Pullman Power Products Division of Pullman Incorporated		IX-UT-1-W77 DOCUMENT NO.
PREPARED BY: D. F. GEHR	APPROVED BY: A. BAIR	DATE: 7/17/78
SEABROOK PROJECT PROCEDURE	TO BE USED ONLY ON JOB # 7035	PAGE NO. 1 OF 10

81-01-08A

LATEST REV. DATE
10/24/79

ULTRASONIC EXAMINATION OF WELDMENTS

PREPARED BY

PULLMAN POWER PRODUCTS

DIVISION OF PULLMAN INCORPORATED

HEADQUARTERS AT

WILLIAMSPORT, PENNSYLVANIA

UE&C CODE
01

REVISION	PREPARED BY	APPROVED BY	INITIALS	DESCRIPTION
7/17/78	D.F.Gehr	A. Bair	AB	Initial Issue
01 10/24/79	D.Walker	A. Bair	AB	Revised para. 2.6, 2.6.1, 2.6.2 Added new para. 13.0, 13.1, Renumbered old para. 13.0, 13.1

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1.0 SCOPE

1/20/78 1.1 This procedure is written to comply with the ultrasonic examination requirements of the following codes (hereafter called "Referenced Codes"), and Addenda to those codes (hereafter called "Referenced Addenda").

ASME Section III ANSI B31.1

5/11/78 ASME Section V

1/20/78 1.2 It is required that the ultrasonic examiner have at his disposal and understand the contents of this document and the Referenced Codes.

1/20/78 1.3 Performance and evaluation of ultrasonic examinations shall be performed only by qualified personnel; certified by the Quality Assurance Department of Pullman Power Products in accordance with the requirements of ASNT No. SNT-TC-1A.

1.4 This procedure covers shear wave (angle-beam) or longitudinal (Straight beam) using contact technique with hand operated probes.

1.5 The pulse-echo method shall be used to meet the requirements of this procedure

1.6 The principal objective of the methods given herein is the detection, location and evaluation of discontinuities within the weld and heat affected zones. The welds shall be examined by the angle beam method where practical. In the examinations of weldments where geometry does not allow angle beam examination from both sides of the weld from a single surface or a combination of surfaces, either a combination of angle beam and straight beam or straight beam in two (2) directions at 20° to each other shall be used.

2.0 EQUIPMENT

2.1 Examination shall be conducted with an ultrasonic, pulsed reflection type system generating frequencies over the range of 1 MHz to 5 MHz unless otherwise specified by the referencing code section or material specification.

2.2 When specifically required, the electronic apparatus shall contain a calibrated attenuator accurate over its range to ± 20 percent or ± 2dB.

2.0 Equipment (Continued)

2.2 which will allow comparison of indications beyond the viewable portion of the cathode ray tube (CRT) presentation of the instrument.

2.3 The apparatus shall have horizontal linearity of plus or minus 5 percent over 80 percent of the sweep length presented on the CRT for the longest sound path to be utilized.

2.4 Transducers

2.4.1 Shall be constructed from materials which will provide adequate penetration and resolution with minimum noise.

2.4.2 Nominal test frequency shall be 2.25 MHz unless variables such as grain structure, thickness or geometry necessitate use of other frequencies to assure adequate penetration. Minimum frequency will be 1 MHz.

2.4.3 The transducer crystal shape may be square or round with a maximum size of 1 inch and a minimum size of 1/4 inch.

2.4.4 The beam angle shall be between 40^{o} and 75^{o} the beam angle and exit point shall be determined prior to start of the test. The exit point shall be marked on the transducer and the angle shall be $\pm 2^{o}$ of that stated in the examination report. It may be necessary to prepare special wedges or shoes to assure coverage. The beam angle will be calibrated by use of an IIW block prior to start of examination.

2.5 Couplant

2.5.1 Couplants used to assure transmission of signal between transducer and test surface will be oil, glycerine or other approved material.

2.6 Equipment, Electronic Apparatus

10/24/79 2.6.1 Examination shall be conducted with an ultrasonic, pulsed reflection type system generating frequencies over the range of 1 to 5 MHz unless otherwise specified by the referencing Code Section or material specification.

10/24/79 2.6.2 When specifically required, the electronic apparatus shall contain a calibrated attenuator, accurate over its range to ± 20% or ± 2 dB which will allow comparison of indications beyond the viewable portion of the cathode ray tube (CRT) presentation of the instrument.

3.0 EXAMINATION STANDARDIZATION

3.1 To assure complete coverage of the examined material, each pass of the search unit shall overlap a minimum of 10% of the transducer width.

3.2 The rate of manual scanning shall not exceed 6 inches per second.

4.0 CALIBRATION

4.1 Reference standards shall be manufactured to provide a means of establishing a D.A.C. (Distance Amplitude Correction) curve and evaluating discontinuities located in the weld zone and heat affected area.

4.2 Drilled holes shall serve as basic calibration reflectors to establish a primary reference response of the equipment and to construct a distance-amplitude corrective curve. These holes shall be located either in the finished component or in a basic calibration block or similar metallurgical structure, and the same or an equivalent P-Number grouping as the finished component. For the purpose of this paragraph, P-Numbers 1, 3, 4 and 5 materials are considered equivalent. The reference block for pipe over 20" diameter may be flat or essentially the same curvature as the pipe to be examined.

4.3 The thickness of basic calibration blocks, if used, shall be related to the finished component thickness as shown in Appendix A. Where two or more thicknesses are involved, the calibration block thickness shall be determined from the thickness of the component where the search unit is applied.

4.4 The basic calibration hole shown in Appendix A, Figure 1 shall be drilled parallel to the contact surface of the basic calibration block or the component. The location, depth and diameter of this hole shall be obtained from the table in Appendix A.

4.5 Other calibration reflectors may be used, provided equivalent responses to that from the basic calibration hole are demonstrated.

5.0 SURFACE PREPARATION

5.1 The finished contact surfaces shall be free from roughness, weld spatter or any foreign matter that would interfere with free movement of the search unit or impair the transmission of ultrasonic vibrations. It shall be determined that the surface preparation will not affect the material tolerances. A 250 RMS or better surface is acceptable and a smooth, tightly adhering paint surface is acceptable.

6.0 WELD SURFACE PREPARATION

6.1 The weld surface shall be prepared so that the configuration lends itself to shear wave and longitudinal testing. The weld surface shall be finished so it cannot mask or be confused with reflections from discontinuities and should merge smoothly into the surfaces of the adjacent base material.

6.2 Where a pipe is welded to valves, fittings or other appurtenances or where the weld can only be approached from one side, it must be flush with the parent material from the approach side; so that full coverage by a V path is obtained.

6.3 Undercutting that will produce reflections which may be confused with those caused by discontinuities, is not acceptable-

7.0 CALIBRATION OF EQUIPMENT - Angle Beam Method

7.1 The proper functioning of the examination equipment shall be checked and the equipment calibrated on a frequency basis as follows:

7.1.1 At the beginning of each day of examination.
7.1.2 After testing 10 ft. of weld.
7.1.3 After two hours of an examination period.
7.1.4 Any time the examiner suspects a change in test conditions.
7.1.5 Any change in examination personnel.

7.2 If recalibration reveals a change in equipment conditions, all welds examined prior to the last acceptable calibration shall be re-examined.

7.3 Distance amplitude correction curves shall be constructed by utilizing responses from the basic calibration hole described in Para. 4.4 this procedure. The first point on the curve is obtained by placing the search unit as near as possible, but not less than 3/8 Vee path or 2 inches; whichever is less, from the calibration hole and positioning for maximum response. The gain control is then set so this response is 75 percent of full screen on the cathode ray tube (C.R.T.). This is the primary reference response. Without changing the gain, the search unit should be placed similarly at other positions covering the expected examination distance range, and the corresponding responses marked on the CRT screen. These points are joined by a smooth line whose length should cover the examination range. (See Appendix B - Figure 1.)

7.0 Calibration of Equipment - Angle Beam Method (Continued)

7.4 Transfer Method

7.4.1 Transfer methods are used to correlate the responses from the basic calibration block and from the component. Transfer is accomplished by noting the difference between responses received from the same reference reflector in the basic calibration block and in the component and correcting for the difference. The reference reflectors may be V notches, (which must subsequently be removed) an angle beam search unit acting as a reflector or any other reflector which will aid in accomplishing the transfer.

7.4.2 The transfer method for vessels shall be used at least once for each 10 ft. of weld or less per plate and shall be performed at least twice for each type of welded joint.

7.4.3 The transfer method for pipe shall be used. As a minimum, once for each welded joint for pipe sizes 10 inches in diameter and over, and once for each 5 ft. of welded for pipe less than 10 inches in diameter.

8.0 EXAMINATION PROCEDURE (Angle Beam Method)

8.1 Where possible, butt welds shall be examined from both sides of the weld, usually from only one surface.

8.2 The reference level sensitivity for monitoring is the primary reference response corrected for distance by the distance-amplitude curve or electronically, and modified by the transfer method if used. When possible, scanning shall be performed at a gain setting of 2 times (6dB) the reference level sensitivity.

8.3 The reference level for monitoring discontinuities is the primary reference response, corrected for distance by the distance-amplitude curve or electronically, modified by the transfer method.

8.4 For detection of discontinuities parallel to the weld, in the scanning motion, the search unit shall be placed on the contact surface with the beam aimed at about 90 degrees to the weld and manipulated laterally and longitudinally so the ultransonic beam passes through all of the weld metal in two different approaches of the beam to the reflector.

01-01-08

8.0 Examination Procedure (Angle Beam Method) (Continued)

8.5 In detection of discontinuities transverse to the weld, if the weld has been made sufficiently smooth, one search unit may be placed on the centerline of the weld with the beam directed along the weld to scan the entire depth and width of the weld.

9.0 STRAIGHT BEAM METHOD

9.1 For calibration of equipment, the nominal frequency shall be 2.25 MHz unless variables such as production material grain structure require the use of other frequencies to assure adequate penetration.

9.2 A distance amplitude correction curve need not be constructed when the thickness of material is less than 1 inch. For greater thicknesses, using the proper basic calibration block, (See Appendix A, Figure 1) and search unit shall be positioned for maximum response from the basic calibration hole at ¼ T, and the signal amplitude shall be adjusted to 50 percent of full cathode ray tube screen. This is the primary reference response. Without changing the gain control, the search unit shall be then positioned for maximum response from the basic calibration hole at 3/4 T its amplitude marked on the CRT screen, and the two points joined with a straight line extended to cover the test range.

9.3 The reference level for monitoring discontinuities is the primary reference response corrected by a distance-amplitude curve or electronically.

10.0 EXAMINATION PROCEDURE (Straight Beam Method)

10.1 Scanning motion-- the weld shall be examined by moving the search unit progressively along and across a sufficient contact area so as to scan the entire weld.

10.2 Sensitivity level--when possible, scanning shall be performed at a minimum gain setting of twice (6dB) the primary reference level. Evaluation of discontinuities shall be done with the gain control set at the reference level.

10.3 Monitoring of procedures--penetration shall be verified by obtaining a reflection from an opposite parallel surface, or obtaining the back reflection on similar material while using approximately the same length of sound travel.

10.0 Examination Procedure (Straight Beam Method) (Continued)

10.4 The volume of base material and weld through which the beam will travel in angle beam examination shall be examined with a straight beam search unit.

/20/78 11.0 ACCEPTANCE STANDARDS - ASME SECTION III WITH REFERENCED ADDENDA

All indications which produce a response greater than 20 percent of the reference level shall be investigated to the extent that the operator can determine the shape, identity and location of all such reflectors and evaluate them in terms of the acceptance-rejection standards as follows:

11.1 Discontinuities are unacceptable, if the amplitude exceeds the reference level, and discontinuities have lengths which exceed:

(1) 1/4 inch for t up to 3/4 inch, inclusive
(2) 1/3 t for t from 3/4 inch to 2 1/4 inch, inclusive;
(3) 3/4 inch to t over 2 1/4 inch

where t is the thickness of the weld being examined; if a weld joins two members having different thicknesses at the weld, t is the thinner of these two thicknesses.

11.2 Where discontinuities are interpreted to be cracks or incomplete penetration, they are unacceptable regardless of discontinuity or signal amplitude.

7/17/78 11.3 Only Level II and Level III personnel qualified in accordance with Procedure II-2 (NDE Personnel Control & Administration of training, examination, qualification and certification) shall perform and interpret for acceptance/rejection.

12.0 EXAMINATION OF REPAIRS

12.1 Repairs shall be re-examined by the same procedures used for original detection of the discontinuity.

10/24/79 13.0 POST EXAMINATION CLEANING

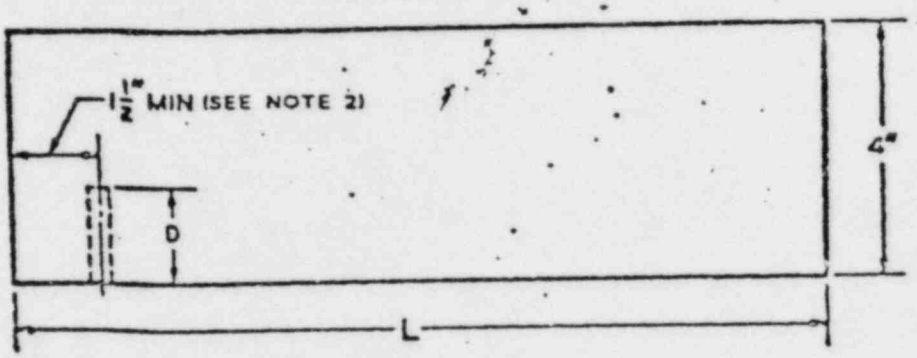
10/24/79 13.1 Following any nondestructive examination in which examination materials are applied to the piece, the piece shall be thoroughly cleaned in accordance with applicable material or procedure specifications.

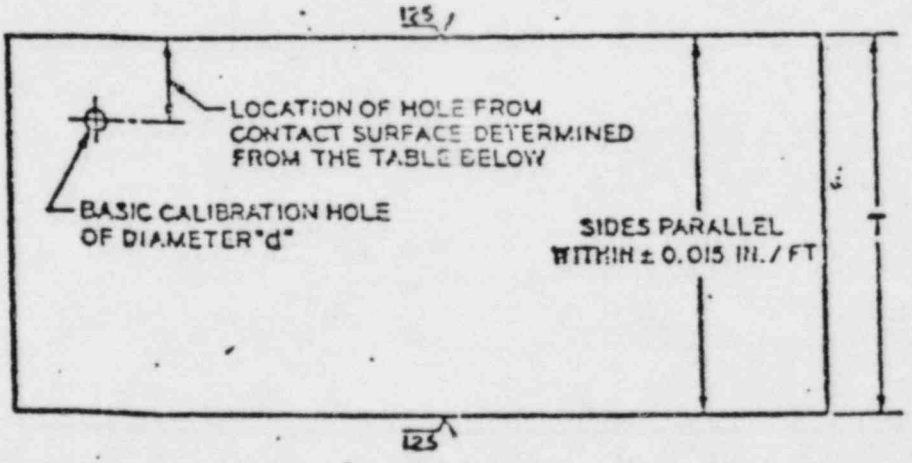
10/24/79 14.0 REPORT OF EXAMINATION

10/24/79 14.1 The report shall include all procedures and equipment sufficiently identified to permit repetition of the examination at a later date. This includes initial calibration data for the equipment and any significant changes in subsequent rechecks; and a marked-up drawing or sketch indicating the weld(s) examined and the item or piece number.

10/24/79 14.2 See Appendix C, Ultrasonic Test Report Form.

APPENDIX A





L = Length of block determined by the angle of search unit and the vee-path used
T = Thickness of basic calibration block (see table below)
D = Depth of side-drilled hole (see table below)
d = Diameter of side-drilled hole (see table below)
t = Nominal production material thickness

Nominal Production Material Thickness (*t*), in.	Basic Calibration Block Thickness (*T*), in.	Hole Location	Hole Diameter (*d*), in.	Minimum Hole Depth (*D*), in.
Up to 1 incl.	¾ or *t*	1/2 *T*	5/32	1½
Over 1 thru 2	1½ or *t*	1/2 *T*	¼	1½
Over 2 thru 4	3 or *t*	1/2 *T*	5/16	1½
Over 4 thru 6	5 or *t*	1/2 *T*	⅜	1½
Over 6 thru 8	7 or *t*	1/2 *T*	7/16	1½
Over 8 thru 10	9 or *t*	1/2 *T*	½	1½
Over 10	*t*	1/2 *T*	See Note 1	1½

Note 1—For each increase in thickness of 2 in., or a fraction thereof, the hole diameter shall increase 1/16 in.

Note 2—For block sizes over 3 in. in thickness (*T*), the distance from the hole to the end of the block shall be ½*T* min. to prevent coincident reflections from the hole and the corner in the ¼ th vee-path position. Blocks fabricated with a 1½-in. minimum dimension need not be modified if the corner and hole indications can be easily resolved.

BASIC CALIBRATION BLOCK

Pullman Power Products Division of Pullman Incorporated		IX-UT-1-W77 DOCUMENT NO.
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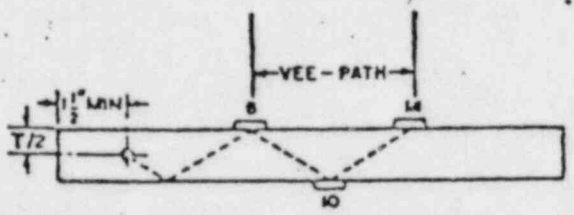
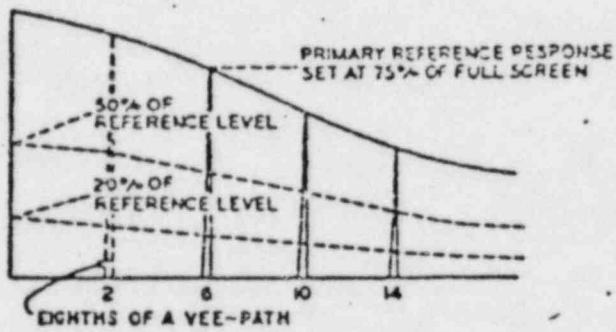
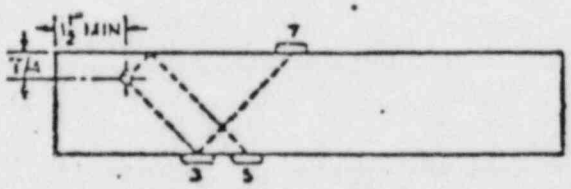
APPENDIX B

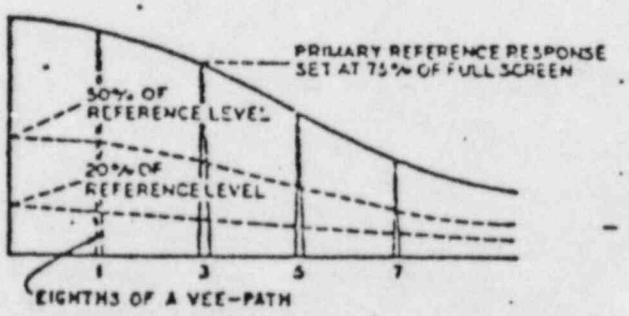


FOR THICKNESS 1 INCH OR LESS





FOR THICKNESS OVER 1 INCH



, TYPICAL DISTANCE AMPLITUDE CORRECTION CURVE (ANGLE BEAM METHOD)

(Distance in eighths of a vee-path. For example, 14 is 1 4/8 of a vee-path.)

Pullman Power Products Division of Pullman Incorporated		FORM 36 DOCUMENT NO.
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ULTRASONIC FLAW DETECTION RECORD

APPENDIX C

JOB NO. _____ DATE _____

PIECE NO. _____ "F" NO. _____

EXAMINATION PROCEDURE NO. _____

ACCEPTANCE CRITERIA _____

EQUIPMENT MODEL NO. _____

TRANSDUCER: SIZE _____ FREQUENCY _____ SHOE _____
ANGLE _____ MODE _____ CONTACT _____

COUPLANT: _____

DESCRIPTION OF INSPECTION TECHNIQUE: MANUAL _____ ROTATION _____ STATIONARY _____

CALIBRATION DATA: _____

RECORD OF EXAMINATION RESULTS

NAME OF INSPECTOR _____

SNT-TC-1A LEVEL _____

RECORD OF RE-EXAMINATION

NAME OF INSPECTOR _____

SNT-TC-1A LEVEL

Pullman Power Products Division of Pullman Incorporated		IX-UT-1-W77 DOCUMENT NO.
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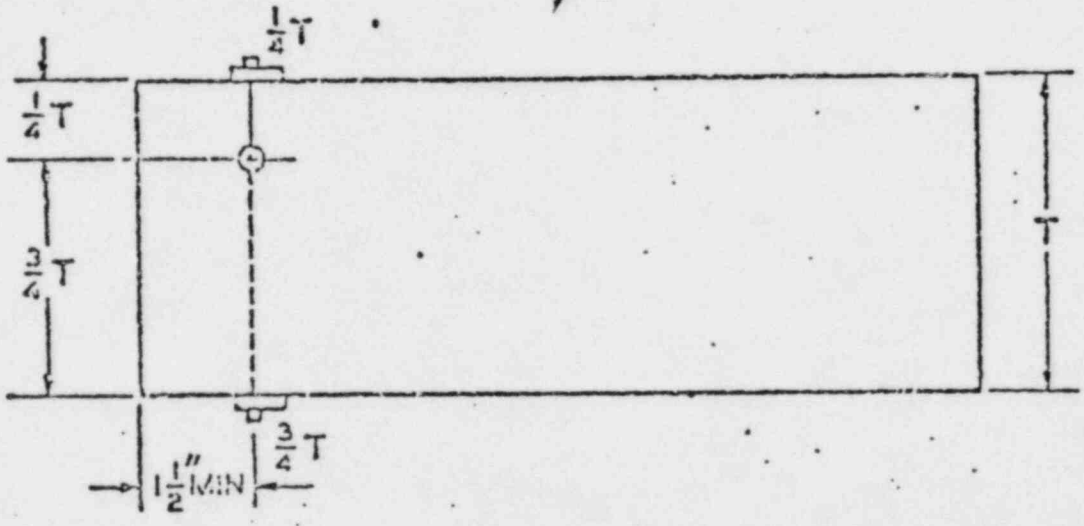
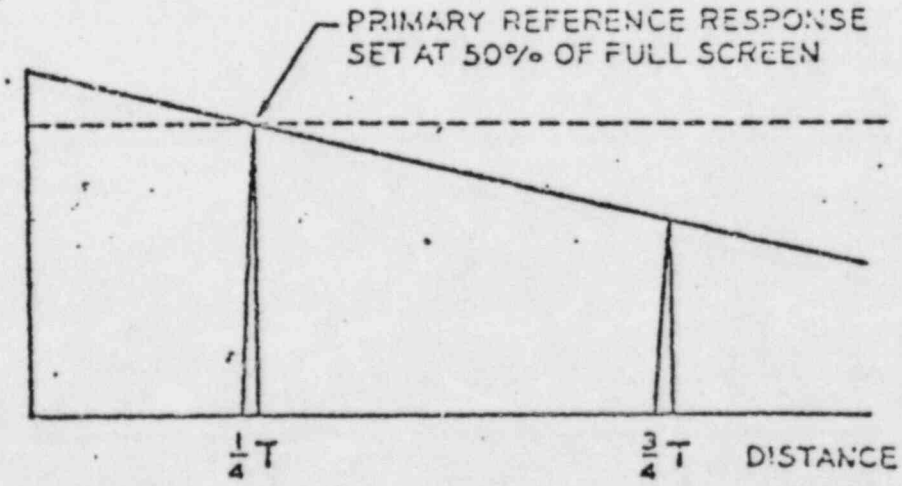
APPENDIX D



(a)



(b)

TYPICAL DISTANCE AMPLITUDE CORRECTION CURVE
(STRAIGHT BEAM METHOD)

JOB NO.	PURCHASE ORDER COMM.	PURCHASE ORDER SEQ. (SUBT. NO.)	FOREIGN PRINT NO.	ISSUE	ACTION DISC	STATUS	VENDOR DRAWING OR DOCUMENT NO.	REV. NO.	SIZE	ORIG DISC	ACTION	CODE
1 7	8 10	11 14	15 19	20 21	22 23	24 25	26 42	43 44	45	46 47	79	80
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DESCRIPTION LINE 1	LINE 2	VENDOR'S NAME	ACTION	CODE
24 43	44 63	64 72	74	60
NDE (PQR) ULTRASONIC EXAM. OF WELDMENTS	P-H			2

LETTER TO UE&C	UE&C LOG-IN DATE	CLIENT'S REVIEW TO CLIENT	CLIENT'S REVIEW FROM CLIENT	UE&C REVIEW TO VENDOR	UE&C REVIEW STATUS	FINAL DISTRIBUTION DATE	ACTION CODE	CODE
24 29	30 35	36 41	42 47	48 53	54 55	56 61	79	80
921780926	18PP-54	ITF-206	SF 131	90				3

UNITED ENGINEERS & CONSTRUCTORS INC.

Reviewed only for general arrangement and overall dimensions as set forth in purchase order or contract. The review does not constitute acceptance of any design, material, component or equipment not fulfilling all contract specifications and drawing requirements.

- [X] PROCEED AS PER P.O. OR CONTRACT
- [ ] SUBMIT REVISED DRAWINGS FOR REVIEW
- [ ] SEND CORRECTED DRAWINGS FOR RECORD

BY M. S. Edgar DATE 10-11-78

CHECK			
FILE		ELEC	
SQUAD #		MECH S	
CLIENT		MECH	
VFR		STRUCT	
FIELD		INST	
PCM		NUCLEAR	
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FORM SE-41 REV 7/74

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