes	PT5.1PC SD-47
Drywell Pressure	yes	NA	0	yes	Alarm & Recorder	yes	PT5.1PC SD-47
Average Drywell Temperature	yes	NA	0	yes	Alarm & Recorder	no	SD-24

TABLE 2

BRUNSWICK - 1
B-32 RECIRCULATION SYSTEM PIPE WELDS
LOOP A

WELD NO.	SERVICE SENSITIVE (Yes or No)	SRI
28-A-2	N	1.080
28-A-3	N	1.464
28-A-4	N	1.410
28-A-5	N	0.948
28-A-6	N	0.974
28-A-7	N	1.379
28-A-8	N	1.408
28-A-9	N	1.068
28-A-10	N	1.584
28-A-11	N	1.522
28-A-12	N	1.123
28-A-13	N	1.128
28-A-14	N	1.513
28-A-15	N	1.421
28-A-16	N	0.979
28-A-17	N	1.019
28-A-18	N	0.950
28-A-9BC	N	1.200
28-A-12BC	N	1.039
28-A-15BC	N	0.984
22-AM-1	N	1.148
22-AM-2	N	1.112
22-AM-3	N	1.027
22-AM-4	N	1.240
22-AM-5	N	1.175
22-AM-6	N	1.144

TABLE 2 (Continued)

BRUNSWICK - 1
B-32 RECIRCULATION SYSTEM PIPE WELDS
LOOP A

WELD NO.	SERVICE SENSITIVE	SRI
12-AR-A1	Y	1.081
12-AR-A2	Y	1.479
12-AR-A3	Y	1.458
12-AR-A4	Y	1.273
12-AR-B1	Y	1.005
12-AR-B2	Y	1.393
12-AR-B3	Y	1.505
12-AR-B4	Y	1.362
12-AR-C1	Y	1.571
12-AR-C2	Y	1.579
12-AR-C3	Y	1.544
12-AR-C4	Y	1.599
12-AR-D1	Y	1.081
12-AR-D2	Y	1.457
12-AR-D3	Y	1.436
12-AR-D4	Y	1.348
12-AR-E1	Y	1.142
12-AR-E2	Y	1.565
12-AR-E3	Y	1.528
12-AR-E4	Y	1.584
4-A-1	Y	1.222
4-A-2	N	1.553
4-A-3	N	1.535
4-A-4	N	1.177
4-A-5	N	1.159
4-A-6	N	1.299
4-A-7	N	1.268
4-A-8	N	1.420
4-A-9	N	1.449
4-A-10	Y	1.194

TABLE 3

BRUNSWICK - 1
B-32 RECIRCULATION SYSTEM PIPE WELDS
LOOP B

WELD NO.	SERVICE SENSITIVE	SRI
28-B-2	N	1.028
28-B-3	N	1.341
28-B-4	N	1.324
28-B-5	N	0.925
28-B-6	N	0.935
28-B-7	N	1.361
28-B-8	N	1.364
28-B-9	N	1.051
28-B-10	N	1.514
28-B-11	N	1.462
28-B-12	N	1.116
28-B-13	N	1.121
28-B-14	N	1.484
28-B-15	N	1.400
28-B-16	N	0.972
28-B-17	N	1.011
28-B-18	N	0.951
28-B-9BC	N	1.200
28-B-12BC	N	1.035
28-B-15BC	N	0.984
22-BM-1	N	1.144
22-BM-2	N	1.204
22-BM-3	N	1.214
22-BM-4	N	1.248
22-BM-5	N	1.135

TABLE 2 (Continued)

BRUNSWICK - 1
B-32 RECIRCULATION SYSTEM PIPE WELDS
LOOP B

WELD NO.	SERVICE SENSITIVE	SRI
12-BR-F1	Y	1.116
12-BR-F2	Y	1.526
12-BR-F3	Y	1.450
12-BR-F4	Y	1.456
12-BR-G1	Y	1.096
12-B4-G2	Y	1.506
12-BR-G3	Y	1.526
12-BR-G4	Y	1.418
12-BR-H1	Y	1.592
12-BR-H2	Y	1.569
12-BR-H3	Y	1.534
12-BR-H4	Y	1.528
12-BR-J1	Y	1.058
12-BR-J2	Y	1.410
12-BR-J3	Y	1.450
12-BR-J4	Y	1.300
12-BR-K1	Y	1.070
12-BR-K2	Y	1.420
12-BR-K3	Y	1.381
12-BR-K4	Y	1.248
4-B-1	Y	1.224
4-B-2	N	1.556
4-B-3	N	1.538
4-B-4	N	1.176
4-B-5	N	1.159
4-B-6	N	1.298
4-B-7	N	1.268
4-B-8	N	1.417
4-B-9	N	1.451
4-B-10	Y	1.195

Request for Additional Information
Implementation of NUREG-0313, Rev. 1
Brunswick Steam Electric Plant, Units 1 and 2
Docket Nos. 50-324 and 50-325

1. Unidentified Leakage Monitoring (IV.B.1 of NUREG-0313, Rev. 1).

   a. Identify the methods to detect and monitor unidentified leakage in the pressure boundary piping of your BWR. Some of these methods are enumerated in Regulatory Guide 1.45, Paragraph 3.

   b. Please fill out the attached table of information regarding the systems identified in the above paragraph.

2. Augmented ISI of Nonconforming Service Sensitive Pipe

   a. Please identify the methods for augmented ISI of the nonconforming service sensitive pipe (IV.B.3 of NUREG-0313 Rev. 1).

   b. Provide a copy of the specifications for the augmented ISI method or methods (IV.B.3 of NUREG-0313 Rev. 1).

   c. Identify each of the augmented ISI methods used and the training and certification levels the individuals using those methods received. Indicate if cracked specimens are used in your training (IV.B.3 of NUREG-0313 Rev. 1).

   d. Identify the proportion of the nonconforming service sensitive pipe that is being inspected (IV.B.2.b of NUREG-0313 Rev. 1).

   e. Identify the inspection interval of each system of the nonconforming service sensitive pipe (IV.B.2.b of NUREG-0313 Rev. 1).

   f. Identify the Stress Rule Index Numbers for the welded joints in the nonconforming service sensitive pipe (IV.B.1.b (6) of NUREG-0313 Rev. 1).

3. Augmented ISI of Nonconforming Nonservice Sensitive Piping

   a. Please identify the methods for augmented ISI of the nonconforming nonservice sensitive piping (IV.B.3 of NUREG-0313 Rev. 1).

   b. Please provide a copy of the specifications for the augmented ISI method or methods (IV.B.3 of NUREG-0313 Rev. 1).

   c. Identify each of the augmented ISI methods used and the training and certification levels the individuals using those methods received. Indicate if cracked specimens are used in your training (IV.B.3 of NUREG-0313 Rev. 1).

   d. Identify the proportion of the nonconforming nonservice sensitive piping that is being inspected (IV.B.2.b of NUREG-0313 Rev. 1).

e. Identify the Stress Rule Index Numbers for the welded joints in the nonconforming nonservice sensitive piping (IV.B.1.b (6) of NUREG-0313 Rev. 1).

f. Identify the proposed inspection interval for each system of nonconforming nonservice sensitive piping (IV.B.1.b of NUREG-0313 Rev. 1).

ATTACHMENT 1

SOUTHWEST RESEARCH INSTITUTE
NUCLEAR PROJECTS
OPERATING PROCEDURE

SwRI-NDT-600-31
Revision 9
December 1982

Title

MANUAL ULTRASONIC EXAMINATION OF AUSTENITIC PRESSURE PIPING WELDS

EFFECTIVITY AND APPROVAL

Revision 9 of this procedure became effective on 12/22/82. Other revisions of the base document may be effective concurrently.

SA: CK

Approvals			
Written By: Hector Diaz	Date: 27 Dec 82	Technical Review: Stan Walker	Date: 22 Dec 1982
Manager of Q.A.: Bruce Nakoski	Date: 12/22/82	Cognizant Director: Wayne T. Flach	Date: 12/22/82

The following information may be used for convenience. Completion of this portion is not mandatory.

Deviation No.								
Date Effective								
Procedure Section(s) Affected								

Notes:

MANUAL ULTRASONIC EXAMINATION OF
AUSTENITIC PRESSURE PIPING WELDS

SwRI-NDT-600-31

1. PURPOSE

This procedure provides the technical information and detailed steps required to ensure a complete and accurate manual ultrasonic examination of similar or dissimilar metal welds and adjacent base material in cla or unclad austenitic pressure piping in accordance with the applicable ASME Boiler and Pressure Vessel Codes.

2. SCOPE AND APPLICATION

Pressure piping welds and the adjacent base material in the nominal thickness range of greater than 0.4 inch to 5.0 inches shall be examined.

Manual, contact, pulse-echo, shear-wave angle-beam, and longitudinal-wave straight-beam ultrasonic techniques shall be utilized for the examination of welds and adjacent base material in extruded austenitic pressure piping.

Similar and dissimilar metal circumferential and longitudinal pipe welds and branch pipe connection butt welds to be examined shall be as specified in the applicable SwRI Examination Plan.

3. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1977 Edition, with Addenda through Summer 1978, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1977 Edition, with Addenda through Summer 1978, "Nondestructive Examination," with the exception of the following:

(a) Subparagraph T-533.1 of Article 5, Section V, requires the basic calibration block for production material thickness (t) up to and including 1 inch to be 3/4 inch or t. Paragraph 5.3 of this procedure requires the basic calibration block to be either t, no more than 25% less than t, or closer in thickness to the production material than the 3/4-inch alternate

thickness allowed by Article 5 for production material thicknesses up to and including 1 inch. This exception will assure a more accurate calibration than the Article 5 basic calibration block design allowed by Code.

(b) Subparagraph T-535.1 of Article 5 states that transfer (attenuation compensation) be accomplished between the production material and basic calibration block and a correction made for the difference. Paragraph 7.5.2 of this procedure describes the method used to conduct attenuation measurements. These attenuation measurements shall be recorded and considered during analysis and evaluation of indications. No attempt shall be made by the examiner to compensate for observed differences before or during the examinations.

(3) ASME Boiler and Pressure Vessel Code, Section IX, 1977 Edition with Addenda through Summer 1978, "Welding and Brazing Qualifications"

(3) SwRI Nuclear Quality Assurance Program Manual (NQAPM)

3.1 Calibration and Examination Records

SwRI-NDTR Form No.	Revision Date
17-18	7-31-75
17-19	7-10-80
17-25	7-10-80
17-37	2-18-80
17-86	7-25-80
17-87	7-25-80

4. RESPONSIBILITY

(1) The Director of the Department of Engineering Services, Quality Assurance Systems and Engineering Division, shall be responsible for the preparation, review, approval, and control of this procedure.

(2) The Project Manager shall be responsible for the implementation of this procedure in accordance with the NQAPM specified in the applicable SwRI Project Plan.

(3) The examiner shall be responsible for implementing the requirements of this procedure.

(4) The Manager of the Support and Administration Section, Quality Assurance Systems and Engineering Division, shall be responsible for storage of records generated in accordance with this procedure.

5. PERSONNEL AND EQUIPMENT

5.1 Personnel Certification

Personnel performing ultrasonic examinations shall be certified in accordance with SwRI NQAP 11-1, "Special Process Control."

5.2 Reference Block

Reference blocks used for screen distance calibration and verification shall be of the same material as the production material; i.e., stainless steel or carbon steel, and shall be one of the following: (1) SwRI Half-Round, (2) AWS Type DC, or (3) IIW.

5.3 Basic Calibration Block for Circumferential, Longitudinal, and Branch Pipe Connection Welds

Side-drilled basic calibration hole reflectors, in accordance with Section V of the ASME Boiler and Pressure Vessel Code, shall be placed in a block manufactured from material of similar metallurgical structure and of the same or equivalent P-number grouping as the production material, as identified in Section IX of the ASME Boiler and Pressure Vessel Code. The calibration material shall be determined by the production piping material to which the search unit is applied.

The basic calibration block thickness shall be determined by the thickness of the production piping material to which the search unit is applied and Article 5 of Section V. When a basic calibration block of the same thickness as the production piping material is not available and where the production piping material thickness is 1 inch or less, the basic calibration block thickness shall be no more than 25% thinner than the production material thickness or shall be closer to the production material thickness than the 3/4-inch thick alternate calibration block allowed by Article 5.

Approved drawings of basic calibration blocks to be used in accordance with this procedure are contained in the applicable SwRI Examination Plan.

The surface finish of the basic calibration block shall be representative of the surface finish of the piping.

Flat basic calibration blocks or blocks of essentially the same curvature as the part to be examined may be used when contact surface curvatures are greater than 20 inches in diameter.

A curved basic calibration block shall be used to establish distance amplitude correction (DAC) curves for examinations on contact surfaces in the range of curvature from 0.9 to 1.5 times the basic calibration block diameter, when contact surface curvature is 20 inches in diameter or less.

The curvature of the main run pipe shall be used to establish the requirements for the basic calibration block curvature for the examination of branch pipe connection welds.

5.4 Search Units

(1) The search unit size shall be selected according to the following:

Straight-Beam

Nominal Production Material Thickness	Nominal Search Unit Size
2.0" or less	1/4" Round
1.0" to 3.0"	3/8" Round
2.0" to 4.0"	1/2" Round
3.0" to 5.0"	3/4" to 1" Round

Angle-Beam

The search unit size for carbon steel shall be selected according to the following:

Nominal Production Material Thickness	Nominal Search Unit Size
1.0" or less	1/4" x 1/4", 1/4" Round
0.4" to 2.0"	3/8" x 3/8", 3/8" Round
0.75" to 4.0"	1/2" x 1/2", 1/2" Round
2.0" to 5.0"	1/2" to 1", 3/4" Round

(2) The nominal search unit size for austenitic materials shall be 3/8" round or 3/8" x 3/8".

(3) The exit point of the sound beam and the actual refracted beam angle of shear-wave search units shall be determined on an IIW block. The exit point shall be marked on the search unit wedge.

(4) The nominal angle-beam shear-wave search unit frequency for examination of austenitic piping shall be 1.5 MHz.

(5) The nominal straight-beam longitudinal-wave search unit frequency for austenitic piping shall be 1.5 MHz or 2.25 MHz.

(6) The nominal search unit frequency for the carbon steel side of dissimilar piping welds shall be 2.25 MHz.

(7) The longitudinal-wave search unit frequency for attenuation measurements shall be 2.25 MHz to simulate a 1.5 MHz shear mode, and 5.0 MHz to simulate a 2.25 MHz shear mode.

(8) For examination of circumferential piping welds, search unit wedges shall be fabricated to produce 45° ±2° and 60° ±2° refracted shear-waves.

(9) For examination of longitudinal piping welds or branch pipe connection welds to piping, search unit wedges shall be fabricated to produce 45° ±2° refracted shear waves.

5.5 Ultrasonic Instrument

The examiner shall use a Sonic FTS Mark I ultrasonic instrument which shall be aligned and shall display an alignment calibration tag as required by NQAP 10-1.

5.6 Couplant

(1) USP-grade glycerine or deionized water (with or without wetting agent) shall be used when performing ultrasonic calibrations and examinations in accordance with this procedure.

(2) USP-grade glycerine shall be certified for sulfur content and total halogens in accordance with ASTM D-129-64 and ASTM D-808-63. The residual amount of total sulfur or halogens shall not exceed 1% by weight. Deionized water, when used, shall be supplied by the customer.

(3) Couplant materials used for examinations shall be the same as used for the calibration.

5.7 Thermometer

Quicktemp thermometer Model 5X-666, calibrated and certified in accordance with the applicable revision of SwRI Nuclear Projects Operating Procedure XII-PM-104 shall be used to measure calibration block and component surface temperature.

6. CALIBRATION METHOD

6.1 Instrument Linearity

The ultrasonic instrument shall be verified at the beginning of each day for amplitude linearity and amplitude control linearity in accordance with Paragraphs 6.1.1 and 6.1.2. Data required shall be recorded on the SwRI Instrument Linearity Verification Record and the sheet number shall be referenced on the applicable SwRI Sonic Instrument Calibration Record.

6.1.1 Amplitude Linearity

(1) Position a shear-wave search unit on a calibration block to obtain indications from the 1/2T and 3/4T holes.

(2) Adjust the search unit position to give a 2:1 ratio between the two indications, with the larger indication (1/2T hole) set at 80% of full screen height (FSH) and the smaller indication (3/4T hole) set at 40% of FSH.

(3) Without moving the search unit, adjust the instrument sensitivity (gain) to set the larger indication to 100% of FSH.

(4) With the larger indication at 100%, record the amplitude of the smaller indication, estimated to the nearest 1% of FSH.

(5) Successively set the larger indication from 100% to 20% of FSH in 10% increments (or 2 dB steps if a fine control is not available); observe and record the smaller indication estimated to the nearest 1% of FSH at each setting. The reading must be 50% of the larger amplitude within 5% of FSH.

6.1.2 Amplitude Control Linearity

(1) Position a shear-wave search unit on a calibration block to obtain maximum amplitude from the 1/2T hole.

(2) Without moving the search unit and according to the following table, set the indication to the required percent of FSH and increase or decrease the dB as specified. The signal shall be estimated and recorded to the nearest 1% of FSH and shall fall within the limits of the following table:

Indication Set at % of Full Screen	dB Control Change*	Indication Limits, % of Full Screen
80%	-6dB	32 to 48%
80%	-12dB	16 to 24%
40%	+6dB	64 to 96%
20%	+12dB	64 to 96%

*Minus denotes decrease in amplitude; plus denotes increase.

6.2 Calibration

The complete ultrasonic calibration shall be performed prior to the examination.

NOTES

The REJECT control shall be maintained in the 0 position during calibration and examination.

The nominal piping production material thickness shall be used to determine the correct calibration block and search units for the examination of piping components which may be thicker than the nominal pipe size and welded to the pipe. The Level II examiner shall ensure that complete coverage of the thicker piping component is obtained. Additional calibration vee-path positions and larger screen sizes may be required to assure this coverage. The additional calibration vee-path positions and larger screen size shall be used for the examination from the thicker component and the nominal pipe side of the weld.

The FREQ MHz control shall be turned to 1 when a 1.5 MHz search unit is used, to 2 with a 2.25 MHz search unit, and to 5 with a 5.0 MHz search unit.

The type and length of the search unit cable shall be recorded on the SwRI Sonic Instrument Calibration Record.

The centerline of the search unit shall be at least 3/4 inch from the nearest side of the block. Rotating the beam into the corner formed by the hole and the side of the block may produce a higher amplitude at a longer beam path. This beam path shall not be used for calibration.

All spaces on the SwRI Sonic Instrument Calibration Record shall be filled in.

6.2.1 Temperature

The temperature of the calibration block shall be within 25°F of the component temperature and shall be recorded on the SwRI Sonic Instrument Calibration Record for the initial calibration and each verification.

The surface temperature of the component to be examined shall be taken prior to performing an examination and shall be recorded on the applicable SwRI Examination Record.

6.3 Calibration for Circumferential Butt Welds

6.3.1 Straight-Beam Distance Calibration

The screen distance chosen shall be the shortest applicable size to include at least 1/4t beyond the thickest production material to which the search unit is applied.

Observing back reflections from the applicable reference block, adjust the MAT'L CAL, RANGE, and DELAY controls to obtain the required linear sound path distance displayed along the screen baseline.

6.3.2 Angle-Beam Distance Calibration

The screen distance chosen shall be the shortest applicable size to include at least 1/8 vee-path past the anticipated examination range.

Observing radius echoes from the applicable reference block, adjust the MAT'L CAL, RANGE, and DELAY controls to obtain the required linear sound path distance displayed along the screen baseline.

When the same instrument is used for both 45° and 60° examinations, the screen distance calibration shall be conducted in the following manner:

(1) The screen distance size shall be determined by the angle-beam search unit requiring the longer examination range.

(2) Position the 45° ±2° search unit on the appropriate reference block and record all required reference block entries on the appropriate SwRI Sonic Instrument Calibration Record.

(3) Without changing the MAT'L CAL, RANGE, or DELAY controls, repeat step (2) with the 60° ±2° search unit.

(4) No attempt shall be made to compensate for the delay difference between 45° ±2° and 60° ±2° screen distance calibrations. This difference shall be considered when resolving indications.

6.3.3 Straight-Beam Distance Amplitude Correction

A DAC curve shall be established by utilizing responses from the basic calibration holes.

6.3.3.1 Production Material 1 Inch or Less in Thickness

(1) Position the straight beam search unit to obtain maximum response from the 1/2T hole.

(2) Adjust instrument gain controls to obtain the primary reference response at an amplitude of 50% ±5% of FSH.

(3) Draw a straight horizontal line on the instrument screen at the primary reference amplitude to extend a distance equal to the nominal thickness of the production material.

(4) Signal amplitudes for indications recorded shall be referenced as a percentage of this line.

6.3.3.2 Production Material Greater Than 1 Inch in Thickness

(1) Position the straight-beam search unit to obtain maximum response from the calibration hole selected from the following, which produces the highest amplitude:

Hole
1/4T
1/2T (if present)
3/4T

(2) Adjust the instrument gain controls to obtain a primary reference response at 50% ±5% of FSH and mark this amplitude on the screen. The gain controls shall not be adjusted once the primary reference response has been established.

(3) Position the search unit to obtain maximum response from the remaining calibration holes and mark each amplitude on the screen.

(4) Join these points with a smooth curved line which shall extend 1/4T beyond the last qualified calibration point.

6.3.4 Angle-Beam Distance Amplitude Correction

If a curved block is used, DAC curves for the examination of circumferential welds shall be constructed by utilizing the responses from the holes oriented perpendicular to the axis of the basic calibration block.

6.3.4.1 Material 1 Inch or Less in Thickness

45° and 60° DAC

(1) Position the 45° ±2° search unit to obtain maximum response from the calibration hole and vee-path position, selected from the following, which produces the highest amplitude:

Hole	Vee-Path Positions
1/2T	2/8, 6/8, 10/8

(2) Adjust the instrument gain controls to obtain a primary reference response at 75% ±5% of FSH and mark this amplitude on the screen. The gain controls shall not be adjusted once the primary reference response has been established.

(3) Position the search unit to obtain maximum response from the remaining vee-path positions and mark each amplitude on the screen.

(4) Join these points with a smooth curved line which shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

(5) Repeat steps (1) through (4) using a 60° ±2° search unit.

EXCEPTIONS

If the configuration of the weld is such that the 60° ±2° search unit sound-beam is not directed into the A-B-E-F intersect (as depicted in SKETCH 1) on the straight pass, a 14/8 vee-path calibration shall be accomplished with a 45° ±2° search unit.

6.3.4.2 Material Greater Than 1 Inch to 3 Inches in Thickness

45° and 60° DAC

(1) Position the 45° ±2° search unit to obtain maximum response from the calibration hole and the vee-path position, selected from the following, which produces the highest amplitude:

Hole	Vee-Path Positions
1/4T	7/8
1/2T (if present)	2/8
3/4T	3/8, 5/8

(2) Adjust the instrument gain controls to obtain a primary reference response at 75% ±5% of FSH and mark this amplitude on the screen. The gain controls shall not be adjusted once the primary reference response has been established.

(3) Position the search unit to obtain maximum response from the remaining vee-path positions and mark each amplitude on the screen.

(4) Join these points with a smooth curved line which shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

(5) Repeat steps (1) through (4) using a 60° ±2° search unit.

EXCEPTION

If the configuration of the weld is such that a 60° ±2° search unit beam is not directed into the weld root, a 13/8 vee-path calibration shall be accomplished with a 45° ±2° search unit.

6.3.4.3 Material Greater Than 3 Inches to 5 Inches in Thickness

45° and 60° DAC

(1) Position the 45° ±2° search unit to obtain maximum response from the calibration hole and the vee-path position, selected from the following, which produces the highest amplitude:

Hole	45° Vee-Path Positions
1/4T	7/8
1/2T (if present)	2/8
3/4T	3/8, 5/8

(2) Adjust the instrument gain controls to obtain a primary reference response at 75% ±5% of FSH and mark this amplitude on the screen. The gain controls shall not be adjusted once the primary reference response has been established.

(3) Position the search unit to obtain maximum response from the remaining vee-path positions and mark each amplitude on the screen.

(4) Join these points with a smooth curved line which shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

(5) Repeat steps (1) through (4) with a 60° ±2° search unit utilizing the following vee-path positions:

Hole	60° Vee-Path Positions
1/4T	1/8
1/2T (if present)	2/8, 6/8
3/4T	3/8, 5/8

6.3.4.4 Clad Piping 45° and 60° DAC

(1) Position the 45° ±2° search unit to obtain maximum response from the calibration hole and the vee-path position, selected from the following, which produces the highest amplitude:

Hole	Vee-Path Positions
1/4T	1/8
1/2T (if present)	2/8
3/4T	3/8

(2) Adjust the instrument gain controls to obtain a primary reference response at 75% ±5% of FSH and mark this amplitude on the screen. The gain controls shall not be adjusted once the primary reference response has been established.

(3) Position the search unit to obtain maximum response from the remaining vee-path positions and mark each amplitude on the screen.

(4) Join these points with a smooth curved line which shall extend 1/8 vee-path beyond the last qualified calibration point.

(5) Repeat steps (1) through (4) with a 60° ±2° search unit.

6.4 Calibration for Branch Pipe Connection and Longitudinal Seam Welds

6.4.1 Straight-Beam Distance Calibration

The straight-beam distance calibration shall be the same as that described in Paragraph 6.3.1.

6.4.2 Angle-Beam Distance Calibration

The screen distance chosen shall be the shortest applicable size to include at least 1/8 vee-path past the anticipated examination range.

Observing the radius echoes from the applicable reference block, adjust the MAT'L CAL, RANGE, and DELAY controls of the instrument to obtain the required linear sound path distance displayed along the screen baseline.

6.4.3 Straight-Beam Distance Amplitude Correction

The straight-beam distance amplitude correction shall be the same as that described in Paragraph 6.3.3.

6.4.4 Angle-Beam Distance Amplitude Correction

If a curved block is utilized, DAC curves shall be constructed by utilizing the responses from the basic calibration holes oriented axially with the basic calibration block.

6.4.4.1 Material 1 Inch or Less in Thickness

45° DAC

(1) Position the 45° ±2° search unit to obtain maximum response from the calibration hole and vee-path position, selected from the following, which produces the highest amplitude:

Hole	Vee-Path Positions
1/2T	2/8, 6/8, 10/8

(2) Adjust the instrument gain controls to obtain a primary reference response at 75% ±5% of FSH and mark this amplitude on the screen. The gain controls shall not be adjusted once the primary reference response has been established.

(3) Position the search unit to obtain maximum response from the remaining vee-path positions and mark each amplitude on the screen.

(4) Join these points with a smooth curved line which shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

6.4.4.2 Material Greater Than 1 Inch to 5 Inches in Thickness

45° DAC

(1) Position the 45° ±2° search unit to obtain maximum response from the calibration hole and the vee-path position, selected from the following, which produces the highest amplitude:

Hole	Vee-Path Positions
1/4T	7/8
1/2T (if present)	2/8
3/4T	3/8, 5/8

(2) Adjust the instrument gain controls to obtain a primary reference response at 75% ±5% of FSH and mark this amplitude on the screen. The gain controls shall not be adjusted once the primary reference response has been established.

(3) Position the search unit to obtain maximum response from the remaining vee-path positions and mark each amplitude on the screen.

(4) Join these points with a smooth curved line which shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

6.4.4.3 Clad Piping 45° DAC

This calibration shall be the same as that described in Paragraph 6.3.4.4, steps (1) through (4), using the 45° ±2° search unit only.

6.5 Secondary DAC Calibrations

If all points on the DAC curve do not appear at 20% of FSH or greater, a secondary DAC curve shall be constructed as follows:

(1) All secondary DAC curves shall contain at least 2 points.

(2) The DAC point at 2 lines or greater in amplitude and adjacent to a DAC point that falls below 2 lines of amplitude shall be brought to the primary reference level by manipulating the gain controls. This point shall be marked on the instrument screen. The adjacent point(s), previously at less than 2 lines of amplitude, shall be marked on the screen and all points connected with a smooth curved line. The gain setting for this secondary DAC curve shall be recorded on the appropriate SwRI Sonic Instrument Calibration Record.

EXCEPTIONS

When the first DAC point is the only point above 2 lines of amplitude, the next highest point shall be brought to the primary reference level. This point shall be marked on the instrument screen. The other points previously at less than 2 lines of amplitude shall be marked on the screen and all points connected with a smooth curved line. The gain setting for this secondary DAC curve shall be recorded on the appropriate SwRI Sonic Instrument Calibration Record.

It shall not be necessary to construct a secondary DAC when the calibration consists of a 2/8, 6/8, and 10/8 vee-path.

6.6 Calibration Verification

6.6.1 Sweep Range and DAC Curve Verification

Sweep range calibration shall be verified on the appropriate reference block; and DAC curve calibration, if applicable, shall be verified on the appropriate basic calibration block:

(1) At the start of a series of examinations

(2) With any substitution of the same type and length of search unit cable

(3) With any substitution utilizing the same type of power source; e.g., a change from one direct current to another direct current source

(4) At least every 4 hours during the examination

(5) At the finish of a series of examinations

(6) Whenever the validity of the calibration is in doubt

6.6.2 Calibration Changes

(1) Perform the following if any point on the DAC curve has decreased more than 20% of FSH or 2 dB in amplitude, or any point on the sweep line has moved more than 10% of the sweep reading or 5% of full sweep, whichever is less:

(a) Void all examinations referring to the calibration in question and performed after the last valid calibration verification.

(b) Conduct a new calibration.

(c) Reexamine the areas for which examinations have been voided.

(2) Perform the following if any point on the DAC curve has increased in amplitude more than 20% of FSH or 2 dB:

(a) Correct the calibration.

(b) Reexamine all indications recorded since the last valid calibration verification.

(c) Enter proper values on a new SwRI Examination Record.

6.6.3 Recalibration

Substitution of any of the following shall be cause for recalibration:

(1) Search unit (wedge/transducer)

(2) Couplant

(3) Ultrasonic instrument

(4) Examination personnel

(5) Cable type of length

(6) Change in type of power source; e.g., a change from alternating to direct current

7. EXAMINATION

7.1 Examination Areas

7.1.1 Circumferential and Longitudinal Butt Welds in Piping

Circumferential and longitudinal full-penetration butt welds with a nominal thickness of greater than 0.4 inch to 5.0 inches shall be examined from the outside surface of the pipe.

Scanning of the weld and base material shall be adequate to ensure complete coverage for 1/3t from the inside surface of the pipe as shown in SKETCH 1. The base material shall be examined for a distance of a 1/4 inch as measured from the outside surface fusion line on each side of the weld.

Class 1 longitudinal welds shall be examined along the entire length of the weld during the preservice examination and for at least one pipe-diameter length or 12 inches, whichever is less, from the fusion line of the intersecting circumferential weld during inservice examinations.

Class 2 longitudinal welds shall be examined for at least 2-1/2t length from the fusion line of the intersecting circumferential weld during preservice and inservice examinations.

7.1.2 Butt Welds of Branch Pipe Connections

Full penetration butt welds of branch pipe connections in pressure piping greater than 0.4 inch to a maximum of 5.0 inches nominal thickness shall be examined from the outside surface of the pipe.

Scanning of the weld and base material shall be adequate to ensure complete coverage for 1/3t from the inside surface of the pipe. The base material shall be examined for a distance of a 1/4 inch measured from the outside surface fusion line on the main run pipe side of the weld.

7.2 Surface Condition

The contact surfaces shall be free from weld spatter, roughness, or other conditions which interfere with free movement of the search unit or impair the transmission of ultrasound.

7.3 Indication Length Zero Reference (Lo) Location

Areas to be examined in accordance with this procedure shall have an Lo marked in accordance with the applicable revision of SwRI Nuclear Projects Operating Procedure IX-FE-103.

7.4 Scanning Parameters

When practicable, scanning shall be performed at a minimum gain setting of 2 times the reference level sensitivity.

Instrument gain setting for scanning shall be determined on the basic calibration block as follows for each primary reference level utilized:

(1) With the instrument at the primary reference level, manipulate the search unit on the basic calibration block to obtain a signal of 40% of FSH from a calibration reflector (side-drilled hole).

(2) Add 6 dB of gain by utilizing the 6 dB switch (if present), the fine gain control or a combination of the fine and coarse gain controls and choose the method which yields a signal response closest to 80% FSH.

(3) The signal response of the method chosen shall be within ±2 dB of 80% FSH. This amplitude and method shall be recorded on the Ultrasonic Instrument Calibration Record.

The method chosen above shall be used during the valid calibration period for all scanning at 2 times the reference level sensitivity.

7.4.1 Scanning

Scanning overlap shall be a minimum of 10% of the search unit piezoelectric element dimension perpendicular to the direction of scan.

The search unit movement rate for scanning shall not exceed 6 inches per second.

7.5 Attenuation and Thickness Measurements

7.5.1 Longitudinal Attenuation Measurements

A straight-beam search unit as described for attenuation measurements (Paragraph 5.4) shall be placed on the appropriate basic calibration block. Obtain a backwall reflection, setting this signal between 50% and 90%

of FSH. Record the signal amplitude and instrument gain settings on the appropriate SwRI Sonic Instrument Calibration Record for Attenuation/Lamination Examination. Adjust the instrument gain controls to display the next backwall reflection at the same amplitude at which the preceding backwall reflection was recorded. Record the signal amplitude, instrument gain settings, and the dB difference required to obtain the adjacent backwall reflections at an equal amplitude.

Place the straight-beam search unit on the examination surface and determine the dB difference required to obtain signals of equal height from two adjacent backwall reflections. Record this dB difference on the appropriate SwRI Examination Record. The search unit for attenuation measurements shall be placed adjacent to Lo on the base material away from the heat-affected zone (HAZ). If attenuation measurements cannot be taken adjacent to Lo, the location of the measurements shall be recorded on the appropriate SwRI Examination Record. Measurements shall be taken at least at the following locations:

(1) Two positions for circumferential and longitudinal welds, one on each side of the weld

(2) One position adjacent to Lo on the main run pipe base material for branch connection welds

NOTE

Attenuation measurements shall not be conducted for longitudinal or branch connection welds if measurements have been conducted in the applicable piping base material.

No attenuation measurements shall be conducted on clad piping.

7.5.2 Thickness Measurements

Thickness measurements shall be taken at a minimum of three points adjacent to Lo for longitudinal and circumferential welds (on the centerline of the weld and at one point in the base material on each side of the weld). Thickness measurements shall be taken at a minimum of two points adjacent to Lo for branch pipe connection welds (one on the base material of the main run pipe, and one on the base material of the branch connection). If these measurements cannot be taken adjacent to Lo, the location of the measurements shall be recorded on the appropriate SwRI Examination Record.

Screen distance calibration for this examination shall be conducted in accordance with Paragraph 6.3.1. Measurements shall be taken by placing the straight-beam search unit in the appropriate position on the examination surface and observing the position of the back wall reflection on the instrument screen. These measurements shall be recorded on the appropriate SwRI Examination Record.

7.6 Examination of Circumferential and Longitudinal Butt Welds in Piping

7.6.1 Angle-Beam Examination for Indications Parallel with the Weld

Angle-beam examinations for circumferential welds shall be accomplished using 45° ±2° and 60° ±2° refracted shear-waves from both sides of the weld. For this examination, the sound-beam shall be directed perpendicularly into the weld to detect indications parallel with the weld. Calibration for these examinations shall be in accordance with Paragraphs 6.3.2 and 6.3.4.

Angle-beam examinations for longitudinal welds shall be accomplished using a 45° ±2° refracted shear wave from both sides of the weld. For this examination, the sound-beam shall be directed perpendicularly into the weld to detect indications parallel with the weld. Calibration for this examination shall be in accordance with Paragraphs 6.4.2 and 6.4.4.

7.6.2 Alternate Examination

A 45° ±2° and 60° ±2° shear-wave examination shall be conducted as required to assure complete coverage from both sides of the circumferential weld. A 45° ±2° shear-wave examination shall be conducted as required to assure complete coverage from both sides of the longitudinal weld. Any areas of the weld not receiving complete coverage from both sides shall be examined from one side of the weld with the required shear-wave(s) and a straight-beam longitudinal-wave applied to the surface of the weld crown in the affected areas. Calibration for the longitudinal-wave search unit shall be in accordance with Paragraphs 6.3.1 and 6.3.3.

7.6.3 Angle-Beam Examination for Indications Perpendicular to the Weld

An angle-beam examination shall be conducted on each weld using a 45° ±2° shear-wave. This examination shall be conducted by placing the search unit on the weld with the sound beam directed into and parallel with the weld to detect indications perpendicular to the weld. The entire length and width of the weld shall be scanned with the search unit beam directed in this manner, once in a clockwise and once in a counterclockwise direction.

For austenitic materials, the search unit shall then be placed on the base metal with the search unit wedge touching the edge of the weld crown and the sound beam directed tangential into the weld at a 45° ±10° angle. The entire length of the weld shall be scanned with the search unit beam directed in this manner on each accessible side of the weld. The search unit shall then be turned 90° and the scans repeated. Calibration for these examinations shall be in accordance with Paragraphs 6.3.2 and 6.3.4 for circumferential welds, and Paragraphs 6.4.2 and 6.4.4 for longitudinal welds and branch pipe connection welds. Geometric root ripple echoes occurring at the same metal path distance as flaws adjacent to the weld root are to be expected. A flaw must be distinguished from root ripple by the greater echo amplitude of a flaw compared to the amplitude of the root ripple at the same location. A flaw indication adjacent to the weld root tends to mask out several facets of the root ripple and travels along the baseline through the root ripple package.

7.6.4 Angle-Beam Examination for Indications in Austenitic Base Material Perpendicular to the Weld

An angle-beam examination shall be conducted on 1t of base material adjacent to each weld using a 45° ±2° shear-wave. This examination shall be conducted by placing the search unit on the base material with the sound beam directed parallel to the weld to detect indications perpendicular to the weld. The base material within 1t of the weld shall be scanned with the search unit directed in this manner, once in a clockwise direction and once in a counterclockwise direction. Calibration for these examinations shall be in accordance with Paragraphs 6.3.2 and 6.3.4 for circumferential welds, and Paragraphs 6.4.2 and 6.4.4 for longitudinal welds and branch pipe connection welds.

7.7 Examination of Butt Welds of Branch Pipe Connections

7.7.1 Straight-Beam Examination of Welds

A straight-beam examination shall be performed on the surface of the weld crown when possible. Calibration for the straight-beam examination shall be in accordance with Paragraphs 6.3.1 and 6.3.3.

7.7.2 Angle-Beam Examination for Indications Parallel with the Weld

An angle-beam examination shall be accomplished using a 45° ±2° refracted shear-wave from the main run pipe side of the weld. For this examination the sound beam shall be directed perpendicularly into the weld to detect indications parallel with the weld. Calibration for these examinations shall be in accordance with Paragraphs 6.4.2 and 6.4.4.

7.7.3 Angle-Beam Examination for Indications Perpendicular to the Weld

The angle-beam examination for indications perpendicular to the weld shall be the same as the examination described in Paragraph 7.6.3.

7.8 Postexamination Cleaning

Arrangements shall be made with the customer for postexamination removal of couplant materials.

8. RECORDING CRITERIA

Ultrasonic reflectors producing a response greater than 50% of the reference level shall be recorded on the appropriate SwRI Ultrasonic Examination Record.

Any ultrasonic reflectors not readily attributable to geometry by the examiner shall be recorded on the appropriate SwRI Ultrasonic Examiantion Record and investigated by a Level II or Level III examiner to the extent necessary to determine the shape, identity, and location of the reflector. Examples of non-geometric reflectors (which may occur at any ampliutde) are those which are slightly removed from the weld root and/or chamfer, mask the root indications, are transverse to the weld, or have linear dimensions with side branches.

The end points of the indication as determined by 100% DAC shall be recorded.

Indications shall be recorded in accordance with the techniques outlined in the applicable revision of SwRI Nuclear Projects Operating Procedure IX-FE-117.

Indications investigated and found to be other than geometrical in nature, regardless of the amplitude, shall be reported to the customer for evaluation.

Scanning limitations shall be recorded.

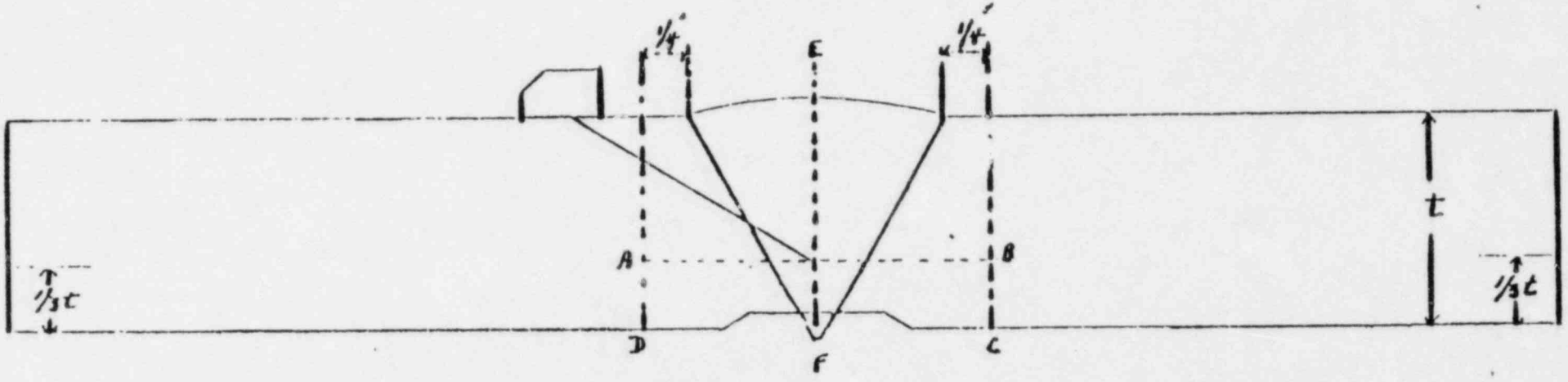
9. EVALUATION

Evaluation of reportable indications shall be the responsibility of the customer, or the customer's representative, and shall be conducted in accordance with ASME Boiler and Pressure Vessel Code, Section XI, Article IWA-3000. The applicable year and Addenda of the Code shall be as specified in Paragraph 3. of this procedure.

10. RECORDS

The customer shall receive copies of documents generated in accordance with this procedure in the examination report.

Documents generated in accordance with this procedure shall be stored and retained as a portion of the examination report. The examination report shall be stored by the Manager of the Support and Administration Section, Quality Assurance Systems and Engineering Division, in the Data Storage Facility for the period specified by the contractual agreement with the customer.



EXAM VOLUME A-B-C-D

EXAMINATION AREA FOR CIRCUMFERENTIAL
AND LONGITUDINAL WELDS

SKETCH 1

PROCEDURE DEVIATION

SITE:			PROCEDURE / REVISION NO.
Brunswick Unit 1			700-5/9

DEVIATION NO.	PAGE	DATE REQUESTED:	SECTION:	PAGE
4	1 OF 2	January 18, 1983	7., 8.	18, 19, 20 OF 23

1. EXAMINATION AREAS AFFECTED BY DEVIATION: (list each specific area or component to be examined in accordance with this deviation (state examination period, component identification, line identification, weld identification, etc.)

Mechanized examinations conducted on austenitic piping during the 1983 ISI shall be affected.

2. DEVIATION: It is requested that the paragraphs below in the above procedure / revision be deviated (revised) as follows (use exact wording if revised, additional sheets may be used if necessary):

Add the following as the third and fourth paragraphs of 7.1.3:

For austenitic materials, the search unit shall be placed on the base metal with the search unit wedge touching the edge of the weld crown and the sound beam directed tangential into the weld at a 45° ± 10° angle. The entire length of the weld shall be scanned with the search unit beam directed in this manner on each accessible side of the weld. The search unit shall then be turned 90° and the scans repeated. Geometric root ripple echoes occurring at the same metal path distance as flaws adjacent to the weld root are to be expected. A flaw must be distinguished from root ripple by the greater echo amplitude of a flaw compared to the amplitude of the root ripple at the same location. A flaw indication adjacent to the weld root tends to mask out several facets of the root ripple and travels along the baseline through the root ripple package.

An angle-beam examination shall be conducted on 1t of austenitic base material adjacent to each austenitic weld using a 45° ± 2° shear-wave. This examination shall be conducted by placing the search unit on the base material with the sound beam directed parallel to the weld to detect indications perpendicular to the weld. The base material within 1t of the weld shall be scanned with the search unit directed in this manner, once in a clockwise direction and once in a counterclockwise direction.

3. JUSTIFICATION: Reason change is necessary and what it is expected to accomplish (use additional sheets if necessary):

This change is necessary to incorporate changes requested by Carolina Power & Light Company.

Change 8.0 to read as follows:

Ultrasonic reflectors producing a response greater than 50% of the reference level shall be recorded and investigated by a Level II or Level III examiner to the extent necessary to define the shape, identity, and location of the reflector. Additionally, all ultrasonic reflectors (regardless of signal amplitude) not readily attributable to geometry by the examiner shall be recorded and investigated by a Level II or Level III examiner to the extent necessary to determine the shape, identity, and location of the reflector. Examples of non-geometric reflectors (which may occur at any amplitude) are those which are slightly removed from the weld root and/or chamfer, mask the root indications, are transverse to the weld, or have linear dimensions with side branches.

Indications not readily attributable to geometry by the examiner, when scanning in the X direction (length of indication), shall require scans in the Y direction (width of indication), extending to loss of signal along the X axis. The scans in the Y direction shall extend to loss of signal along the Y axis.

Y scan increments shall be one-tenth inch. All Y scans shall run in the same direction, upon completion of which an X-scan shall be run at the maximum amplitude location.

Indications investigated and found to be other than geometrical in nature shall be reported to the customer for evaluation.

Scanning limitations shall be recorded.

PROCEDURE DEVIATION

SITE:	PROCEDURE / REVISION NO.
Brunswick, Unit 1	700-5/9

DEVIATION NO.	PAGE	DATE REQUESTED:	SECTION:	PAGE
2	1 OF 1	November 30, 1982	7.	19 OF 23

1. EXAMINATION AREAS AFFECTED BY DEVIATION: List each specific area or component to be examined in accordance with this deviation (state examination period, component identification, line identification, weld identification, etc.)

Piping examinations required to be performed during the 1982 Inservice Examination at Brunswick Steam Electric Plant, Unit 1 shall be affected by this deviation.

2. DEVIATION: It is requested that the paragraphs below in the above procedure / revision be deviated from as follows (use clear wording proposed, additional sheets may be used if necessary):

Delete the last two paragraphs of 7.3 when examinations are to be performed on piping Components which received a base material lamination scan during a previous examination.

APPROVED: Robert A Seyl 1-13-83
BSEP/OPA QA SPEC

3. JUSTIFICATION: Reason change is necessary and what it is intended to accomplish (use additional sheets if necessary):

This deviation is necessary to make a change at the request of Carolina Power & Light Company.

REQUESTED BY	DATE	TECHNICAL REVIEW	DATE	MANAGER OF Q.A.	DATE	DEPARTMENT DIRECTION	DATE	DC	
D N Tounsend	12/1/82		Dec 1, 1982		12/6/82		12/9/82		

BWR FORM PE---1

SOUTHWEST RESEARCH INSTITUTE
NUCLEAR PROJECTS
OPERATING PROCEDURE

SwRI-NDT-700-5
Revision 9
December 1981

Title: MECHANIZED ULTRASONIC EXAMINATION OF VESSEL COMPONENTS, VESSEL WELDS, AND PIPING WELDS

EFFECTIVITY AND APPROVAL

Revision 9 of this procedure became effective on Jan. 04, 1982. Other revisions of the base document may be effective concurrently.

SA

Approvals

Written By	Date	Technical Review	Date
J W Fawnell	18 Dec 81		

Manager of Q.A.	Date	Cognizant Director	Date
	12/31/81		1/4/82

The following information may be used for convenience. Completion of this portion is not mandatory.

Deviation No.								
Date Effective								
Procedure Section(s) Affected								

Notes: APPROVED: Robert A Severyl 1-13-83
BSEP/OQP QA SPEC

MECHANIZED ULTRASONIC EXAMINATION OF VESSEL COMPONENTS, VESSEL WELDS, AND PIPING WELDS

SwRI-NDT-700-5

1.0 PURPOSE

This procedure provides the technical information and detailed steps required to ensure proper mechanized ultrasonic examination of nonwelded pressure vessel components, vessel and piping welds and adjacent base materials in accordance with the applicable ASME Boiler and Pressure Vessel Code.

2.0 SCOPE AND APPLICATION

Mechanized ultrasonic examinations shall be performed using surface waves, shear-wave angle-beam and longitudinal-wave angle- and straight-beam, immersion or contact pulse echo techniques on pressure vessels or piping.

Nonwelded pressure vessel components greater than 0.4 inch to 12.0 inches in wall thickness, pressure vessel welds and adjacent base material greater than 0.4 inch to 2.0 inches in wall thickness, and pressure piping welds and adjacent base material greater than 0.4 inch to 5.0 inches in wall thickness shall be examined in accordance with this procedure. Welds or components to be examined shall be as specified in the applicable SwRI Scan Plan and Examination Plan.

Examinations may be conducted on clad or unclad components.

2.1 Applicable Documents

The following documents, as applicable, form a part of this procedure:

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1977 Edition, with Addenda through Summer 1978, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1977 Edition, with Addenda through Summer 1978, "Nondestructive Examination," with the exception of the following:

(a) Subparagraph T-533.1 of Article 5 requires the basic calibration block for production material thicknesses up to and including 1 inch to be 3/4 inch or "t." Paragraph 5.3 of this procedure requires the basic

calibration block to be either "t," no more than 25% less than "t," or closer in thickness to the production material than the 3/4-inch alternate thickness allowed by Article 5 for production material thicknesses up to and including 1 inch. This exception will assure a more accurate calibration than the Article 5 basic calibration block design allowed by Code.

(b) Subsubparagraph T-535.1 (d) of Article 5 states that transfer (attenuation compensation) be accomplished between the production material and basic calibration block and a correction made for the difference. No attempt shall be made by the examiner to compensate for observed difference in the acoustic properties between the basic calibration block and the production material, as referenced in 7.1.

(3) ASME Boiler and Pressure Vessel Code, Section IX, 1977 Edition with Addenda through Summer 1978 "Welding and Brazing Qualifications"

(4) SwRI Nuclear Quality Assurance Program Manual (NQAPM)

3.0 RESPONSIBILITY

(1) The Director of the Department of Engineering Services within the Quality Assurance Systems and Engineering Division shall be responsible for the preparation, review, control, and approval of this procedure.

(2) The Project Manager shall be responsible for the implementation of this procedure in accordance with the NQAPM specified in the applicable SwRI Project Plan.

(3) The examiner shall be responsible for implementing the requirements of this procedure.

(4) The Manager of the Support and Administration Section of the Quality Assurance Systems and Engineering Division shall be responsible for storage of records generated in accordance with this procedure.

4.0 CODE AND PROCEDURE REQUIREMENTS

The requirements listed below shall be applied when performing mechanized ultrasonic examinations in accordance with this procedure.

Requirements		Section
(1)	Weld types and configurations to be examined, including thickness dimensions, materials, and product form	7.0
(2)	The examination surface(s)	7.0
(3)	Surface condition	7.0
(4)	Couplant	5.0
(5)	Technique used	2.0
(6)	Angles and mode of wave propagation in the material	5.0
(7)	Type and size of search unit	5.0
(8)	Examination frequency	5.0
(9)	Search unit wedges, shoes, or saddles	5.0
(10)	Ultrasonic instrument	5.0
(11)	Calibration method used	6.0
(12)	Scanning	7.0
(13)	Recording of data	8.0
(14)	Automatic defect alarm and recording equipment	5.0
(15)	Rotating, revolving scanning mechanisms	5.0
(16)	Personnel qualification	5.0
(17)	Type and length of search unit cable	6.0

5.0 PERSONNEL AND EQUIPMENT

5.1 Personnel Certification

Personnel performing examinations in accordance with this procedure shall be certified in accordance with SwRI NQAP 11-1, "Special Process Control."

5.2 Reference Block

Reference blocks to be used for screen distance calibration and verification shall be as follows:

(1) SwRI Half-Round (Sketch 1)

(2) AWS Type DC (Sketch 2)

(3) IIW (Sketch 3)

The reference block shall be of the same basic material as the production material; i.e., carbon steel or stainless steel.

5.2.1 Reference Block Selection

Reference blocks shall be used as follows for screen distance calibration:

(1) Straight Beam

Screen Distance	Block Type	Block Dimension
1.0", 2.0"	SwRI Half-Round	1.0"
	AWS Type DC	0.5" or 1.0"
	IIW	1.0"
2.5", 5.0", 10.0"	SwRI Half-Round	1.0"
	AWS Type DC	1.0"
	IIW	1.0"
20.0"	IIW	4.0"

(2) Angle Beam

Screen Distance	Block Type	Block Dimension
2.0", 2.5", 5.0"	SwRI Half-Round AWS Type DC	1.0" Radius 1.0" and 2.0" Radii
10.0"	SwRI Half-Round, AWS Type DC	1.0" Radius 1.0" and 2.0" Radii
	IIW Block	4.0" Radius
20.0", 40.0"	IIW Block	4.0" Radius

5.3 Basic Calibration Block

If examinations are to be conducted on a clad component from the clad surface, the basic calibration block shall be clad to the nominal thickness of the component cladding ±1/8 inch. Deposition of clad shall be by the automatic method used on the inside of the component. Where the automatic method is impractical, deposition of clad shall be by the manual method used to cover the circumferential welds of the component.

The basic calibration block, except for inner radii examinations, shall contain side-drilled basic calibration hole reflectors, in accordance with Article 5 of Section V. The reflectors in the inner radius basic calibration block shall be notches. The reflectors shall be placed in a block manufactured from material of the same or equivalent P-number grouping as the production material, as identified in Section IX of the ASME Code. P-numbers P-1, P-3, P-4, and P-5 shall be considered to be equivalent for the purposes of this examination. When two different P-number materials are involved, the calibration material shall be determined by the production material to which the search unit is applied.

The basic calibration block thickness shall be determined by the thickness of the production material to which the search unit is applied and by Article 5. When a basic calibration block of the same thickness as the production material is not available and where the production material thickness is 1 inch or less, the basic calibration block thickness shall be no more than 25% thinner than the production material thickness or shall be closer to the production material thickness than the 3/4-inch thick alternate calibration block allowed by Article 5. Approved drawings of the basic calibration blocks to be used in accordance with this procedure are in the applicable SwRI Scan Plan.

A flat basic calibration block or block of essentially the same curvature as the part to be examined shall be used for examinations on contact surface curvatures greater than 20 inches in diameter.

For contact surfaces 20 inches or less in diameter, a single curved basic calibration block may be used to establish sensitivity calibration for examinations conducted on contact surfaces in the range of curvature from 0.9 to 1.5 times the basic calibration block diameter.

5.4 Search Units

The size of search units shall be selected according to the following table:

(1) Angle Beam

Nominal Production Material Thickness	Nominal Search Unit Size
0.4" to 1.0"	1/4" x 1/4", 1/4" Round
0.4" to 2.0"	3/8" x 3/8", 3/8" Round
0.75" to 4.0"	1/2" x 1/2", 1/2" Round
2.0" to 7.0"	1/2" x 1", 3/4" Round
5.0" to 12.0"	1" x 1", 1" Round, 1-1/8" Round

(2) Straight Beam

Nominal Production Material Thickness	Nominal Search Unit Size
0.4" to 2.0"	1/4" Round
1.0" to 3.0"	3/8" Round
2.0" to 4.0"	1/2" Round
3.0" to 7.0"	3/4" or 1" Round
5.0" to 12.0"	1" Round or 1-1/8" Round

The exit point of the sound beam and the actual refracted beam angle of shear-wave search units shall be determined on an IIW block. The exit point shall be marked on the search unit wedge.

Search unit wedges shall be fabricated to ensure that the proper angle of refracted shear- or longitudinal-waves are produced in accordance with the appropriate SwRI Scan Plan.

The nominal search unit frequency for examination of carbon steel piping welds, vessel welds, nozzle-to-shell welds, nozzle inner radii, and integral extensions shall be 2.25 MHz.

The nominal shear-wave search unit frequency for examination of austenitic piping shall be as follows:

Nominal Frequency	Search Unit Size
2.25 MHz	1/4" x 1/4", 1/4" Round
1.5 MHz	3/8" x 3/8", 3/8" Round
1.5 MHz	1/2" x 1/2", 1/2" Round
1.5 MHz	3/4" Round, 1/2" x 1"

The nominal longitudinal wave search unit frequency for austenitic piping shall be 1.5 MHz or 2.25 MHz.

5.5 Ultrasonic Instrument and Scanning Mechanisms

The examiner shall select an appropriate ultrasonic instrument from the following:

(1) Sonic FTS Mark II

(2) Sonic UWA Mark III

(3) Branson Sonoray Series 600

Rotating, revolving, or scanning mechanisms used when performing mechanized ultrasonic examinations shall be described in the SwRI Scan Plan.

Automatic defect alarm and recording equipment to be utilized is specified in the applicable revisions of SwRI Nuclear Projects Operating Procedures XII-PM-106, XII-PM-108-4, and XII-PM-129.

Each instrument shall be aligned and shall display an alignment calibration sticker as required by NQAP 10-1.

5.6 Couplant

(1) USP-grade glycerine or deionized water (with or without wetting agent) shall be used when performing ultrasonic calibrations and examinations in accordance with this procedure.

(2) Couplant materials used for examinations shall be the same as used for the calibration.

(3) Light oil or other compounds which, in the opinion of the Level II examiner, provide adequate ultrasonic coupling may be used upon concurrence of the Project Manager responsible for the examination.

(4) All couplants other than deionized water shall be certified for sulfur content and total halogens in accordance with ASTM D-129-64 and ASTM D-808-63. The residual amount of total sulfur or halogens shall not exceed 1% by weight. Deionized water, when used, shall be supplied by the customer.

5.7 Thermometer

Quicktemp thermometer Model 5X-666, calibrated and certified in accordance with SwRI Nuclear Projects Operating Procedure XII-PM-104 shall be used as required to measure basic calibration block and component surface temperature.

6.0 CALIBRATION METHOD

Calibration details such as vee-path positions and sweep distance shall be described in the applicable SwRI Scan Plan.

The complete ultrasonic examination system calibration shall be performed prior to the examination.

NOTES

The "REJECT" control shall be maintained in the "0" position during calibration and examination.

The nominal piping production material thickness shall be used to determine the correct calibration block and search units for the examination of piping components which may be thicker than the nominal pipe size and welded to the pipe. The Level II examiner shall ensure that complete coverage of the thicker piping component is obtained. Additional calibration vee-path positions and larger screen sizes may be required to assure this coverage. The additional calibration vee-path positions and larger screen size shall be used for the examination from the thicker component and the nominal pipe side of the weld.

The "FREQ MHz" control shall be turned to "1" when a 1.5 MHz search unit is used and to "2" with a 2.25 MHz search unit.

The crew leader of the crew conducting the initial calibration for a group of examinations shall sign the calibration sheet in one of the spaces provided, preferably the top space. He shall also date the sheet and enter the time of completion of the calibration in the time space on the sheet.

Each subsequent shift shall verify the calibration at the beginning of each shift following the initial calibration. The crew leader shall at that time sign his name to the calibration sheet and enter the date and time of that verification adjacent to his signature. He shall also enter the time and his initials in the calibration verification section of the sheet.

The temperature of the basic calibration block during calibration and verifications shall be within 25°F of the component temperature. For examinations from the inside surface of the vessels, water temperature inside the vessel may be used for component temperature. Under no circumstances shall examinations be performed if the temperature of the basic calibration block is not within 25°F of the component to be examined. The temperature of the basic calibration block during the initial calibration and the temperature during each verification shall be recorded on the applicable SwRI Instrument Calibration Record. The component temperature prior to performing the examination and upon completion of the examination shall be recorded on the applicable SwRI Examination Record.

6.1 Instrument Linearity

The ultrasonic instrument shall be verified for amplitude linearity and amplitude control linearity in accordance with Paragraphs 6.1.1 and 6.1.2. This verification shall be conducted at the beginning of each day. Data required shall be recorded on the "SwRI Instrument Linearity Verification" Record and the sheet number referenced on the applicable SwRI Instrument Calibration Record.

6.1.1 Amplitude Linearity

(1) Position a shear-wave search unit on an SwRI Half-Round reference block and obtain at least two radius echoes.

(2) Adjust the search unit position to give a 2-to-1 ratio between two radius echoes with the larger indication set at 80% of full screen height (FSH) and the smaller indication set at 40% of FSH.

(3) Without moving the search unit, adjust the instrument sensitivity (gain) to set the larger indication to 100% of FSH.

(4) With the larger indication at 100%, record and the position of the smaller indication, estimated to the nearest 1% of FSH.

(5) Successively set the larger indication from 100% to 20% of FSH in 10% increments (or 2 dB steps if a fine control is not available). Observe and record the smaller indication, estimated to the nearest 1% of FSH, at each setting. The reading must be 50% of the larger amplitude within 5% of FSH.

6.1.2 Amplitude Control Linearity

EXCEPTION

Am amplitude control linearity check is not required if an electronic DAC is utilized and/or the gain controls are not to be manipulated.

(1) Position a shear-wave search unit on an SwRI Half-Round reference block to obtain maximum amplitude from the radius.

(2) Without moving the search unit and according to the following table, set the indication to the required percent of the FSH and increase or decrease the dB as specified. The signal shall be estimated and recorded to the nearest 1% of FSH and shall fall within the limits of the following table:

Indication Set at % of Full Screen	dB Control Change*	Indication Limits, % of Full Screen
80%	-6 dB	32 to 48%
80%	-12dB	16 to 24%
40%	+6dB	64 to 96%
20%	+12dB	64 to 96%

*Minus denotes decrease in amplitude; plus denotes increase.

6.2 Straight-Beam Distance Calibration

Distance calibration for circumferential welds and longitudinal welds shall be constructed by observing the back reflections from an applicable reference block and adjusting the "MAT'L CAL," "DELAY," and "RANGE" controls

to obtain a linear sound path distance displayed along the screen baseline. In all cases, the screen distance chosen shall be the shortest applicable size to include at least 1/4t beyond the nominal production material thickness.

Distance calibration for integral extensions shall be constructed by observing the back reflections from an applicable reference block and adjusting the "MAT'L CAL," "DELAY," and "RANGE" controls to obtain a linear sound path distance displayed along the screen baseline. In all cases, the screen distance chosen shall be the shortest applicable size to include at least 25% of the wall thickness beyond the anticipated examination distance.

6.3 Angle-Beam Distance Calibration

Distance calibration for circumferential welds and longitudinal welds shall be constructed by observing the radius echoes from an applicable reference block for the material and thickness involved and adjusting the "MAT'L CAL," "DELAY," and "RANGE" controls to obtain a linear sound path distance displayed along the screen baseline. In all cases, the screen distance chosen shall be the shortest applicable size to include at least 1/8 vee-path beyond the anticipated examination distance.

Distance calibration for integral extensions shall be constructed by observing the radius echoes from an applicable reference block for the material and thickness involved and adjusting the "MAT'L CAL," "DELAY," and "RANGE" controls to obtain a linear sound path distance displayed along the screen baseline. In all cases, the screen distance chosen shall be the shortest applicable size to include at least 25% of the wall thickness beyond the anticipated examination distance.

The search unit wedge shall be removed prior to the preliminary distance calibration for nozzle inner radius from the outer blend radius and for other examinations utilizing angle-beam longitudinal-wave search units. Observing the back reflections from an applicable reference block, adjust the "MAT'L CAL," "DELAY," and "RANGE" control to obtain a linear sound path distance displayed along the screen baseline. After the preliminary distance calibration, remount and couple the search unit wedge to the search unit. Position the search unit for the maximum response from a reflector in the basic calibration block. Physically measure the metal path distance to this reflector and adjust the signal to the appropriate location on the screen baseline, only using the "DELAY" control. This completes the distance calibration.

6.4 Straight-Beam Distance Amplitude Correction for Material 1.0-Inch or Less in Thickness

Straight-beam DAC for material 1 inch or less in thickness shall be a one-point zone calibration which does not use electronic DAC.

Position the search unit to obtain maximum response from the basic calibration hole at 1/2T. Adjust this amplitude to the primary reference level at 50% ±5% of full screen height (FSH) and mark the amplitude on the screen. A straight horizontal line shall then be drawn on the instrument screen at the amplitude of the primary level. The line shall extend a distance equal to the nominal thickness of the production material. All indications recorded shall be referenced as a percentage of this line for signal amplitude.

6.5 Electronic Distance Amplitude Correction

Electronic DAC is used to set reflector responses from a calibration block equal in amplitude regardless of the distance of the reflector from the search unit.

6.5.1 Angle Beam and Straight Beam for Welds

Electronic DAC curves shall be constructed by utilizing the responses from the basic calibration hole(s). The initial point on the DAC curve is established by manipulating the search unit to obtain maximum response from the nearest suitable position. The instrument gain is then adjusted so that this response is 50% ±5% FSH. This is the primary reference response and shall be marked on the instrument screen. The search unit shall be placed similarly at other required positions. Using the electronic DAC controls, adjust remaining responses to the primary reference level and mark their amplitudes on the screen. These points shall be joined by a straight horizontal line, not to extend more than 1/8 vee-path or 1/4T beyond the last qualified calibration point.

6.5.2 Multiple-Point Zone Calibration

Maximum response from the nearest suitable reflector [illegible] obtained by manipulating the search unit. Adjust the instrument [illegible] response at 50% ±5% FSH. This is the primary reference response [illegible] marked on the instrument screen. The search unit shall be placed [illegible] maximum response from the other required reflectors. Using the electronic DAC controls, adjust their maximum responses to the primary reference level and mark their amplitudes on the screen. These points shall be joined by a straight horizontal line, not to extend more than 20% of the wall thickness to either side of the calibrated zone.

6.5.3 Single-Point Zone Calibration for Inner Radius Without Using Electronic Distance Amplitude Correction

Examination of the inner radius from the inside surface shall be conducted without using the electronic DAC controls. Two search units shall be

used for this examination. One search unit will act as an ultrasonic mirror and the other search unit will be connected to the instrument. Submerge the basic calibration block in deionized water. Position the search units to reflect the sound beam off the radius in the basic calibration block and to obtain the signal back from the ultrasonic mirror. Adjust the instrument "MAT'L CAL," "DELAY," and "RANGE" controls so the reflection from the ultrasonic mirror is displayed on the instrument screen. Position the search units to obtain the first reflection from the notch in the radius of the basic calibration block. This signal will appear on the instrument screen between the initial pulse and the signal obtained from the ultrasonic mirror. Adjust the "MAT'L CAL," "DELAY," and "RANGE" controls to set the signal from the notch to approximately the center of the screen while retaining the signal from the ultrasonic mirror on the instrument screen. Adjust the gain controls to set the signal amplitude to 75% ±5% FSH. This is the primary reference level and shall be marked on the instrument screen. A line shall be drawn on the instrument screen through this point not to extend more than 20% of the wall thickness to either side of the point.

6.6 Calibration Verification

6.6.1 Frequency of Instrument Calibration Verification

(1) Sweep range calibration shall be verified on the appropriate reference block and DAC curve calibration, if applicable, shall be verified on the appropriate basic calibration block:

(a) At the start of a series of examinations

(b) With any substitution of the same type and length of search unit cable

(c) With any substitution utilizing the same type of power source; e.g., a change from one direct current source to another direct current source.

(d) At least every 12 hours during the examination

(e) At any time when, in the opinion of the examiner, there is doubt as to the validity of the calibration

(2) When a group of examinations has been completed using a given calibration, the final verification shall be initialed by the crew leader in charge.

(3) The last calibration verification at the end of a shift shall be conducted during the interface period and in conjunction with the oncoming crew. The two crew leaders shall verify the calibration together as a handoff. Both crew leaders' initials should appear on the calibration sheet for verification conducted in this manner.

NOTES

The mechanized positioning equipment calibration shall be verified in conjunction with the instrument calibration verification or at least every 12 hours during the examination. Device counts per increment shall be verified to coincide with counts per increment as specified in the Scan Plan examination tables. The "0" position and linearity of the X and Y readout shall be verified in accordance with the appropriate Operating Guide.

Ultrasonic instrument functional checks shall be conducted every 4 hours during scanning to determine if any apparent functional changes have occurred in the instrument. If any reflector from the function block has moved on the sweep line more than 5% of full screen width or changed in amplitude more than 20% or 2 dB, the instrument calibration shall be verified on the appropriate reference and basic calibration blocks.

6.6.2 Calibration Changes

(1) Perform the following if any point on the DAC curve has decreased more than 20% or 2 dB in amplitude, any point on the DAC has moved on the sweep line more than 5% of full screen width or more than 10% of the sweep division reading, whichever is less:

(a) Void all examinations referring to the calibration in question and performed after the last valid calibration verification.

(b) Conduct a new calibration.

(c) Reexamine the areas for which examinations have been voided.

(2) Perform the following if any point on the DAC has increased in amplitude more than 20% or 2 dB:

(a) Correct the calibration.

(b) Reexamine all indications recorded since the last valid calibration verification.

(c) Enter proper values on a new SwRI Examination Record.

6.6.3 Recalibration

Substitution of any of the following shall be cause for recalibration:

(1) Search unit (wedge/transducer)

(2) Couplant

(3) Ultrasonic instrument

(4) Examination personnel (substitution of examination personnel shall be defined as any substitution of the Level II or the Level III crew leader during a shift)

(5) Cable type or length

(6) Change in type of power source; e.g., a change from alternating to direct current

6.4 Calibration Data

Calibration data will be recorded on the appropriate SwRI Instrument Calibration Record and will include, but not be limited to:

(1) Serial number of the reference block

(2) Serial number of the basic calibration block

(3) Type, manufacturer, and serial number of the ultrasonic instrument

(4) Type, size, beam angle, and serial number of the ultrasonic search unit

(5) Nominal search unit frequency

(6) Couplant (which shall be the same as used in the actual examination)

(7) Signature and ultrasonic certification level of examiner making calibration

(8) Date calibrated

(9) Time of calibration and calibration verification

7.0 EXAMINATION

7.1 Examination Areas

The following are specific areas on which mechanized ultrasonic examination of pressure vessel welds, piping welds, adjacent base material, and components from the inner or outer surface of pressure vessels shall be performed:

(1) Piping welds and adjacent base material in a thickness range of greater than 0.4 inch and up to 5.0 inches

(2) Vessel welds and adjacent base material in a thickness range of greater than 0.4 inch and up to 2.0 inches

(3) Nonwelded vessel components (i.e., nozzle inner radius, and integral extensions) in a thickness range of greater than 0.4 inch and up to 12.0 inches

Attempts to determine differences in the acoustic properties between the basic calibration block and the production material which would result in an instrument gain change are not permitted.

7.1.1 Vessel Welds

Examinations shall be performed on components in their completed condition. Examination of vessel welds shall include the weld and base material for 1/2t from the fusion line of the weld. The required 1/2t examination area on base material thicknesses that differ on each side of the weld shall be determined by the nominal thickness of the base material on the side of the weld from which the examination is to be performed. The 1/2t to be examined shall be measured from the outside surface fusion line at the weld crown.

The examination of vessel welds and adjacent base material shall be conducted with a 45° ±2° and a 60° ±2° search unit. The 45° ±2° and the

60° ±2° search units shall be used to direct the sound beam perpendicularly into the weld. This examination shall be conducted from both sides of the weld, when practicable. The 45° ±2° search unit shall also be utilized to conduct a transverse examination of the weld and 1/2t of base material on each side of the weld. The sound beam shall be directed parallel to the weld to conduct the examination; then the search unit shall be turned 180° and the examination repeated.

7.1.2 Nonwelded Vessel Components

Examinations shall be performed on components in their completed condition. The examination area for nonwelded components shall be as specified in the applicable SwRI Scan Plan.

Inner radius examinations from the outer blend radius shall use refracted longitudinal waves which strike the inner radius at 45° ±10°. Inner radius examinations from inside the vessel shall be conducted at 1/4-inch increments with an angle-beam search unit producing a nominal 45° in water and surface waves along the inner radius section.

7.1.3 Piping Welds

The examination area for piping welds shall be the lower 1/3t of the weld and base material. The piping base material shall be examined for 1/4 inch, as measured from the outside surface fusion line on each side of the weld.

Piping welds shall be examined with a 45° ±2° and a 60° ±2° search unit. The 45° ±2° and 60° ±2° search units shall be used to direct the sound beam perpendicularly into the weld. This examination shall be conducted from both sides of the weld. The 45° ±2° search unit shall also be utilized to conduct a transverse examination of the weld. The sound beam shall be directed parallel to the weld to conduct the examination; then the search unit shall be turned 180° and the examination repeated.

7.2 Surface Condition

The contact surfaces shall be free from weld spatter, roughness, or other conditions which interfere with free movement of the search unit or impair the transmission of ultrasound.

7.3 Scanning

Scanning overlap shall be a minimum of 10% of the transducer piezoelectric element dimension perpendicular to the direction of scan. Scanning coverage for welded vessel components shall be adequate to examine the weld and 1/2t of base material from the fusion line of the weld. Scanning

coverage for piping welds shall be adequate to examine the required portion of the weld and base material for 1/4 inch, as measured from the fusion line on each side of the weld. Scanning coverage for nonwelded components shall be specified in the applicable SwRI Scan Plan.

Examination techniques including search unit angles, contact surface and examination coverage will be described in the detailed SwRI Scan Plan for the particular examination. The SwRI Scan Plan shall be approved by the Director of the Department of Engineering Services.

Scanning shall be performed at the primary reference level sensitivity.

The search unit movement rate for scanning shall not exceed 6 inches per second.

Before the angle-beam examination of welds, a lamination scan using straight-beam shall be performed, covering as much as practical of the area through which the angle beam is later to be passed. Screen distance calibration for this examination shall be conducted in accordance with Paragraph 6.2 of this procedure. Scanning sensitivity shall be as required to maintain back reflection at an amplitude of between 50% and 90% of FSH.

This lamination scan is performed by noting whether back echoes are lost or intermediate echoes are observed in any of the areas to be examined with an angle-beam search unit. Intermediate echoes having an amplitude equal to or greater than 50% of the initial back reflection shall be recorded. To record an intermediate indication, obtain a back reflection signal from an indication-free area and adjust the instrument gain control until this signal is at 75% ±5% of FSH. Record the intermediate indication when its amplitude is equal to 50% of the initial back reflection and accompanied by a 50% loss of back reflection. If total loss of back reflection accompanies the intermediate echo, the area of total loss of back reflection shall be recorded.

7.4 Postexamination Cleaning

Arrangements shall be made with the customer for postexamination removal of couplant materials.

8.0 RECORDING CRITERIA

Ultrasonic reflectors producing a response greater than 50% of the reference level shall be recorded. Indications found to be greater than 50% of the reference level and not readily attributable to geometry by the examiner, when scanning in the X direction (length of indication), shall require scans in the

Y direction (width of indication), extending to the 20% limits along the X axis. The scans in the Y direction shall extend to the 20% limits of the indication along the Y axis.

Y scan increments shall be one-tenth inch (when incrementing with the SwRI rotator, the increments shall be one-half degree). All Y scans shall be run in the same direction, upon completion of which an X-scan shall be run at the maximum amplitude location.

Indications 100% or greater of the reference level shall be investigated by a Level II or a Level III examiner to the extent necessary to determine the shape, identity and location of the reflector.

Indications 100% or greater of the reference level investigated and found to be other than geometrical in nature shall be reported to the customer for evaluation.

Scanning limitations shall be recorded.

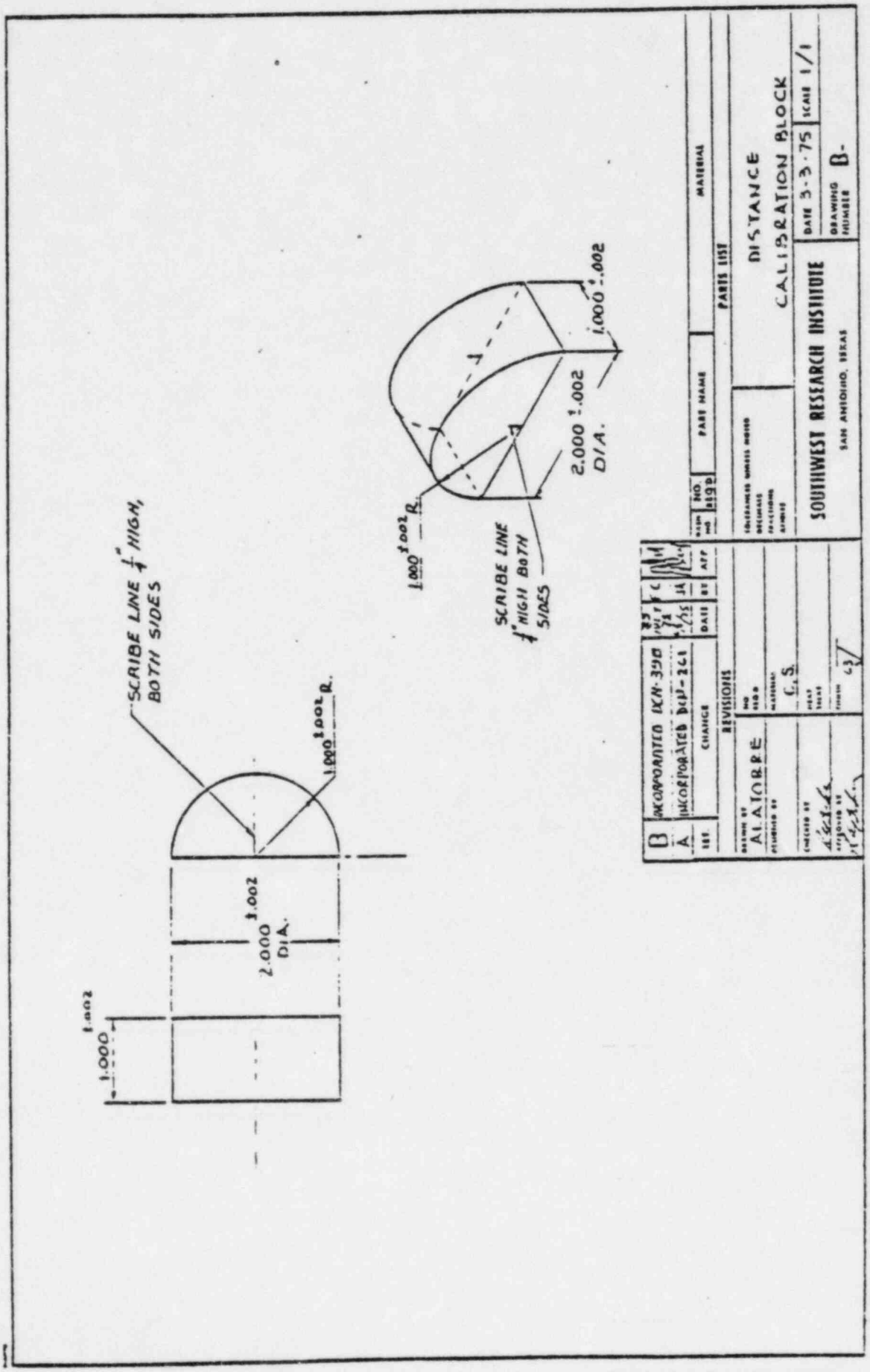
9.0 EVALUATION

Evaluation of reportable indications shall be the responsibility of the customer, or the customer's representative, and shall be conducted in accordance with Article IWA-3000 of the ASME Boiler and Pressure Vessel Code, Section XI. The applicable year and Addenda of the Code shall be as specified in Paragraph 2.1(1) of this procedure.

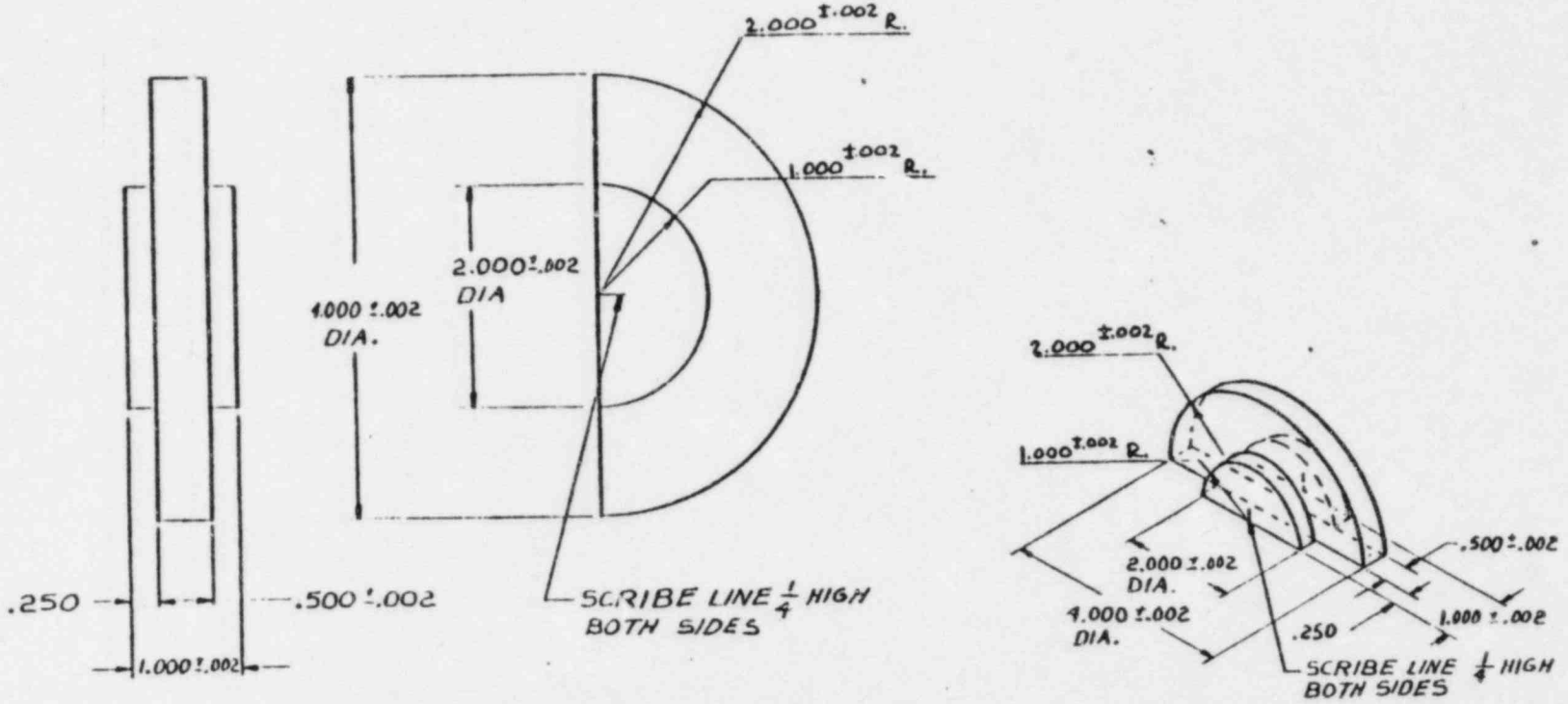
10.0 RECORDS

The customer shall receive copies of documents generated in accordance with this procedure in the examination report.

Documents generated in accordance with this procedure shall be stored and retained as a portion of the examination report. The examination report shall be stored by the Manager of the Support and Administration Section, Quality Assurance Systems and Engineering Division, in the Data Storage Facility for the period specified by the contractual agreement with the customer.


SCRIBE LINE 1" HIGH, BOTH SIDES
1.000 ±.002
2.000 DIA.
1.000 ±.002 R.
SCRIBE LINE 1" HIGH BOTH SIDES
1.000 ±.002 R.
2.000 ±.002 DIA.
SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO, TEXAS
DISTANCE CALIBRATION BLOCK
PARTS LIST
MATERIAL
PART NAME
DATE 3-3-75
SCALE 1/1
DRAWING NUMBER B-
INCORPORATED DCN-398
INCORPORATED DEP-261
CHANGE
REVISIONS
ALAMORE
C.S.

SKETCH 1

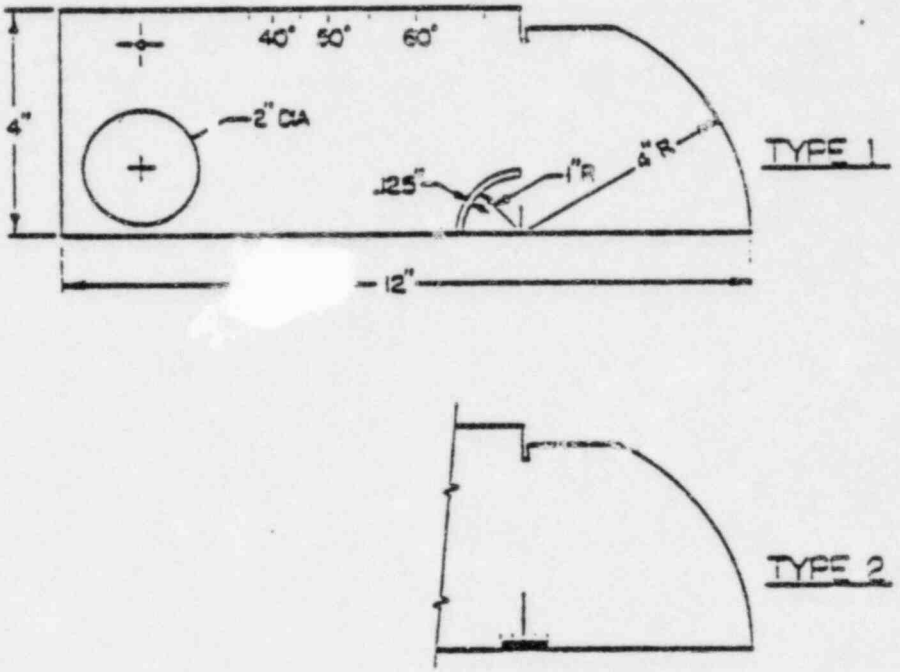


REVISIONS					PARTS LIST			
LET.	CHANGE	DATE	BY	APP	DASH NO	NO REQ'D	PART NAME	MATERIAL
A	INCORPORATED DCN-224	4/15/75	JA	[illegible]				

DRAWN BY J RAMOS	NO REQ'D	TOLERANCES UNLESS NOTED DECIMALS 1.005 FRACTIONS ANGLES	DISTANCE CALIBRATION BLOCK TYPE "DC"
DESIGNED BY	MATERIAL S. S.		
CHECKED BY [illegible]	HEAT TREAT	SOUTHWEST RESEARCH INSTITUTE SAN ANTONIO, TEXAS	DATE 3-13-75 SCALE 1/
APPROVED BY [illegible]	FINISH 63		DRAWING NUMBER B-7000

SKETCH 2

IIW REFERENCE BLOCK



NOTE:
OTHER IIW APPROVED REFERENCE BLOCKS WITH SLIGHTLY DIFFERENT DIMENSIONS OR DISTANCE CALIBRATION SLOT FEATURES ARE PERMISSIBLE.

SKETCH 3

PROCEDURE DEVIATION

SITE:	PROCEDURE / REVISION NO.
Brunswick Unit 1	600-31/9

DEVIATION NO.	PAGE	DATE REQUESTED:	SECTION:	PAGE
3	1 OF 1	14 January 1983	8.	24 OF 26

1. EXAMINATION AREAS AFFECTED BY DEVIATION: (List each specific area or component to be examined in accordance with this deviation (state examination period, component identification, line identification, weld identification, etc.))

Examinations on austentic material conducted during the 1983 inservice inspection shall be affected by this deviation.

THIS DEVIATION SUPERCEDES DEVIATION 2

2. DEVIATION: (It is requested that the paragraphs below in the above procedure / revision be deleted from as follows (use exact wording proposed, additional sheets may be used if necessary):

Change the first paragraph of 8. to read as follows:

> Ultrasonic reflectors producing a response greater than 50% of the reference level shall be recorded on the appropriate SwRI Ultrasonic Examination record and investigated.

Change the second paragraph of 8. to read as follows:

> Additionally all ultrasonic reflectors (regardless of signal amplitude), not readily attributable to geometry by the examiner shall be recorded on the appropriate SwRI Ultrasonic Examination Record and investigated by a Level II or Level III examiner to the extent necessary to determine the shape, identity, and location of the reflector. Examples of non-geometric reflectors (which may occur at any amplitude) are those which are slightly removed from the weld root and/or chamfer, mask the root indications, are transverse to the weld, or have linear dimensions with side branches.

Add the following as the third Paragraph of 8.:

> When the amplitude of an indication fluctuates above and below the required recording amplitude along its length, the total length of the indication will be determined by the end points where the signal is discernible from the noise.

3. JUSTIFICATION: (Reasons thereof is necessary and when it is planned to accomplish (use additional sheets if necessary):

These changes are made at the request of the customer.

PREPARED BY / DATE / TECHNICAL REVIEW / DATE / MANAGER QA / DATE / DIRECTOR DEPARTMENT / DATE / QC

for BEN

CAROLINA POWER & LIGHT COMPANY
TECHNICAL SERVICES DEPARTMENT
ENGINEERING & CONSTRUCTION QUALITY ASSURANCE SECTION
QA REVIEW

JULY 1979

DATE _____

EXTERNAL ROUTING

FILE NO.(S) BP P-5/5

PROJECT BSEP SwRI

DOCUMENT IDENTIFICATION Manual Ultrasonic Examination of Austenitic Pressure Piping Welds TRANSMITTED BY _____ DATE 1/5/83

DOCUMENT NO. SwRI-NDT-600-31 REV. 9 DATE 12/82

* QA OPEN ITEMS (ASTERISK DENOTES QA COMMENTS WHICH MUST BE RESOLVED WITH QA CONCURRENCE).

☐ NO QA OPEN ITEMS ☐ ALL PREVIOUS OPEN QA ITEMS RESOLVED

☐ INTENDED CORRECTIVE ACTION IS SATISFACTORY, HOWEVER, COMPLETION OF ACTION IS NEEDED TO CLOSE OUT OPEN ITEM(S).

☐ PRIOR QA ITEM NUMBER(S) _____, OF QA REVIEW RECORD DATED _____ ARE (PENDING RESOLUTION) (RESOLVE

☐ PRIOR QA ITEM NUMBER(S) _____, OF QA REVIEW RECORD DATED _____ ARE (PENDING RESOLUTION) (RESOLVE

INTERNAL QA ROUTING

DATE: 1/7/83

1. ~~OSTIVAL~~ CEO

Recommend approval subject to the following comment:

1. Change the ~~if~~ recording level specified in 1st paragraph under 8. RECORDING CRITERIA to 20%.

REVIEW PERFORMED IN ACCORDANCE WITH PROCEDURE NO.

PROCEDURE DEVIATION

SITE:	PROCEDURE / REVISION NO.		
Brunswick, Unit 1	600-31/9		
DEVIATION NO. 2	PAGE 1 OF 3	DATE REQUESTED: 7 January 1983	SECTION: 3.,7.,8	PAGE *OF 26

1. EXAMINATION ITEM AFFECTED BY DEVIATION: (List each specific area or component to be examined in accordance with this deviation (give examination parts, component identification, line identification, weld identification, etc.)

Manual ultrasonic examinations to be conducted in accordance with SwRI-NDT-600-31 revision 9 conducted during the 1983 I51 shall be affected by this deviation.

*pages 3,20 and 24:

2. DEVIATION: It is requested that the paragraphs below in the above procedure / revision be deviated (read as follows (use exact wording proposed, additional sheets may be used if necessary)):

Change 3.1 to read as follows:

3.1 Calibration and Examination Records

SwRI-NDTR Form No.	Revision Date
17-18	7-31-75
17-19	7-10-80
17-25	7-10-80
17-37	2-19-80
17-86	7-25-80
17-87	7-25-80

Change 7.4 to read as follows:

When practicable, scanning shall be performed at a minimum gain setting of 5 times the reference level sensitivity.

Instrument gain setting for scanning shall be determined on the basic calibration block as follows for each primary reference level utilized.

(1) With the instrument at the primary reference level position the search unit on the basic calibration block to obtain a signal from a calibration reflector (side-drilled hole) of 20% FSH.

3. JUSTIFICATION: (Reason change is necessary and what it is intended to accomplish (use additional sheets if necessary)):

This change is necessary to incorporate changes requested by Carolina Power and Light.

MANAGER QA DATE 2-9-83

TECHNICAL REVIEW DATE 2-9-83

APPROVED BY DATE 2-9-83

(2) Add 14 dB of gain by utilizing the 14 dB switch, if present. Observe the signal amplitude (If the 14 dB switch is not present on the instrument, use the method in step (3) for scanning sensitivity).

(3) Add 14 dB of gain by utilizing a combination of both fine and coarse gain controls. Observe the signal amplitude.

(4) Choose the method above which yields a signal response closest to 100% of FSH.

(5) The method chosen shall then be used for all scanning at 5 times the reference level sensitivity.

The examiner shall ensure that the signal response of the method chosen is within ±2dB of 100% FSH. Record this amplitude and method on the SwRI Instrument Calibration Record.

Instrument gain settings for scanning shall be recorded on the appropriate SwRI Examination Record.

Change 8. to read as follows:

Ultrasonic reflectors producing a response greater than 20% of the reference level shall be recorded on the appropriate SwRI Ultrasonic Examination Record.

Any ultrasonic reflectors not readily attributable to geometry by the examiner shall be recorded on the appropriate SwRI Ultrasonic Examination Record and investigated by a Level II or Level III examiner to the extent necessary to determine the shape, identity, and location of the reflector. Examples of non-geometric reflectors (which may occur at any amplitude) are those which are slightly removed from the weld root and/or chamfer, mask the root indications, are transverse to the weld, or have linear dimensions with side branches.

Indications 100% or greater of the reference level shall be investigated by a Level II or Level III examiner to the extent necessary to determine the shape, identity, and location of the reflector.

The end points of the indication is determined by 100% DAC shall be recorded.

Indications shall be recorded in accordance with the techniques outlined in the applicable revision of Swâl Nuclear Projects Operating Procedure IX-PE-117, except as modified by this procedure.

Indications investigated and found to be other than geometrical in nature, regardless of the amplitude, shall be reported to the customer for evaluation.

Scanning limitations shall be recorded.

When the amplitude of an indication fluctuates above and below the required recording amplitude along its length, the total length of the indication will be determined by the end points where the signal is discernible from the noise.

TO: Ali Egap - ISI Coordinator
C/EL BSEP
Southport, N. C.

CAROLINA POWER & LIGHT CO

SUBJECT: BASE MATERIAL LAMINATIONS SCAN REQUIREMENTS | ATTENTION | DATE: 11-23-82

REF: SWRI's LETTER ON SUBJECT AND DATED 11-9-82

I CONCUR WITH SWRI's POSITION AS INDICATED IN THE SUBJECT LETTER.

NO REPLY NECESSARY

cc: R. Saunders
R. Gosser
File
J. Hancock

PLEASE REPLY TO → SIGNED C. E. Metcalf

CC.
- Mr. Carl Osman W/A - UT Level III
- Mr. Ray Coburn W/A - Q.A.
- Mr. Jim Boone W/A
- Mr. Bruce Winkley W/A.
- ISI Project File, B10-10056 W/A.

DATE SIGNED M. Egap 11/23/82

RECIPIENT - REPLY & RETAIN PINK COPY • DETACH & RETURN THIS COPY TO SENDER.

SOUTHWEST RESEARCH INSTITUTE

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QUALITY ASSURANCE SYSTEMS
AND ENGINEERING DIVISION

TELEX 767209 NUC ENGR SNT A
TELEX 767579 NUC ENGR SNT
TELECOPIER 684-4622

November 9, 1982

To: John Hancock!
Please your
comment and approv.
Att. Ryan
11/17/82
PRIORITY

Mr. C.R. Dietz
General Manager
Brunswick Steam Electric Plant
Carolina Power & Light Company
P.O. Box 10429
Southport, North Carolina 28461-0429

SUBJECT: Base Material Lamination Scan Requirements

REFERENCE: BSEP Letter October 18, 1982, File B10-10056
Base Material Lamination Scan Requirements

Dear Mr. Dietz:

The requirement for base material lamination scans prior to each angle beam examination has been the subject of many discussions. The laminations of concern are fabrication imperfections which are present from time of manufacture and will not appear during service. To fully address the subject it must divide into three areas of interest; vessels over two inches thick, ferritic piping and austenitic piping. Each of these components are addressed differently by the Code.

(1) Vessels over two inches thick: The Summer 1978 Addenda to Section XI (IWA 2232) refers to Article 4 of Section V for examinations of vessels over two inches thick. Article 4, T-451.3, requires straight beam scanning for planar reflectors (which are defined in Section XI IWA 3000). Article 4, T-451.3 requires evaluation of laminar reflectors to determine their interference with angle beam examinations.

SwRI position is that since straight beam scanning for both planar and laminar indications is done with the same search unit and screen distance calibration, although amplitude calibrations differ, there is little gained by deleting the lamination scan. In the case of mechanized vessel examintions where a three transducer module (45 degrees, 0 degree, 60 degrees) is used, there is even less reason to delete the lamination scan since the entire area is being covered for angle beam, and the data is available without extra collection effort.

(2) Ferritic piping: The Summer 1978 Addenda to Section XI (IWA 2232) refers to Appendix III for ultrasonic examina-

tion of Class 1 and Class 2 ferritic piping. Appendix III makes no mention of scanning for laminar defects. Although Section V is not referenced for the examination of ferritic piping, Section V, T-534.3 states "the volume of base material through which the sound will travel in angle beam examination shall be completely scanned with a straight beam search unit to detect reflectors which might affect interpretation of angle beam results." Although Section V guidance is not specified, good practice dictates that the affect of laminar interference should be checked before performing an angle beam scan.

SwRI's position is that if PSI or previous examination data is available to determine that no laminations exist in the area of concern which would affect angle beam scans; the lamination scan may be deleted for that weld.

(3) Austenitic piping: No specific mention of austenitic materials is made in Section XI except in Appendix III, Supplement 7 which does not address the requirement for lamination areas. Again, we refer to SectionV, T-534.3 as being a logical and conservative practice.

SwRI's position for austenitic piping is the same as for ferritic piping; if previous examintion data can be researched and the examiner assured that there will be no laminar interference with angle beam scans, the lamination scan may be omitted without a deleterious affect on the examination.

In summary, lamination scans should continue to be performed on ferritic vessels over two inches in thickness, particularly when examined with mechanized techniques. Lamination scans may be deleted for examinations of ferritic and austenitic piping if sufficient previous data is available to ensure the absence of laminations which would interfere with angle beam scans. It is recommended that the concurrence of the local athorized nuclear inspector and NRC representative be obtained.

If we may be of further assistance in this or other matters, please contact us.

Sincerely,

J.R. Ingamells
Research Engineer
Inspection Engineering Section
Department of Engineering Services

/kp

SOUTHWEST RESEARCH INSTITUTE
NUCLEAR PROJECTS
OPERATING PROCEDURE

Title

MANUAL ULTRASONIC EXAMINATION OF AUSTENITIC PRESSURE PIPING WELDS

EFFECTIVITY AND APPROVAL

Revision 9 of this procedure became effective on 12/22/82. Other revisions of the base document may be effective concurrently.

SA: C.K

Approvals

Written By	Date	Technical Review	Date
Hector Diaz	22 Dec 82	Stan Walker	22 Dec 1982
Manager of Q.A.	**Date**	**Cognizant Director**	**Date**
Bruce Nichols	12/22/82	Wayne J. Flack	12/22/82

The following information may be used for convenience. Completion of this portion is not mandatory.

Deviation No.								
Date Effective								
Procedure Section(s) Affected								

Notes:

MANUAL ULTRASONIC EXAMINATION OF AUSTENITIC PRESSURE PIPING WELDS

SwRI-NDT-600-31

1. PURPOSE

This procedure provides the technical information and detailed steps required to ensure a complete and accurate manual ultrasonic examination of similar or dissimilar metal welds and adjacent base material in clad or unclad austenitic pressure piping in accordance with the applicable ASME Boiler and Pressure Vessel Codes.

2. SCOPE AND APPLICATION

Pressure piping welds and the adjacent base material in the nominal thickness range of greater than 0.4 inch to 5.0 inches shall be examined.

Manual, contact, pulse-echo, shear-wave angle-beam, and longitudinal-wave straight-beam ultrasonic techniques shall be utilized for the examination of welds and adjacent base material in extruded austenitic pressure piping.

Similar and dissimilar metal circumferential and longitudinal pipe welds and branch pipe connection butt welds to be examined shall be as specified in the applicable SwRI Examination Plan.

3. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1977 Edition, with Addenda through Summer 1978, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1977 Edition, with Addenda through Summer 1978, "Nondestructive Examination," with the exception of the following:

(a) Subparagraph T-533.1 of Article 5, Section V, requires the basic calibration block for production material thickness (t) up to and including 1 inch to be 3/4 inch or t. Paragraph 5.3 of this procedure requires the basic calibration block to be either t, no more than 25% less than t, or closer in thickness to the production material than the 3/4-inch alternate

thickness allowed by Article 5 for production material thicknesses up to and including 1 inch. This exception will assure a more accurate calibration than the Article 5 basic calibration block design allowed by Code.

(b) Subparagraph T-535.1 of Article 5 states that transfer (attenuation compensation) be accomplished between the production material and basic calibration block and a correction made for the difference. Paragraph 7.5.2 of this procedure describes the method used to conduct attenuation measurements. These attenuation measurements shall be recorded and considered during analysis and evaluation of indications. No attempt shall be made by the examiner to compensate for observed differences before or during the examinations.

(3) ASME Boiler and Pressure Vessel Code, Section IX, 1977 Edition with Addenda through Summer 1978, "Welding and Brazing Qualifications"

(3) SwRI Nuclear Quality Assurance Program Manual (NQAPM)

3.1 Calibration and Examination Records

SwRI-NDTR Form No.	Revision Date
17-18	7-31-75
17-19	7-10-80
17-25	7-10-80
17-37	2-18-80
17-86	7-25-80
17-87	7-25-80

4. RESPONSIBILITY

(1) The Director of the Department of Engineering Services, Quality Assurance Systems and Engineering Division, shall be responsible for the preparation, review, approval, and control of this procedure.

(2) The Project Manager shall be responsible for the implementation of this procedure in accordance with the NQAPM specified in the applicable SwRI Project Plan.

(3) The examiner shall be responsible for implementing the requirements of this procedure.

(4) The Manager of the Support and Administration Section, Quality Assurance Systems and Engineering Division, shall be responsible for storage of records generated in accordance with this procedure.

5. PERSONNEL AND EQUIPMENT

5.1 Personnel Certification

Personnel performing ultrasonic examinations shall be certified in accordance with SwRI NQAP 11-1, "Special Process Control."

5.2 Reference Block

Reference blocks used for screen distance calibration and verification shall be of the same material as the production material; i.e., stainless steel or carbon steel, and shall be one of the following: (1) SwRI Half-Round, (2) AWS Type DC, or (3) IIW.

5.3 Basic Calibration Block for Circumferential, Longitudinal, and Branch Pipe Connection Welds

Side-drilled basic calibration hole reflectors, in accordance with Section V of the ASME Boiler and Pressure Vessel Code, shall be placed in a block manufactured from material of similar metallurgical structure and of the same or equivalent P-number grouping as the production material, as identified in Section IX of the ASME Boiler and Pressure Vessel Code. The calibration material shall be determined by the production piping material to which the search unit is applied.

The basic calibration block thickness shall be determined by the thickness of the production piping material to which the search unit is applied and Article 5 of Section V. When a basic calibration block of the same thickness as the production piping material is not available and where the production piping material thickness is 1 inch or less, the basic calibration block thickness shall be no more than 25% thinner than the production material thickness or shall be closer to the production material thickness than the 3/4-inch thick alternate calibration block allowed by Article 5.

Approved drawings of basic calibration blocks to be used in accordance with this procedure are contained in the applicable SwRI Examination Plan.

The surface finish of the basic calibration block shall be representative of the surface finish of the piping.

Flat basic calibration blocks or blocks of essentially the same curvature as the part to be examined may be used when contact surface curvatures are greater than 20 inches in diameter.

A curved basic calibration block shall be used to establish distance amplitude correction (DAC) curves for examinations on contact surfaces in the range of curvature from 0.9 to 1.5 times the basic calibration block diameter, when contact surface curvature is 20 inches in diameter or less.

The curvature of the main run pipe shall be used to establish the requirements for the basic calibration block curvature for the examination of branch pipe connection welds.

5.4 Search Units

(1) The search unit size shall be selected according to the following:

Straight-Beam

Nominal Production Material Thickness	Nominal Search Unit Size
2.0" or less	1/4" Round
1.0" to 3.0"	3/8" Round
2.0" to 4.0"	1/2" Round
3.0" to 5.0"	3/4" to 1" Round

Angle-Beam

The search unit size for carbon steel shall be selected according to the following:

Nominal Production Material Thickness	Nominal Search Unit Size
1.0" or less	1/4" x 1/4", 1/4" Round
0.4" to 2.0"	3/8" x 3/8", 3/8" Round
0.75" to 4.0"	1/2" x 1/2", 1/2" Round
2.0" to 5.0"	1/2" to 1", 3/4" Round

(2) The nominal search unit size for austenitic materials shall be 3/8" round or 3/8" x 3/8".

(3) The exit point of the sound beam and the actual refracted beam angle of shear-wave search units shall be determined on an IIW block. The exit point shall be marked on the search unit wedge.

(4) The nominal angle-beam shear-wave search unit frequency for examination of austenitic piping shall be 1.5 MHz.

(5) The nominal straight-beam longitudinal-wave search unit frequency for austenitic piping shall be 1.5 MHz or 2.25 MHz.

(6) The nominal search unit frequency for the carbon steel side of dissimilar piping welds shall be 2.25 MHz.

(7) The longitudinal-wave search unit frequency for attenuation measurements shall be 2.25 MHz to simulate a 1.5 MHz shear mode, and 5.0 MHz to simulate a 2.25 MHz shear mode.

(8) For examination of circumferential piping welds, search unit wedges shall be fabricated to produce 45° ±2° and 60° ±2° refracted shear-waves.

(9) For examination of longitudinal piping welds or branch pipe connection welds to piping, search unit wedges shall be fabricated to produce 45° ±2° refracted shear waves.

5.5 Ultrasonic Instrument

The examiner shall use a Sonic FTS Mark I ultrasonic instrument which shall be aligned and shall display an alignment calibration tag as required by NQAP 10-1.

5.6 Couplant

(1) USP-grade glycerine or deionized water (with or without wetting agent) shall be used when performing ultrasonic calibrations and examinations in accordance with this procedure.

(2) USP-grade glycerine shall be certified for sulfur content and total halogens in accordance with ASTM D-129-64 and ASTM D-808-63. The residual amount of total sulfur or halogens shall not exceed 1% by weight. Deionized water, when used, shall be supplied by the customer.

(3) Couplant materials used for examinations shall be the same as used for the calibration.

5.7 Thermometer

Quicktemp thermometer Model 5X-666, calibrated and certified in accordance with the applicable revision of SwRI Nuclear Projects Operating Procedure XII-PM-104 shall be used to measure calibration block and component surface temperature.

6. CALIBRATION METHOD

6.1 Instrument Linearity

The ultrasonic instrument shall be verified at the beginning of each day for amplitude linearity and amplitude control linearity in accordance with Paragraphs 6.1.1 and 6.1.2. Data required shall be recorded on the SwRI Instrument Linearity Verification Record and the sheet number shall be referenced on the applicable SwRI Sonic Instrument Calibration Record.

6.1.1 Amplitude Linearity

(1) Position a shear-wave search unit on a calibration block to obtain indications from the 1/2T and 3/4T holes.

(2) Adjust the search unit position to give a 2:1 ratio between the two indications, with the larger indication (1/2T hole) set at 80% of full screen height (FSH) and the smaller indication (3/4T hole) set at 40% of FSH.

(3) Without moving the search unit, adjust the instrument sensitivity (gain) to set the larger indication to 100% of FSH.

(4) With the larger indication at 100%, record the amplitude of the smaller indication, estimated to the nearest 1% of FSH.

(5) Successively set the larger indication from 100% to 20% of FSH in 10% increments (or 2 dB steps if a fine control is not available); observe and record the smaller indication estimated to the nearest 1% of FSH at each setting. The reading must be 50% of the larger amplitude within 5% of FSH.

6.1.2 Amplitude Control Linearity

(1) Position a shear-wave search unit on a calibration block to obtain maximum amplitude from the 1/2T hole.

(2) Without moving the search unit and according to the following table, set the indication to the required percent of FSH and increase or decrease the dB as specified. The signal shall be estimated and recorded to the nearest 1% of FSH and shall fall within the limits of the following table:

Indication Set at % of Full Screen	dB Control Change*	Indication Limits, % of Full Screen
80%	-6dB	32 to 48%
80%	-12dB	16 to 24%
40%	+6dB	64 to 96%
20%	+12dB	64 to 96%

*Minus denotes decrease in amplitude; plus denotes increase.

6.2 Calibration

The complete ultrasonic calibration shall be performed prior to the examination.

NOTES

The REJECT control shall be maintained in the 0 position during calibration and examination.

The nominal piping production material thickness shall be used to determine the correct calibration block and search units for the examination of piping components which may be thicker than the nominal pipe size and welded to the pipe. The Level II examiner shall ensure that complete coverage of the thicker piping component is obtained. Additional calibration vee-path positions and larger screen sizes may be required to assure this coverage. The additional calibration vee-path positions and larger screen size shall be used for the examination from the thicker component and the nominal pipe side of the weld.

The FREQ MHz control shall be turned to 1 when a 1.5 MHz search unit is used, to 2 with a 2.25 MHz search unit, and to 5 with a 5.0 MHz search unit.

The type and length of the search unit cable shall be recorded on the SwRI Sonic Instrument Calibration Record.

The centerline of the search unit shall be at least 3/4 inch from the nearest side of the block. Rotating the beam into the corner formed by the hole and the side of the block may produce a higher amplitude at a longer beam path. This beam path shall not be used for calibration.

All spaces on the SwRI Sonic Instrument Calibration Record shall be filled in.

6.2.1 Temperature

The temperature of the calibration block shall be within 25°F of the component temperature and shall be recorded on the SwRI Sonic Instrument Calibration Record for the initial calibration and each verification.

The surface temperature of the component to be examined shall be taken prior to performing an examination and shall be recorded on the applicable SwRI Examination Record.

6.3 Calibration for Circumferential Butt Welds

6.3.1 Straight-Beam Distance Calibration

The screen distance chosen shall be the shortest applicable size to include at least 1/4t beyond the thickest production material to which the search unit is applied.

Observing back reflections from the applicable reference block, adjust the MAT'L CAL, RANGE, and DELAY controls to obtain the required linear sound path distance displayed along the screen baseline.

6.3.2 Angle-Beam Distance Calibration

The screen distance chosen shall be the shortest applicable size to include at least 1/8 vee-path past the anticipated examination range.

Observing radius echoes from the applicable reference block, adjust the MAT'L CAL, RANGE, and DELAY controls to obtain the required linear sound path distance displayed along the screen baseline.

When the same instrument is used for both 45° and 60° examinations, the screen distance calibration shall be conducted in the following manner:

(1) The screen distance size shall be determined by the angle-beam search unit requiring the longer examination range.

(2) Position the 45° ±2° search unit on the appropriate reference block and record all required reference block entries on the appropriate SwRI Sonic Instrument Calibration Record.

(3) Without changing the MAT'L CAL, RANGE, or DELAY controls, repeat step (2) with the 60° ±2° search unit.

(4) No attempt shall be made to compensate for the delay difference between 45° ±2° and 60° ±2° screen distance calibrations. This difference shall be considered when resolving indications.

6.3.3 Straight-Beam Distance Amplitude Correction

A DAC curve shall be established by utilizing responses from the basic calibration holes.

6.3.3.1 Production Material 1 Inch or Less in Thickness

(1) Position the straight beam search unit to obtain maximum response from the 1/2T hole.

(2) Adjust instrument gain controls to obtain the primary reference response at an amplitude of 50% ±5% of FSH.

(3) Draw a straight horizontal line on the instrument screen at the primary reference amplitude to extend a distance equal to the nominal thickness of the production material.

(4) Signal amplitudes for indications recorded shall be referenced as a percentage of this line.

6.3.3.2 Production Material Greater Than 1 Inch in Thickness

(1) Position the straight-beam search unit to obtain maximum response from the calibration hole selected from the following, which produces the highest amplitude:

Hole
1/4T
1/2T (if present)
3/4T

(2) Adjust the instrument gain controls to obtain a primary reference response at 50% ±5% of FSH and mark this amplitude on the screen. The gain controls shall not be adjusted once the primary reference response has been established.

(3) Position the search unit to obtain maximum response from the remaining calibration holes and mark each amplitude on the screen.

(4) Join these points with a smooth curved line which shall extend 1/4T beyond the last qualified calibration point.

6.3.4 Angle-Beam Distance Amplitude Correction

If a curved block is used, DAC curves for the examination of circumferential welds shall be constructed by utilizing the responses from the holes oriented perpendicular to the axis of the basic calibration block.

6.3.4.1 Material 1 Inch or Less in Thickness

45° and 60° DAC

(1) Position the 45° ±2° search unit to obtain maximum response from the calibration hole and vee-path position, selected from the following, which produces the highest amplitude:

Hole	Vee-Path Positions
1/2T	2/8, 6/8, 10/8

(2) Adjust the instrument gain controls to obtain a primary reference response at 75% ±5% of FSH and mark this amplitude on the screen. The gain controls shall not be adjusted once the primary reference response has been established.

(3) Position the search unit to obtain maximum response from the remaining vee-path positions and mark each amplitude on the screen.

(4) Join these points with a smooth curved line which shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

(5) Repeat steps (1) through (4) using a 60° ±2° search unit.

EXCEPTIONS

If the configuration of the weld is such that the 60° ±2° search unit sound-beam is not directed into the A-B-E-F intersect (as depicted in SKETCH 1) on the straight pass, a 14/8 vee-path calibration shall be accomplished with a 45° ±2° search unit.

6.3.4.2 Material Greater Than 1 Inch to 3 Inches in Thickness

45° and 60° DAC

(1) Position the 45° ±2° search unit to obtain maximum response from the calibration hole and the vee-path position, selected from the following, which produces the highest amplitude:

Hole	Vee-Path Positions
1/4T	7/8
1/2T (if present)	2/8
3/4T	3/8, 5/8

(2) Adjust the instrument gain controls to obtain a primary reference response at 75% ±5% of FSH and mark this amplitude on the screen. The gain controls shall not be adjusted once the primary reference response has been established.

(3) Position the search unit to obtain maximum response from the remaining vee-path positions and mark each amplitude on the screen.

(4) Join these points with a smooth curved line which shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

(5) Repeat steps (1) through (4) using a 60° ±2° search unit.

EXCEPTION

If the configuration of the weld is such that a 60° ±2° search unit beam is not directed into the weld root, a 13/8 vee-path calibration shall be accomplished with a 45° ±2° search unit.

6.3.4.3 Material Greater Than 3 Inches to 5 Inches in Thickness

45° and 60° DAC

(1) Position the 45° ±2° search unit to obtain maximum response from the calibration hole and the vee-path position, selected from the following, which produces the highest amplitude:

Hole	45° Vee-Path Positions
1/4T	7/8
1/2T (if present)	2/8
3/4T	3/8, 5/8

(2) Adjust the instrument gain controls to obtain a primary reference response at 75% ±5% of FSH and mark this amplitude on the screen. The gain controls shall not be adjusted once the primary reference response has been established.

(3) Position the search unit to obtain maximum response from the remaining vee-path positions and mark each amplitude on the screen.

(4) Join these points with a smooth curved line which shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

(5) Repeat steps (1) through (4) with a 60° ±2° search unit utilizing the following vee-path positions:

Hole	60° Vee-Path Positions
1/4T	1/8
1/2T (if present)	2/8, 6/8
3/4T	3/8, 5/8

6.3.4.4 Clad Piping 45° and 60° DAC

(1) Position the 45° ±2° search unit to obtain maximum response from the calibration hole and the vee-path position, selected from the following, which produces the highest amplitude:

Hole	Vee-Path Positions
1/4T	1/8
1/2T (if present)	2/8
3/4T	3/8

(2) Adjust the instrument gain controls to obtain a primary reference response at 75% ±5% of FSH and mark this amplitude on the screen. The gain controls shall not be adjusted once the primary reference response has been established.

(3) Position the search unit to obtain maximum response from the remaining vee-path positions and mark each amplitude on the screen.

(4) Join these points with a smooth curved line which shall extend 1/8 vee-path beyond the last qualified calibration point.

(5) Repeat steps (1) through (4) with a 60° ±2° search unit.

6.4 Calibration for Branch Pipe Connection and Longitudinal Seam Welds

6.4.1 Straight-Beam Distance Calibration

The straight-beam distance calibration shall be the same as that described in Paragraph 6.3.1.

6.4.2 Angle-Beam Distance Calibration

The screen distance chosen shall be the shortest applicable size to include at least 1/8 vee-path past the anticipated examination range.

Observing the radius echoes from the applicable reference block, adjust the MAT'L CAL, RANGE, and DELAY controls of the instrument to obtain the required linear sound path distance displayed along the screen baseline.

6.4.3 Straight-Beam Distance Amplitude Correction

The straight-beam distance amplitude correction shall be the same as that described in Paragraph 6.3.3.

6.4.4 Angle-Beam Distance Amplitude Correction

If a curved block is utilized, DAC curves shall be constructed by utilizing the responses from the basic calibration holes oriented axially with the basic calibration block.

6.4.4.1 Material 1 Inch or Less in Thickness

45° DAC

(1) Position the 45° ±2° search unit to obtain maximum response from the calibration hole and vee-path position, selected from the following, which produces the highest amplitude:

Hole	Vee-Path Positions
1/2T	2/8, 6/8, 10/8

(2) Adjust the instrument gain controls to obtain a primary reference response at 75% ±5% of FSH and mark this amplitude on the screen. The gain controls shall not be adjusted once the primary reference response has been established.

(3) Position the search unit to obtain maximum response from the remaining vee-path positions and mark each amplitude on the screen.

(4) Join these points with a smooth curved line which shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

6.4.4.2 Material Greater Than 1 Inch to 5 Inches in Thickness

45° DAC

(1) Position the 45° ±2° search unit to obtain maximum response from the calibration hole and the vee-path position, selected from the following, which produces the highest amplitude:

Hole	Vee-Path Positions
1/4T	7/8
1/2T (if present)	2/8
3/4T	3/8, 5/8

(2) Adjust the instrument gain controls to obtain a primary reference response at 75% ±5% of FSH and mark this amplitude on the screen. The gain controls shall not be adjusted once the primary reference response has been established.

(3) Position the search unit to obtain maximum response from the remaining vee-path positions and mark each amplitude on the screen.

(4) Join these points with a smooth curved line which shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

6.4.4.3 Clad Piping 45° DAC

This calibration shall be the same as that described in Paragraph 6.3.4.4, steps (1) through (4), using the 45° ±2° search unit only.

6.5 Secondary DAC Calibrations

If all points on the DAC curve do not appear at 20% of FSH or greater, a secondary DAC curve shall be constructed as follows:

(1) All secondary DAC curves shall contain at least 2 points.

(2) The DAC point at 2 lines or greater in amplitude and adjacent to a DAC point that falls below 2 lines of amplitude shall be brought to the primary reference level by manipulating the gain controls. This point shall be marked on the instrument screen. The adjacent point(s), previously at less than 2 lines of amplitude, shall be marked on the screen and all points connected with a smooth curved line. The gain setting for this secondary DAC curve shall be recorded on the appropriate SwRI Sonic Instrument Calibration Record.

EXCEPTIONS

When the first DAC point is the only point above 2 lines of amplitude, the next highest point shall be brought to the primary reference level. This point shall be marked on the instrument screen. The other points previously at less than 2 lines of amplitude shall be marked on the screen and all points connected with a smooth curved line. The gain setting for this secondary DAC curve shall be recorded on the appropriate SwRI Sonic Instrument Calibration Record.

It shall not be necessary to construct a secondary DAC when the calibration consists of a 2/8, 6/8, and 10/8 vee-path.

6.6 Calibration Verification

6.6.1 Sweep Range and DAC Curve Verification

Sweep range calibration shall be verified on the appropriate reference block; and DAC curve calibration, if applicable, shall be verified on the appropriate basic calibration block:

(1) At the start of a series of examinations

(2) With any substitution of the same type and length of search unit cable

(3) With any substitution utilizing the same type of power source; e.g., a change from one direct current to another direct current source

(4) At least every 4 hours during the examination

(5) At the finish of a series of examinations

(6) Whenever the validity of the calibration is in doubt

6.6.2 Calibration Changes

(1) Perform the following if any point on the DAC curve has decreased more than 20% of FSH or 2 dB in amplitude, or any point on the sweep line has moved more than 10% of the sweep reading or 5% of full sweep, whichever is less:

(a) Void all examinations referring to the calibration in question and performed after the last valid calibration verification.

(b) Conduct a new calibration.

(c) Reexamine the areas for which examinations have been voided.

(2) Perform the following if any point on the DAC curve has increased in amplitude more than 20% of FSH or 2 dB:

(a) Correct the calibration.

(b) Reexamine all indications recorded since the last valid calibration verification.

(c) Enter proper values on a new SwRI Examination Record.

6.6.3 Recalibration

Substitution of any of the following shall be cause for recalibration:

(1) Search unit (wedge/transducer)

(2) Couplant

(3) Ultrasonic instrument

(4) Examination personnel

(5) Cable type of length

(6) Change in type of power source; e.g., a change from alternating to direct current

7. EXAMINATION

7.1 Examination Areas

7.1.1 Circumferential and Longitudinal Butt Welds in Piping

Circumferential and longitudinal full-penetration butt welds with a nominal thickness of greater than 0.4 inch to 5.0 inches shall be examined from the outside surface of the pipe.

Scanning of the weld and base material shall be adequate to ensure complete coverage for 1/3t from the inside surface of the pipe as shown in SKETCH 1. The base material shall be examined for a distance of a 1/4 inch as measured from the outside surface fusion line on each side of the weld.

Class 1 longitudinal welds shall be examined along the entire length of the weld during the preservice examination and for at least one pipe-diameter length or 12 inches, whichever is less, from the fusion line of the intersecting circumferential weld during inservice examinations.

Class 2 longitudinal welds shall be examined for at least 2-1/2t length from the fusion line of the intersecting circumferential weld during preservice and inservice examinations.

7.1.2 Butt Welds of Branch Pipe Connections

Full penetration butt welds of branch pipe connections in pressure piping greater than 0.4 inch to a maximum of 5.0 inches nominal thickness shall be examined from the outside surface of the pipe.

Scanning of the weld and base material shall be adequate to ensure complete coverage for 1/3t from the inside surface of the pipe. The base material shall be examined for a distance of a 1/4 inch measured from the outside surface fusion line on the main run pipe side of the weld.

7.2 Surface Condition

The contact surfaces shall be free from weld spatter, roughness, or other conditions which interfere with free movement of the search unit or impair the transmission of ultrasound.

7.3 Indication Length Zero Reference (Lo) Location

Areas to be examined in accordance with this procedure shall have an Lo marked in accordance with the applicable revision of SwRI Nuclear Projects Operating Procedure IX-FE-103.

7.4 Scanning Parameters

When practicable, scanning shall be performed at a minimum gain setting of 2 times the reference level sensitivity.

Instrument gain setting for scanning shall be determined on the basic calibration block as follows for each primary reference level utilized:

(1) With the instrument at the primary reference level, manipulate the search unit on the basic calibration block to obtain a signal of 40% of FSH from a calibration reflector (side-drilled hole).

(2) Add 6 dB of gain by utilizing the 6 dB switch (if present), the fine gain control or a combination of the fine and coarse gain controls and choose the method which yields a signal response closest to 80% FSH.

(3) The signal response of the method chosen shall be within ±2 dB of 80% FSH. This amplitude and method shall be recorded on the Ultrasonic Instrument Calibration Record.

The method chosen above shall be used during the valid calibration period for all scanning at 2 times the reference level sensitivity.

7.4.1 Scanning

Scanning overlap shall be a minimum of 10% of the search unit piezoelectric element dimension perpendicular to the direction of scan.

The search unit movement rate for scanning shall not exceed 6 inches per second.

7.5 Attenuation and Thickness Measurements

7.5.1 Longitudinal Attenuation Measurements

A straight-beam search unit as described for attenuation measurements (Paragraph 5.4) shall be placed on the appropriate basic calibration block. Obtain a backwall reflection, setting this signal between 50% and 90%

of FSH. Record the signal amplitude and instrument gain settings on the appropriate SwRI Sonic Instrument Calibration Record for Attenuation/Lamination Examination. Adjust the instrument gain controls to display the next backwall reflection at the same amplitude at which the preceding backwall reflection was recorded. Record the signal amplitude, instrument gain settings, and the dB difference required to obtain the adjacent backwall reflections at an equal amplitude.

Place the straight-beam search unit on the examination surface and determine the dB difference required to obtain signals of equal height from two adjacent backwall reflections. Record this dB difference on the appropriate SwRI Examination Record. The search unit for attenuation measurements shall be placed adjacent to Lo on the base material away from the heat-affected zone (HAZ). If attenuation measurements cannot be taken adjacent to Lo, the location of the measurements shall be recorded on the appropriate SwRI Examination Record. Measurements shall be taken at least at the following locations:

(1) Two positions for circumferential and longitudinal welds, one on each side of the weld

(2) One position adjacent to Lo on the main run pipe base material for branch connection welds

NOTE

Attenuation measurements shall not be conducted for longitudinal or branch connection welds if measurements have been conducted in the applicable piping base material.

No attenuation measurements shall be conducted on clad piping.

7.5.2 Thickness Measurements

Thickness measurements shall be taken at a minimum of three points adjacent to Lo for longitudinal and circumferential welds (on the centerline of the weld and at one point in the base material on each side of the weld). Thickness measurements shall be taken at a minimum of two points adjacent to Lo for branch pipe connection welds (one on the base material of the main run pipe, and one on the base material of the branch connection). If these measurements cannot be taken adjacent to Lo, the location of the measurements shall be recorded on the appropriate SwRI Examination Record.

Screen distance calibration for this examination shall be conducted in accordance with Paragraph 6.3.1. Measurements shall be taken by placing the straight-beam search unit in the appropriate position on the examination surface and observing the position of the back wall reflection on the instrument screen. These measurements shall be recorded on the appropriate SwRI Examination Record.

7.6 Examination of Circumferential and Longitudinal Butt Welds in Piping

7.6.1 Angle-Beam Examination for Indications Parallel with the Weld

Angle-beam examinations for circumferential welds shall be accomplished using 45° ±2° and 60° ±2° refracted shear-waves from both sides of the weld. For this examination, the sound-beam shall be directed perpendicularly into the weld to detect indications parallel with the weld. Calibration for these examinations shall be in accordance with Paragraphs 6.3.2 and 6.3.4.

Angle-beam examinations for longitudinal welds shall be accomplished using a 45° ±2° refracted shear wave from both sides of the weld. For this examination, the sound-beam shall be directed perpendicularly into the weld to detect indications parallel with the weld. Calibration for this examination shall be in accordance with Paragraphs 6.4.2 and 6.4.4.

7.6.2 Alternate Examination

A 45° ±2° and 60° ±2° shear-wave examination shall be conducted as required to assure complete coverage from both sides of the circumferential weld. A 45° ±2° shear-wave examination shall be conducted as required to assure complete coverage from both sides of the longitudinal weld. Any areas of the weld not receiving complete coverage from both sides shall be examined from one side of the weld with the required shear-wave(s) and a straight-beam longitudinal-wave applied to the surface of the weld crown in the affected areas. Calibration for the longitudinal-wave search unit shall be in accordance with Paragraphs 6.3.1 and 6.3.3.

7.6.3 Angle-Beam Examination for Indications Perpendicular to the Weld

An angle-beam examination shall be conducted on each weld using a 45° ±2° shear-wave. This examination shall be conducted by placing the search unit on the weld with the sound beam directed into and parallel with the weld to detect indications perpendicular to the weld. The entire length and width of the weld shall be scanned with the search unit beam directed in this manner, once in a clockwise and once in a counterclockwise direction.

For austenitic materials, the search unit shall then be placed on the base metal with the search unit wedge touching the edge of the weld crown and the sound beam directed tangential into the weld at a 45° ±10° angle. The entire length of the weld shall be scanned with the search unit beam directed in this manner on each accessible side of the weld. The search unit shall then be turned 90° and the scans repeated. Calibration for these examinations shall be in accordance with Paragraphs 6.3.2 and 6.3.4 for circumferential welds, and Paragraphs 6.4.2 and 6.4.4 for longitudinal welds and branch pipe connection welds. Geometric root ripple echoes occurring at the same metal path distance as flaws adjacent to the weld root are to be expected. A flaw must be distinguished from root ripple by the greater echo amplitude of a flaw compared to the amplitude of the root ripple at the same location. A flaw indication adjacent to the weld root tends to mask out several facets of the root ripple and travels along the baseline through the root ripple package.

7.6.4 Angle-Beam Examination for Indications in Austenitic Base Material Perpendicular to the Weld

An angle-beam examination shall be conducted on 1t of base material adjacent to each weld using a 45° ±2° shear-wave. This examination shall be conducted by placing the search unit on the base material with the sound beam directed parallel to the weld to detect indications perpendicular to the weld. The base material within 1t of the weld shall be scanned with the search unit directed in this manner, once in a clockwise direction and once in a counterclockwise direction. Calibration for these examinations shall be in accordance with Paragraphs 6.3.2 and 6.3.4 for circumferential welds, and Paragraphs 6.4.2 and 6.4.4 for longitudinal welds and branch pipe connection welds.

7.7 Examination of Butt Welds of Branch Pipe Connections

7.7.1 Straight-Beam Examination of Welds

A straight-beam examination shall be performed on the surface of the weld crown when possible. Calibration for the straight-beam examination shall be in accordance with Paragraphs 6.3.1 and 6.3.3.

7.7.2 Angle-Beam Examination for Indications Parallel with the Weld

An angle-beam examination shall be accomplished using a 45° ±2° refracted shear-wave from the main run pipe side of the weld. For this examination the sound beam shall be directed perpendicularly into the weld to detect indications parallel with the weld. Calibration for these examinations shall be in accordance with Paragraphs 6.4.2 and 6.4.4.

7.7.3 Angle-Beam Examination for Indications Perpendicular to the Weld

The angle-beam examination for indications perpendicular to the weld shall be the same as the examination described in Paragraph 7.6.3.

7.8 Postexamination Cleaning

Arrangements shall be made with the customer for postexamination removal of couplant materials.

8. RECORDING CRITERIA

Ultrasonic reflectors producing a response greater than 50% of the reference level shall be recorded on the appropriate SwRI Ultrasonic Examination Record.

Any ultrasonic reflectors not readily attributable to geometry by the examiner shall be recorded on the appropriate SwRI Ultrasonic Examiantion Record and investigated by a Level II or Level III examiner to the extent necessary to determine the shape, identity, and location of the reflector. Examples of non-geometric reflectors (which may occur at any ampliutde) are those which are slightly removed from the weld root and/or chamfer, mask the root indications, are transverse to the weld, or have linear dimensions with side branches.

The end points of the indication as determined by 100% DAC shall be recorded.

Indications shall be recorded in accordance with the techniques outlined in the applicable revision of SwRI Nuclear Projects Operating Procedure IX-FE-117.

Indications investigated and found to be other than geometrical in nature, regardless of the amplitude, shall be reported to the customer for evaluation.

Scanning limitations shall be recorded.

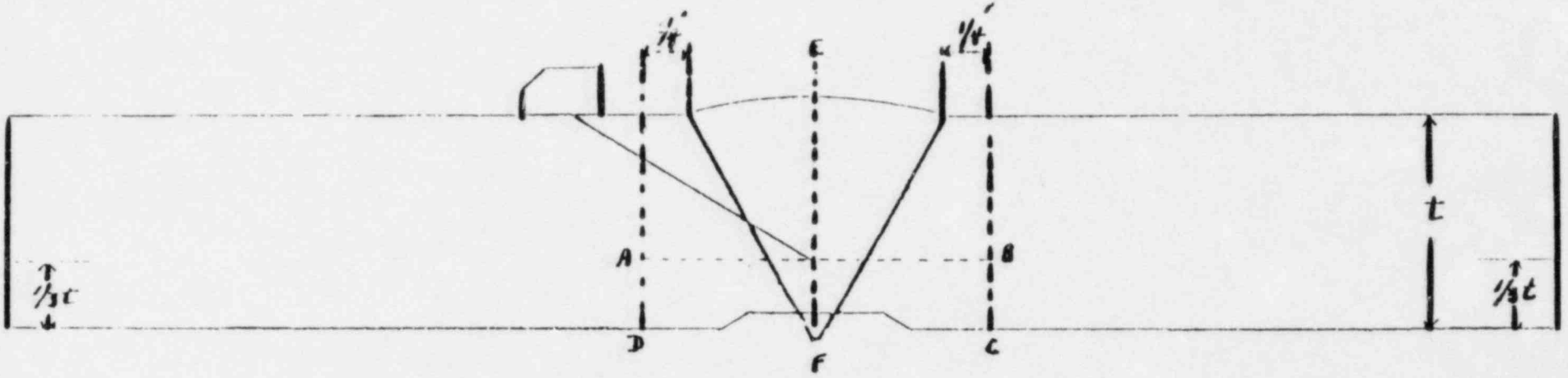
9. EVALUATION

Evaluation of reportable indications shall be the responsibility of the customer, or the customer's representative, and shall be conducted in accordance with ASME Boiler and Pressure Vessel Code, Section XI, Article IWA-3000. The applicable year and Addenda of the Code shall be as specified in Paragraph 3. of this procedure.

10. RECORDS

The customer shall receive copies of documents generated in accordance with this procedure in the examination report.

Documents generated in accordance with this procedure shall be stored and retained as a portion of the examination report. The examination report shall be stored by the Manager of the Support and Administration Section, Quality Assurance Systems and Engineering Division, in the Data Storage Facility for the period specified by the contractual agreement with the customer.



EXAMINATION AREA FOR CIRCUMFERENTIAL
AND LONGITUDINAL WELDS

SKETCH 1