



ULTRASONIC EXAMINATION PROCEDURE FOR
FLUED HEAD WELDS
FOR
SHOREHAM NUCLEAR POWER PLANT
UNIT 1

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ULTRASONIC EXAMINATION PROCEDURES FOR FLUED HEAD WELDS

1. SCOPE

1.1 AREA OF EXAMINATION

This document covers the ultrasonic examination procedures for flued head welds and adjacent base metal for a distance of 2T from the pipe side of the weld.

1.2 TYPE OF EXAMINATION

1.2.1 Volumetric examination shall be performed using ultrasonic pulse echo nominal 45° and 60° angle beam shear wave and 0° longitudinal straight beam techniques applied to the outside surfaces of the piping.

1.2.2 In addition, a supplemental examination may be performed from the flued head side, provided the flued head wall thickness is within the $\pm 12.5\%$ range of the nominal pipe wall thickness.

1.2.3 The examination shall be performed using manual search units (transducers).

1.3 TIME OF EXAMINATION

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

1.4 MATERIALS

The piping and flued heads are constructed of austenitic stainless steel or carbon steel.

2. REFERENCES

1. ASME Boiler and Pressure Vessel Code, Section XI, 1977 Edition, through Winter 1978 addenda.
2. ASNT Recommended Practice, SNT-TC-1A, 1975 Edition.
3. 80A9053; NES Procedure for Ultrasonic Instrument Linearity Verification, (Latest Revision).
4. 80A9068; NES Procedure for Training and Certification of Nondestructive Examination Personnel (Latest Revision).

3. PROCEDURE CERTIFICATION

The examination procedures described in this document comply with Section XI of the ASME Boiler and Pressure Vessel Code, 1977 Edition, through Winter 1978 addenda, except where examination coverage is limited by part geometry or access.

4. PERSONNEL CERTIFICATION

4.1 PERSONNEL CERTIFICATION REQUIREMENTS

- 4.1.1 Each person performing ultrasonic examination governed by this procedure shall be certified in accordance with References 2(1), 2(2), and 2(4).
- 4.1.2 An examination crew shall consist of one or two members as needed. At least one member of each crew shall have a minimum qualification of Level II in accordance with the above referenced documents. The remaining member(s) shall have a minimum qualification of Level I.

4.2 PERSONNEL RECORDS

- 4.2.1 Records of personnel qualification shall be maintained by the Examination Contractor.
- 4.2.2 A copy of the examiner's certification summary and a current eye test, as required by SNT-TC-1A, shall be filed with each permanent examination record, with a copy submitted to the Plant Owner, or his Agent, prior to performing examinations per this procedure.

5. EXAMINATION REQUIREMENTS

5.1 EXAMINATION FREQUENCY

- 5.1.1 The nominal examination frequency shall be 2.25MHz for all straight beam and angle beam examinations .
- 5.1.2 Other pulse frequencies shall be used if such variables as material attenuation, grain structure, etc., necessitate their use to achieve penetration or resolution. This information shall be recorded on the data sheets.

5.2 EXAMINATION ANGLES AND COVERAGE

- 5.2.1 The intent of this procedure is to provide maximum examination coverage in ensure weld integrity. Each weld shall be scanned with minimum 25% overlap of the transducer width (diameter) for each scan pass. The rate of search unit movement shall not exceed six (6) inches per second.
- 5.2.2 Each weld and the adjacent volume of base metal of 2T on the pipe side of the weld shall be ultrasonically examined using 45° and 60° angle beam techniques applied in one direction perpendicular to the weld axis where part geometry or access permit.
- 5.2.3 Straight beam techniques shall be applied, where part geometry permits, to the adjacent base metal volume for 2T on the pipe side of the weld. Indications detected are to be recorded in accordance with paragraph 10.1.1 of this procedure. Indications detected shall be recorded and data used during evaluation of angle beam examination results.
- 5.2.4 Where examination surface, geometry, or other conditions (weld, contour, access, etc.) do not permit a meaningful ultrasonic examination to be performed, the examiner shall record the area of nonexamination and the particular interfering condition. In addition, he may make a sketch of the weld and adjacent pipe and fitting conditions on an attached sheet. Photos may be taken when possible and incorporated as part of the report.

5.3 LIQUID COUPLANT

- 5.3.1 The ultrasonic couplant shall be suitable for use on nuclear plant materials and be certified not to exceed 50 ppm halogen and 200 ppm sulfur.
- 5.3.2 The couplant shall be supplied in clean containers of sufficient quantity to perform the examination.
- 5.3.3 The couplant shall be applied manually with a brush or other suitable device.
- 5.3.4 Where required, the examiner shall be responsible for removing couplant from the examination surface at the conclusion of the examination.

5.4 SURFACE PREPARATION

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

5.5 WELD IDENTIFICATION

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

5.6 DATUM POINT

- 5.6.1 The examiner shall verify that there has been marked a reference datum point on each weld from which all examination data and reported indications shall be referenced. Radiographic datum markings are to be used if they exist on the base material adjacent to the weld.
- 5.6.2 If Datum markings do not exist, the examiner shall mark the pipe in the following manner:
1. Datum points shall be marked by the use of low stress stamps or and shall not be deeper than 1/32".
 2. The datum point for all flued head welds in horizontal lines shall be located on the top of the pipe at weld centerline.
 3. Each weld datum point, along with respective weld reference points and divisions, shall be shown on each examination report.

6. EQUIPMENT REQUIREMENTS

6.1 EXAMINATION CONTRACTOR'S EQUIPMENT

The following test equipment, or its equivalent, shall be provided by the Examination Contractor for examination of welds specified in this procedure.

1. Pulse echo ultrasonic instrument
2. Wedges, 45° and 60°
3. Search units, 1/4" through 1" Dia.; 2.25 MHz. 0°
4. Search units, 2.25MHz angle beam of a suitable size
5. Couplant
6. Thermometer.

6.2 PLANT OWNER'S EQUIPMENT

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

1. Scaffolding
2. Water, Air, and Electricity
3. Adequate Temporary Lighting

4. Crane or Lifting Devices
5. Applicable piping Calibration Blocks
6. Test Surface Preparation (cleaning and finishing)
7. Drawings of each Examination Area
8. Post-examination Cleanup of Test Area.

7. CALIBRATION REQUIREMENTS

7.1 CALIBRATION DATA PACKAGES

Calibration Data Packages shall be numbered 2950-1, 2950-2, 2950-3, etc., and shall be signed by the Examiner(s) upon completion, noting applicable NDE certification levels. A Calibration Data Package shall consist of a Calibration Data Sheet(s), Report Sheet(s), and an Indication Evaluation Forms(s), as required.

7.2 REFERENCE SENSITIVITY LEVEL

- 7.2.1 The reference sensitivity level shall be the distance amplitude curve initially obtained directly from the calibration block and shall be the sensitivity level used for evaluating and recording all indications.
- 7.2.2 During actual weld scanning, the reference sensitivity level shall be increased at least 2X (6dB), but no more than 10dB greater. The actual scan sensitivity shall be recorded on the Calibration Data Sheet.

7.3 TIMES OF CALIBRATION

- 7.3.1 Basic instrument calibration shall be performed using the appropriate calibration block, search units, and instrumentation immediately prior to the examination of the piping welds specified in this procedure.
- 7.3.2 Instrument vertical linearity checks shall be performed at the beginning of each day of examination in accordance with the the procedure referenced in paragraph 2(3) using an angle beam search unit.
- 7.3.3 Examination system calibration checks shall be performed at least at the beginning and at the completion of each four (4) hour period of examination and/or at the change of examination personnel, equipment, search units, coupler shoes, etc., and at the completion of the examination of each similar series of welds in accordance with Section 8.3 of this procedure.

7.4 CALIBRATION RESPONSE

- 7.4.1 Calibration response shall be checked at the primary reference sensitivity level.
- 7.4.2 Signal response obtained during calibration check shall be within plus or minus 20% of that established during basic instrument calibration.
- 7.4.3 If any point on the Distance Amplitude Correction (DAC) curve is below the 20% limit, the examiner shall:
1. Mark all data sheets since previous calibration void.
 2. Recalibrate examination system.
 3. Reexamine voided areas.
- 7.4.4 If any point on the DAC curve is above the 20% limit, the examiner shall:
1. Recalibrate examination system.
 2. Re-evaluate all indications recorded since the previous calibration check at the corrected sensitivity level.
- 7.4.5 If any point on the DAC curve has moved horizontally more than 5% of the sweep line from its original settings, the examiner shall:
1. Correct the sweep calibration and note it on the Calibration Data Sheet.
 2. Void any data sheets made since the previous calibration check which have recorded indications and reexamine those areas.

8. EXAMINATION SYSTEM CALIBRATION

8.1 STRAIGHT BEAM CALIBRATION FOR BASE MATERIAL

Straight beam calibration for all base material through which the angle beams will pass shall be performed at a sensitivity level which gives an initial back reflection signal amplitude from the component of at least 80%, but no more than 100% Full Screen Height (FSH).

8.2 ANGLE BEAM CALIBRATION

- 8.2.1 Horizontal Linear Range shall be established using the appropriate Metal Path Calibration.

- 8.2.2 After the Horizontal Linear Range has been established, maximize the signal response from the notches in the first full vee path (ID and OD) and set the notch producing the highest amplitude to 80% FSH. Mark the location and amplitude on the CRT.
- 8.2.3 Without changing sensitivity settings, maximize the signal response from the remaining notch, and mark its location and amplitude on the CRT screen. Connect the notch responses with a smooth line directly on the CRT and extrapolate the DAC curve to cover the entire area of examination to 1½ vee. When possible, the notch response at the 1½ vee may be used for aid in extrapolation.
- 8.2.4 This is the primary reference sensitivity. Record all sensitivity control settings on the appropriate Calibration Data Sheet.
- 8.2.5 In addition, the amplitudes and positions of responses from the side drilled holes shall be recorded and marked on the CRT screen.
- 8.2.6 Mark the area of examination from 1½T to 2½T on the CRT screen. The examiner shall pay particular attention to this area, since this is the examination area of interest.
- 8.2.7 Repeat steps (1) through (6) for each different weld thickness just prior to examination.
- 8.2.8 The technique described here shall also be used for calibration for the Supplemental Examination performed from the flued head side of the weld.

8.3 STRAIGHT BEAM AND ANGLE BEAM CALIBRATION CHECK

Calibration checks, as required, shall be performed as follows:

- 8.3.1 Adjust the sensitivity control settings to those recorded for the calibrated reference sensitivity.
- 8.3.2 Reposition search unit at each respective test hole and observe maximum signal response amplitudes.
- 8.3.3 See Section 7.4 for signal response requirements during calibration check.

9. EXAMINATION PROCEDURES

9.1 STRAIGHT BEAM EXAMINATION OF BASE MATERIAL FOR INTERFERING CONDITIONS

Straight beam examinations of the base metal volume for a distance of 2T beyond the weld edge on the pipe side of the weld shall be performed at a

sensitivity level which will give a minimum back reflection signal amplitude of at least 80% FSH, but not to exceed 100% FSH.

9.2 ANGLE BEAM EXAMINATION OF THE WELD AND ADJACENT AREA

- 9.2.1 All angle beam examinations shall be performed at a scanning sensitivity level 2X (6dB) but no more than 10DB greater than the calibrated reference sensitivity level.
- 9.2.2 The search unit shall be swivelled to ensure maximum coverage as it is moved along a rectilinear scan pattern allowing a minimum of 25% overlap of the transducer element width (diameter).
- 9.2.3 Continue scanning sequences until all the weld and adjacent area has been examined. Examination shall not be considered complete until all recordable indications have been evaluated per Section 10.1.1.

10. EVALUATION CRITERIA

10.1 RECORDING OF INDICATIONS

- 10.1.1 For straight beam examinations of base metal for interfering conditions, all areas giving indications equal to or greater than the remaining back reflection shall be recorded on the appropriate data sheet prior to angle beam examination of the weld and required volume.
1. Each recorded area shall be identified as to distance from surface, length and position relative to the weld datum point.
 2. Recorded data shall be taken on each parallel scan pass at increments not to exceed that permitted by the 25% overlap of transducer element diameter (width).
- 10.1.2 For angle beam examinations of weld and adjacent area, all indications showing a signal amplitude response equal to or greater than 50% of the reference response shall be recorded on the appropriate data sheet.
1. Each recorded indication shall be identified as to depth (as percent of thickness), distance from surface, length, signal amplitude and location relative to the weld datum point.
 2. Recorded data shall be taken on each parallel scan pass at increments not to exceed that permitted by the 25% overlap of transducer element diameter (width).
- 10.1.3 Indications from all welds shall be reported in inches upstream or downstream of the flued head surface and in inches CW or CCW from the weld datum point when looking with direction of flow as indicated in appropriate isometric.

10.2 EVALUATION OF INDICATIONS

- 10.2.1 Evaluation of all indications shall be made at the reference sensitivity and in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, 1977 Edition, through Winter 1978 addenda. All evaluations shall be performed by a Level III examiner.
- 10.2.2 Results of this evaluation shall be reported to the Plant Owner or his Agent in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, 1977 Edition, through Winter 1978 addenda. Disposition of evaluation results shall be made in accordance with the Owner's Plant Procedures.

11. EXAMINATION RECORDS

11.1 CERTIFICATION OF RECORDS

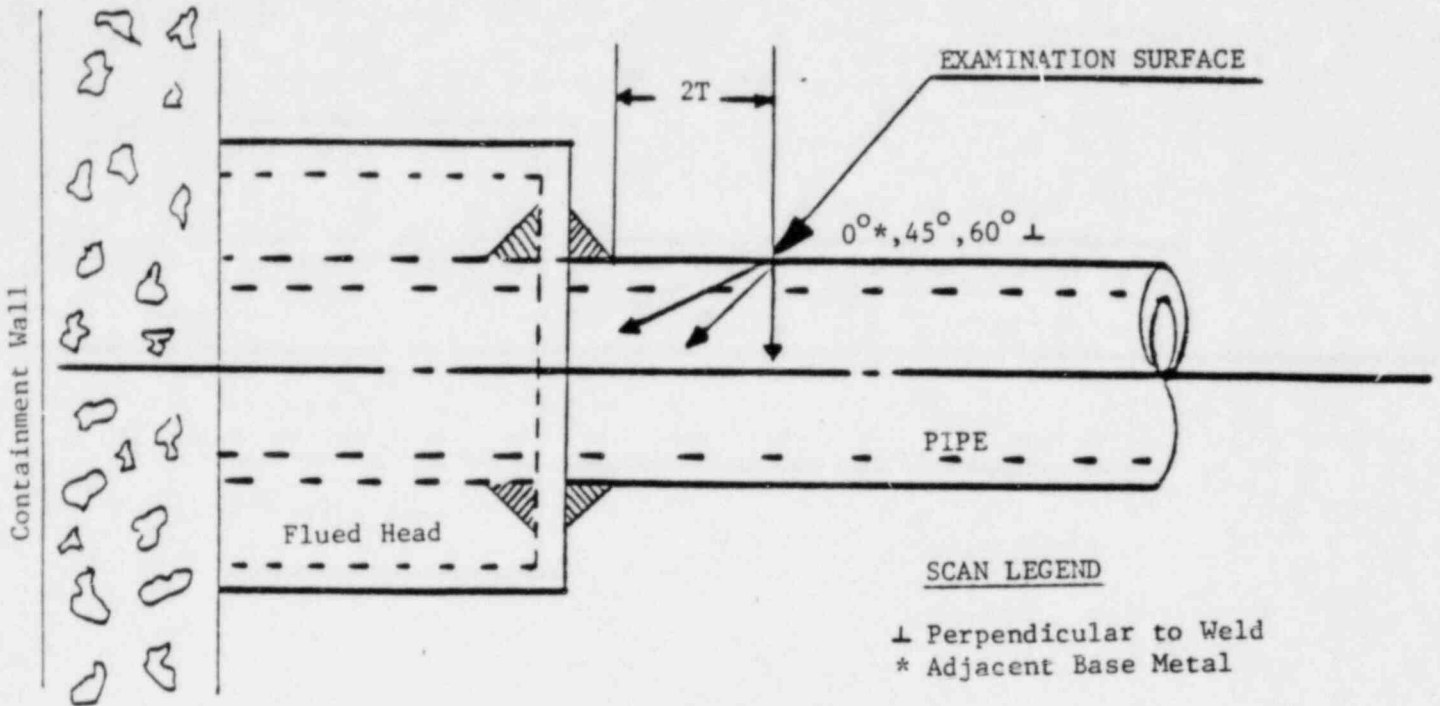
The Examiner shall complete and sign all data sheets immediately upon the completion of each weld examination. The data sheets may be reviewed by the authorized Code Inspector.

11.2 FILING OF RECORDS

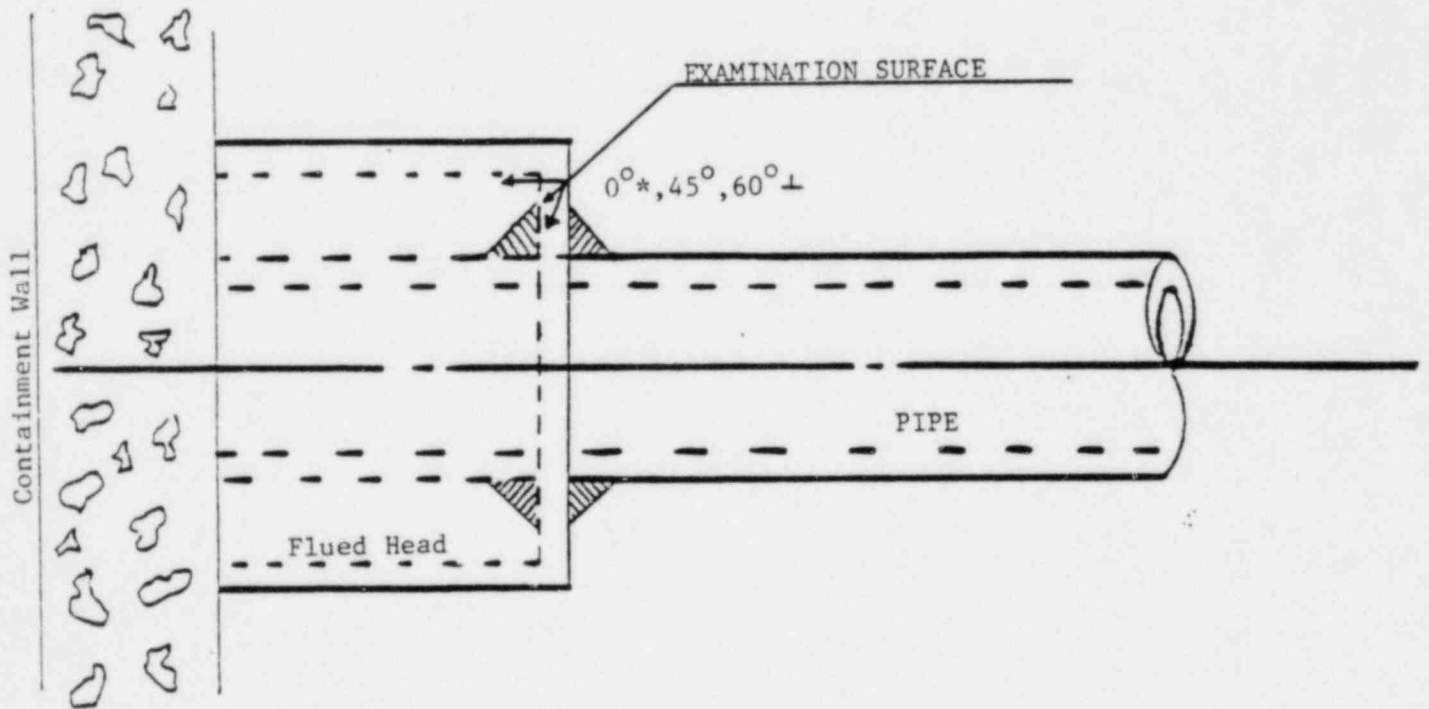
The examiner shall be responsible for submitting to the Plant Owner, or his Agent, a completely documented set of examination records including certification of personnel qualifications with a current eye test report in accordance with SNT-TC-1A.

11.3 PROCEDURE CORRECTIONS AND ADDITIONS

- 11.3.1 All procedure corrections and/or additions required during the preservice examinations shall be made in accordance with requirements of NES QA Program Plan No. NES 80A0448.
- 11.3.2 The examiner shall contact the LILCO representative on site to initiate all changes. All changes shall be documented in the record of revisions section of this procedure.



TYPICAL CONFIGURATION OF FLUED HEADS



SUPPLEMENTAL EXAMINATION OF FLUED HEADS

Figure 1

METAL PATH CALIBRATION TABLE

1&1/2 VEE SCAN PATH EXAMINATION

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

FULL VEE SCAN PATH EXAMINATION

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

1/2 VEE SCAN PATH EXAMINATION

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

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

FIGURE

Plant/Unit _____
Comp/System _____
ISO _____ Loop _____

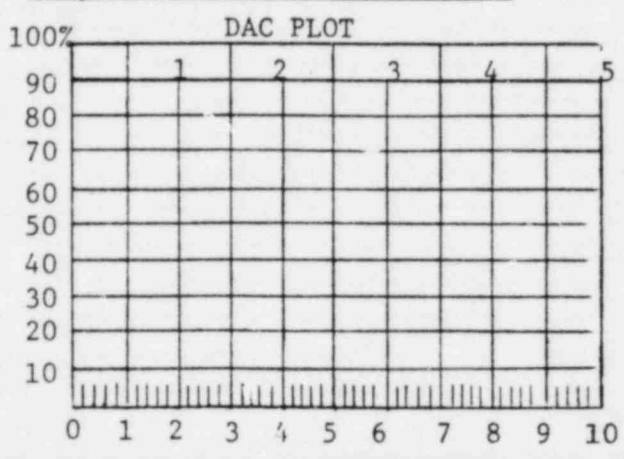
CALIBRATION DATA SHEET

Page _____ of _____
Data Sheet No. _____
Procedure No. _____
Subject: _____
Rev/Change No. _____
Calibration Block No. _____
Fabrication No. _____
Surface _____
Block Temp _____ °F
Comp. Temp _____ °F
Thickness _____
CRT Calibrated in _____
Each Maj. Screen Div= _____

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

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

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



SCAN AREA	
0° WRV	
0° Mar'l	
== To Weld	
⊥ To Weld	
Calibration	
Axial	
Circ	

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

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

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

EXAMINERS 1 _____ Date _____ Level _____
2 _____ Date _____ Level _____
REVIEWERS 1 _____ Date _____
2 _____ Date _____
3 _____ Date _____

ADDITIONAL SHEETS? CHECK BOX		
Continuation	Beam Plot	
Supplements	None	



NUCLEAR ENERGY SERVICES, INC.

NES DIVISION

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9/21/82
Date

ISI FIELD CHANGE AUTHORIZATION

Document Title UT EXAM OF FLUO HEAD WELDS Document No. 80A2950 Rev. 0

Field Change No. FC-1 Originator S. FOOTE

Description of Field Change:

- 1) PARA 8.3 DELETE REF. TO STRAIGHT BEAM
- 2) PARA 8.3.2 CHANGE HOLE TO NOTCH
- 3) PARA 9.2.1 CHANGE 10 DB TO 10dB
PARA 9.2.3 REVISE ... SECTION 10.1.1 TO READ ... PARAGRAPH 10.2.1

Reason for Change:

TYPO'S + CORRECTIONS

Approvals:

<u>NES</u>	<u>John D. ... Level II UT</u>	<u>9/21/82</u>
<u>LILCO</u>	<u>John ... for SMK</u>	<u>9/21/82</u>

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